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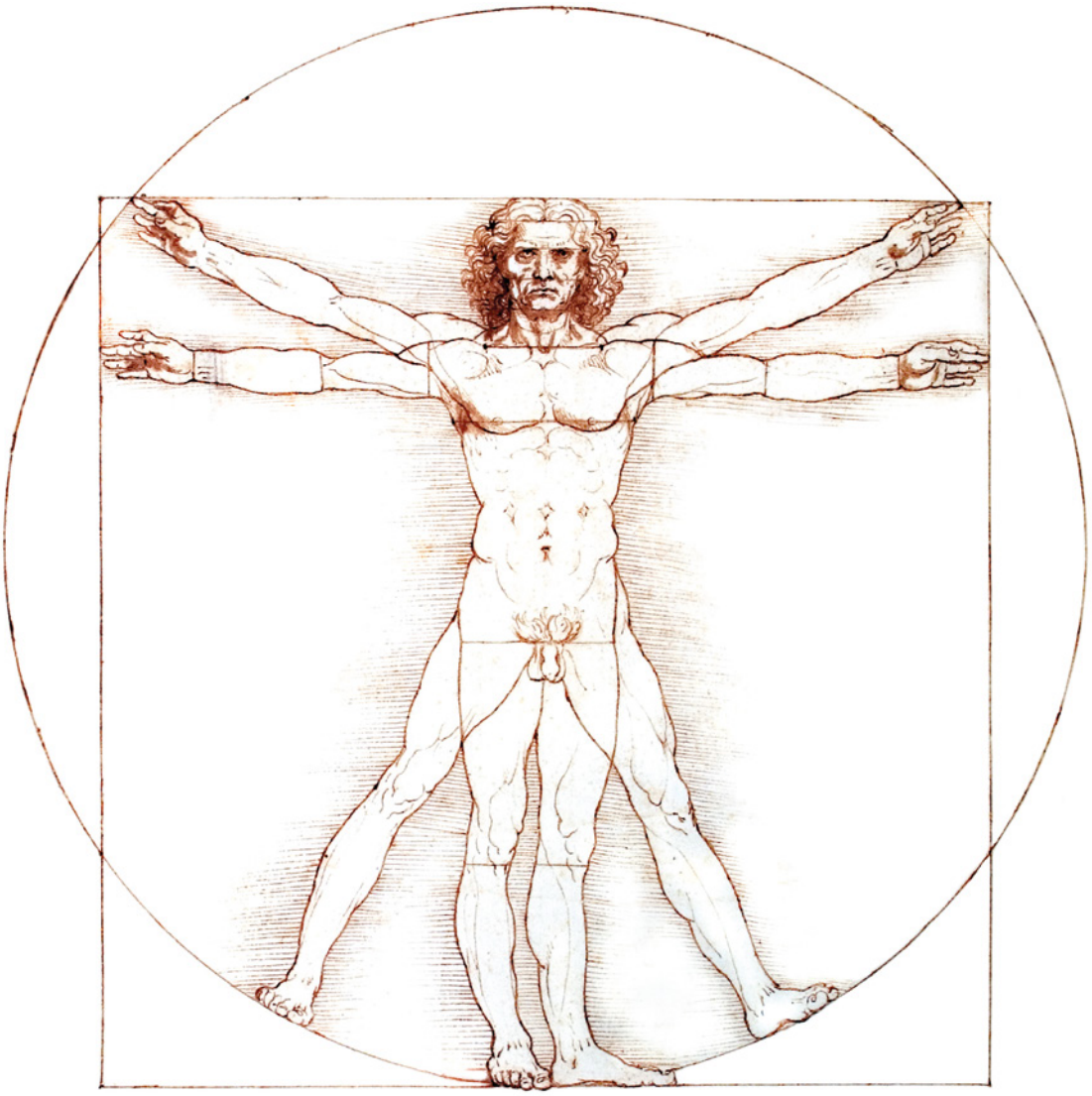
SIdP Società Italiana di Parodontologia e Implantologia

Joint Meeting

Congress **Scientific** Report



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This report provides a summary of 11 principal sessions which took place at the EAO's 31st Annual Scientific Meeting. The report was written by a group of delegates who have been preparing scientific reports on the EAO Congress since 2015. The EAO wishes to emphasise that this is not a peer-reviewed scientific report. The contents do not necessarily represent the views of the EAO and readers are responsible for independently evaluating any information contained in the report. Nonetheless, the EAO hopes that the report will provide a useful and informative summary of the proceedings of its 31st Annual Scientific Meeting.

Contents

Acknowledgements

The EAO would like to gratefully acknowledge the substantial work carried out by the Congress Scientific Report Subcommittee. The Board of Directors would also like to thank all chairs and speakers who have agreed to share their presentations.

Methodology

The methodology underpinning this report is as follows:

1. A team of dentist delegates volunteered to write the report and arranged to attend all the sessions covered in it during the EAO's 2024 meeting in Milan.
2. They provided a draft summary of each presentation to the EAO, which arranged for a copywriting team to edit it.
3. The editors returned the edited contributions to the authors highlighting any questions they had.
4. On receipt of responses to their questions, the editors updated the contributions, then forwarded them to each of the speakers featured, along with a request for a selection of their slides (selected by the authors).
5. Each speaker was contacted to request their feedback.

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EAO Congress Scientific Report; Milan 2024, Session 1

Bone grafting the truth of the biology

Hendrik Terheyden

Type of bone defects

This presentation described the progression of alveolar ridge resorption following tooth extraction and the implications for dental implantology and bone augmentation. The speaker introduced a four-stage classification system for defects that corresponds to distinct stages of bone loss and resorption in the alveolar ridge over time (Figure 1). This classification can guide treatment decisions and help predict outcomes for bone augmentation and implant success. Dr Terheyden divided his presentation into two sections, covering the defect stadium and the defect type, which has a certain influence on the choice of the materials.

Within weeks of tooth extraction, the buccal wall is resorbed, typically leading to a 'knife-edge' ridge within three months.[1] Over the course of a year, the palatal or lingual walls also begin resorbing, resulting in vertical bone loss. After several years, the resorption process leads to a 'four-quarter' defect with significant loss of the alveolar crest. The stages are classified based on the severity of bone loss, which in turn influences the choice of treatment, materials, and potential success rate.

Studies have validated the utility of this classification, showing that the degree of resorption influences treatment success. For instance, titanium mesh used for bone augmentation shows high success rates in early-stage defects (one-quarter), but outcomes decline as defects worsen (three- and four-quarter stages). Additionally, studies have established that resorption stages correlate with the likelihood of the formation of pseudo-periosteum. This is a soft tissue layer that can complicate healing under titanium mesh.[2,3]

Several other classification systems exist, each with different criteria:

- **Cawood JL, Howel RA.**[4] Classification developed for edentulous ridges but does not address implant-specific needs.

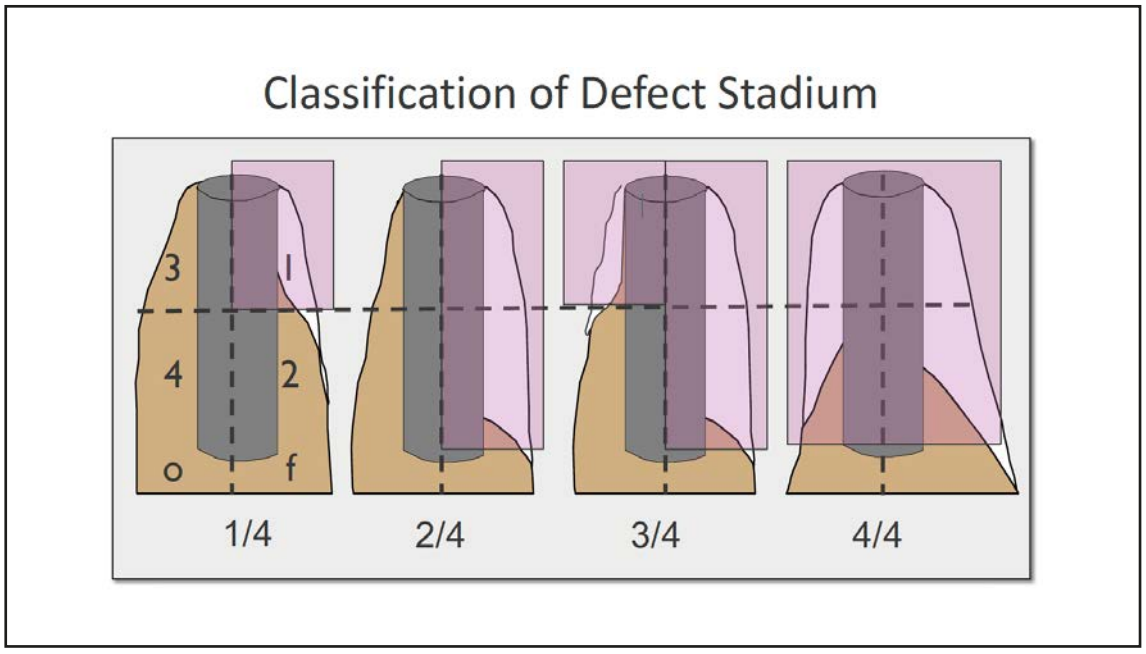


Figure 1: Key stages of alveolar bone resorption

1 Araújo MG, Lindhe J. Dimensional ridge alterations following tooth extraction. An experimental study in the dog. J Clin Periodontol [Internet]. 2005 Feb [cited 2024 Nov 5];32(2):212–8. Available from: https://pubmed.ncbi.nlm.nih.gov/15691354/

2 Nan X, Wang C, Li L, Ma X, Chen T, Huang Y. Application of three-dimensional printing individualized titanium mesh in alveolar bone defects with different Terheyden classifications: A retrospective case series study. Clin Oral Implants Res [Internet]. 2023 Jun 1 [cited 2024 Nov 5];34(6):639–50. Available from: https://pubmed.ncbi.nlm.nih.gov/36916464/

3 Liu C, Li J, Zhang S, Xiao H, Wang Y, Zhang J. Assessment of the application of a novel three-dimension printing individualized titanium mesh in alveolar bone augmentation: A retrospective study. Clin Implant Dent Relat Res [Internet]. 2024 [cited 2024 Nov 5]; Available from: https://pubmed.ncbi.nlm.nih.gov/39135363/

4 Cawood JI, Howell RA. A classification of the edentulous jaws. Int J Oral Maxillofac Surg [Internet]. 1988 [cited 2024 Nov 5];17(4):232–6. Available from: https://pubmed.ncbi.nlm.nih.gov/3139793/

- **Seibert JS.**[5] Focuses on the nature of bone loss (horizontal, vertical, or both) but does not describe detailed stages of resorption.
- **Hsu CH, Chen Z, Urban IA, Wang HL.**[6] Considers defect length alongside bone resorption.

Modifiers in bone augmentation outcomes

The 'envelope concept' is a critical factor in defining the outcome of bone augmentation. It describes the limit of the alveolar ridge's natural contour that augmentation materials can realistically achieve. Augmentation beyond this line tends to remodel back to the initial contour. Successful bone augmentation requires working within the 'red room' (space within this contour), allowing space for regeneration. Implant size and spacing at adjacent teeth both also affect outcomes, as does the health of neighbouring periodontal structures.[7] The more room that is created behind the envelope, the more successful the augmentation is.

Another major consideration is angiogenesis – the growth of new blood vessels – which plays a key role in the success of bone grafts. Research indicates that grafts can only achieve about 3.7 mm of vertical and horizontal augmentation due to limitations in blood vessel penetration.[8] Therefore, large defects may require block grafts rather than particulate grafts. Block grafts can achieve up to 4.5 mm of horizontal gain and 5.8 mm of vertical gain.

Treatment recommendations by defect stage

The speaker outlined the treatment methods that are suitable for each defect stage, as set out in Figure 2.

- One-quarter defects: guided bone regeneration (GBR)
- Knife-edge ridges: bone splitting
- Three-quarter defects: block shell grafting
- Four-quarter defects: iliac block grafting (as large defects require substantial sized grafts)

Conclusions of part one

- the defect stadium is a significant predictor of success
- defect stadium is greater than defect length
- the biological limit of 3–4 mm is not sufficient for all defect stadiums

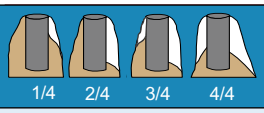
Situation 	Bone augmentation method indicated
1/4 Bone defect	Single-stage GBR with bone substitute material Simultaneous dental implant placement Alternative: Block graft in maxillary anterior region
2/4 Bone defect	Block graft Single or two stage dental implant placement Alternative: Bone splitting (>4-5mm)
3/4 Bone defect	Block shell graft technique Two stage dental implant placement Alternative: Swing osteotomy
4/4 Bone defect (both walls missing)	Interpositional bone graft Two stage dental implant placement Alternative: Distraction osteogenesis (e.g. maxillary anterior region)

Figure 2: Decision-making according to defect stage

5 Seibert J. Treatment of moderate localized alveolar ridge defects. Preventive and reconstructive concepts in therapy. Dent Clin North Am. 1993;
6 Hsu CH, Chen Z, Urban IA, Wang HL. Simple-Challenging-Difficult (SCD) Difficulty Classification for Vertical Bone Augmentation. J Esthet Restor Dent [Internet]. 2024 [cited 2024 Nov 5]; Available from: https://pubmed.ncbi.nlm.nih.gov/39383027/
7 Jiang X, Zhang Y, Di P, Lin Y. Hard tissue volume stability of guided bone regeneration during the healing stage in the anterior maxilla: A clinical and radiographic study. Clin Implant Dent Relat Res [Internet]. 2018 Feb 1 [cited 2024 Nov 5];20(1):68–75. Available from: https://pubmed.ncbi.nlm.nih.gov/29283207/
8 Troeltzsch M, Troeltzsch M, Kauffmann P, Gruber R, Brockmeyer P, Moser N, et al. Clinical efficacy of grafting materials in alveolar ridge augmentation: A systematic review. J Craniomaxillofac Surg [Internet]. 2016 Oct 1 [cited 2024 Nov 5];44(10):1618–29. Available from: https://pubmed.ncbi.nlm.nih.gov/27622971/

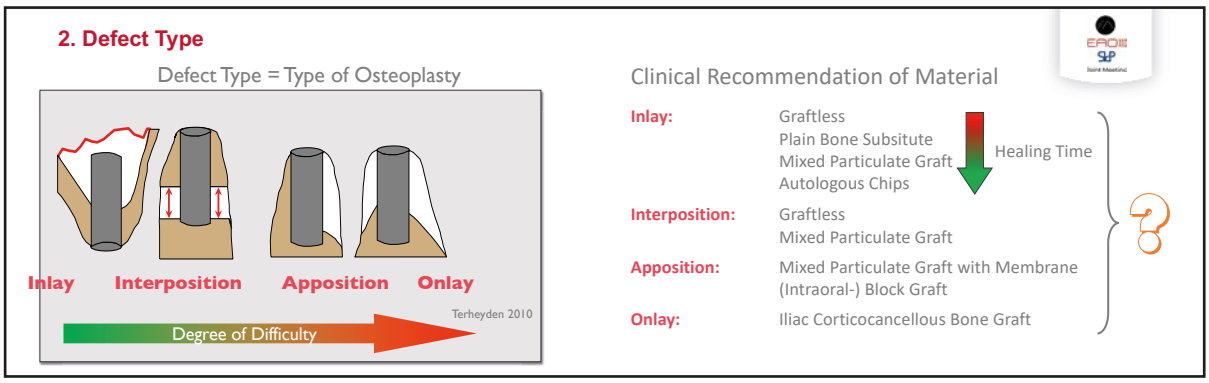


Figure 3: Types of bone defects and recommended techniques for their reconstruction

Choosing the correct osteoplasty technique

Depending on the characteristics of the defect, different grafting techniques are required (Figure 3):

1. Inlay osteoplasty (e.g. sinus lift)
2. Interpositional grafting (e.g. vertical interposition within two vascularised surfaces)
3. Appositional grafting (adding bone to the outer surface)
4. Onlay grafting (placing bone material directly on top of the defect).

Each technique has specific material requirements. For example, inlay grafts such as sinus lifts may heal with minimal material, while onlay grafts require iliac blocks or membranes to maintain stability.

Stability and remodelling of bone grafts

Studies show that if bone grafts can be maintained for three years, they tend to remain stable long-term (although nothing lasts longer than the patient's own bone). A process called 'creeping substitution', whereby the graft material is incorporated into the natural bone, must also be taken into account. This was described by Georg Axhausen in 1907.

Cortical autografts and deproteinised bone substitutes are favoured for their slow resorption rates, which provides the necessary stability for the bone graft to remodel and integrate with native bone. As a result, after three years there is nothing left but native bone.

It is important to remember that the alveolar bone is defined by dental function. For this reason, the alveolar ridge of an elderly person is very similar to that of a newborn (Figure 4).

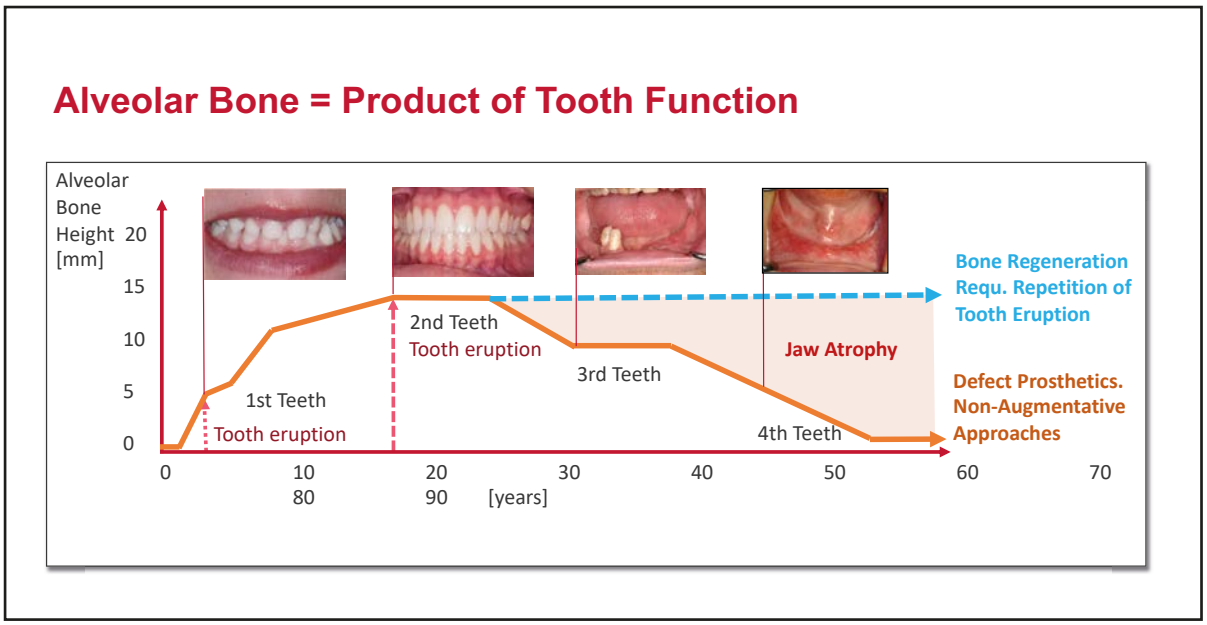


Figure 4: When teeth are missing, the body reabsorbs the bone, leaving two options: bone regeneration (dotted line) or replacing the missing bone with prosthetic materials (yellow line).

The clinician's goal should be restoration through functional osseointegration, as advocated by Professor Brånemark. Based on studies carried out by Dr Terheyden and colleagues, it is clear that regeneration using bone substitutes is very slow, and the process of osteoconduction may take more than 6 months.[9,10] He believes the best approach is a mixture of 25% autologous bone and 75% bone substitute in order to activate the patient's cellular response.

Biomaterials can attract biofilms, leading to infection and potential failure of the graft. Over-reliance on antibiotics to control biofilms is not ideal due to rising antibiotic resistance.[11] Thus, minimising the presence of foreign materials and using autologous (patient-derived) materials where possible is preferable.

Practical application: downgrading defects

'Downgrading' refers to the use of surgical techniques to reduce the severity of a defect, making it possible to opt for simpler, less invasive procedures and avoid the use of complex materials. For instance, a vertical defect might be treated with a sandwich interpositional graft, in which bone material is placed between two vascularised surfaces, rather than using more invasive block grafting. This technique offers successful long-term results with fewer complications.[12] By interposing a bone substitute between two bone surfaces (sandwich), twice the distance for angiogenesis is achieved.

Soft tissue considerations

Soft tissue management is also critical, as improper handling can lead to dehiscence and the exposure of grafts. The speaker demonstrated techniques such as tunnelling, where bone grafts are carefully inserted under the tissue without major incisions, thus reducing the risks associated with traditional approaches.

Conclusions of part two

- The defect type informs the choice of material.

When it comes to method, there are two questions to be answered:

- How do I augment?
- What are the clinician's abilities/skills?

Conclusion

The presentation concluded by emphasising the importance of understanding defect stages and types in order to predict augmentation success and determine the most suitable techniques and materials. The speaker encouraged a focus on surgical skill rather than over-reliance on materials, noting that successful augmentation depends on the clinician's expertise in adapting techniques to the patient's unique anatomical needs.

This comprehensive approach, which blends classification with skilful surgical management and minimal reliance on foreign materials, was presented as a strategy for achieving stable, long-lasting results in dental implantology and alveolar bone restoration (Figure 5).

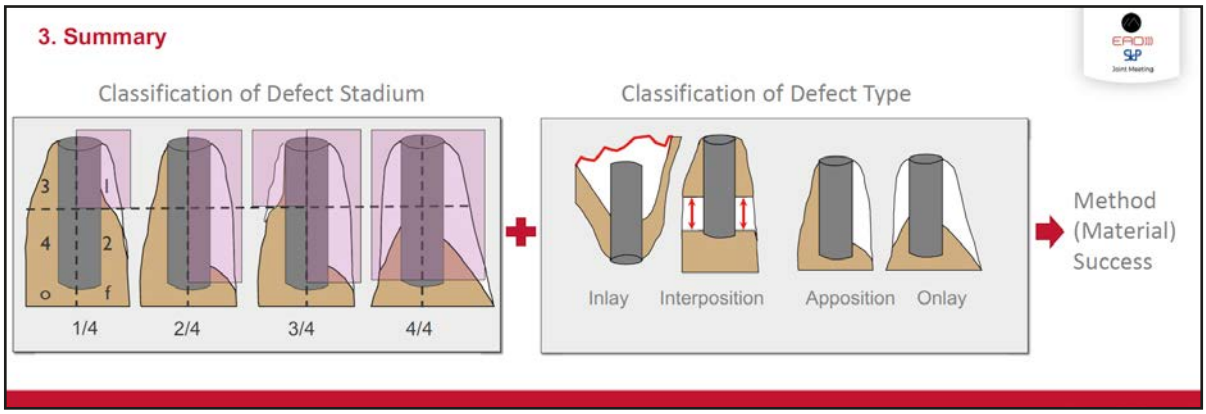


Figure 5: Summary of defect stadium and defect type. Further details can be found in the author's book, published by Quintessence Pub Co.

9 Jensen T, Schou S, Gundersen HJG, Forman JL, Terheyden H, Holmstrup P. Bone-to-implant contact after maxillary sinus floor augmentation with Bio-Oss and autogenous bone in different ratios in mini pigs. Clin Oral Implants Res [Internet]. 2013 Jun [cited 2024 Nov 5];24(6):635–44. Available from: https://pubmed.ncbi.nlm.nih.gov/22530746/

10 Jensen T, Schou S, Svendsen PA, Forman JL, Gundersen HJG, Terheyden H, et al. Volumetric changes of the graft after maxillary sinus floor augmentation with Bio-Oss and autogenous bone in different ratios: a radiographic study in minipigs. Clin Oral Implants Res [Internet]. 2012 Aug [cited 2024 Nov 5];23(8):902–10. Available from: https://pubmed.ncbi.nlm.nih.gov/22044477/

11 Basma H, Misch C. Extraction Socket Grafting and Ridge Augmentation Failures Associated with Clindamycin Antibiotic Therapy: A Retrospective Study. Int J Oral Maxillofac Implants [Internet]. 2021 Jan [cited 2024 Nov 5];36(1):122–5. Available from: https://pubmed.ncbi.nlm.nih.gov/33600532/

12 Geng Y ming, Zhou M, Parvini P, Scarlat S, Naujokat H, Abraha SM, et al. Sandwich osteotomy in atrophic mandibles: A retrospective study with a 2- to 144-month follow-up. Clin Oral Implants Res [Internet]. 2019 Oct 1 [cited 2024 Nov 5];30(10):1027–37. Available from: https://pubmed.ncbi.nlm.nih.gov/31356695/

Thomas Starch-Jensen

Clinical indication for materials: blocks vs particulate grafts

In order to place implants successfully in cases with alveolar ridge atrophy, ridge augmentation is often necessary. This compensates for bone loss following tooth extraction, where up to two-thirds of the ridge may be lost due to socket remodelling and vertical ridge reduction. This bone loss can reach 29–63% horizontally and 11–22% vertically.[1] Ridge augmentation supports optimal implant positioning for prosthetic needs. The clinician must decide whether to use block grafts or particulate grafts based on the defect type, the properties of the graft material, and the clinical scenario.

Selection of grafting material: properties and indications

A range of grafting materials are available, each with unique properties, as shown in Figure 1.

Autogenous bone. Harvested from the patient, this is osteoinductive and osteoconductive. It is easy to handle but resorbs quickly and involves higher donor site morbidity.

Xenografts and alloplastic materials. These alternatives are osteoconductive only. They are highly resistant to resorption and easy to handle, making them practical for certain clinical situations.

Considerations when selecting a graft

The purpose of a grafting material is to repair bone defects and facilitate bone regeneration, thereby providing mechanical stability for implants. There are a number of factors to consider when selecting a graft.

Biocompatibility and disease risk. Autogenous bone eliminates disease risk, while other materials carry minimal risk if they are handled appropriately.

Osteoinductive and osteoconductive potential. For bone growth, some defects may require osteoinductive materials, especially if the defect is extensive.

Volume stability and resistance to resorption. The material's resistance to resorption is critical for volume maintenance over time, particularly in areas with soft tissue pressure.

Taking a defect-specific approach

Choosing the appropriate bone substitute and achieving adequate integration involves consideration of the defect being treated. The following variables must be taken into account:

- Vascularisation
- Immobilisation/fixation of the grafting material
- Passive-tension flap closure
- Temporary prosthesis

When making the choice between particulate bone and block grafts, it is important to consider their characteristics, as well as their origin (Figure 2).

Assessing both the patient and the type of defect will inform the choice of material to graft. It is important to consider any limits regarding the vascularisation of the graft, as previously set out by Dr Terheyden. The review by Troeltzsch et al states that up to 3.7 mm can be obtained with particulate bone and up to 5.8 mm with block grafts.[2]

Work by the group of Daniel Buser and Vivian Chappuis has demonstrated that for lateral ridge augmentations with an autogenous bone block covered with a synergenic bone substitute

	Autogenous	Allogenic	Xenogenic	Alloplastic
Biocompatible	***	**	**	***
Osteoinductive	***	*	-	-
Osteoconductive	***	***	***	**
Resistant	*	*	***	*/**
Handling	***	***	***	***
Morbidity	***	-	-	-

*** = High; ** = Moderate; * = Little; - = None

Figure 1: Clinical properties of graft materials

1 Tan WL, Wong TLT, Wong MCM, Lang NP. A systematic review of post-extractional alveolar hard and soft tissue dimensional changes in humans. Clin Oral Implants Res [Internet]. 2012 Feb [cited 2024 Nov 6];23 Suppl 5(SUPPL. 5):1–21. Available from: https://pubmed.ncbi.nlm.nih.gov/22211303/

2 Troeltzsch M, Troeltzsch M, Kauffmann P, Gruber R, Brockmeyer P, Moser N, et al. Clinical efficacy of grafting materials in alveolar ridge augmentation: A systematic review. J Craniomaxillofac Surg [Internet]. 2016 Oct 1 [cited 2024 Nov 5];44(10):1618–29. Available from: https://pubmed.ncbi.nlm.nih.gov/27622971/

	Autogenous		Allogenic		Xenogenic		Alloplastic	
	Block	Particulate	Block	Particulate	Block	Particulate	Block	Particulate
Bone regeneration	**	***	*	*	-	-	-	-
Vascularization	**	***	**	***	*	*/**	*	*/**
Fixation	***	-	***	-	*	-	*	-
Resistant	**	*	**	*	***	***	*/**	*/**
Handling	**	***	**	***	*	***	*	***
Morbidity	***	*/**	-	-	-	-	-	-

*** = High; ** = Moderate; * = Little; - = None

Figure 2: Characteristics of grafting materials according to their origin and nature.

material, there is very little resorption of the grafting material and a high success rate after 10 years.[3]

In reviews performed by the speaker focusing on implant survival comparing synergistic bone block grafts and alloplastic bone blocks with autogenous bone blocks alone, the survival rates appear to be similar, but there is a higher risk of long-term complications. This is probably due to poor vascularisation, which leads to a higher risk of graft exposure three to four years after placement.[4,5] When treating this type of horizontal defect, the preferred approach is to use lateral augmentation with an autogenous bone block graft, which has been shown to have a high success rate in long-term studies. The sausage technique can also be used.

Dr Starch-Jensen presented a study comparing autogenous block grafts with particulate grafts in the maxilla.[6] There were no significant differences, with a resorption rate of 81 percent and 78 per cent respectively. As Prof Terheyden noted, when using a particulate graft it can be helpful to combine it with a synergenic bone graft, which is slow to resorb or non-resorbable, in order to stabilise the volume of the augmented area. A combination of 75% to 50% has been shown to be stable over time in several studies. Another option is the use of the 'sausage technique' pioneered by Istvan Urban.

The speaker referred to several studies carried out by his group using the sausage technique. These achieved increases of 5.6 mm (4.5–6.2) using a combination of 25%, 50% or 100% synergenic bone, combined with high implant survival and good volumetric stability.[7,8,9]

For clinical situations involving a severe horizontal defect, combined with a vertical defect, distraction osteogenesis is a potential option (Figure 3). However, several reviews indicate that where these large vertical and horizontal defects are present, it is necessary to augment them with an autonomous bone block graft either from the iliac crest or the ascending mandibular ramus.

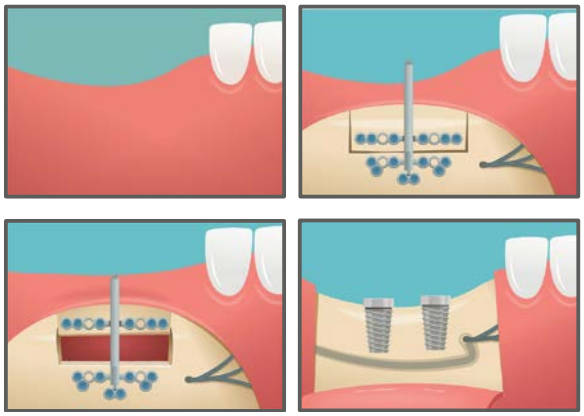


Figure 3: Schematic representation of osteogenic distraction.

3 Chappuis V, Cavusoglu Y, Buser D, von Arx T. Lateral Ridge Augmentation Using Autogenous Block Grafts and Guided Bone Regeneration: A 10-Year Prospective Case Series Study. Clin Implant Dent Relat Res [Internet]. 2017 Feb 1 [cited 2024 Nov 6];19(1):85–96. Available from: https://pubmed.ncbi.nlm.nih.gov/27476677/

4 Starch-Jensen T, Deluiz D, Tinoco EMB. Horizontal Alveolar Ridge Augmentation with Allogeneic Bone Block Graft Compared with Autogenous Bone Block Graft: a Systematic Review. J oral Maxillofac Res [Internet]. 2020 Mar 31 [cited 2024 Nov 6];11(1). Available from: https://pubmed.ncbi.nlm.nih.gov/32377325/

5 Christensen JG, Grønlund GP, Georgi SR, Starch-Jensen T, Bruun NH, Jensen SS. Horizontal Alveolar Ridge Augmentation with Xenogenic Block Grafts Compared with Autogenous Bone Block Grafts for Implant-retained Rehabilitation: a Systematic Review and Meta-Analysis. J oral Maxillofac Res [Internet]. 2023 Jun 30 [cited 2024 Nov 6];14(2). Available from: https://pubmed.ncbi.nlm.nih.gov/37521322/

6 Dasmah A, Thor A, Ekestubbe A, Sennerby L, Rasmusson L. Particulate vs. block bone grafts: three-dimensional changes in graft volume after reconstruction of the atrophic maxilla, a 2-year radiographic follow-up. J Craniomaxillofac Surg [Internet]. 2012 Dec [cited 2024 Nov 7];40(8):654–9. Available from: https://pubmed.ncbi.nlm.nih.gov/22137760/

7 Aludden H, Mordenfeld A, Dahlin C, Hallman M, Starch-Jensen T. Histological and histomorphometrical outcome after lateral guided bone regeneration augmentation of the mandible with different ratios of deproteinized bovine bone mineral and autogenous bone. A preclinical in vivo study. Clin Oral Implants Res [Internet]. 2020 Oct 1 [cited 2024 Nov 7];31(10):1025–36. Available from: https://pubmed.ncbi.nlm.nih.gov/32790921/

8 Mordenfeld A, Aludden H, Starch-Jensen T. Lateral ridge augmentation with two different ratios of deproteinized bovine bone and autogenous bone: A 2-year follow-up of a randomized and controlled trial. Clin Implant Dent Relat Res [Internet]. 2017 Oct 1 [cited 2024 Nov 7];19(5):884–94. Available from: https://pubmed.ncbi.nlm.nih.gov/28656713/

9 Aludden H, Starch-Jensen T, Dahlin C, Sdik J, Cederlund A, Mordenfeld A. Histological and radiological outcome after horizontal guided bone regeneration with bovine bone mineral alone or in combination with bone in edentulous atrophic maxilla: A randomized controlled trial. Clin Oral Implants Res [Internet]. 2024 Apr 1 [cited 2024 Nov 7];35(4):396–406. Available from: https://pubmed.ncbi.nlm.nih.gov/38291545/

In the posterior maxilla, treatment is relatively simple and involves a sinus elevation with any type of particulate graft. By contrast, treating the posterior mandibular area is complicated and generally requires a block graft with good stability against pressure and movement.

The choice between different graft materials, and whether to use block or particulate options for each of them, depends on several factors:

- **Defect size and shape.** Larger or more complex defects may benefit from block grafts, while simpler, well-contained defects can often be managed with particulate grafts.
- **Desired bone volume and resorption resistance.** Autogenous blocks provide robust volume gains but may be supplemented with non-resorbable xenografts for added stability.
- **Patient-specific factors.** Donor site morbidity, patient preferences, and defect vascularisation influence both material selection and grafting method.

Conclusion

Choosing the optimal grafting material and technique is essential for successful alveolar ridge augmentation. The defect's anatomy, the desired bone volume, and the material's properties (such as resorption resistance and ease of handling) must all be carefully evaluated. For high-stress or complex sites, autogenous blocks, sometimes combined with xenogenic grafts, are ideal, while particulates may suffice in simpler cases. Innovations such as the sausage technique and distraction osteogenesis offer promising options for challenging cases, with the sinus lift remaining a reliable method in the posterior maxilla. Long-term studies illustrate that with proper planning and material selection, high success rates and levels of patient satisfaction are achievable across a range of clinical scenarios.

EAO Congress Scientific Report; Milan 2024, Session 2

Understanding and managing soft tissue at the implant level

Peri-implant soft tissue has been shown to be a key factor in long-term treatment success. The buccal mucosa and its margin are the main components of pink aesthetics. Properly dimensioned soft tissue facilitates maintenance, and may prevent the occurrence of peri-implantitis.

The session addressed this important issue from the following perspectives:

- The position of the implant, and its design, which influence the soft tissue configuration.
- The shape of the abutment, which is closely related to the soft tissue architecture.
- The therapeutic tools that are available to manipulate the peri-implant soft tissue to improve the long-term success of implant restorations.

Daniel Buser

Hybrid vs. non-hybrid implants: influence on peri-implant soft tissue health

The speaker began by placing current knowledge in the broader context of the evolution of modern implant dentistry, which he has described in a recent paper.[1] The long-term predictability of implants has been demonstrated in several 10-year clinical studies with failure rates of less than 2%. These positive figures have been confirmed by the results from the University of Bern.

Successful outcomes (measured in decades) should therefore be the primary goal of therapy, and require long-term peri-implant tissue health and stability. However, there is currently a high prevalence of complications and failures in the market. This is due to a number of factors, including:

- Inadequate training and clinical experience of the implant surgeon.
- Implant components and biomaterials that have been placed on the market without proper scientific support.
- Unproven treatment concepts, often promoted by companies and their spokespeople.

This situation is well illustrated by the prevalence of peri-implantitis, which according to various systematic reviews[2] ranges from 12% of implants to 18% of patients, rising up to 28% in the presence of multiple risk factors. Among these risk factors, exposure of the micro-rough implant surface to the oral environment via the peri-implant sulcus, often following a poor surgical performance by the clinician, should be considered the two most important risk factors.

Failures can arise from the treatment team, patients factors, the chosen treatment approach, or implants and biomaterials.[3] The speaker attributed 80% of the problems to the clinician(s) due to a lack of training, skills and experience.

In 1986, the second generation of Straumann implants was launched with a TPS surface to improve osseous anchorage. This was in contrast to the original smooth or machined surface of the Branemark implant. However, the latter presented fewer infection problems than the former, and peri-implantitis was soon recognised as an entity.[4]

There was a paradigm shift in the late nineties concerning implant surfaces. All companies moved to some form of micro-rough implant surface after pre-clinical studies showed greater bone-to-implant contacts and removal torque values with a new SLA

1 Buser D, Sennerby L, De Bruyn H. *Modern implant dentistry based on osseointegration: 50 years of progress, current trends and open questions*. Periodontol 2000. 2017;73(1):7-21. DOI:10.1111/prd.12185.

2 Rakic M, Galindo-Moreno P, Monje A, Radovanovic S, Wang HL, Cochran D, Sculean A, Canullo L. *How frequent does peri-implantitis occur? A systematic review and meta-analysis*. Clin Oral Investig. 2018;22(4):1805-1816. DOI:10.1007/s00784-017-2276-y.
Dreyer H, Grischke J, Tiede C, Eberhard J, Schweitzer A, Toikkanen SE, Glöckner S, Krause G, Stiesch M. *Epidemiology and risk factors of peri-implantitis: A systematic review*. J Periodontal Res. 2018;53(5):657-681. DOI:10.1111/jre.12562.
Diaz P, Gonzalo E, Villagra LJG, Miegimolle B, Suarez MJ. *What is the prevalence of peri-implantitis? A systematic review and meta-analysis*. BMC Oral Health. 2022;22(1):449. DOI:10.1186/s12903-022-02493-8.

3 Buser & Chen, ITI Treatment Guide #3, 2008

4 Mombelli A, van Oosten MA, Schurch E Jr, Land NP. *The microbiota associated with successful or failing osseointegrated titanium implants*. Oral Microbiol Immunol. 1987;2(4):145-51. DOI:10.1111/j.1399-302x.1987.tb00298.x.

surface.[5] Indeed, micro-rough surfaces offered significant clinical advantages: fewer early failures, especially in poor quality bone such as in the maxilla, and the possibility of using short implants without bicortical stabilisation.

While most implant brands maintain the micro-rough surface up to the implant shoulder, in 1993 Dennis Tarnow proposed a hybrid design comprising a micro-rough implant with a machined surface in the transcrestal or transmucosal zone. The goal was to prevent exposure of the surface roughness in the sulcus, a contributing factor to peri-implantitis.

In a Swedish long-term study, non-hybrid micro-rough implants showed a significantly higher odds ratio of late implant loss than hybrid implants.[6] In a cohort study, non-hybrid Astra implants had a 10-year failure rate of 5.2% and a prevalence of peri-implantitis of 11.8%, with early bone loss identified as a clear predictor of peri-implantitis.[7] In contrast, the corresponding 10-year figures for hybrid Tissue-Level Straumann implants were 1.2% and 1.8% in a retrospective study.[8]

In 1997, it was decided at the University of Bern to change the surgical protocol with TL implants by placing the micro-rough implant surface about 1 mm below the crest to install a certain safety buffer against an exposure of the micro-rough surface to the peri-implant sulcus. The concept of the hybrid implant was the logical consequence. A recent experimental study confirmed the detrimental effect of plaque accumulation on the rough exposed surface of the implant.[9] (Figure 1)

In conclusion:

- We have a pandemic of peri-implantitis and it is essential that we address it.
- The majority of complications and failures are caused by inappropriate surgery leading to an exposed micro-rough implant surface.
- To reduce the prevalence of peri-implantitis, the strategy of implant education must be revised, combined with a paradigm shift towards hybrid implants. There are many hybrid designs, but they are not being sufficiently promoted by companies. (Figure 2)
- All of us are implicated in this problem. It's everyone's job to foster education and push companies to move towards hybrid implants. Everyone will benefit: patients, dentists and implant companies.

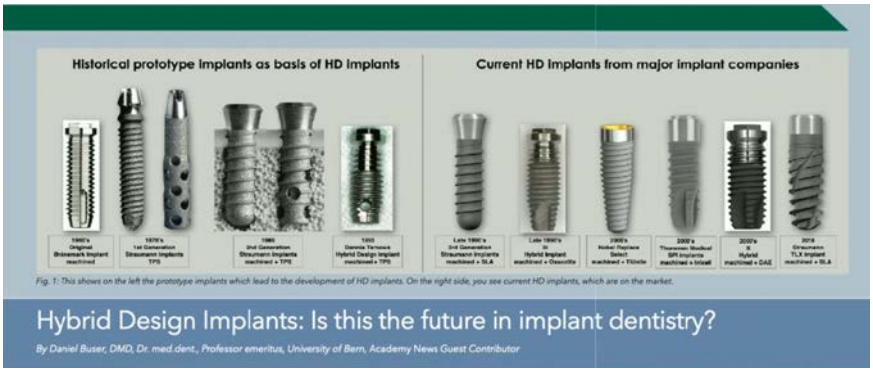


Figure 1

Figure 2

5 Buser D, Schenk RK, Steinemann S, Fiorellini JP, Fox CH, Stich H. *Influence of surface characteristics on bone integration of titanium implants. A histomorphometric study in miniature pigs.* J Biomed Mater Res. 1991;25(7):889-902. DOI:10.1002/jbm.820250708.
Buser D, Nydegger T, Oxland T, Cochran DL, Schenk RK, Hirt HP, Snétivy D, Nolte LP. *Interface shear strength of titanium implants with a sandblasted and acid-etched surface: a biomechanical study in the maxilla of miniature pigs.* J Biomed Mater Res. 1999;45(2):75-83. DOI:10.1002/(sici)1097-4636(199905)45:2<75::aid-jbm1>3.0.co;2-p.

6 Derks J, Håkansson J, Wennström JL, Tomasi C, Larsson M, Berglundh T. *Effectiveness of implant therapy analyzed in a Swedish population: early and late implant loss.* J Dent Res. 2015;94(3 Suppl):44S-51S. DOI:10.1177/0022034514563077.

7 Windael S, Collaert B, De Buyser S, De Bruyn H, Vervaeke S. *Early peri-implant bone loss as a predictor for peri- implantitis: A 10-year prospective cohort study.* Clin Implant Dent Relat Res. 2021;23(3):298-308. DOI:10.1111/ cid.13000.

8 Buser D, Janner SF, Wittneben JG, Brägger U, Ramseier CA, Salvi GE. *10-year survival and success rates of 511 titanium implants with a sandblasted and acid-etched surface: a retrospective study in 303 partially edentulous patients.* Clin Implant Dent Relat Res. 2012;14(6):839-51. DOI:10.1111/j.1708-8208.2012.00456.x.

9 Song YW, Park JY, Na JY, Kwon YH, Cha JK, Jung UW, Thoma DS, Jung RE. *Does an untreated peri-implant dehiscence defect affect the progression of peri-implantitis?: A preclinical in vivo experimental study.* Clin Oral Implants Res. 2024. DOI:10.1111/clr.14324. Epub ahead of print.

Ana Torres

Abutment design at the level of soft tissues

The supracrestal component or transmucosal area is where the peri-implant soft tissue adheres to the implant/abutment surface to create a biological seal that protects the bone crest. In a bone-level implant, this zone corresponds to the abutment, and the shape of the abutment also has an impact on the aesthetic outcome.

Two meta-analyses examined abutment-related factors that may influence peri-implant soft tissue inflammation and found no significant differences in surface type, design or decontamination method.[1] However, BOP values for Ti were higher compared to Zi abutments.

The goal of treatment is to achieve harmony between the restoration and the soft tissue. This is highly dependent on the transmucosal contours of the abutment, and achieving success begins with the customisation of the provisional restoration. Critical and subcritical contours with regard to this have already been defined.[2] (Figure 3)

Successfully creating a harmonious emergence profile depends on two key factors:

- optimal bone and soft tissue levels
- sculpting the tissue by incremental changes

In the case of an immediate implant, the aim is to support the soft tissue to prevent it from collapsing during the healing process. The best way to do this is to have the emergence profile of the provisional prepared before the implant is placed.

The critical contour maintains the soft tissue architecture by supporting the mucosal margin without compression. The subcritical contour should be flat or concave to create the 'regeneration space' where the coagulum is stabilised.[3] Convexity in this area would occupy this space and lead to recession of the mucosal margin.[4]

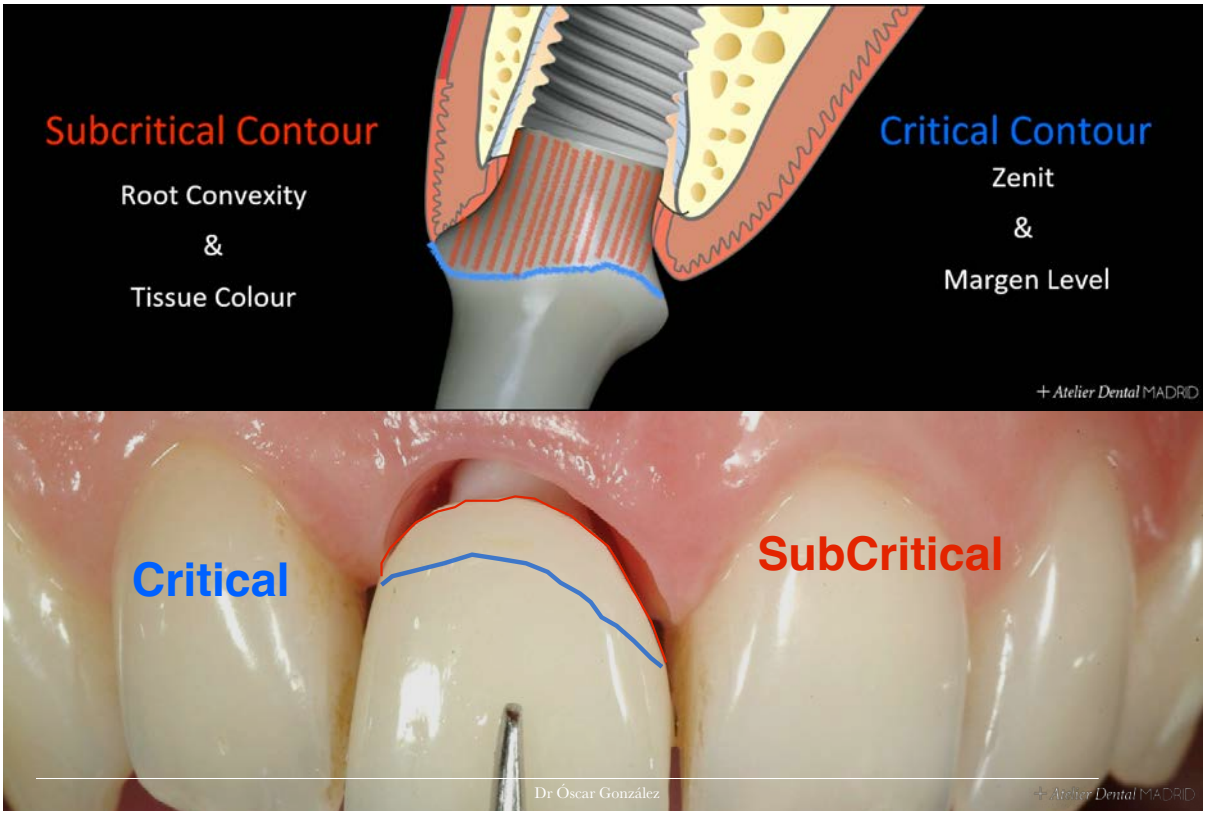


Figure 3

1 Sanz-Martín I, Sanz-Sánchez I, Carrillo de Albornoz A, Figuero E, Sanz M. *Effects of modified abutment characteristics on peri-implant soft tissue health: A systematic review and meta-analysis.* Clin Oral Implants Res. 2018;29(1):118-29. DOI:10.1111/clr.13097.
Sanz-Sánchez I, Sanz-Martín I, Carrillo de Albornoz A, Figuero E, Sanz M. *Biological effect of the abutment material on the stability of peri-implant marginal bone levels: A systematic review and meta-analysis.* Clin Oral Implants Res. 2018;29 Suppl 18:124-44. DOI:10.1111/clr.13293.

2 Su H, Gonzalez-Martin O, Weisgold A, Lee E. *Considerations of implant abutment and crown contour: critical contour and subcritical contour.* Int J Periodontics Restorative Dent. 2010;30(4):335-43. PMID: 20664835.

3 González-Martín O, Lee E, Weisgold A, Veltri M, Su H. *Contour Management of Implant Restorations for Optimal Emergence Profiles: Guidelines for Immediate and Delayed Provisional Restorations.* Int J Periodontics Restorative Dent. 2020;40(1):61-70. DOI:10.11607/prd.4422.

4 Siegenthaler M, Strauss FJ, Gamper F, Hämmerle CHF, Jung RE, Thoma DS. *Anterior implant restorations with a convex emergence profile increase the frequency of recession: 12-month results of a randomized controlled clinical trial.* J Clin Periodontol. 2022;49(11):1145-57. DOI:10.1111/jcpe.13696.

After the tissues have matured, different approaches can be followed: (Figure 4)

- For an over-augmented ridge, the first step is to move the critical contour to an apical position. The modification of the provisional is made chair-side, by sandblasting, applying adhesive, adding nano-hybrid flowable composite and polishing thoroughly. The pressure on the tissue should be controlled, with ten minutes being the maximum time of ischemia.
- If a slightly deficient margin is found, assuming there is sufficient buccal tissue thickness and the implant is positioned deep enough, the subcritical contour can be modified to push the tissue and increase its volume (Figure).
- In cases of severe deficiency, soft tissue augmentation will be required

Finally, the transmucosal area should be transferred to the model using either an analogue technique, such as customising an impression coping, or digitally. The 'inverse scan body concept' has been proposed by the speaker's group and consists of two STL files, with a scan that clones the emergence profile achieved by the provisional that is then integrated into the scanned model.

The critical contour affects the zenith and the margin level, while the subcritical contour affects the root convexity and the tissue colour (Figure).

DELAYED IMPLANTS

	Facial soft tissue margin coronal to ideal level	Facial soft tissue margin at ideal level	Facial soft tissue margin slightly apical to ideal level	Interproximal tissue preserved	Interproximal tissue slightly deficient	Palatal
CRITICAL CONTOUR	Overdimension in facial/ apical direction	Equal to the natural tooth	Underdimension in a facial direction	Equal to the natural tooth	Equal to the natural tooth	Equal to the natural tooth
SUBCRITICAL CONTOUR	Flat or slightly concave	Flat or slightly concave	Increase convexity	Equal to the natural tooth	Increase convexity	Equal to the natural tooth

Gonzalez-Martin O, et al. Contour Management of Implant Restorations for Optimal Emergence Profiles: Guidelines for Immediate and Delayed Provisional Restorations. J Periodontics Restorative Dent 2020;40:61–70

IMMEDIATE IMPLANTS

	Facial	Interproximal	Palatal
CRITICAL CONTOUR	Reduce 0.5 -1 mm compared to the natural tooth	Equal to the natural tooth	Equal to the natural tooth
SUBCRITICAL CONTOUR	As concave as possible	As concave as possible	As concave as possible

Gonzalez-Martin O, et al. Contour Management of Implant Restorations for Optimal Emergence Profiles: Guidelines for Immediate and Delayed Provisional Restorations. J Periodontics Restorative Dent 2020;40:61–70

Figure 4

Raffaele Cavalcanti

Can soft tissue be predictably manipulated for long-term stability?

Long-term soft tissue stability is closely related to long-term peri-implant health, as defined elsewhere.[1] A systematic review of success criteria distinguished between implant level, peri- implant soft tissue, prosthetic level and PROMs/patient satisfaction.[2]

Marginal recession is an aesthetic complication that can occur due to a number of factors. These include implant malposition, lack of buccal bone, thin soft tissue, lack of keratinised tissue, the attachment status of the adjacent teeth, and surgical trauma.

It is well established that when the buccal bone width is less than 1.5mm, the tissues are more prone to change over time, leading to aesthetic and biological complications. Simultaneous bone augmentation can reduce this tendency,[3] while soft tissue augmentation improves survival, reduces the risk of peri-implantitis, and maintains marginal stability over time.[4] There is evidence that autogenous grafts, which increase both mucosal thickness and keratinised tissue, result in less marginal bone loss and better peri-implant health,[5] and that thin phenotype and <2 mm of keratinised tissue may be significant risk factors for peri-implant disease.[6]

The speaker illustrated the differences in outcomes when a soft tissue augmentation was or wasn't performed in a range of thin phenotype clinical cases. He concluded that while marginal

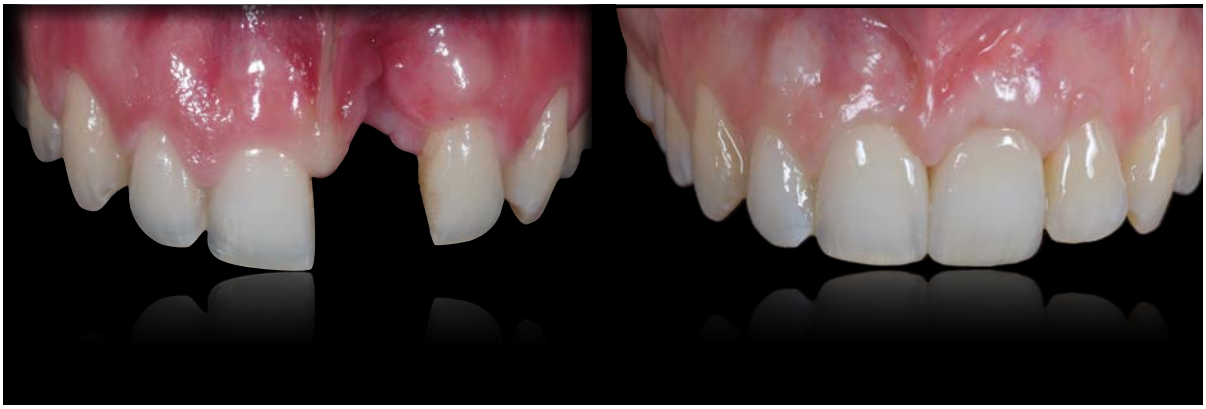


Figure 5

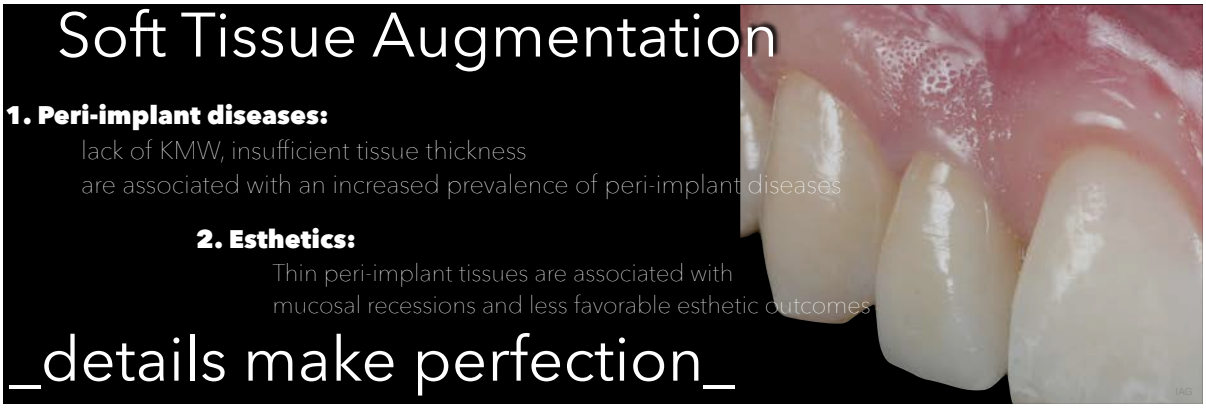


Figure 6

1 Araujo MG, Lindhe J. *Peri-implant health.* J Clin Periodontol. 2018;45 Suppl 20:S230-S6. DOI:10.1111/jcpe.12952.
Berglundh T, Armitage G, Araujo MG, et al. *Peri-implant diseases and conditions: Consensus report of workgroup 4 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions.* J Clin Periodontol. 2018;45 Suppl 20:S286-S91. DOI:10.1111/jcpe.12957.

2 Papaspyridakos P, Chen CJ, Singh M, Weber HP, Gallucci GO. *Success criteria in implant dentistry: a systematic review.* J Dent Res. 2012;91(3):242-8. DOI:10.1177/0022034511431252.

3 Jensen SS, Aghaloo T, Jung RE, et al. *Group 1 ITI Consensus Report: The role of bone dimensions and soft tissue augmentation procedures on the stability of clinical, radiographic, and patient-reported outcomes of implant treatment.* Clin Oral Implants Res. 2023;34 Suppl 26:43-9. DOI:10.1111/clr.14154.
Monje A, Roccuzzo A, Buser D, Wang HL. *Influence of buccal bone wall thickness on the peri-implant hard and soft tissue dimensional changes: A systematic review.* Clin Oral Implants Res. 2023;34 Suppl 26:8-27. DOI:10.1111/ clr.14177.

4 Stefanini M, Barootchi S, Sangiorgi M, Pispero A, Grusovin MG, Mancini L, Zucchelli G, Tavelli L. *Do soft tissue augmentation techniques provide stable and favorable peri-implant conditions in the medium and long term? A systematic review.* Clin Oral Implants Res. 2023;34 Suppl 26:28-42. DOI:10.1111/clr.14150.

5 Thoma DS, Naenni N, Figuero E, Hämmerle CHF, Schwarz F, Jung RE, Sanz-Sánchez I. *Effects of soft tissue augmentation procedures on peri-implant health or disease: A systematic review and meta-analysis.* Clin Oral Implants Res. 2018;29 Suppl 15:32-49. DOI:10.1111/clr.13114.

6 Gharpure AS, Latimer JM, Aljofi FE, Khang JH, Daubert DM. *Role of thin gingival phenotype and inadequate keratinized mucosa width (< 2 mm) as risk indicators for peri-implantitis and peri-implant mucositis.* J Periodontol. 2021;92:1687–96. DOI:10.1002/JPER.20-0792.

recession is a common feature 5 years after lateral GBR,[7] soft tissue grafting improves marginal stability and should be routinely considered in the aesthetic zone. The thicker and lighter the mucosa are near the margin, the better the patient's aesthetic perception of the result.[8]

The speaker presented a complex case involving traumatic tooth extraction where soft tissue augmentation was performed prior to the GBR procedure to obtain sufficient tissue for primary closure. A customised titanium mesh was then used for bone augmentation. The implant was placed during the third surgery, with a connective tissue graft also required when the implant was uncovered to provide the necessary volume. (Figure 5)

In conclusion, insufficient tissue thickness or a lack of keratinised tissue is associated with the prevalence of peri-implant disease. Additionally, thin peri-implant tissues are prone to marginal recession and aesthetic complications. (Figure 6)

Discussion

How deep should the implant be placed?

In the aesthetic zone a minimum depth is required in order to conform the transmucosal area by shaping the abutment contours. However, the majority of implants are non-aesthetic cases and these present a completely different scenario. The rule 'as deep as necessary and as shallow as possible' should be applied, taking into account anterior versus posterior cases, healthy patients versus periodontal patients, etc. Case selection is crucial.

Other factors include the location of the microgap, the type of implant-abutment connection, and the level of the rough surface, which should always be subcrestal.

Soft tissue augmentation

The timing of connective tissue grafting is not based on a fixed protocol and depends on the circumstances of the case. In some situations it is performed as the first surgery; in others it takes place when the implant is uncovered. The clinician usually uses the healing window of the GBR to perform the soft tissue augmentation.

Soft tissue substitutes work well to maintain mucosal thickness and prevent recession, but when it comes to changing the biotype, an autograph is the gold standard.

7 Cairo F, Nieri M, Cavalcanti R, Landi L, Rupe A, Sforza NM, Pace R, Barbato L. *Marginal soft tissue recession after lateral guided bone regeneration at implant site: A long-term study with at least 5 years of loading.* Clin Oral Implants Res. 2020;31(11):1116-24. DOi:10.1111/clr.13658. Epub 2020 Sep 23.

8 Khorshed A, Vilarrasa J, Monje A, Nart J, Blasi G. *Digital evaluation of facial peri-implant mucosal thickness and its impact on dental implant aesthetics.* Clin Oral Investig. 2023;27(2):581-90. DOI:10.1007/s00784-022-04753-x.

EAO Congress Scientific Report; Milan 2024, Session 3

Management of severely compromised dentition

This session looked at decision-making in patients with severe periodontal disease and asked the following questions:

- Can we keep the teeth?
- Can we replace the dentition in a way that is both functional and aesthetic with a complete rehabilitation on implants?
- How can we combine teeth and implants in cases involving severely compromised teeth?

João Caramês

Immediate placement and loading

When managing cases involving severely compromised dentition, decision-making is a multifactorial process that must take into account:

- the condition of the remaining dentition
- the patient's expectations, compliance and economic capability

The assessment of the remaining dentition should not only evaluate each tooth individually, but also consider the arch as a whole. These factors must be considered alongside each other together in the decision-making process.[1] (Figure 1).

The speaker asked the question 'How can successful full-arch implant rehabilitation be planned in a patient with terminal

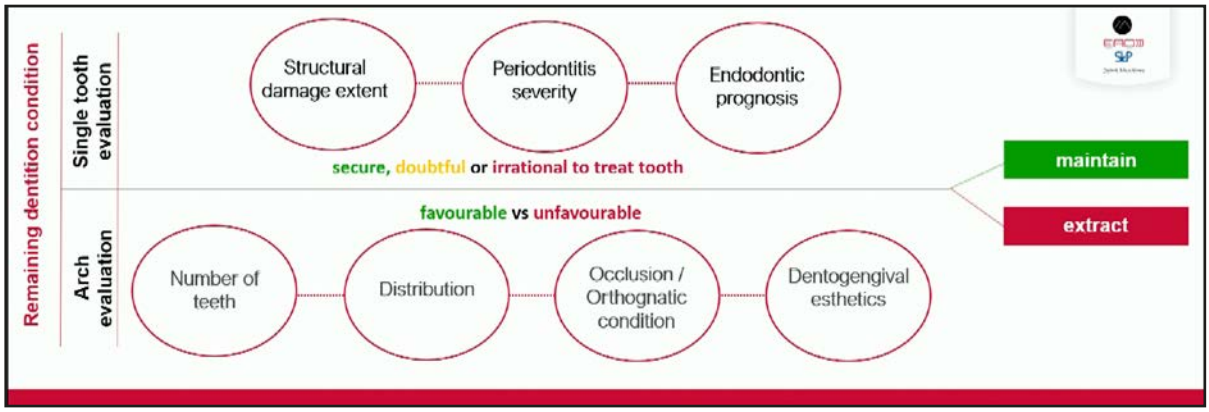


Figure 1: Decision making according to the condition of the remaining dentition.

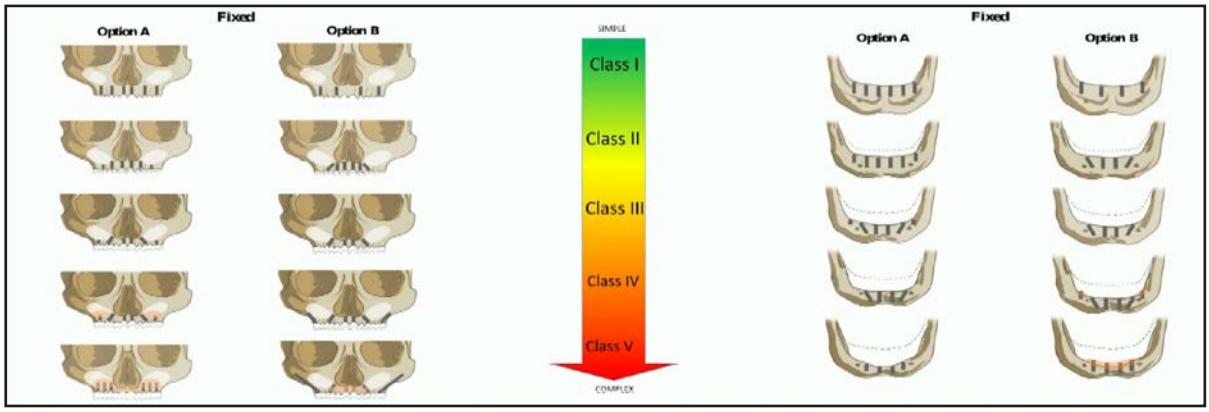


Figure 2: degree of complexity based on bone atrophy

1 *(Mitrani R, Papaspyridakos P, Bedrossian EA, Goldberg J, Tsigarida A, Chochlidakis K. Treatment planning algorithm for patients with a terminal dentition. J Prosthet Dent. 2024 May 25:S0022-3913(24)00351-2. doi: 10.1016/j.prosdent.2024.04.029. Epub ahead of print. PMID: 38797577)*

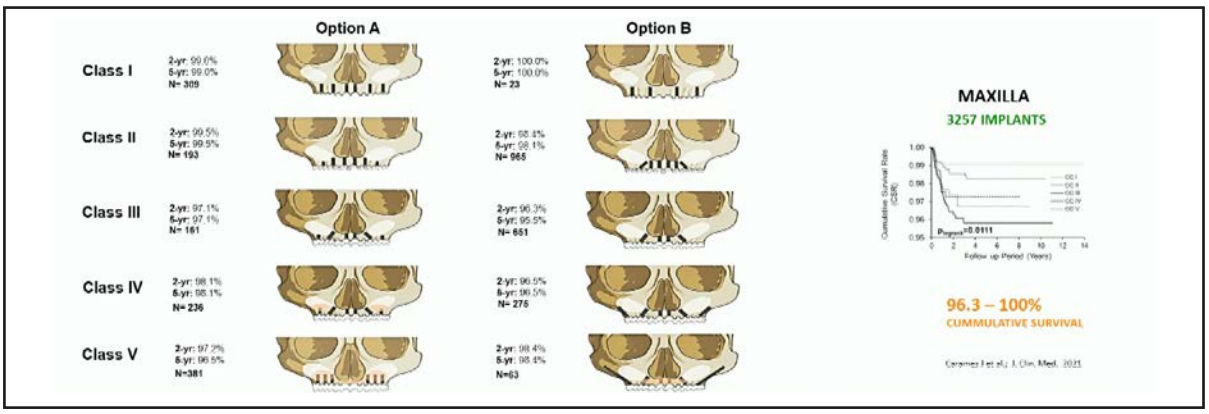


Figure 3: survival rates, maxilla

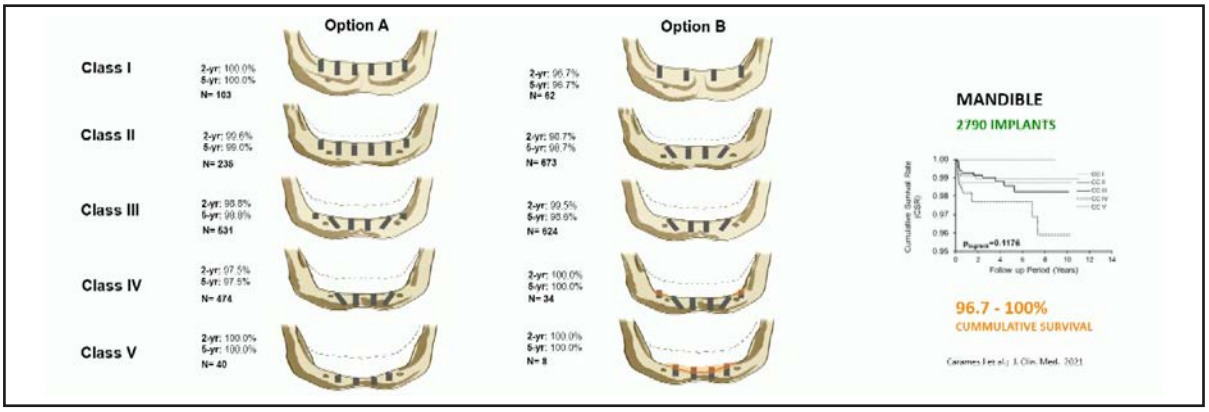


Figure 4: survival rates, mandible

dentition?' He then shared a classification tool for determining the degree of complexity of full-arch rehabilitation which takes a number of important factors into account. As well as looking at the patient and rehabilitation-related factors, it considers the extent of bone atrophy in the jaws and enables the ideal number and location of implants to be determined. (Figure 2)

Survival rates of between of 96% and 100% have been demonstrated for each option at 2 and 5 years in a study of 1,200 cases of immediate full-arch rehabilitation.[2,3] (Figures 3,4)

These data support the principle that adapting the rehabilitation to the level of bone atrophy, as well as patient-specific risk status, can result in high cumulative survival rates at a range of levels of bone atrophy. The speaker's conclusion was that clinicians should adapt their technique to the patient, not the patient to the technique.

Based on observational studies of full-arch rehabilitations in patients with stage IV periodontitis, 10-year estimates of tooth loss were lower than the corresponding estimates for implants. Estimated loss of tooth- and implant-supported restorations at 10 years was similar. Technical complications were more prevalent for implant-supported restorations, compared with tooth-supported restorations.[4]

The speaker emphasised the importance of maintenance protocols in rehabilitation involving patients with stage IV periodontitis, as a recent systematic review illustrated that peri-implantitis, or peri-implantitis-like symptoms, were observed at an estimated 9% of implants (after 3.1 years).[4]

2 *A comprehensive classification to full arch implant rehabilitation. Caramês J. Rev Port Estomatol Med Den Cir Maxilofac. 2019;60:175–188.*

3 *Caramês JMM, Marques DNDS, Caramês GB, Francisco HCO, Vieira FA. Implant Survival in Immediately Loaded Full-Arch Rehabilitations Following an Anatomical Classification System-A Retrospective Study in 1200 Edentulous Jaws. J Clin Med. 2021 Nov 4;10(21):5167. doi: 10.3390/jcm10215167. PMID: 34768687; PMCID: PMC8584991.*

4 *Tomasi C, Albouy JP, Schaller D, Navarro RC, Derks J. Efficacy of rehabilitation of stage IV periodontitis patients with full-arch fixed prostheses: Tooth-supported versus Implant-supported-A systematic review. J Clin Periodontol. 2022 Jun;49 Suppl 24:248-271. doi: 10.1111/jcpe.13511. Epub 2021 Nov 10. PMID: 34761430.*

Alberto Fonzar

Saving the residual dentition

In this presentation, the speaker used a series of cases involving patients with stage IV periodontal disease to illustrate the importance of both providing periodontal treatment and monitoring the evolution of the disease. This can be a viable alternative to an immediate full-arch rehabilitation on teeth or implants.

He highlighted the need for treatment and monitoring that takes into account both the patient's periodontal status and their ongoing involvement and motivation. It is crucial to establish this before subjecting patients to a much more complex and expensive treatment.

He emphasised the importance of not rushing to extract all the teeth and perform a full-arch rehabilitation with implants. Based on current guidelines for the treatment of stage IV periodontitis, if the infection-inflammation cycle can be broken through a combination of patient motivation and scrupulous supportive therapy, even teeth with severe bone loss can remain healthy and functional for decades.[1]

Before deciding on a definitive treatment plan, both the patient and the periodontal tissues must be given time to fully express their healing potential. This is in contrast to reaching an overall prognosis and treatment plan too early on, and in 'one shot'. (Figure 1)

This approach demonstrates that many clinical cases where the first response might be to extract the teeth can actually end up being healthy after appropriate periodontal treatment.

The speaker then explored whether teeth that were affected by periodontitis could be used to support full-arch fixed rehabilitations. He noted that where the remaining teeth were virgin, using those teeth to support a full-arch fixed prosthesis might be 'too expensive' from a biological perspective. Tooth preparation is per se a risk factor, especially if the abutments are to be endodontically treated. (Figure 2) However, the use of periodontally affected teeth as abutments seems to be a significant prognostic factor for tooth loss.[1]

The speaker concluded by saying that the goal should always be to try and maintain the natural teeth wherever possible, and to avoid rushing when considering treatment involving a full-arch fixed prosthesis, whether retained on implants or teeth. Instead, the literature recommends taking time to provide periodontal treatment and observe ongoing maintenance in order to assess healing potential, rather than performing a full-arch treatment plan too soon.[1]

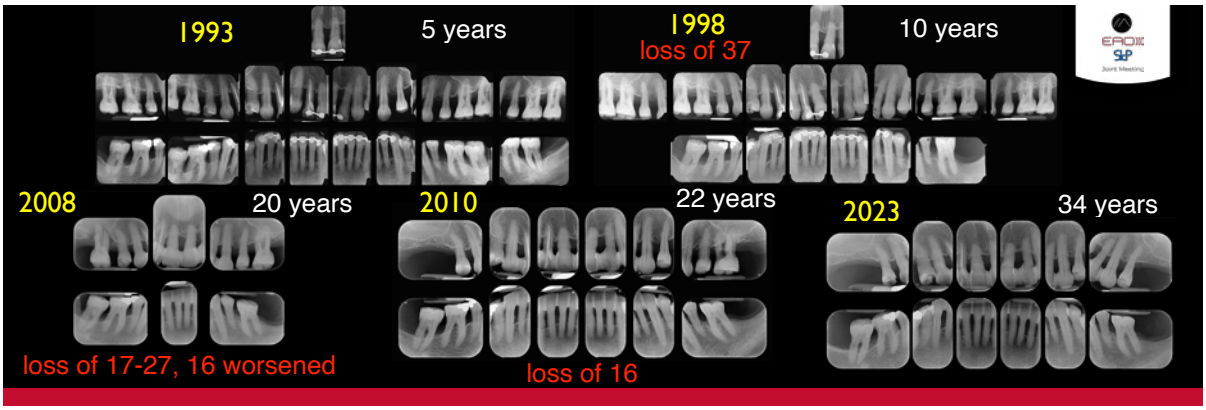


Figure 1: Case with 34 years of follow-up that involved periodontal treatment and maintenance, during which only four teeth were lost.

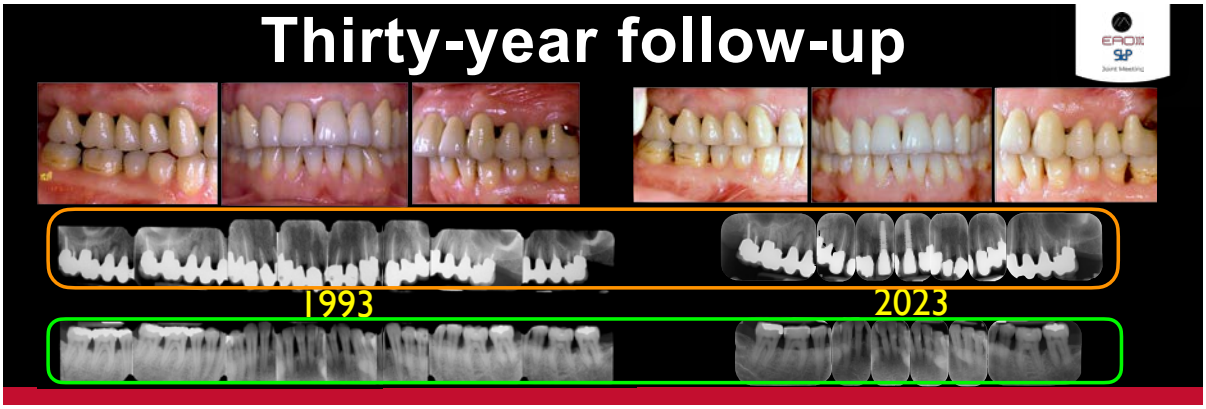


*Figure 2: Case involving prosthetically treated upper teeth, vs. inferior teeth treated only periodontally, at 30-year follow-up.*****

1 Herrera D, Sanz M, Kebschull M, Jepsen S, Sculean A, Berglundh T, Papapanou PN, Chapple I, Tonetti MS; EFP Workshop Participants and Methodological Consultant. Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline. J Clin Periodontol. 2022 Jun;49 Suppl 24:4-71. doi: 10.1111/jcpe.13639. PMID: 35688447.

Konstantinos Chochlidakis

Taking a staged approach to terminal dentition

The decision to edentulate patients with a terminal dentition needs to be carefully analysed, as its nature is inherently multifactorial, including not only the condition of the remaining dentition but the patient's level of compliance, financial capabilities, expectations, and wishes. The remaining dentition needs to be evaluated quantitatively and qualitatively, and there are clear parameters that need to be individually assessed. Important factors that should be thoroughly evaluated include the periodontal damage, structural damage, number and distribution of remaining teeth, and dentogingival and dentofacial aesthetics. The speaker shared a decision-making algorithm from his recent publication in the Journal of Prosthetic Dentistry.[1]

'Terminal dentition' refers to dentition that is compromised to the extent that teeth are non-restorable, or present with inadequate support, and therefore must be extracted. In these cases, the

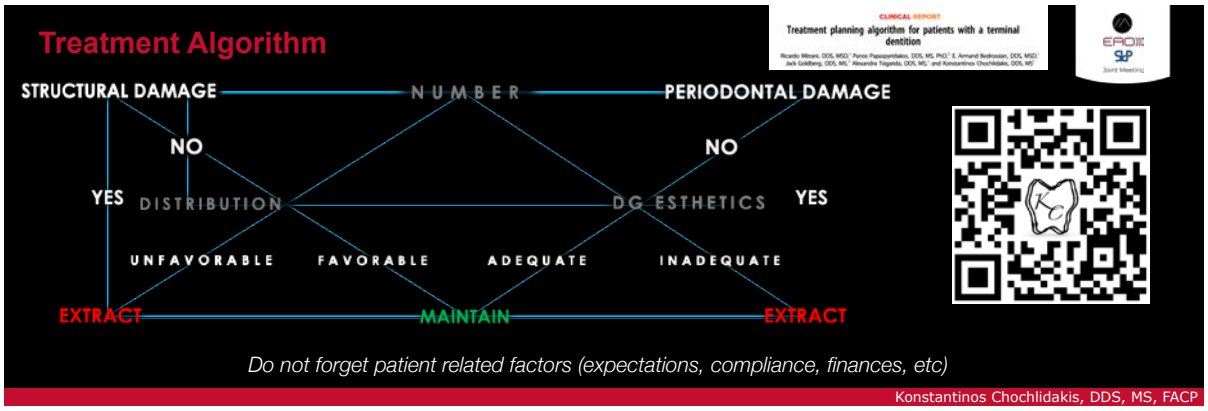


Figure 1: Treatment algorithm

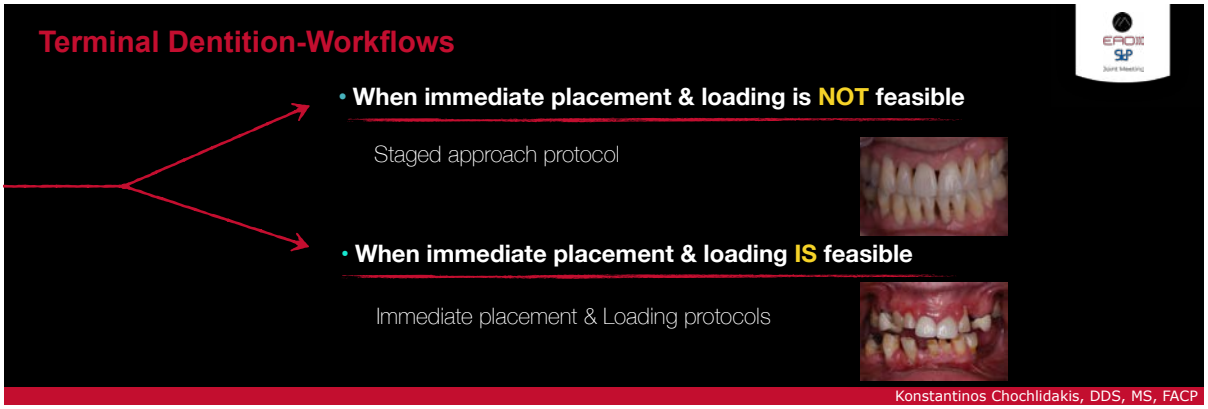


Figure 2: Terminal dentition workflows

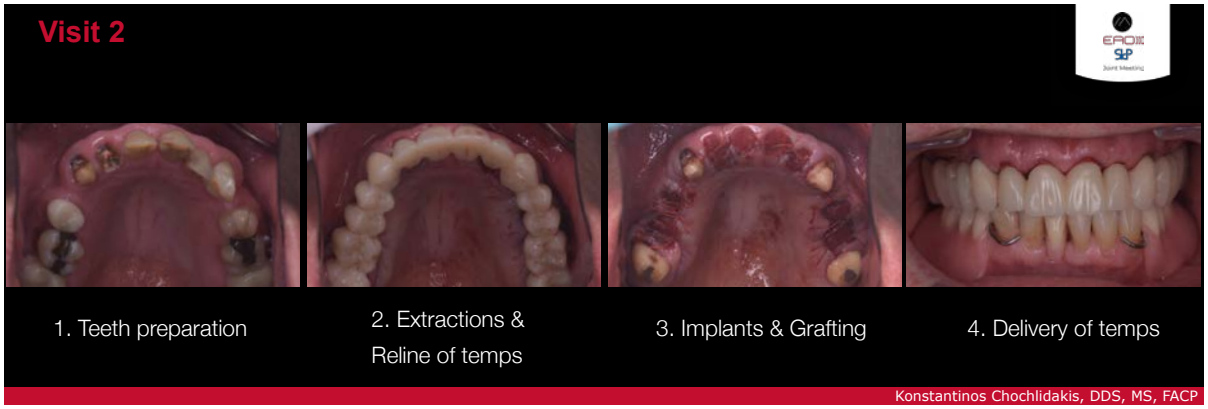


Figure 3: Workflow for full-arch provisional prosthesis

1 Mitrani R, Papaspyridakos P, Bedrossian EA, Goldberg J, Tsigarida A, Chochlidakis K. Treatment planning algorithm for patients with a terminal dentition. J Prosthet Dent. 2024 May 25:S0022-3913(24)00351-2. doi: 10.1016/j.prosdent.2024.04.029. Epub ahead of print. PMID: 38797577.

speaker differentiated between two workflows, depending on whether immediate placement and loading was feasible or not. (Figure 2)

Where immediate implant loading is not feasible, or the patient does not want a removable provisional prosthesis, the speaker recommended using the remaining teeth (four in most cases; two from each side) as a support for a full-arch provisional prosthesis during osseointegration. (Figure 3)

After allowing time for osseointegration, the patient then receives a provisional full-arch restoration supported on implants, while the final prosthesis is made. (Figure 4)

This protocol is carried out in stages over three visits. On the first visit, digital data are captured and used to make an eggshell provisional. During the second visit, the relevant extractions are carried out, the implants are placed, and a new scan is taken to make the provisional that will be placed on the implants once the healing period has elapsed. The provisional is placed in eggshell on the remaining teeth. On the third visit, the remainder of the teeth are extracted and the temporary prosthesis is placed on the implants. Based on individual case factors, the definitive implant-supported fixed prosthesis is then placed when all tissues are fully healed.

The speaker made the following concluding remarks about the staged approach:

1. It can be successfully used in patients with terminal dentition.
2. No removable provisional prosthesis is needed.
3. It offers better soft tissue management through the surgery and the provisionals.
4. It offers preserved function and enhanced aesthetics during the treatment.
5. Placement of the implants is prosthetically driven.
6. It should be carried out in no less than two surgical steps, and with extended treatment time.

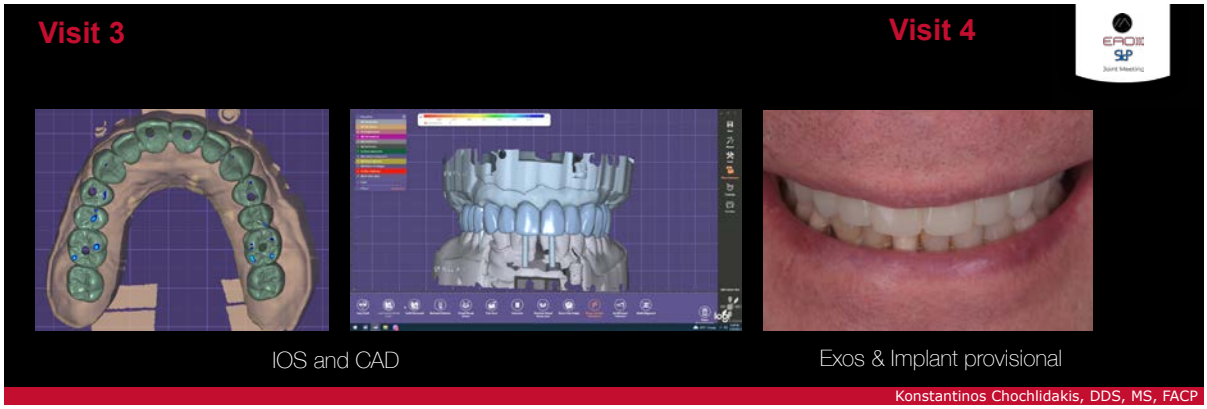


Figure 4: Design of provisional fixed implant restoration

EAO Congress Scientific Report; Milan 2024, Session 4

Advances in implant macro and micro design

Robert Levine

Macro-design

The factors that influence clinicians when defining the macro- and micro-design of an implant are diverse. They include:

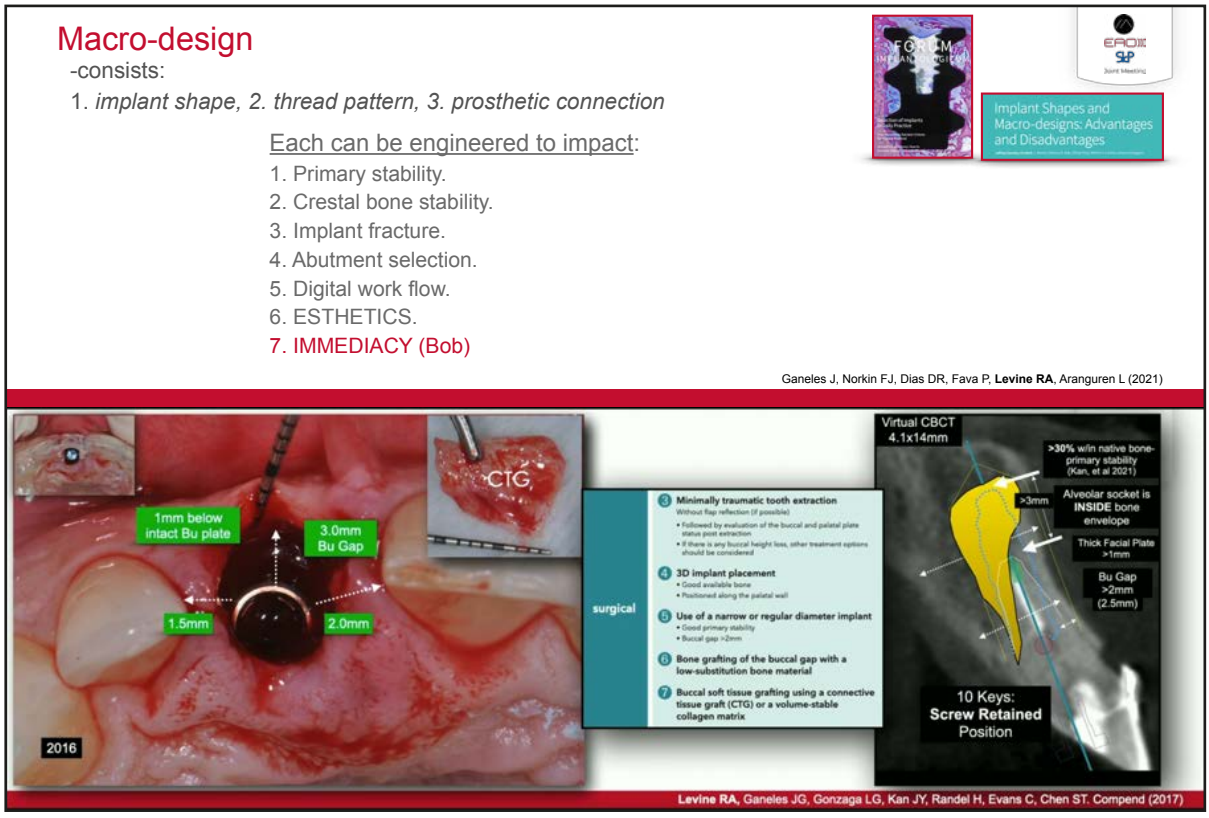
- patient-related metrics (anatomy, restoration plan, restoration length, loading time, aesthetic requirements, planned location of the implant)
- dentist-related criteria (brand preference, cost, personal experience, education, exposure to marketing, inventory)
- referral preference

The macro-design of implants relates to the implant shape, thread pattern and prosthetic connection. Each can be engineered to impact on primary and crestal bone stability, implant fracture resistance, abutment selection, digital workflow, aesthetics and immediacy.

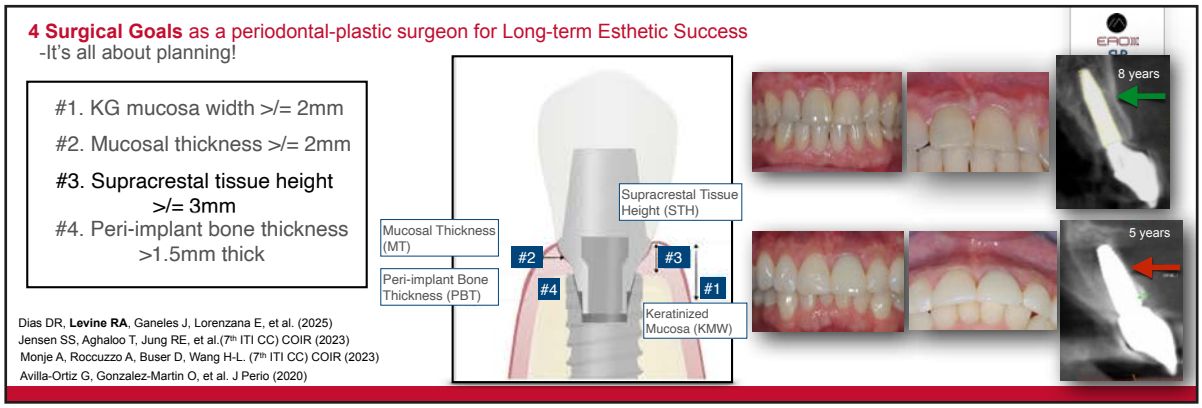
One scientific paper[1] noted that there are around 500 implant manufacturers, with over 4,000 implant brands and designs. It added that many of the different features of the macro-design were potentially marketing-related or business-oriented, rather than evidence-based.

Implants can be tapered (conical) or parallel (cylindrical), bone or tissue level, and feature a gentle or aggressive thread pattern. They can also offer platform switching or a similar platform, and be screw- or cement-retained. The number of options is endless.

Tapered implants help avoid vital structures and hitting adjacent implants or teeth. In the aesthetic zone, a tapered shape reduces the likelihood of perforating the buccal plate apically. Similarly, more aggressive thread designs can perforate the buccal plate in the apical zone. For immediate implant placement, it is important to have a buccal gap of more than two millimetres between the implant and the bone, and aggressive designs can make this difficult.



1 Ganeles J, et al. Implant Shapes and Macro-designs: Advantages and Disadvantages. 2021. https://forum-implantologicum.iti.org/web/forum-implantologicum/feature-article/implant-shapes-and-macrodesigns-advantages-and-disadvantages-202



The speaker described a protocol he has developed called the '10 Keys for Successful Esthetic-Zone Single Immediate Implants'.[2] The checklist is important because aesthetic zone cases are complex, and good planning is critical. The second point of the protocol – the CBCT analysis – is the key one. It recommends an intact buccal bone that is thicker than 1 mm (if possible); an alveolar process at least 8 mm wide; an alveolar socket inside the bone envelope; and the selection of an appropriately sized and positioned implant to allow a buccal gap greater than 2 mm.

The gap size matters: a narrow gap (less than 2 mm) results in about 40% coverage of the buccal wall on average at six years, whereas a wide gap (more than 2 mm) results in about 90% coverage.[3]

There are four surgical goals for long-term aesthetic success: a keratinised mucosa width and mucosal thickness greater than 2 mm, a supracrestal tissue height greater than 3 mm, and a peri-implant bone thickness wider than 1.5 mm.

The drill profiles are different for cylindrical and tapered implant preparation. Additionally, with a tapered design there is typically a very aggressive thread pattern. This is especially significant in dense bone, and can lead to excessive bone compression (over 50 Ncm) resulting in potential surgical complications, such as delayed healing (microfractures, ischemia, bone necrosis), implant fracture, or even implant failure. However, tapered implants have a high primary stability and are recommended in soft bone and immediate loading cases.

The speaker's final thoughts on macro-designs were:

1. Pre-operative virtual CBCT planning is critical to control the buccal gap in immediate implants and understand both the anatomy of the socket and the bone density.
2. Use the '10 Keys' checklist to avoid complications. Always try to achieve the four surgical goals.
3. Understand the importance of operator experience (learning curve).
4. Use aggressive thread patterns in poor bone quality where there is a buccal gap width of more than 2 mm. Avoid using aggressive threads in dense (type 1) bone.
5. Adjust drilling protocol when using aggressive threads. Do not under-prepare the osteotomy, do tapping if necessary, and use new twist drills.
6. For immediate implant placement perform fully guided surgery with copious irrigation.
7. Monitor insertion torque closely. If it's too high, consider removing the implant and aborting.

2 Levine RA, Ganeles J, Gonzaga L, Kan JK, Randel H, Evans CD, Chen ST. 10 Keys for Successful Esthetic-Zone Single Immediate Implants. Compend Contin Educ Dent. 2017 Apr;38(4):248-260.

3 Levine RA, et al. Effect of the buccal gap width following immediate implant placement on the buccal bone wall: A retrospective cone-beam computed tomography analysis. Clin Implant Dent Relat Res. 2022 Aug;24(4):403-413.

Ralf Smeets

Micro-design

Achieving good aesthetic results involves several factors: the 3D position of the implant; the choice of abutment; the timing of loading; hard and soft tissue management; and making the right incisions. 78% of all errors relate to implant position and the anatomy, and only 7% are due to macro- and micro-design of the implant.

Prioritising the parameters that lead to success is essential. The most important of these is patient selection (age, habits, illness, medication), followed by the nature of the defect (number of walls, horizontal or vertical), the size of the interdental space, and the surgical technique (making the correct incisions, extension of the flap). The material type, design and roughness of the implant are less important.

When it comes to osseointegration, the choice of material is key. Other factors include biofunctionalisation, hydrophilicity, roughness and macro-design.

With respect to micro-design, the surface is the key element. There are a lot of processes that can modify the surface, including both subtractive (sandblasting, acid-etching) and additive (plasma spraying) techniques. There are also inorganic, organic and combined biomimetic surfaces. The commercial trend is towards surfaces that will feature biological strategies, such as tissue coating and the use of stem cells.

All manufacturers use the same mainstream engineering techniques to modify the surface topography of their implants. These include sandblasting, acid-etching, anodisation, plasma spraying and laser radiation. They also use the same inorganic coatings (hydroxyapatite, calcium phosphate, conversion coatings, bioactive glasses).

As clinicians, our goal is to try to avoid peri-implantitis. Up to 56% of all implants will prompt a peri-implant reaction (mucositis or peri-implantitis) after 5 to 8 years.

Turning to conversion coatings, the speaker described novel implant surfaces that are created using plasma electrolytic oxidation (PEO) and spark erosion.[1] These are achieved by heating the implant surface. The result is superior to an additive coating, which can become detached when the implant is inserted. Using these techniques, it's possible to whiten the implant and create a super hydrophilic surface. This leads to an enhanced aesthetic result and optimisation of hard and soft tissue management.

New research is increasingly favouring bioactive glasses. Synthetic zirconium dioxide is a great material for the implant soft tissue zone, and combining it with glass is leading to even more biologically favourable surfaces. The main challenge is producing a defined surface roughness on the zirconium dioxide surface without ablative processes. One solution might be the inkjet printing of a glass solder surface.

An established strategy for avoiding infections is to coat the implant with an antibacterial substance. However, this can lead to antibiotic resistance and resistance to other antibacterial substances. The speaker expressed his opinion that there is no longer a clear surgical concept for peri-implantitis treatment, and instead there are only non-surgical treatments. Avoiding peri-implantitis is the only concept. To achieve that he proposed combining antibacterial coatings with plasma electrolytic oxidation, but limited to the crestal part of the implant, because the whitening process leads to a loss of surface roughness, undermining osseointegration.

Other kinds of coatings include organics (growth factors, extracellular matrix proteins, drug-releasing coatings), but in the speaker's opinion they are not viable because there are problems with delivery of the active element and they are very expensive.

The new trend is towards biologisation. For example, when an implant is coated in hyaluronic acid (or perhaps PRP, PRGF or PRF) it optimises the cell niche, creates an ideal surface and reduces the pro-inflammatory response. Strategies for biologisation can include modifying the implant surface, activating the surface with UV light and cold plasma, or even the choice of implant materials. UV or plasma activation (photofunctionalisation) means an implant surface can be briefly switched from being hydrophobic to superhydrophilic just by reducing the hydrocarbons present in the external part,[2] with no relevant changes in surface structure or roughness. And this can be done chairside.

To date there is no good scientific data on the use and impact of PRP, PRGF or PRF on the implant surface. Biofunctionalisation of implant surfaces with hyaluronic acid also requires more research before it can be considered reliable.

1 Jung O, et al. PEO-generated Surfaces Support Attachment and Growth of Cells In Vitro with No Additional Benefit for Micro-roughness in Sa (0.2-4 µm). In Vivo. 2016 Jan-Feb;30(1):27-33.

2 Henningsen A, et al. Changes in surface characteristics of titanium and zirconia after surface treatment with ultraviolet light or non-thermal plasma. Eur J Oral Sci. 2018 Apr;126(2):126-134.

The speaker shared the following take-home messages:

- The primary stability of dental implants is mainly influenced by their macrotopography.
- Micro- and nanotopography affect the interaction of cells and microorganisms with the implant surface, and thus impact secondary stability and the formation of biofilms.
- Antimicrobial surfaces can have a positive effect on long-term success.
- Most implant losses occur after osseointegration is complete and are mainly due to peri-implantitis.
- Clinical studies have shown that micro-rough implant surfaces have a clear advantage of over machined surfaces.

While companies are researching micro- and nanostructures, along with 'intelligent' surfaces to activate fibroblasts and avoid bacteria, the speaker expressed his opinion that there would never be the perfect surface.

He concluded with a reminder that the principal factors impacting the success of implant therapy are the 3D implant position, soft tissue management, making the correct incisions, distance to the buccal wall, and achieving the correct vertical position. He added that for high-risk patients (irradiated, immune suppressed, diabetes) micro-design could potentially make a difference.

Michael Payer

Ceramic implants

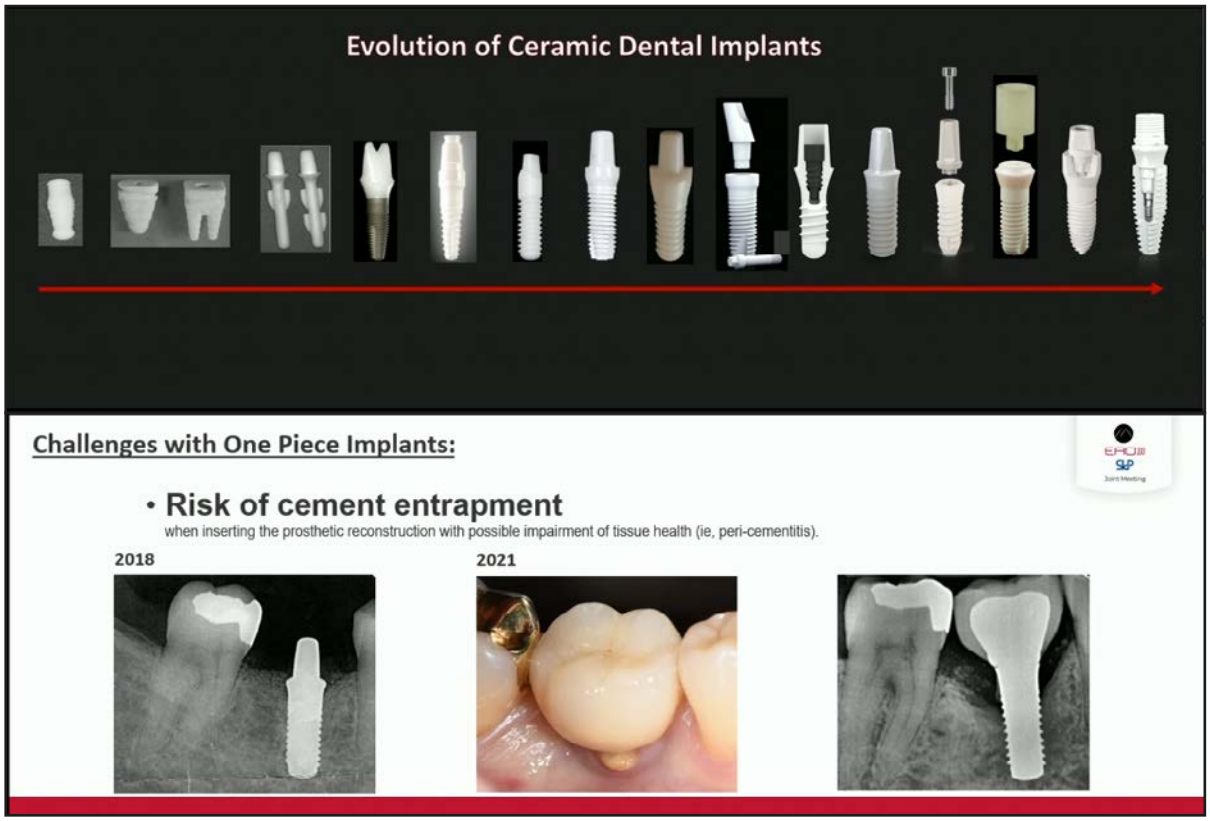
The first ceramic implants were placed 60 years ago and were made of alumina, a material that proved to be incapable of withstanding occlusal forces. As a result, they had very high failure and fracture rates and had to be withdrawn from the market. It was almost 20 years later that another alternative to titanium was brought to market, and that was zirconia. It was initially used by dental technicians as a material for frameworks, crowns and abutments. Then, in the late 1990s and early 2000s, the first zirconia implants appeared on the market. Early examples were monotype (single-piece) implants. Later on, two-piece implants started to become available.

The literature confirms that there is good evidence for the effectiveness of single-piece zirconia implants used for the replacement of 1 to 3 missing teeth, with similar outcomes to titanium implants.[1] Despite this, it's necessary to be aware of some additional factors when using them. For example, there is always some kind of immediate loading; secondly, because the abutment is in the oral cavity, you can't submerge them, as the abutment has a transmucosal design; and most importantly of all, placement must be very precise because the position of the abutment can't or shouldn't be modified afterwards. Modifying the abutment position by grinding weakens the material, and may lead to early aging and high fracture rates.

Careful planning is very important to increase the accuracy of the 3D implant placement position. The use of digital devices, planning software and guided surgery is recommended.

Another challenge with one-piece implants is removing the excess cement from the restoration, as trapped cement may damage the peri-implant soft tissue (leading to peri-cementitis). Pre-cementation techniques, such as the incorporation of venting holes on crowns that allow the cement to escape, can reduce the risk of cement getting trapped. However, when the soft tissue is very tight it's not possible to control the cement excess, and in those cases opting for an immediate provisional restoration is recommended where possible (sufficient primary stability),[2] along with removal of the excess at the control appointment if necessary.

The greatest challenge with two-piece zirconia implants is the connection between the parts, despite there being a wide range of options. These include titanium inserts and titanium screws, carbon fibre, PEEK designs, PEEK screws, ceramic into ceramic, plus early systems that used adhesive fixation of the abutment into the zirconia implant.



1 Balmer M, et al. EAO Position Paper: Current Level of Evidence Regarding Zirconia Implants in Clinical Trials. Int J Prosthodont. 2022 Jul-Aug;35(4):560-566.
2 Payer M, et al. Immediate provisional restoration of single-piece zirconia implants: a prospective case series - results after 24 months of clinical function. Clin Oral Implants Res. 2013 May;24(5):569-75.

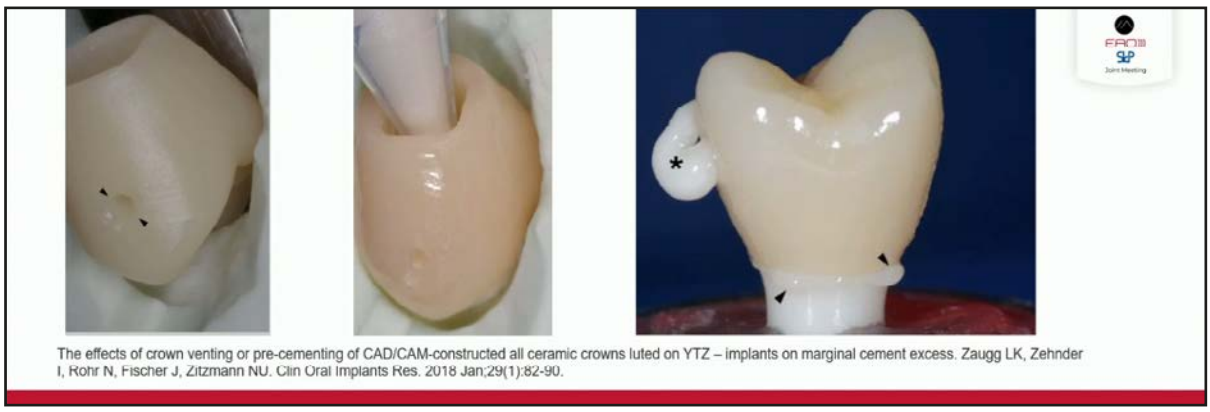
Evidence for two-piece zirconia implants (bone-level) is still limited, potentially due the fact that their construction is very complex.

A recent systematic review[3] found that survival rates of commercially available zirconia implants are significantly higher than those of earlier systems that are no longer marketed. The results confirm that second- and third-generation zirconia surfaces provide better mid-term survival rates than first-generation systems (long-term results are not yet available). The review also found a very low incidence of technical complications (with significantly reduced fracture rates), and in a small cohort they found a very low incidence of biological complications. Although this cohort was too small to draw final conclusions from, the results are consistent with other trials looking into the biological response to zirconia implants.

An RCT carried out by the speaker that was due to be finalised soon afterwards didn't indicate significant differences between two-piece zirconia and titanium implants in terms of clinical, radiographic or survival outcomes.

The speaker closed his presentation with the following conclusions on ceramic implants:

- There is good evidence for the use of one-piece zirconia implants for the fixed replacement of 1 to 3 missing teeth, are this is supported by good outcomes.
- Clinical evidence for two-piece zirconia implants is still limited, but the data is building.
- In terms of restoration of a ceramic implant, monolithic ceramics are recommended, as layered ceramics are associated with more technical complications (chipping).
- The survival rates for commercially available zirconia implants are significantly higher compared with non-commercially available ones. These survival rates are comparable to titanium implants.
- Recent trials and reviews suggest reduced fracture rates and technical complications, along with fewer biological complications.
- More data is needed to reach conclusions regarding the aesthetic aspects of zirconia implants and immunological titanium reaction. There is no data on removable dentures and no standardised data on augmentation procedures over ceramic implants.



3 Roehling S, et al. Clinical and radiographic outcomes of zirconia dental implants-A systematic review and meta-analysis. Clin Oral Implants Res. 2023 Sep;34 Suppl 26:112-124.

EAO Congress Scientific Report; Milan 2024, Session 5

When to go digital and when to go analogue?

This session assessed when it is appropriate to use a digital workflow, and when to use an analogue one.

Gustavo Avila

The surgical perspective

Although the role of dentists is to preserve natural teeth whenever possible, there are occasions when it is necessary to replace lost teeth or extract compromised ones. The goal of such treatment (which can include implant-supported prostheses) should be to provide a natural looking result, combined with long-term health, function and aesthetics.

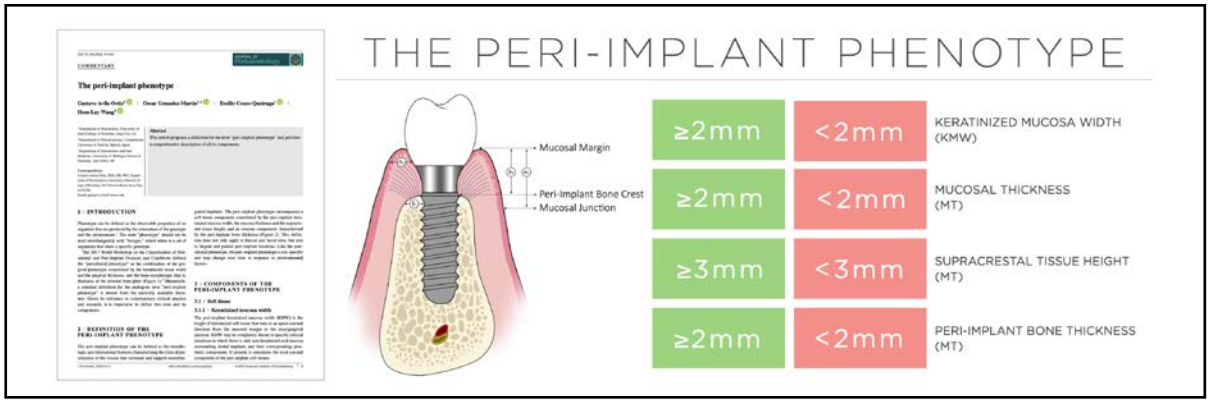
To achieve this, a series of critical factors should be analysed before, during and after treatment. This presentation focused on the 'before', specifically case planning and selection.

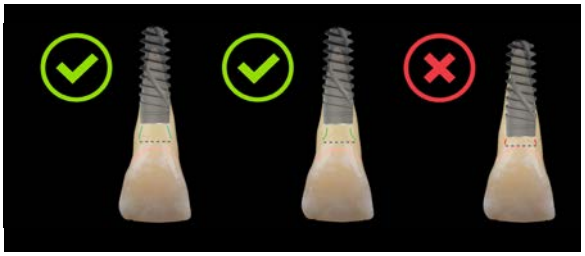
The speaker emphasised that the starting point must be to base any treatment choices on a clear understanding of the biology of peri-implant hard and soft tissues.[1] In particular, it is very important to understand the concept of peri-implant phenotype in order to achieve predictable results in cases where the three-dimensional location of the implant is critical.

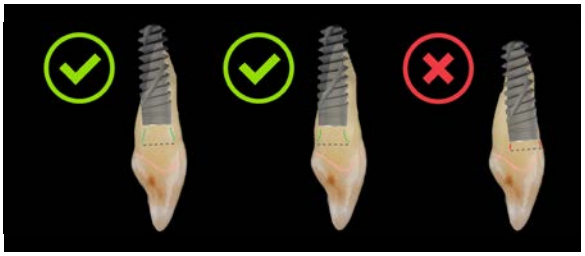
According to a paper published by the Complutense group in 2019 by Ignacio Sanz and colleagues, errors in placement in the buccal-palatal implant position was the most relevant factor associated with issues on the vestibular side of the implant.[2]

To avoid complications, clinicians have access to tools such as guided surgery based on digital workflows. However, the clinician must decide at each step of the treatment plan which digital or analogue tools to use, and to do so based on their knowledge and experience. The principal advantages of a digital workflow are as follows:

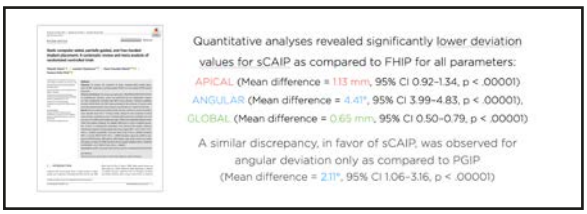
- To assess options in challenging anatomical scenarios preoperatively
- To increase the accuracy of implant positioning
- To perform minimally invasive surgery
- To facilitate immediate restoration







1 Avila-Ortiz G, Gonzalez Martin O, Couso-Queiruga E, Wang H. Tha peri-implant fenotipe. J periodontol. 2020 Mar;91(3):283-288
2 Sanz-Martin I, Regidor E, Navarro J, Sanz-Sanchez I, Sanz M, Ortiz-Vigon, A. Factors associated with the presence of peri-implant buccal soft tissue dehiscences: A case-control study. J Periodontol. 2020 Aug;91(8):1003-1010.



There are two major types of digital guided surgery: static and dynamic. The static option uses printed or milled guides, and the dynamic one combines human and robotic control. Depending on the case, static guided surgery can include tooth-supported, bone-supported or mucosa-supported guides. Each of these can provide partial or full guidance. Regardless of whether the surgery is static or dynamic, the use of digital tools such as CBCT and intraoral scans is typically used to support treatment planning.

The speaker then discussed a meta-analysis looking at the accuracy of computer-aided implant placement.[3] This examined differences in accuracy between implants placed by guided and freehand surgery. It revealed that guided surgery was superior, with a statistically significant difference in all parameters (apical, angular and global). In cases involving partially guided surgery, the values were very similar, apart from for angular deviation.

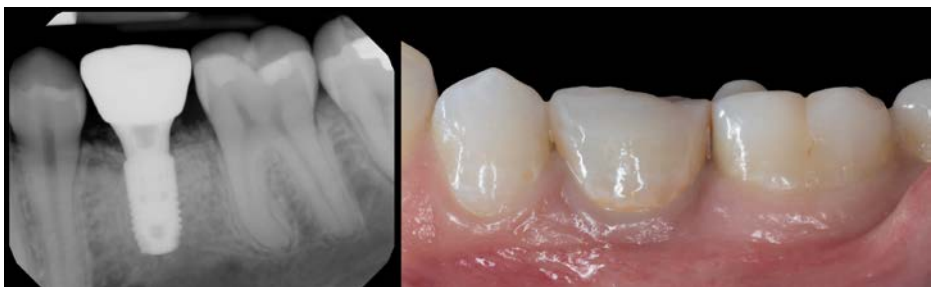
The speaker summarised how to optimise the digital workflow as follows:

- Obtain a CBCT scan
- Obtain an intraoral surface scan
- Do a digital wax-up
- Superimpose the files
- Create a guide and carry out the restoration, , if applicable

By combining these tools, it's even possible to design the definitive abutment in order to carry out a one-abutment one-time treatment and make the provisional PMMA crown before surgery.

The speaker concluded with the observation that analogue and digital shouldn't be thought of as two different and opposing soccer teams. In practice, the key is not in the tools themselves but in the dentist's clinical judgment in using them. His take-home messages were as follows:

- Guided implant placement is a reliable option to optimise therapy
- Guided surgery does not compensate for poor planning or judgment
- Digital technologies can help optimise clinical protocols and outcomes
- Introducing digital workflows requires both financial investment and time
- In some cases guided implant surgery can facilitate immediate restoration



3 Tattan M, Chambrone L, Gonzalez-Martin O, Avila-Ortiz G. Static computer-aided, partially guided, and free-handed implant placement: A systematic review and meta-analysis of randomized controlled trials. Clin Oral Implants Res 2020 Oct;31(10):889-916.

Lukas Waltenberger

Restorative perspective

The speaker began his presentation with the following reflection: 'The replacement of analogue technology with digital technology is inevitable. The question is not 'if' but 'when". He then went on to analyse its use based on the type of treatment:

- Individual crowns
- Short span FDPs
- Full-arch restorations

Individual crowns

Dr Waltenberger discussed a study in which four different workflows for the creation of an individual crown were analysed:[1]

- Immediate digital impression and model-free digital workflow
- Immediate analogue impression and model-based hybrid workflow
- Delayed digital impression and model-free digital workflow
- Delayed analogue impression and model-based hybrid workflow

This confirmed that there is a significant reduction in the time required to take impressions when the process is digital, although delivery times for the crown are similar. The number of adjustments to the crown was similar in the analogue and digital workflows, although more adjustments had to be made when the impression was taken intraoperatively. Overall there is an improvement in restorative efficacy when using digital techniques due to a reduction in treatment time. There are also advantages from the patient's perspective:

- Avoids unpleasant tastes
- Less pain
- Less anxiety and nausea
- Less discomfort

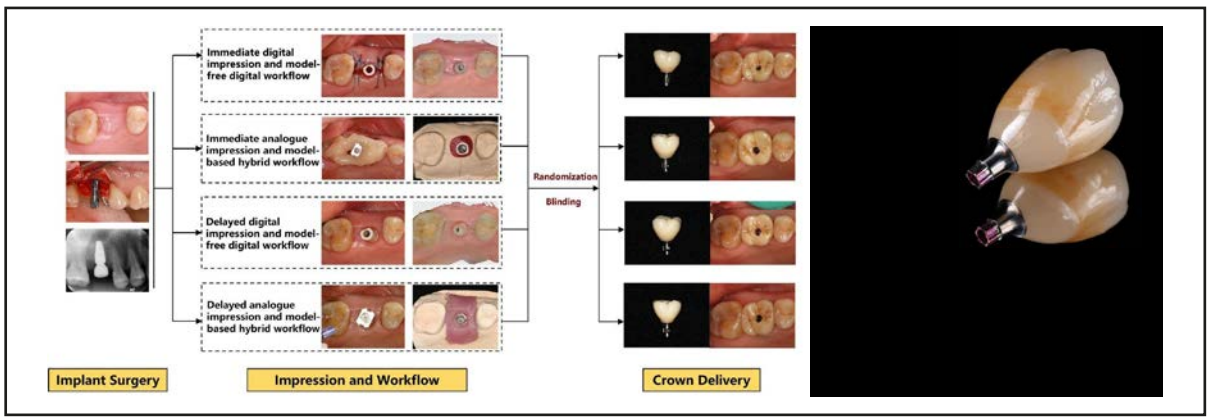
The study also confirmed that a fully digital workflow, without physical models, was practical, illustrating that for unitary crowns going digital makes sense. Reflecting this, the speaker has published a concept called 'SafetyCrown' for completely digital immediate restorations based on the one-abutment one-time concept:[2]

- **First visit.** CBCT, intraoral optical impression and shade selection for the abutment. Virtual planning, design of definitive zirconia abutment with supragingival margin and 3D printing drilling template
- **Second visit.** Implant placement and insertion of definitive abutment. Sutures performed and chairside temporary crown fitted (without static occlusal contact)
- **Third visit.** Delivery of definitive restoration

The speaker conducted a randomised controlled clinical trial to evaluate the effectiveness of this technique.[3] It was carried out once the pretreatment was completed, and involved 39 patients and 45 restorations.

- 90% of restorations were delivered as planned
- Patients expressed a high level of satisfaction with their temporaries
- The importance of a temporary was rated higher by patients who received the treatment
- 45% of the restorations were completed in three visits, and 95% of the remainder were completed in four visits

Based on these results, the protocol not only reduces treatment times, but also leads to improved patient perceptions, with new technology underpinning a change to the treatment workflow.



(4) Guo et al.

1 Guo D, Mühlemann S, Pan S, Zhou Y, Jung RE. A double-blind randomized within-subject study to evaluate clinical applicability of four digital workflows for the fabrication of posterior single implant crown. Clin Oral Implants Res. 2023 Dec;34(12):1319-1329. doi: 10.1111/clr.14171.

2 Waltenberger L, Wolfart S. SafetyCrown: a patient-centered, fully digital concept for immediate implant restoration following the one-abutment/one-time concept-a pilot case series of a new treatment concept. Int J Implant Dent. 2022 Sep 6;8(1):35. doi: 10.1186/s40729-022-00434-2.

3 Waltenberger L, Reich S, Zwahlen M, Wolfart S. Effect of immediate all-digital restoration of single posterior implants: The SafetyCrown concept on patient-reported outcome measures, accuracy, and treatment time-A randomized clinical trial. Clin Implant Dent Relat Res. 2024 Dec;26(6):1135-1148. doi: 10.1111/cid.13374.

Short span FDPs

The accuracy of digital impression taking is different when working with edentulous areas in between or in cases of free end situations, but is still accurate enough for both kinds of impressions. Verification must be carried out on both the registration and the model.

With regard to the intermaxillary relationship, the speaker explained that buccal bite is not a suitable substitute for obtaining a full intermaxillary occlusal record. The use of jaw trackers can improve these, but they are not widely available or used sufficiently.

Creating FDPs means working in the realm of printed models, where there are still some inaccuracies. In practice, model verification is very important because the aim is to achieve perfectly polished monolithic occlusal surfaces, and in the majority of restorations there is little room for error.

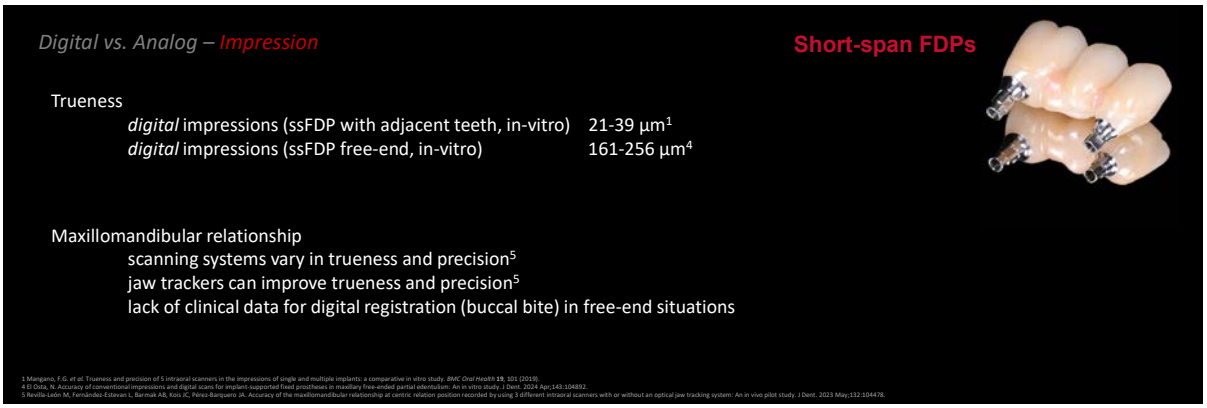
The speaker then presented a case in which a patient wanted the appearance of her provisional prosthesis to be modified. Technological advances mean that after carrying out modifications to the prosthesis, an intraoral scan can be performed to communicate the modifications to the dental technician. They can then make the necessary modifications in the laboratory, also using digital technology. This reduces treatment stress as it ensures the patient is happy with their restoration.

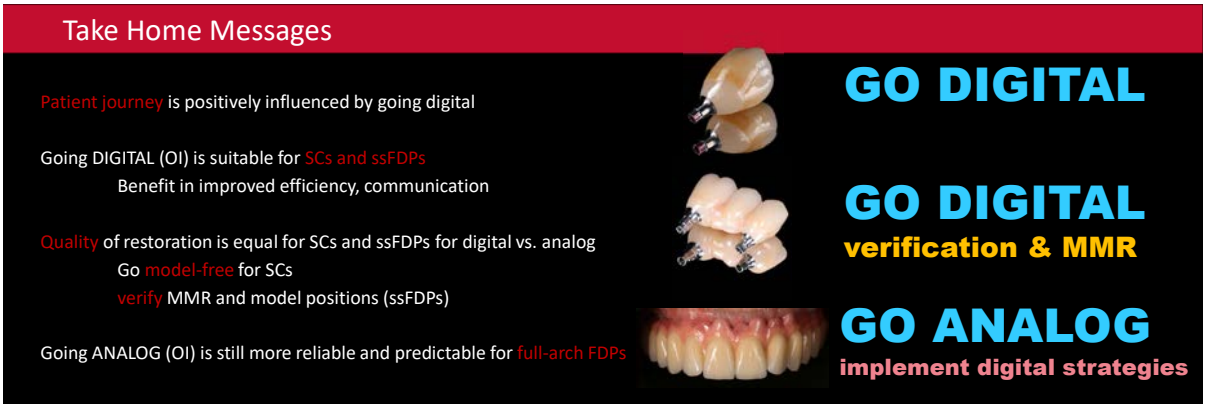
In conclusion, it is possible to work digitally with short span FDPs, although it is important to verify the position of the implants and assess analogue occlusal records.

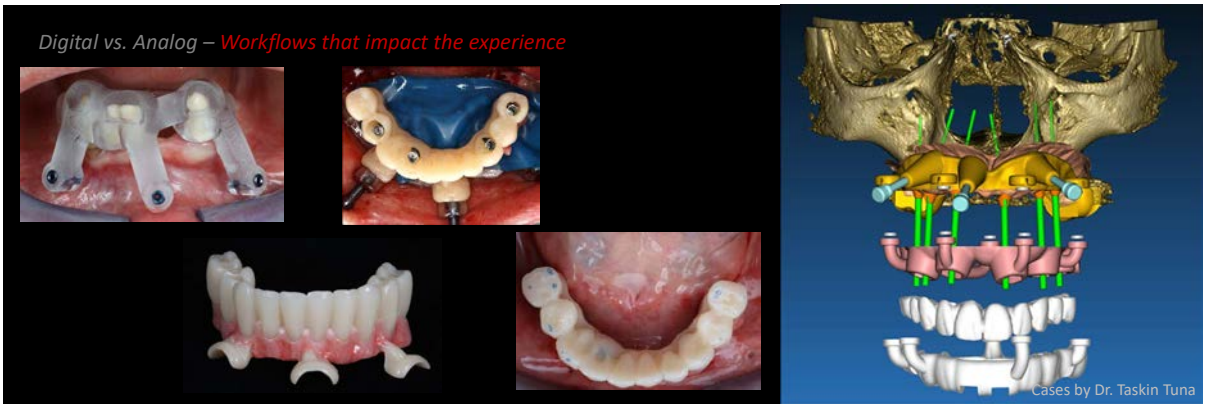
Full-arch FDPs

In cases involving full-arch FDPs, the scan is accurate enough for fabricating restorations, although there is a margin of error regarding angulation of the implants or which scanner system we are using. On the other hand, other tools are available such as scanning aids, frameworks and stereophotogrammetry Despite this, the speaker explained that in these cases he considers a physical model to be necessary, and analogue to be the gold standard.

Patients who are receiving a full-arch FDP must undergo extractions, implant placement(s) and bone augmentation treatments. In such cases, it's less important whether the workflow







is digital or analogue, and it's important to be clear whether a specific approach offers any advantage for the patient.

Having considered this, the speaker noted that in these cases digital technology still offers benefits for the patient, and also changes how the treatment is carried out, allowing the practitioner to adapt the patient's smile and change the intraoral situation in a single appointment.

To conclude, for full-arch cases it's beneficial to go analogue, while also including digital strategies to make the workflow more reliable and predictable. Finally, and to summarise, the speaker noted that digital technology is not simply an alternative approach, but one that has the potential to reduce treatment times, increase safety and enable restorations to be prefabricated. All of these offer improved quality of life for patients.

Giuseppe Romeo

Lab perspective

The speaker began his presentation by asking what the laboratory technician needs to know in order to avoid causing biological damage when making prostheses, such as veneers and crowns for patients with implants. He stressed the importance of all patient information being fully shared between the technician, periodontist, orthodontist and implantologist in order achieve the desired aesthetic result. Such information-sharing is essential in the laboratory to create the aesthetic result how to layer ceramic, when to go digital or analogue or when we layer ceramic or stain ceramic.

It is extremely important for the technician to know which is the superficial contour and which is the deep one, and to assess what will happen in the mouth when we push the tissues with the prosthesis in order to avoid causing biological damage. Lengthening of the teeth can only be done towards the incisal edge or the cervical area, and must be carried out in accordance with a clinical prescription that incorporates all necessary precautions.

In the past, when working manually, the same tooth contours were always made for specific patients. Now the tooth can be segmented, enabling many more combinations between square, triangular and ovoid shapes, leading to much greater variations in the contour of the tooth. This can be achieved using either analogue or digital techniques, as described in a paper by the speaker published in Quintessence in 2013. The patient's face must be taken into consideration in order to develop a plan for the final appearance of the tooth in order to achieve harmonious symmetry between the tooth and the patient's dynamic smile.

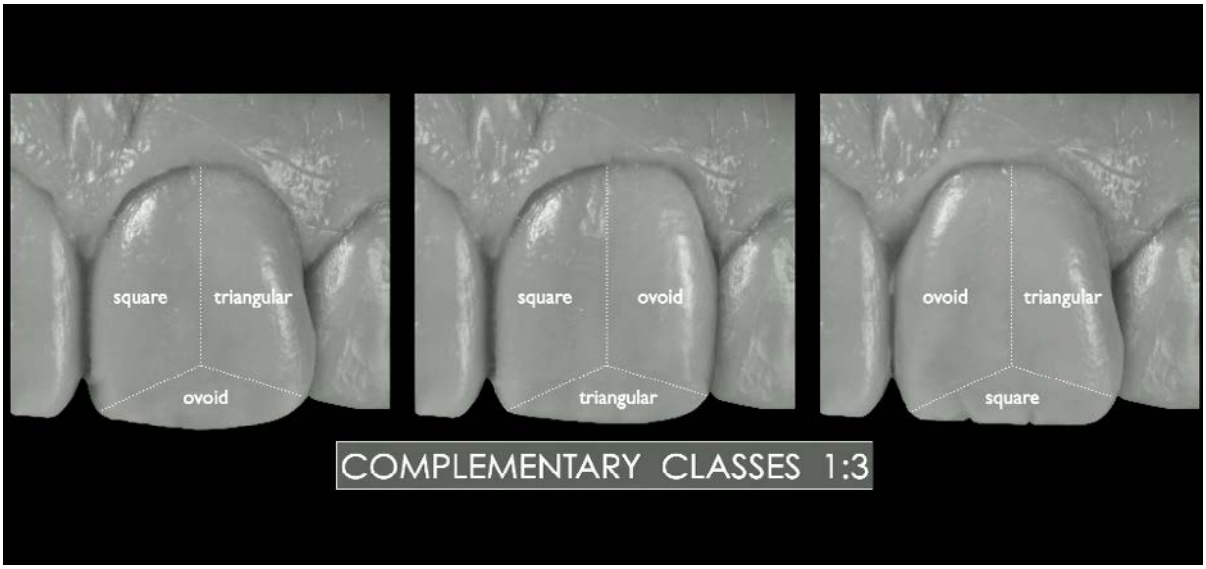
Asking the technician or dentist to work with 48 different contours is complicated, although segmentation makes the process easier, creating the necessary contours to assess the patient's dynamic smile in the frontal aspect.[1] In order to create the central incisors contours, it's necessary to pay attention to the details of those at the sides to achieve harmony. If working on the lateral ones, the same process is followed as for the central ones. Doing this effectively is the responsibility of both the technician and the dentist.

The speaker then discussed the 3D position of anterior implants and the importance of this for achieving a good aesthetic result, based on an adequate emergence profile. This can be achieved using both analogue and digital systems. However, when working on a physical model, the dentist or technician feels and perceives what they do in a similar way to how it is done in the mouth. That sense of similarity is not experienced with digital models, and it takes time to learn to work with them.

For optimal results, it's necessary to stratify the ceramic, since the same results cannot be achieved with digital systems. In the posterior region, it may be sufficient to mask the monolithic ceramic, but that won't be adequate in the anterior region where stratification is important.[2]

The speaker concluded with an emphasis on the following four points:

- The quality of the procedures
- Ensuring excellent communication between the technician and the dentist at all stages
- Adjusting the final occlusion to protect the veneers
- Remembering that the smile exists within the wider context of the face



1 Romeo G, Phark J. Dental Anatomical Combinations : A Guide to Ultimate Dental Esthetics. Smile dental Journal. September 2017. 12(3):10-20
2 Romeo g. Smile makeover and the oral facial harmony concept in a new era: relationship between tooth shape and face configuration. Int J Esthet Dent. 2021 May 10;16(2):202-215

EAO Congress Scientific Report; Milan 2024, Session 6

Abutment junction: what's all the fuss about?

France Lambert

Peri-implant tissue response to bone level implant

Mucosal tissue integration and its role in peri-implant health

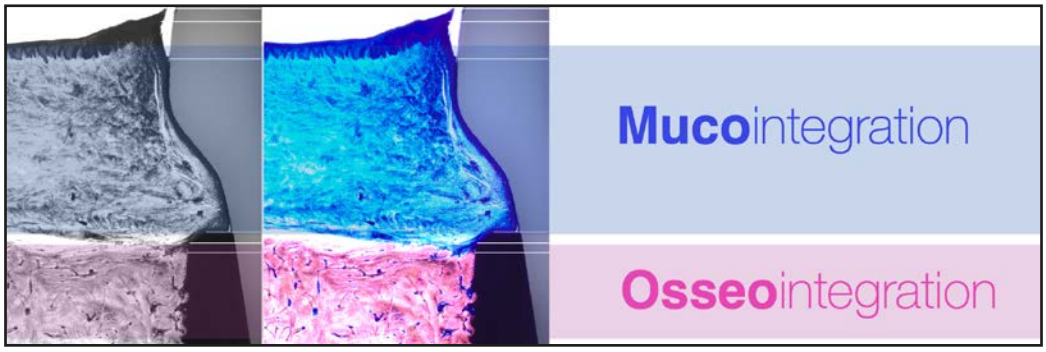
Professor Lambert began by emphasising the critical importance of achieving proper mucosal tissue integration around implants. She explained that this integration functions as a protective barrier, similar to the skin, preventing bacteria from reaching the bone. Without this natural barrier, the risk of difficult-to-manage peri-implant issues increases significantly. As such, understanding peri-implant tissue anatomy, especially the supracrestal complex, is essential. This area requires three to four millimetres of space to ensure that the tissue can adapt well around the implant. Unlike natural teeth, implants have a weaker soft tissue adhesion, so a strategic approach to prosthetic rehabilitation is required to compensate for this difference and protect the area.

Selection of biocompatible materials to improve cellular adhesion

The speaker emphasised that choosing biocompatible materials, such as titanium and zirconia, is crucial for promoting proper cellular adhesion around the implant surface. These materials not only allow epithelial and connective cells to adhere effectively but also encourage their proliferation, which contributes to long-term implant stability. Human biopsy studies have shown that these materials cause less inflammation and bone loss compared to other options. While there are many materials available on the market, Professor Lambert pointed out that not all meet the necessary biocompatibility standards. Sharing a clinical case, she demonstrated that the use of unglazed zirconia led to better cellular adhesion, while a glazed surface showed poorer cell adherence, potentially impacting implant stability.

Soft tissue conditioning and cleaning protocols

To enhance the management of soft tissues around implants, the speaker recommended rigorous cleaning protocols for prosthetic components prior to placement. She described a six-minute ultrasonic cleaning method, which includes cleaning agents, as a routine practice in her clinic. This procedure, she noted, reduces the risk of contamination and creates a more favourable environment for tissue integration. Comparing this method with steam cleaning, Professor Lambert concluded that the ultrasonic approach is more consistent. She stressed the importance of ensuring that components are free from manufacturing residues and organic compounds, as these may impair the health of peri-implant tissues.



Impact of fixation techniques on bone stability

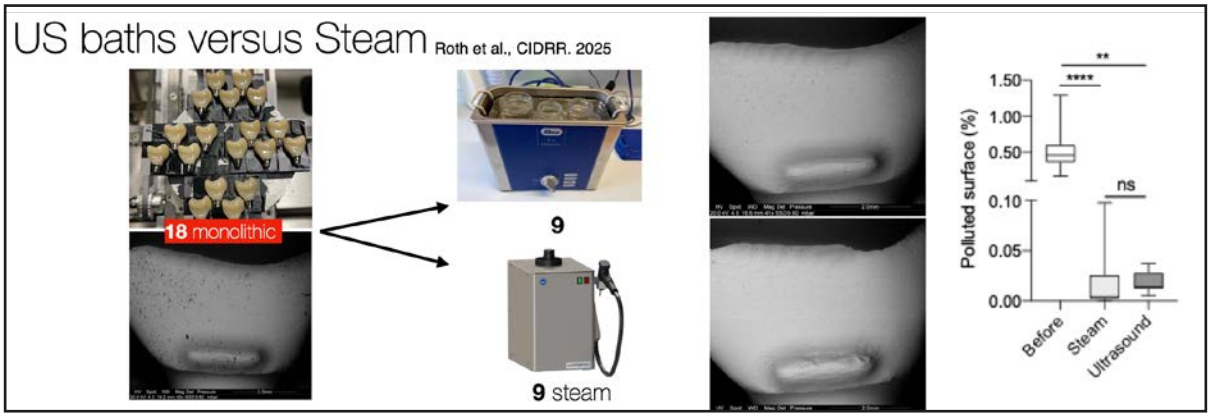
Professor Lambert compared the advantages and disadvantages of cemented versus screw-retained restorations. She explained that screw-retained restorations are generally preferable, as they help minimise disconnections, thereby reducing the risk of early bone loss. Each disconnection, she noted, can traumatise soft tissue, potentially leading to greater bone loss over time. For cases requiring cemented retention, she recommended limiting the cement to a juxta-gingival or slightly subgingival level to avoid affecting the tissues and reduce the risk of peri-implant complications.

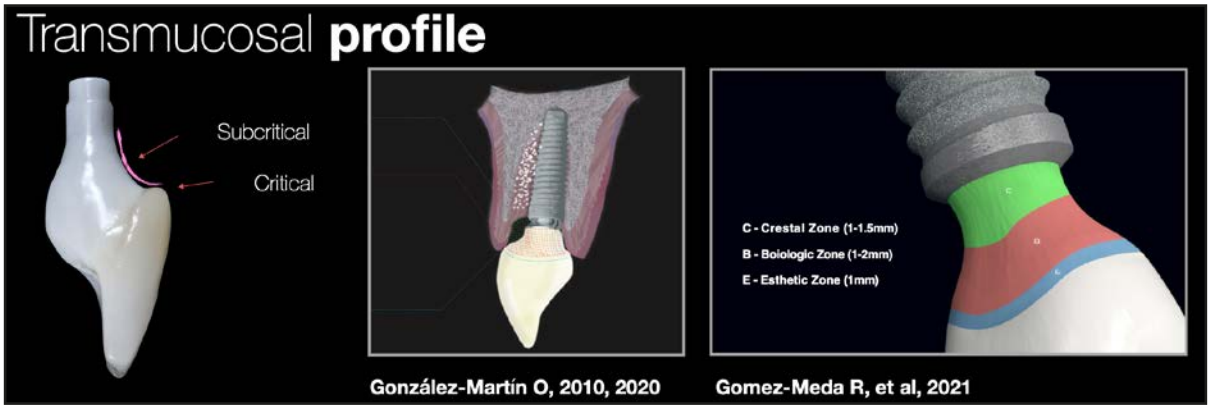
Optimising stability through transmucosal design and emergence profile

Regarding transmucosal design, the speaker highlighted that a slim, concave profile is crucial for successful long-term outcomes. This design creates space for peri-implant tissues, facilitates blood circulation, and improves the mechanical stability of soft tissues. She referenced recent studies that show how implants with narrower, slimmer profiles help organise tissues into a 'ring' structure, providing vertical stability and reducing bone loss during the initial integration phase.

Clinical recommendations for implant type selection

The speaker shared her recommendations for which type of implant to choose, suggesting the use of tissue-level implants in situations where soft tissue stability is a priority, such as in patients at higher periodontal risk, or in the posterior region. She also explored the option of transforming a bone-level implant into a tissue-level one by adding higher and narrower bases, which create a peri-implant environment similar to that of tissue-level implants. This approach is particularly useful for patients with specific prosthetic needs, and can help to prolong implant durability.





Conclusion

Professor Lambert concluded with a series of recommendations aimed at optimising implant stability and minimising the risk of peri-implant complications. She emphasised the importance of choosing biocompatible materials like titanium and zirconia, which have proven effective in supporting soft tissue integration. She also recommended screw-retained implants with minimal disconnections, promoting the 'one abutment, one time' concept to limit trauma to the soft tissues. Finally, she highlighted that a slim, concave transmucosal design can significantly contribute to the stability of peri-implant tissues and the health of the underlying bone.

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Bjarni Pjetursson

Hybrid implant design to maintain peri-implant tissues

Are all implants equally predictable?

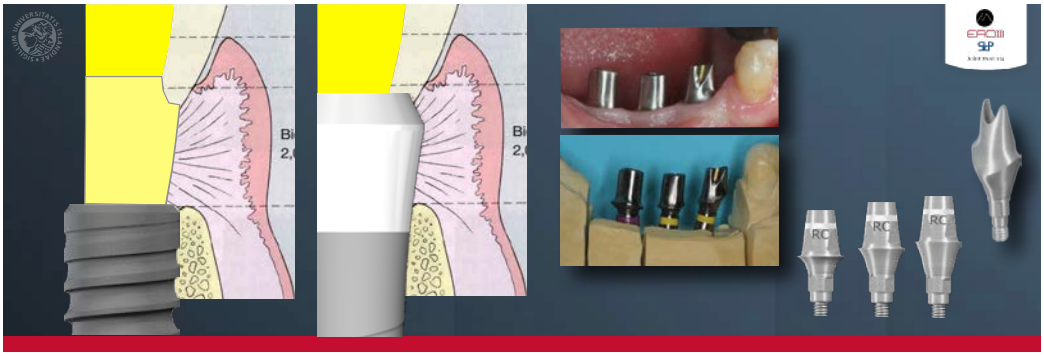
Dr Bjarni Pjetursson opened his discussion by questioning whether all dental implants are truly effective at preserving peri-implant tissues over time. During more than three decades of experience using a range of implant systems, he has observed a wide array of designs and surfaces, each promoted for their supposed benefits to tissue health. However, he stressed that while certain designs may offer specific advantages, achieving reliable, long-term tissue stability around implants depends on factors beyond surface material alone. Implant geometry and placement depth, for example, play essential roles in predicting success.

Influence of surface and geometry

Dr Pjetursson highlighted how an implant's surface and geometry significantly influence bone-to-implant contact and the likelihood of developing peri-implantitis. He explained that bone-level implants, which sit flush with the bone, often lead to bone resorption over time, especially if they are placed too deep. In contrast, hybrid or soft-tissue-level implants, where a portion remains above the bone, appear to yield more predictable outcomes for peri-implant tissue health. Hybrid designs incorporate characteristics of both bone-level and soft-tissue-level implants, allowing for a more stable bone position and improved tissue integration.

Challenges of bone-level implants

Reflecting on his early experience with bone-level implants, Dr Pjetursson noted that they often resulted in bone loss, sometimes extending to the implant's first thread. While innovations like platform switching, introduced nearly four decades ago, were intended to mitigate such bone loss, outcomes have been inconsistent. He presented clinical cases to illustrate that bone-level implants don't always preserve bone height as expected, leading him to question their predictability. In his view, hybrid implants, with a machined collar above the bone, offer a more reliable solution by keeping the microgap away from the bone and reducing bone loss over time.



Importance of long-term studies and multiple-case series

Dr Pjetursson emphasised the necessity of long-term studies and case series, rather than single-case reports, as isolated successes do not guarantee predictable outcomes across a broad patient population. He shared his experience of a particular implant design that initially showed positive results but revealed significant bone loss after several years. Research has demonstrated that implants with a polished neck tend to maintain bone stability more effectively. For the speaker, the evidence underscores the need for long-term studies to validate that implants will consistently perform well over extended periods and across different patient demographics.

Guidelines for implant selection based on location

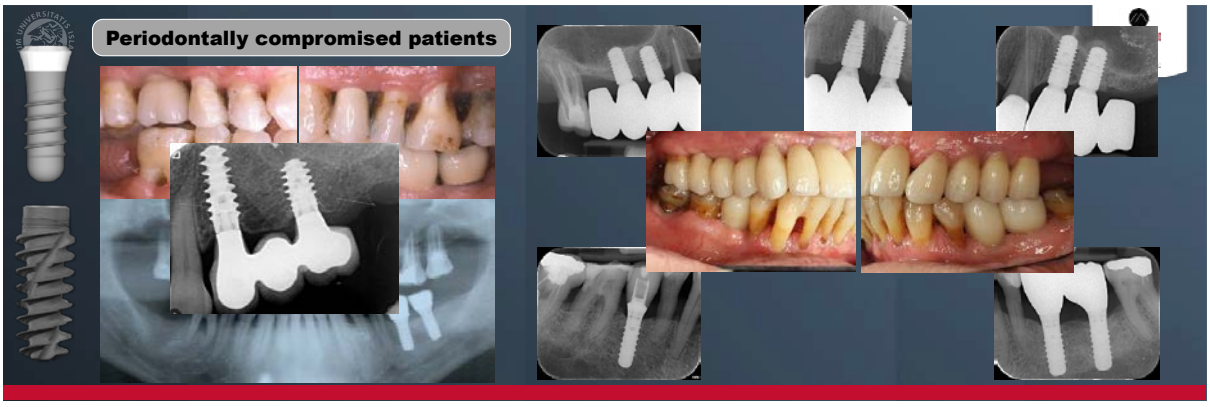
Drawing on his clinical and teaching experience, Dr Pjetursson described how implant selection can be tailored to anatomical location and patient needs. In aesthetic areas, bone-level implants provide more prosthetic flexibility. However, in posterior regions, particularly for patients with thin tissues or a higher risk of bone loss, he recommended soft-tissue-level or hybrid implants. This approach also applies to bridges in the molar region and to cases involving periodontally compromised or edentulous patients, where hybrid implants can help minimise the risk of peri-implantitis by positioning the microgap away from the bone.

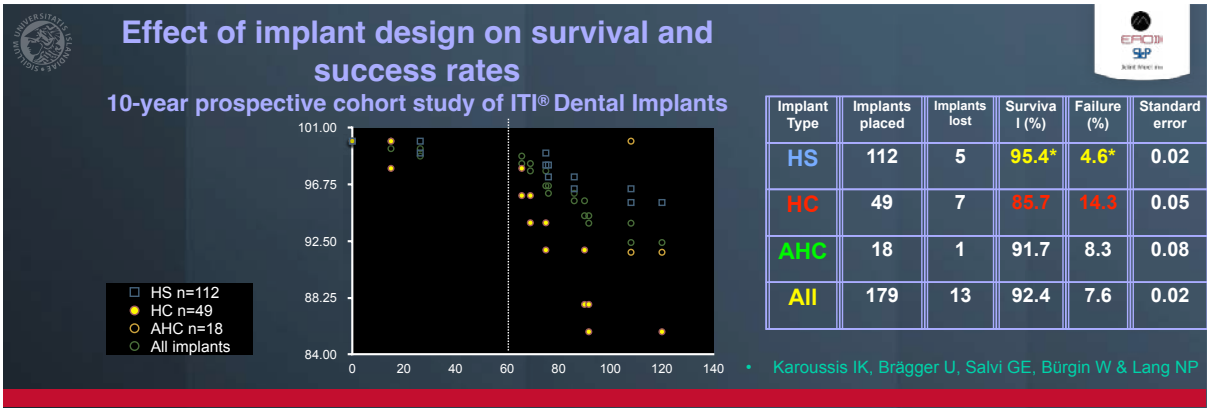
Considerations for high-risk patients

The speaker emphasised that edentulous patients are often at greater risk of peri-implant complications due to limited oral hygiene practices. For these patients, he suggested using hybrid or soft-tissue-level implants to position the microgap away from the bone, thereby reducing the likelihood of infection. In cases involving fixed prostheses in the lower jaw or periodontally compromised patients, he has found that these implant types offer better protection against peri-implantitis, and also simplify maintenance and cleaning over the long term.

Comparing threads and long-term outcomes

Dr Pjetursson concluded by discussing studies comparing threaded and non-threaded implants. In a long-term study, threaded implants showed significantly better survival rates over several years. However, he cautioned that the benefits of different implant types may only become evident after many years, underscoring the importance of thorough, long-term evaluation. This insight calls into question the rapid pace of innovation in implant design, which often proceeds without the time needed to fully assess the long-term implications of new configurations.





Implant Type	Implants placed	Implants lost	Survival (%)	Failure (%)	Standard error
HS	112	5	95.4*	4.6*	0.02
HC	49	7	85.7	14.3	0.05
AHC	18	1	91.7	8.3	0.08
All	179	13	92.4	7.6	0.02

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Paolo Casentini

Introduction to immediate loading protocol

Dr Casentini began by introducing the topic of loading protocols in immediate extraction sites. He referred to the ITI Consensus Conference and identified the protocol for immediate placement as an ideal solution when clinical conditions permit. It offers significant patient benefits, including reduced treatment time and improved quality of life. However, he acknowledged that not all cases meet the ideal criteria and stressed the importance of carefully evaluating each case.

The importance of 3D diagnostics and digital planning

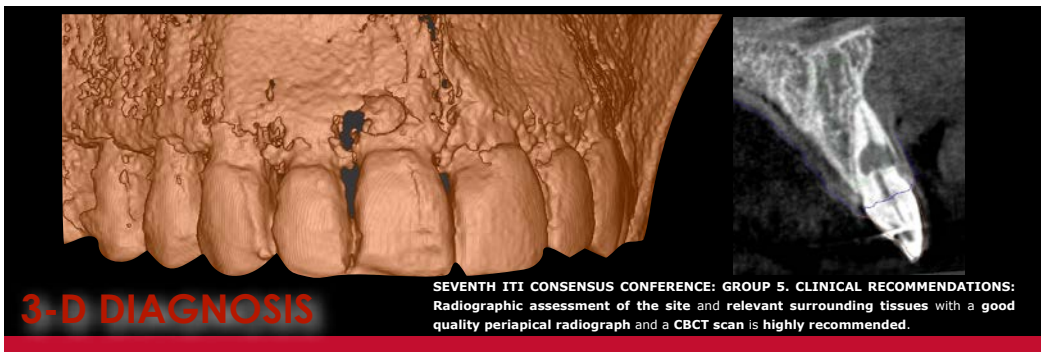
Dr Casentini highlighted the role of 3D diagnosis as an important starting point in treatment planning, as emphasised at the ITI Consensus Conference. Advances in 3D implant planning and computer-guided surgery have allowed clinicians to achieve unprecedented accuracy in implant placement, reducing trauma and improving predictability. He stressed that this accuracy allows for optimal implant positioning and promotes better results for the integration of both hard and soft tissues.

Appearance profile and soft tissue stability

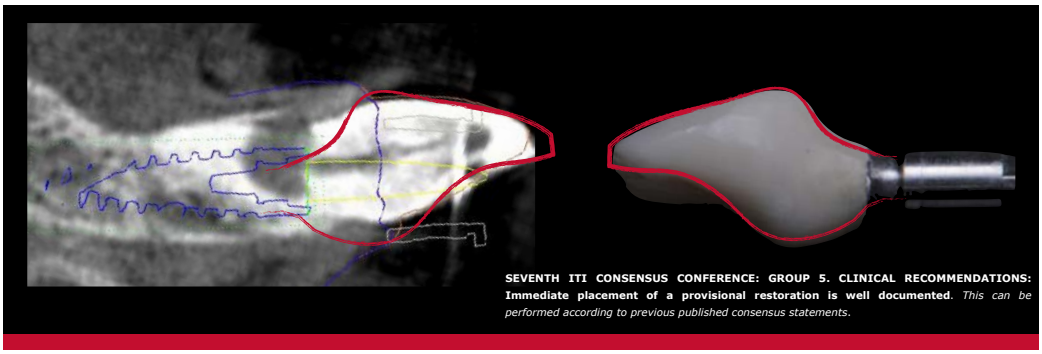
The speaker stressed the importance of digitally planning budding profiles from the early stages of treatment. By designing the proper appearance profile, clinicians can ensure sufficient space for soft tissue support and a stable foundation for the final restoration. This step is important for achieving fully supported and aesthetically satisfactory results, especially in cases that require complex soft tissue management.

Increase of soft and hard tissue

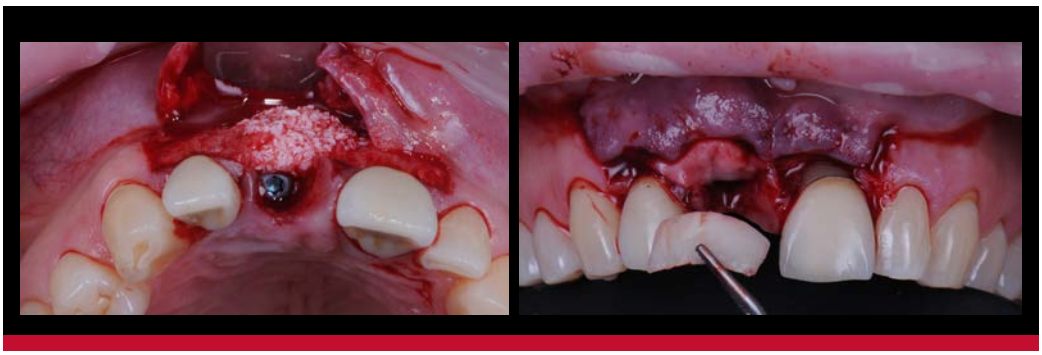
In cases where immediate temporisation is not feasible, Dr Casentini recommended augmenting both soft and hard tissue to improve results. This approach is especially beneficial in compromised cases because it increases the architecture and stability of both soft and hard tissues. He presented clinical examples showing that combining bone and soft tissue augmentation can improve outcomes, even in difficult scenarios.



SEVENTH ITI CONSENSUS CONFERENCE: GROUP 5. CLINICAL RECOMMENDATIONS: Radiographic assessment of the site and **relevant surrounding tissues** with a **good quality periapical radiograph** and a **CBCT scan** is **highly recommended**.



SEVENTH ITI CONSENSUS CONFERENCE: GROUP 5. CLINICAL RECOMMENDATIONS: Immediate placement of a provisional restoration is well documented. *This can be performed according to previous published consensus statements.*



Soft tissue-level implants in the aesthetic zone

The speaker discussed the benefits of using soft tissue-level implants in the aesthetic zone. Recent advances in implant microgeometry, including a narrower platform, have allowed for improved soft tissue integration and primary stability. These implants reduce the need for deep placement and facilitate easier management of soft and hard tissues. He stressed that this approach helps maintain bone levels and supports soft tissue stability over time.

Concept of 'one abutment, one time'

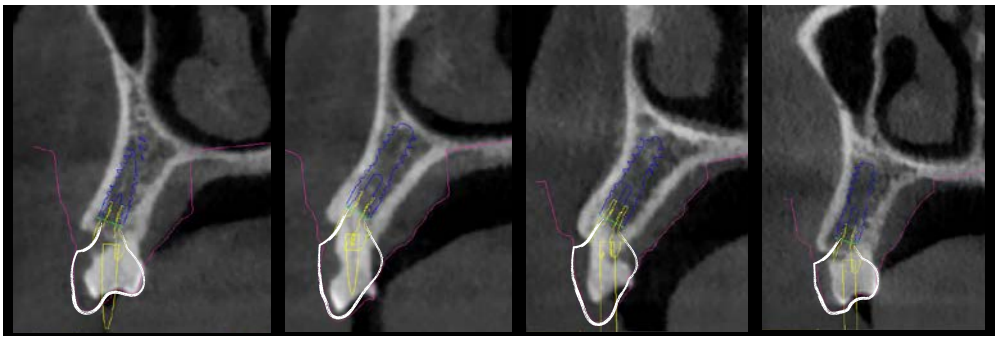
Dr Casentini introduced the concept of 'one abutment, one time', which minimises the impact of the abutment on healing after surgery. The technique involves abutting the implant at final torque during surgery and avoiding further cutting. By eliminating repeated manipulations, this approach maintains a biological seal which minimises bone loss. He shared a 9-year follow-up case showing stable bone levels and excellent soft tissue outcomes, reinforcing the long-term benefits of this method.

Managing complex cases

When treating partially edentulous patients, Dr Casentini stressed the importance of accurate digital planning to address discrepancies between teeth and alveolar axes. He backed the use of screw-retained abutments, as well as digital mock-ups to optimise the position of the implant and compensate for anatomical variations. This approach simplifies the treatment process and helps ensure predictable aesthetic and functional results.

Prosthetics and aesthetic transformation

The speaker concluded by highlighting the transformative power of implant treatment, both in the oral cavity and elsewhere. He shared a case that is due to be featured in ITI Treatment Guide 16, which demonstrates how an implant not only improved the patient's smile, but also positively affected the aesthetics of the face. The 2-year follow-up confirmed stable bone levels and soft tissue outcomes, highlighting the importance of patient motivation and maintaining oral hygiene to achieve long-term success.



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EAO Congress Scientific Report; Milan 2024, Session 7

The role of orthodontic tooth movement in treatment planning

Renato Cocconi

Interdisciplinary digital planning

This presentation centred on the anterior region, and when to open or close gaps in cases involving missing laterals using a digital approach and with the collaboration of different dental specialisms.

The patient must always be fully informed about the treatment being proposed and the relationship between costs and benefits. They must also understand the role of the different branches of dentistry that will contribute to the treatment plan.

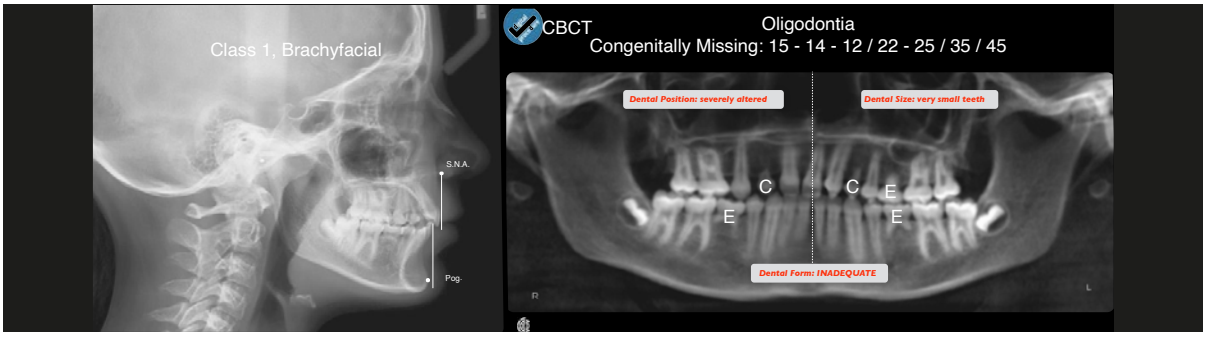
In complex cases, where there are multiple issues to be resolved, it is helpful to address aspects of the case one by one. To address complexity, the input of a range of specialists is required. For the types of cases being described, these include orthodontists, surgeons, periodontists and prosthodontists.

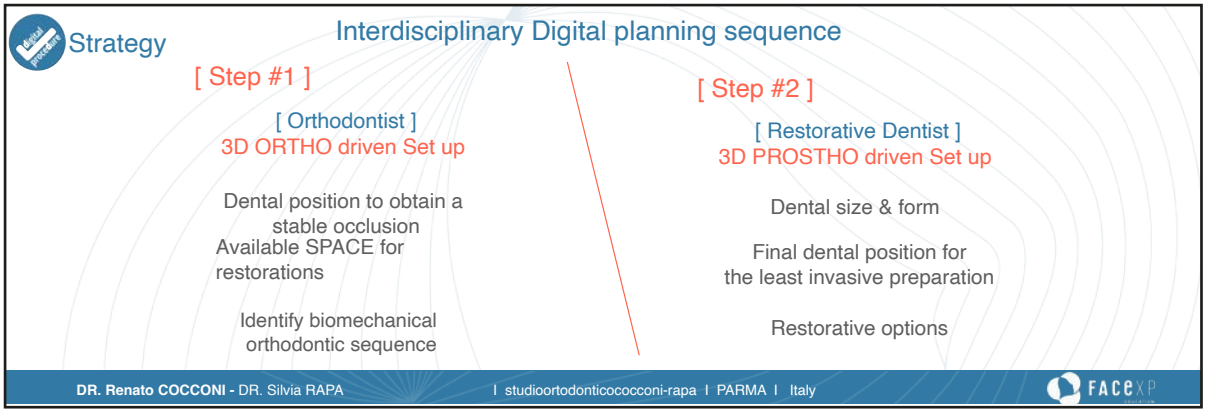
Digital planning is necessary to resolve complex cases in a logical sequence. If we first decide where the teeth ultimately need to be, digital planning helps determine how to reach that goal.[1] It is particularly useful in the following types of cases:

- situations involving complex impairments
- during the transition from adolescence to adulthood
- where comprehensive aesthetic improvements are required

The speaker talked through some clinical cases to illustrate the digital approach he uses for complex cases.

In the first case, the patient had mixed dentition, with a hare-lip and missing 1.2. Treatment involved combining orthognathic surgery for the Class III malocclusion, while opening up space for 1.2 with orthodontic therapy. This was followed by bone grafting and the placement of an implant to replace the missing lateral. Different provisional crowns were used to form adequate soft tissue for the abutment and final crown. Achieving the final outcome involved minimally invasive perio surgery to remodel the contralateral soft tissue from squared to rounded, and placement of feldspathic veneers. This was accompanied by a rhinoplasty, lip reconstruction and lip filling in order to meet the patient's expectations in terms of aesthetic outcome. Throughout the process, the treatment focused on achieving proper function, rather than simply form.





1 American dental association (2021). The practical guide to managing patient expectations

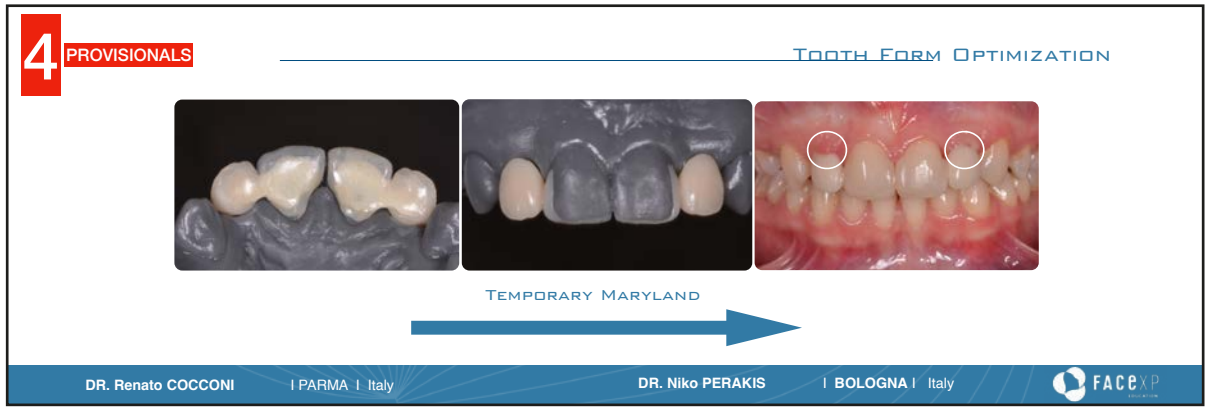
The second case looked at a growing patient. Implant patients who are still growing are susceptible to problems over time relating to papilla morphology, infraoclussion, inclination, and issues with hygiene and long-term maintenance. Patients with a high smile line are at greater risk of aesthetic problems.[2]

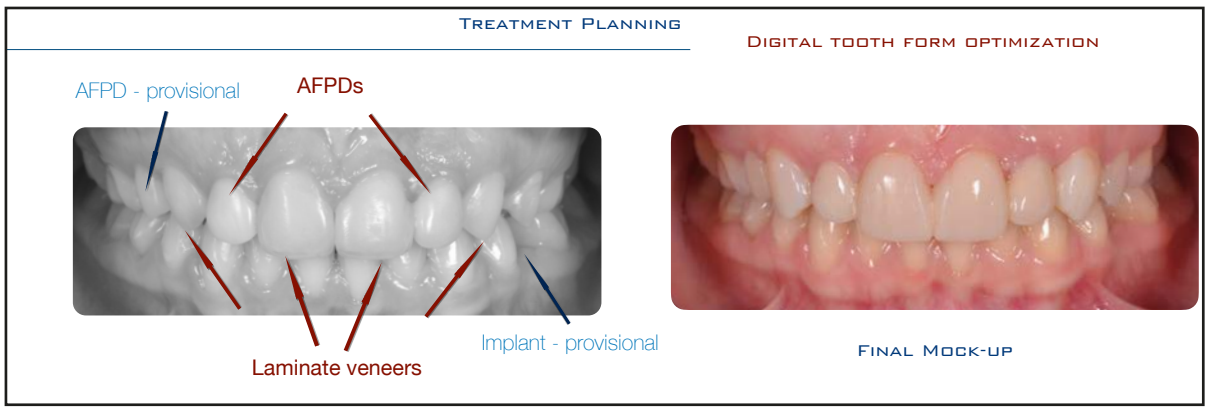
In this case the patient had had a horse-riding accident which resulted in them losing 2.2, 2.3 and 2.4, as well as part of the maxilla. The treatment approach involved bone reconstruction with a non-resorbable membrane and autotransplant of 1.5 in the position of 2.3 following braces therapy. This was accompanied by a bonded Maryland bridge with one wing for the lateral which the patient wore until he was 18. This can be a good medium-term solution as patients transition from adolescence to adulthood.[3]

The speaker noted that in young patients he delays the implant placement in the aesthetic zone until as late as possible.

In the third case the patient's 2.2 was missing, they had a small 1.2, plus Class II malocclusion on one side and Class I on the other. Skeletal anchorage was used to correct the midline, distalise the second quadrant and open up space for 2.2. A provisional for 2.2 was attached to the temporary anchorage devices (TADs) until the orthodontic treatment was finished. Manual composite was used for the anterior teeth, with a Maryland bridge for 2.2 attached with one wing on the canine.[4]

The fourth case involved a patient with oligodontia. A MARPE was used for expansion and second quadrant distalisation. Once





2 Bernard JP, Schatz JP, Christou P, Belser U, Kiliaridis S. Long-term vertical changes of the anterior maxillary teeth adjacent to single implants in young and mature adults. A retrospective study. J Clin Periodontol. 2004 Nov;31(11):1024-8. doi: 10.1111/j.1600-051X.2004.00574.x. PMID: 15491321.

3 Cocconi, Renato et al. Unilateral agenesis of the maxillary lateral incisor: space closure versus space preservation in growing patients. Seminars in Orthodontics, Volume 26, Issue 1, 24 – 32. 2020

4 Wei YR, Wang XD, Zhang Q, Li XX, Blatz MB, Jian YT, Zhao K. Clinical performance of anterior resin-bonded fixed dental prostheses with different framework designs: A systematic review and meta-analysis. J Dent. 2016 Apr;47:1-7. doi: 10.1016/j.jdent.2016.02.003. Epub 2016 Feb 11. PMID: 26875611.

the spacing had been addressed, the speaker used provisionals for laterals attached to the TADs. Following completion of the orthodontic treatment, the prosthodontic workflow was planned. Then, when the anterior teeth had been addressed, aligners were used to achieve the final positions of the posterior teeth. Treatment concluded with a Maryland bridge for the laterals[5] and veneers for the centrals and cuspids.

The patient in the fifth case had undergone prior orthodontic treatment and had a positive overjet with poorly spaced laterals. Treatment involved removing the Maryland bridges, closing the spaces between the laterals and opening the space between centrals slightly. Flowable injection composite was used for the final restoration of the anterior teeth.

Conclusions

- Treatment must be centred on the outcomes that the patient can realistically expect to be achieved.
- It is mandatory to do a 3D digital orthodontic-driven set-up to fully address the occlusion and perfect the size for the restorations.
- A 3D digital prosthodontics-driven set-up is required to plan the final position of the teeth, in order to obtain the optimal form and identify the least invasive preparation techniques.
- Digital technology help clinicians explore different solutions for complex clinical problems.

5 Blatz MB, Alvarez M, Sawyer K, Brindis M. How to Bond Zirconia: The APC Concept. Compend Contin Educ Dent. 2016 Oct;37(9):611-617; quiz 618. PMID: 27700128.

Chris Laspos

Aligner orthodontics. Are there any complex cases?

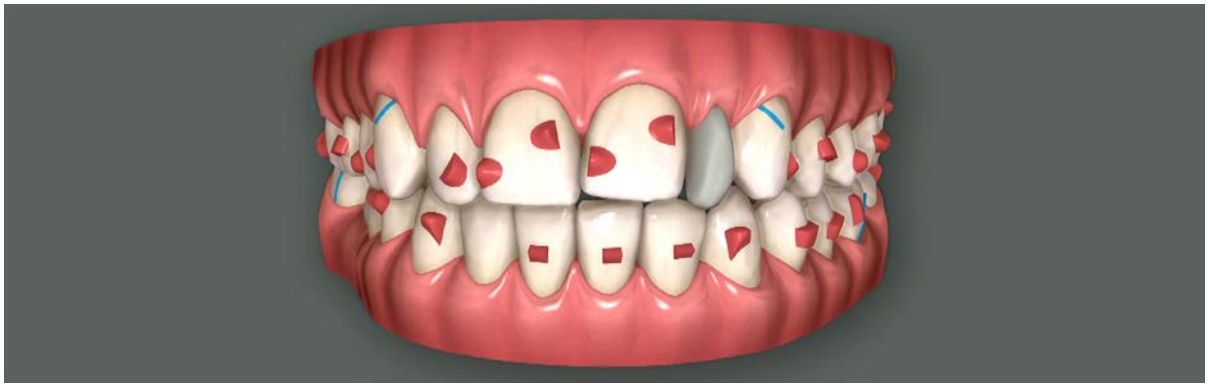
This presentation focused on the use of aligner treatments for resolving complex cases. The speaker presented a clinical case which used the principle of the golden proportion. The process begins with smile design, focusing on the three areas of aesthetics: dental, smile and facial.

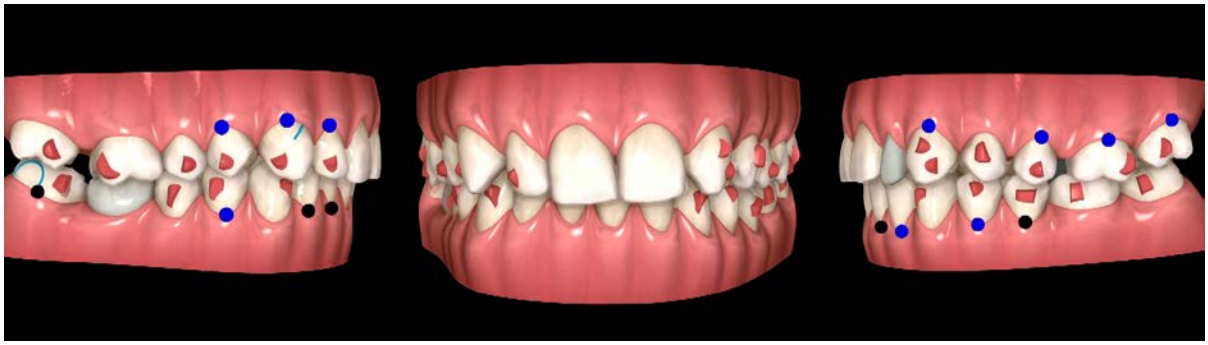
The dental aesthetics are based on achieving golden proportions with regard to the frontal view, including appropriate proportions for the central incisors in terms of width and length. Turning to the smile, the goal is to match the facial and dental midline, and achieve a smile line that is parallel to the inferior lip. Achieving the desired facial aesthetics may require collaboration with an orthognathic team.

In this case the patient had a Class II division I malocclusion. They were missing 2.2 and had a small 1.2. Other characteristics included a long face, mandibular retrusion, facial asymmetry, convex profile and a prominent nose. The midline was shifted to the left and there was tilting of the maxillary incisors.

The case was treated using a digital approach with aligners. The positions of the attachments, buttons and elastics are shown in the accompanying slide.

For the second stage of the treatment, different attachments were used on 2.1 to resolve the tilting. A fixed retainer is always used for midline correction.





Once space had been opened up the for the 2.2, the implant was placed with a provisional crown to contour the soft tissue. The case was completed with whitening, plus veneers on the maxillary incisors.

Conclusions

- Anterior aesthetics are crucial in treatment planning.
- Small details can make a big difference to the final outcome.
- Digital really helps clinicians to improve, and to offer patients something better.
- Use technology wisely. Set the limits and stick to the basics.

Manuel Nienkemper

Aesthetic solutions for complex cases using skeletal anchorage

This presentation looked at how to manage spaces in the posterior region, specifically how to close or open them with the help of skeletal anchorage.

The speaker described how to mesialise a second maxillary molar to the first molar position, a type of treatment that is hard to achieve using orthodontics. The technique discussed used skeletal anchorage.

He demonstrated a way to insert the miniscrews without a CBCT scan by superimposing the scanned model plaster with the cephalometric X-ray.[1,2] A surgical guide is used to insert the TADs around the palatal suture in the midline. During the same visit a mesial slider appliance is placed.[3] There are two ways to make this: it can be cast in the laboratory or created using a digital design, then printed in metal. The idea is to centre the force on the screws, not on the rest of the teeth, thereby avoiding applying undesired force on the teeth.

Another frequently encountered situation in clinical practice is the need to distalise an entire quadrant asymmetrically to align canines or laterals. Skeletal anchorage and aligners are used to achieve this.

In other situations, the speaker described how he uses midline skeletal anchorage to immobilise teeth that he doesn´t want to move.

The following clinical case illustrates a patient with a very low sinus wall floor. To avoid the implant and prevent the need for a sinus floor elevation, the second molar was mesialised.

The final clinical case demonstrated how to intrude a molar using skeletal anchorage in the midline.

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EAO Congress Scientific Report; Milan 2024, Session 8

How can we influence soft tissue healing?

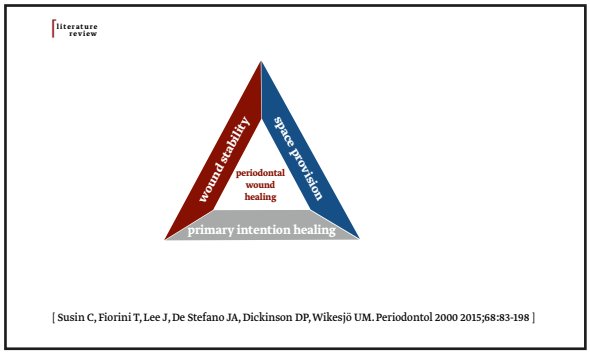
In this session, each of the three speakers approached the topic of soft tissue healing from a specific perspective, looking at surgical factors, biological factors, and the biomaterials that can affect healing.

Otto Zuhr

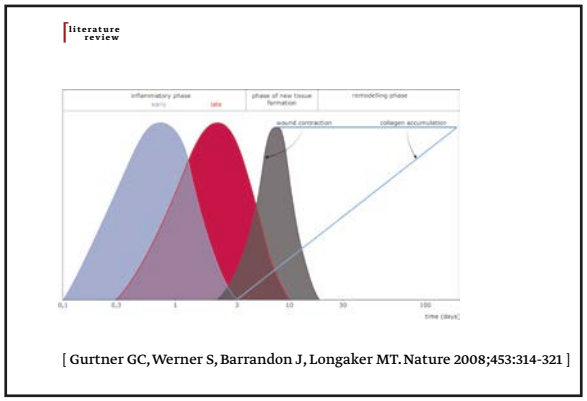
Surgical factors that can influence soft tissue healing

This presentation focused on the surgical factors that can influence soft tissue healing. The speaker began by emphasising that good soft tissue healing is essential to the success of the procedure. The success of any surgical procedure is related to fast and effective wound healing.[1]

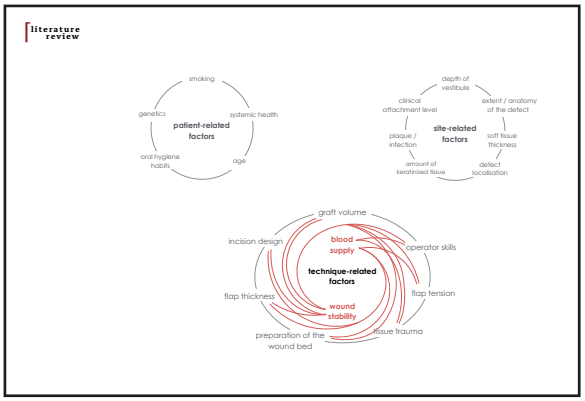
Healing by primary intention is essential to ensure a satisfactory outcome, especially in reconstructive implant and periodontal surgery. This is because it reduces internal contamination, prevents the passage of bacteria into the deep tissue, and allows true regeneration to occur beneath the superficial tissue. The optimal aesthetic outcome of a procedure is directly related to good healing by primary intention.



[Susin C, Fiorini T, Lee J, De Stefano JA, Dickinson DP, Wikesjö UM. Periodontol 2000 2015;68:83-198]



[Gurtner GC, Werner S, Barrandon J, Longaker MT. Nature 2008;453:314-321]



Cortellini et al. have defined clinical strategies detailing advanced flap and combination therapy for root coverage, based on scientific evidence and clinical experience. Throughout the presentation, the speaker talked about the thickness of the soft tissue flap as an essential factor in the outcome of the scar. It's a clinically relevant factor, as thinner flaps are more prone to dehiscence, infection and contamination.[2] He also emphasised that successful periodontal healing depends on primary intention healing, wound stability, and space provision.[3]

In the 1980s, periodontal regeneration procedures were unpredictable. Then, during the 1990s, the Cortellini group proposed the papilla preservation technique, which reduces the flap size and the number of incisions.[2] Using this new approach, success rates substantially improved. Over the following years Cortellini and other authors have evolved techniques to enhance the success of these procedures and reduce complications.

The speaker presented two clinical cases illustrating the principles he had set out. In cases involving papilla preservation, the same four steps are followed:

- incision design
- flap preparation
- flap mobilisation
- flap stabilisation

For cases involving periodontal regeneration with papilla preservation, the use of biomaterials can help prevent the papillae from collapsing.[3]

1 Gurtner GC, Werner S, Barrando J, Longaker MT. Wound repair and regeneration. Nature 2008;453:314-321.
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Juan Blanco

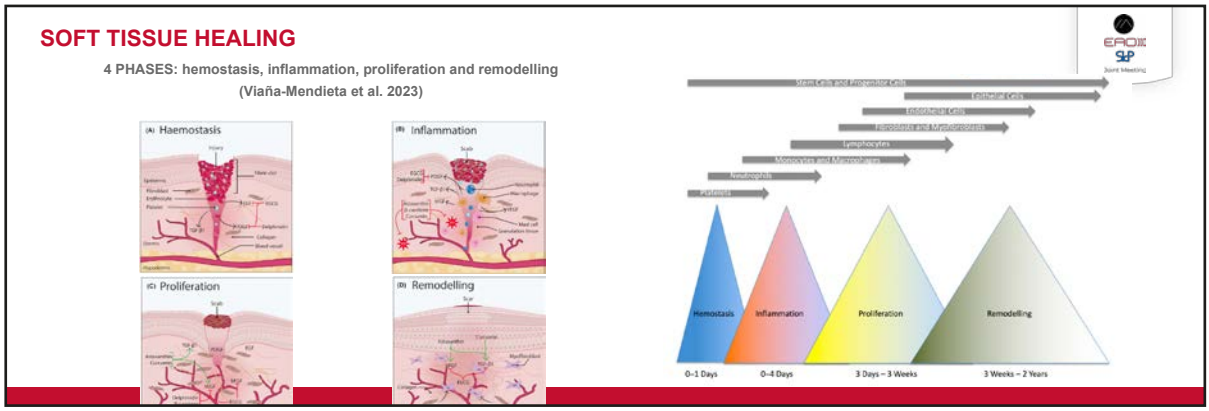
Biological factors that can influence soft tissue healing

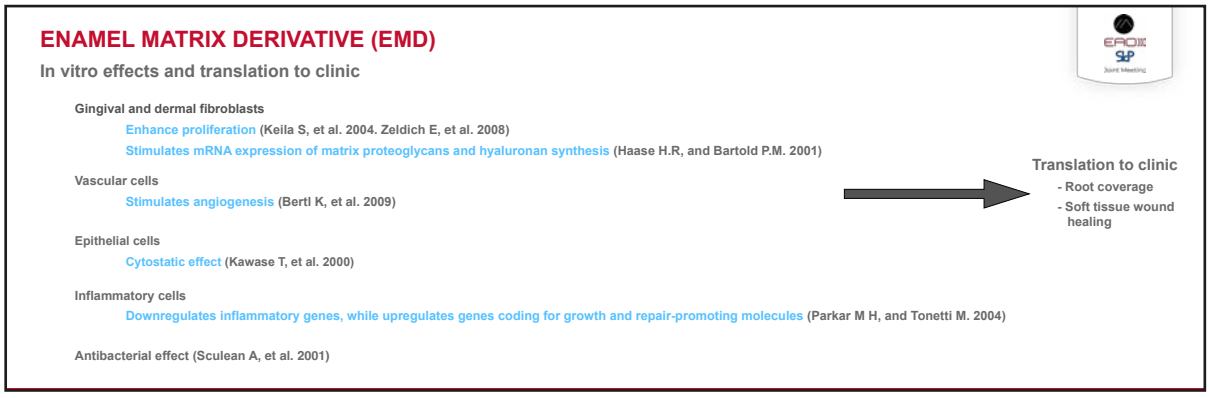
The speaker began by emphasising the importance of understanding tissue healing, and described how this consists of four phases: haemostasis, inflammation, proliferation and remodelling. Different types of cells and molecules are present in these different phases, acting alongside each other for different durations, depending on whether the healing is by first or second intention.[1]

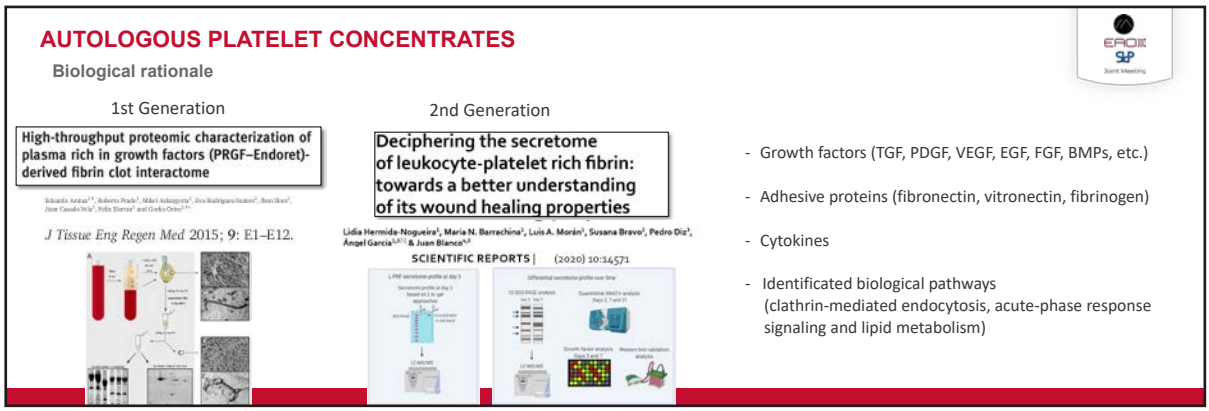
The main biological agents that can help improve healing are:[2]

- enamel matrix derivative (EMD)
- autologous platelet concentrates (PRP, PRGF, L-PRF).
- hyaluronic acid (HA).[2]

With regard to EMD, it is important to understand the biological rationale for its action. It is composed of proteins, not just amelogenins, and demonstrates favourable results in terms of infection control. It's cytostatic and antibacterial, and stimulates







1 Viaña-Mendieta et al 2023. Soft tissue healing.
2 Gustavo Avila-Ortiz, et al. J. Periodontol. 2022.

cellular activity (not only with cementoblasts).[3-4] However, these results have been obtained in vitro, and they still need to be translated into clinical practice.

In cases involving root coverage, EMD isn't a substitute for the gold standard treatment, which is a connective tissue graft. However, it improves the healing of peri-implant soft tissue,[5] as well as healing in the palate after graft harvesting, and it also improves the healing of flaps.[6-7] The speaker concluded by saying that the relatively small improvement in healing produced by EMD can make a difference in certain treatments.[12]

Turning to autologous platelet concentrates, it's necessary to differentiate between first- and second-generation variants, which differ in the concentration of blood platelets. These contain growth factors, adhesive proteins and cytokines.[8-9-10-11]

First-generation variants are rich in platelets and have low fibrin density, while second-generation variants contain more cells and leukocytes, as well as more growth factors. They also have denser fibrin.[8,9,10,11] Additionally, they persist in the area for longer and have a slower absorption mechanism.

In terms of clinical applications, L-PRF is the most documented option for use in the oral cavity. The American Dental Association supports its use, but not as an alternative to connective tissue grafts.[12] L-PRF is beneficial in the coronally advanced flap technique, providing there is pre-existing keratinised gingiva. It improves outcomes when combined with a connective tissue graft or dermal matrix.[13-14] The palatal donor site also heals better in the presence of L-PRF.[15]

In cases involving guided bone regeneration, the use of a plasma membrane helps wound healing and reduces exposures.[16] When used in non-submerged implant surgery, PRF membranes improve both the crestal level and the soft tissue level.[17]

The speaker also discussed hyaluronic acid, which is the newest of these materials to be used in clinical applications. It stimulates cell migration, proliferation and differentiation. It also modulates inflammation and the effect of angiogenesis, and is bacteriostatic. All of these qualities have been demonstrated in vitro,[18-19] although in clinical applications no significant differences have been observed when it is used in the coronally advanced flap technique.[20]

Regarding palatal healing, there is no significant difference when using hyaluronic acid, although cyanoacrylate does show improvement in healing.[21] There is also no significant difference in outcomes with the use of different types of flaps and using hyaluronic acid.[22]

The speaker's take-home messages were as follows:

- Based on in vitro studies, all the biological agents have potential.
- In the clinical setting, for root coverage, biological agents can be used as adjuvants to the existing gold standard technique, particularly in very demanding situations (for example tooth malposition, thin tissue, no vestibule).
- In other clinical situations, autologous platelet concentrates seem to offer superior results, in particular for:
  - Palatal wound healing following a gingival graft.
  - To improve soft tissue healing in surgery involving flap mobilisation (bone augmentation).

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Daniel Thoma

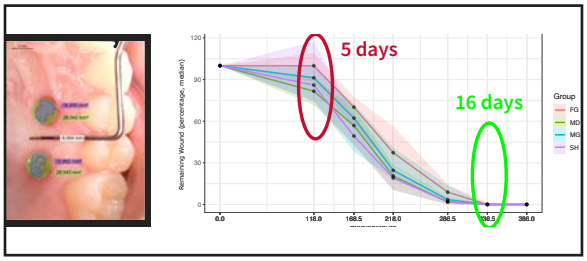
Biomaterials that can influence soft tissue healing

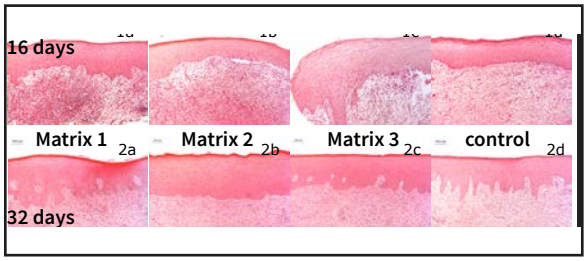
Autogenous soft tissue grafts generally offer greater efficacy for soft tissue augmentation than soft tissue substitutes. However, they lead to the creation of an additional and often painful surgical site.[1,2,3] Conversely, the use of soft tissue substitutes substantially reduces patient morbidity.[2,3] Choosing the optimal grafting material involves consideration of each option's distinct physicochemical properties, combined with the specific clinical scenario.[4]

In the case of submerged healing, five-year outcomes show no significant differences in pink esthetic scores when comparing autogenous grafts and soft tissue substitutes.[5] However, in terms of healing, a slightly higher incidence of incomplete wound closure was observed with soft tissue substitutes at suture removal.[6,7] Regarding peri-implant health, soft tissue substitutes exhibited slightly greater probing depths and marginal bone loss over time when compared to autogenous grafts.[8] However, another study found that sites treated with volume-stable collagen matrix exhibited less peri-implant mucositis than sites with autogenous grafts.[5]

In the case of open healing, soft tissue substitutes have demonstrated faster epithelial maturation during the early healing phase at four days.[9] Histological findings after two months have shown comparable rete pegs, connective tissue formation and fibre orientation between collagen-based matrices and autogenous grafts.[10]

In summary, while the efficacy of soft tissue substitutes remains generally inferior to autogenous grafts, patient morbidity is considerably reduced. Differences in aesthetics and wound healing are minimal,[5,7,8,9,11,12,13,14] although autogenous grafts appear somewhat more favourable for maintaining peri-implant health5. The choice between autogenous grafting and soft tissue substitutes therefore involves balancing efficacy with reduced patient morbidity, with the decision also being influenced by clinical experience of each material.





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EAO Congress Scientific Report; Milan 2024, Session 9

Recession around implants and teeth: What do I do?

Sofia Aroca

Root coverage of gingival recessions

Treatment of soft tissue defects around teeth has several indications, including improving aesthetics, addressing root sensitivity, managing root caries, optimising oral hygiene, and restoring non-carious cervical lesions.

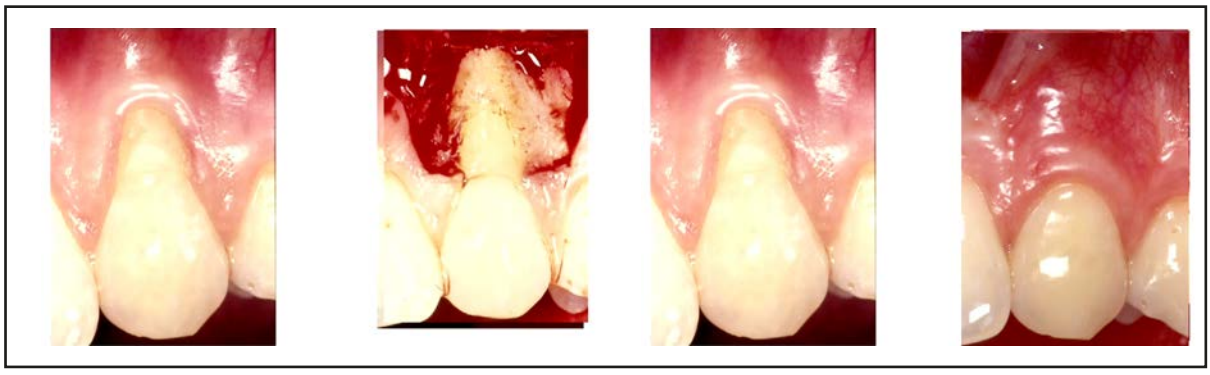
Gingival recession is defined as the apical shift of the gingival margin with exposure of the root surface to the oral cavity, and can be caused by various conditions or pathological phenomena. However, in reality gingival recession is much more than that: it is the loss of clinical attachment and keratinised tissue. When we refer to root coverage, we often neglect this fundamental aspect. Gingival recession is not merely mechanical in nature, and its treatment involves the regeneration of soft tissues.

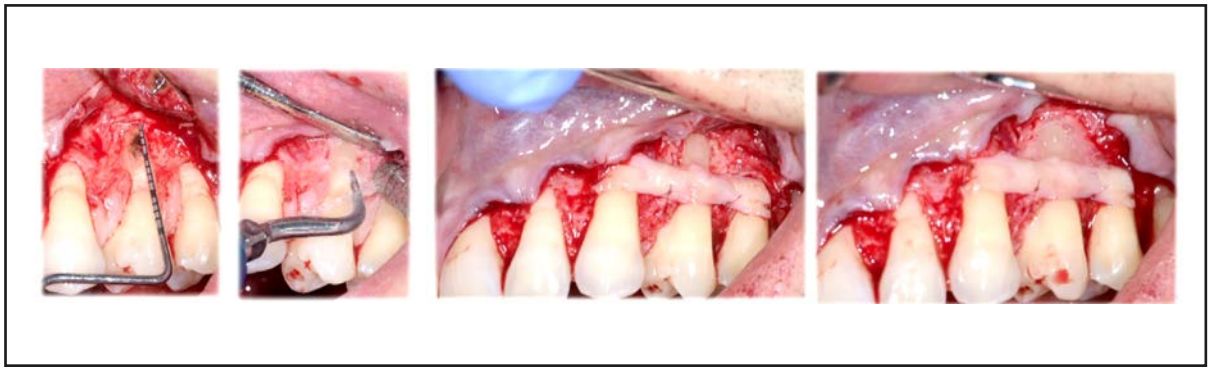
The speaker presented a case of recession due to aggressive brushing to demonstrate the significant healing potential of soft tissue when there is good periodontal health and trauma is eliminated. The split-full-split technique can be used for regeneration in cases like this. Crucially, these processes don't just involve moving tissue and covering the root, but rather doing everything that is technically possible to enable the tissue to express its biological potential.

The speaker then presented a case of multiple recession and NCCL. While the patient had no aesthetic complaints, the lesion should be carefully explored by measuring the depth of the sulcus, its potential bleeding or suppuration and the width of the keratinized tissue. This is because recession problems can often develop into periodontal problems, even in patients who do not have periodontal disease. In this particular case the treatment involves elevating a split-full-split flap to assess the area and clean the root(s) in order to try and resolve the problem. In thin phenotype cases, a connective tissue graft can be added to support the gingival part of the flap, which is then advanced coronally. The speaker used this scenario to emphasise the point that the term 'root coverage' is inadequate for this type of procedure.

She summarised the surgical techniques for treating multiple recession-type defects in two main types as follows:

- Multiple coronally advanced flap with or without connective tissue graft (CTG)
- Modified coronally advanced tunnel plus CTG



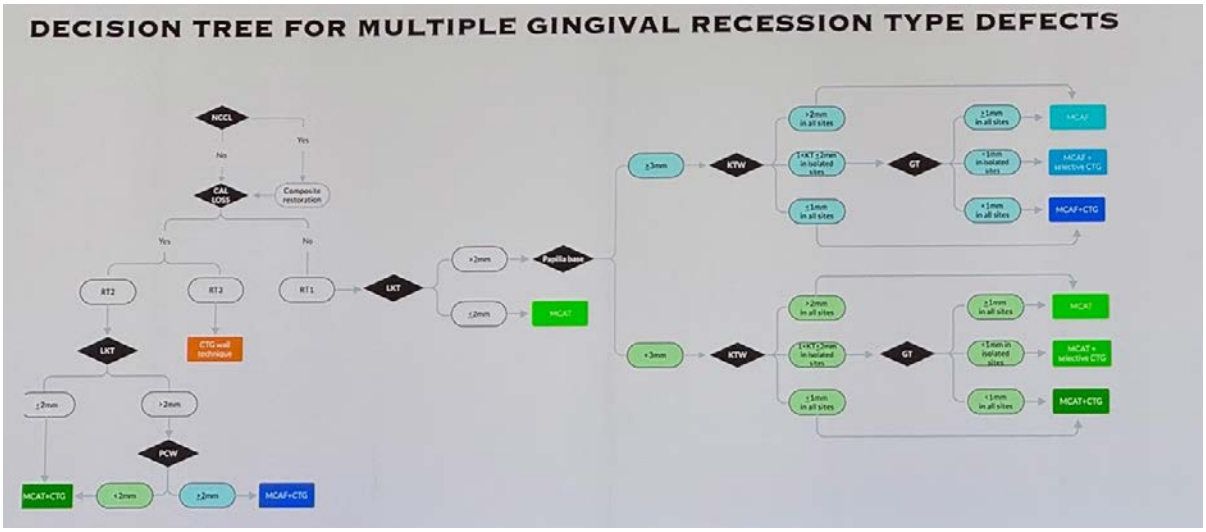


The potential of these techniques has been described numerous times and is supported by many articles demonstrating that they can successfully cover recessions and really give the tissues the possibility to express their biological potential.[1] The tunnel technique has the potential to be effective with or without the use of a connective tissue graft, making it an extremely valuable approach to both cover and regenerate tissue. However, this also makes establishing the criteria for which option to go for more complicated.

Together with Professor de Sanctis, Professor Zucchelli and Giovanna Laura Di Domenico, the speaker has developed a decision-making tree to define which technique should be used, based on the characteristics of the recession. The tree includes several parameters, but not an overwhelming number. From a clinical perspective it's necessary to evaluate whether an RT1, an RT2 or an RT3 type defect is being treated, then pay attention to the morphology of the papilla, the phenotype, the thickness and the width of the keratinised tissue in order to decide which technique to use.

- NCCL = Non Carious Cervical Lesions
- CAL LOSS = Clinical Attachment Level Loss
- LKT = Lateral Keratinised Tissue
- KTW = Keratinised Tissue Width
- GT = Gingival Thickness
- PCW = Papilla Clinical Width
- CTG = Connective Tissue Graft
- MCAT = Modified Coronally Advanced Tunnel

Dr Aroca concluded by saying that the choice of the surgical technique for soft tissue regeneration around teeth does not depend on the local factors – even if it is necessary to assess these – but mainly from the point of view of the biological potential of the tissues. Furthermore, using the decision tree is important as a tool for reducing patient morbidity. She finished by saying that the goal of her presentation had been to convince the audience that the techniques she had described were primarily concerned with soft tissue regeneration, rather than root coverage.



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Martina Stefanini

The management of peri-implant soft tissue defects

Gingival recessions should be considered as mucogingival conditions, the causes of which can vary. However, peri-implant soft tissue defects are different in that they result from mistakes. They reflect errors that have occurred because insufficient care was taken to manage the soft tissue before or during the placement of the implant.[1]

Peri-implant soft tissue defects can occur even in cases of correct implant placement due to lack of soft tissue management. However, the majority are due to bad implant positioning, and this malpositioning can occur in multiple respects. The implant can be too coronal, too apical, too buccal or too close to the adjacent teeth or an adjacent implant. As a result, the decision-making tree that has been developed to determine which treatment is appropriate is quite complex.

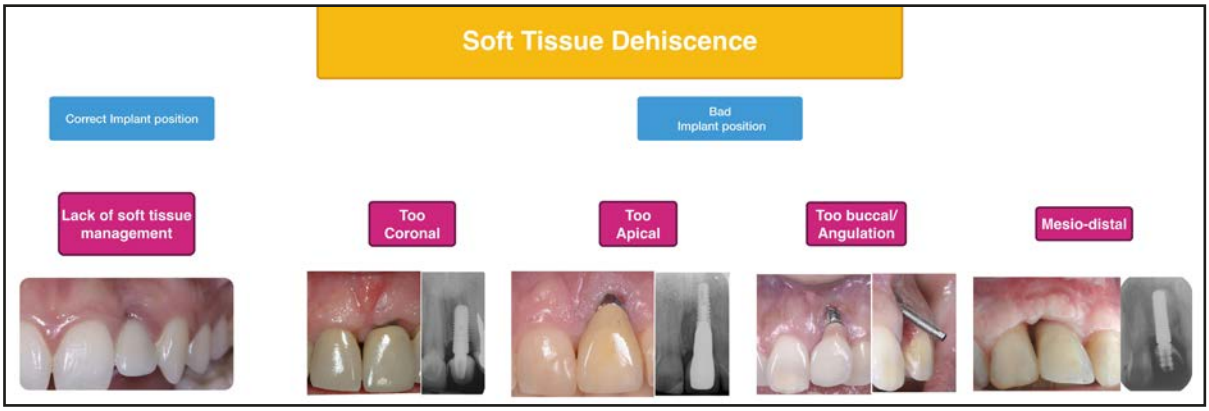
Considering that the implant was placed in the correct position, the next factor to evaluate in the tree is the papilla volume.

1. If there is a good amount of papilla remaining, the resulting defect can be treated simply, as if it was a gingival recession around the tooth. The process involves elevating a flap and applying a connective tissue graft to increase the thickness of the soft tissue in the supracrestal area. This is then covered with a coronally advanced flap. Soft tissue regeneration will occur following tissue maturation.

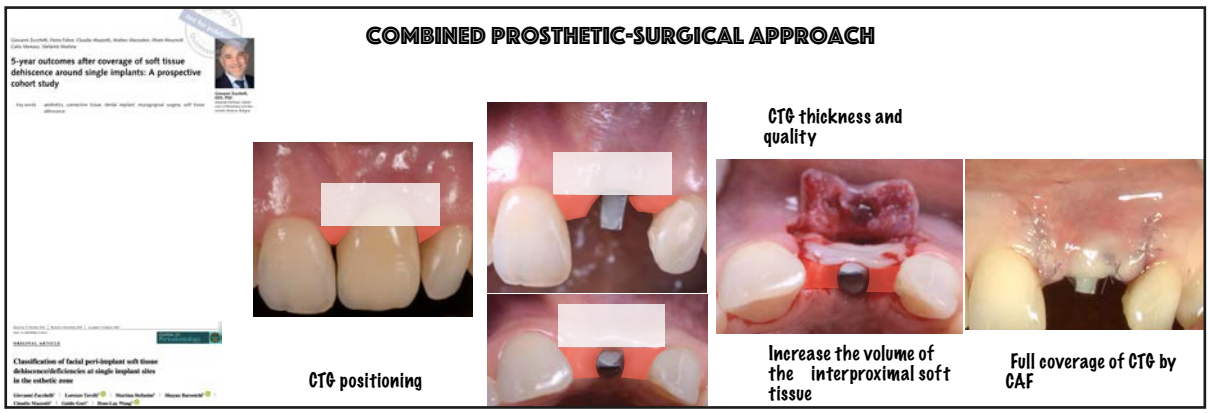
2. If there is NOT a good amount of papilla (in thickness and height) it's not possible to move directly to a surgical procedure. Instead, a **combined prosthetic-surgical approach** is required. This involves making pre-surgical changes to improve the biological situation before performing the coverage.

The first stage involves removing the crown, changing the abutment and placing another abutment with a shorter, narrower crown. After that it's necessary to wait a few months for the soft tissue to fill the space that was occupied by the old crown. This increases the interproximal volume and will provide sufficient vascular supply for the surgical papilla of the coronally advanced flap, allowing the connective tissue graft to be positioned in the ideal location for the future mucosal margin of the implant-supported restoration. The graft is covered with a passive coronally advanced flap.

A trapezoidal flap consisting of two horizontal incisions of three millimetres, plus two vertical releasing incisions, is created. Then, a free gingival graft is placed following de-epithelialisation of the papilla. The success of this treatment depends on achieving complete passivity of the flap so that it can move even more coronally. It is of course of utmost importance to completely submerge the graft to obtain closure by primary intention in order to be sure that the blood clot will remain stable and can mature over time. A provisional crown will then be placed, and the maturation of the tissues will follow.



1 Stefanini M, Marzadori M, Sangiorgi M, Rendon A, Testori T, Zucchelli G. *Complications and treatment errors in peri-implant soft tissue management.* Periodontol 2000. 2023;92(1):263-77. DOI:10.1111/prd.12470.



If there is no interproximal tissue around the implant, the approach is different because removal of the crown will not prompt the growth of interproximal soft tissue. Instead, soft tissue augmentation is combined with **submerged healing**. The implant must be completely covered with soft tissue, then after three months the head can be exposed and soft tissue conditioning can begin through placement of the provisional. This not only increases the thickness but also the height of the interproximal soft tissues prior to placement of the final restoration.[2]

Where the implant has been placed too apically. These cases are sometimes accompanied by changes to the passive eruption of the teeth, allowing tissue reduction techniques to be carried out at adjacent teeth. The surgical treatment again consists of elevating a flap, after which a connective tissue graft is fixed at the base of the anatomical de-epithelialised papilla. This is followed by closure by primary intention, taking care not to produce tension either through the coronal part of the flap or the vertical liberating incision. It is accompanied by crown lengthening, along with apical repositioning of the tissue at the level of the adjacent teeth, supplemented by coronal advancement at the level of the implant-supported crown.

The patient's gingival margin can thus be realigned by combining both techniques.

Incorrect apical and coronal implant placement. When an implant has been placed too coronally, it is important to check the position of the head in relation to the future gingival margin. If the head is coronal to the ideal position of the gingival margin, there is no mucogingival solution by which aesthetics can be improved.

However, if the implant head is positioned too far coronally, but not as far as the ideal level of the gingival margin, there is scope to correct the error and address the shortcoming. If there is only a small amount of papilla, this can again be fixed using the combined approach. In such cases, a coronally advanced flap with a trapezoidal design can be performed for two teeth. De-epithelisation of the anatomical papilla will increase vascular supply and stabilise the connective tissue graft to achieve a thickness that, together with the flap, will lead to a gain of around 2 mm buccally. This is the amount of soft tissue thickness required to maintain peri-implant tissue stability.

2 Stefanini M, Marzadori M, Tavelli L, Bellone P, Zucchelli G. *Peri-implant Papillae Reconstruction at an Esthetically Failing Implant.* Int J Periodontics Restorative Dent. 2020;40(2):213-22. DOI:10.11607/prd.4296.

However, when the implant head is positioned too coronally and remains apical to the gingival margin but the papilla dimension is less than 1 millimetre, submerged healing is the technique of choice. This increases the dimension of the mesial and distal soft tissues adjacent to the implant, as well as the vestibular volume. The technique consists of placing two connective tissue grafts, one on the buccal side and the other extended from the occlusal portion towards the buccal aspect to completely cover the defect with a coronally advanced flap. During the healing of the tissues, a Maryland is placed.

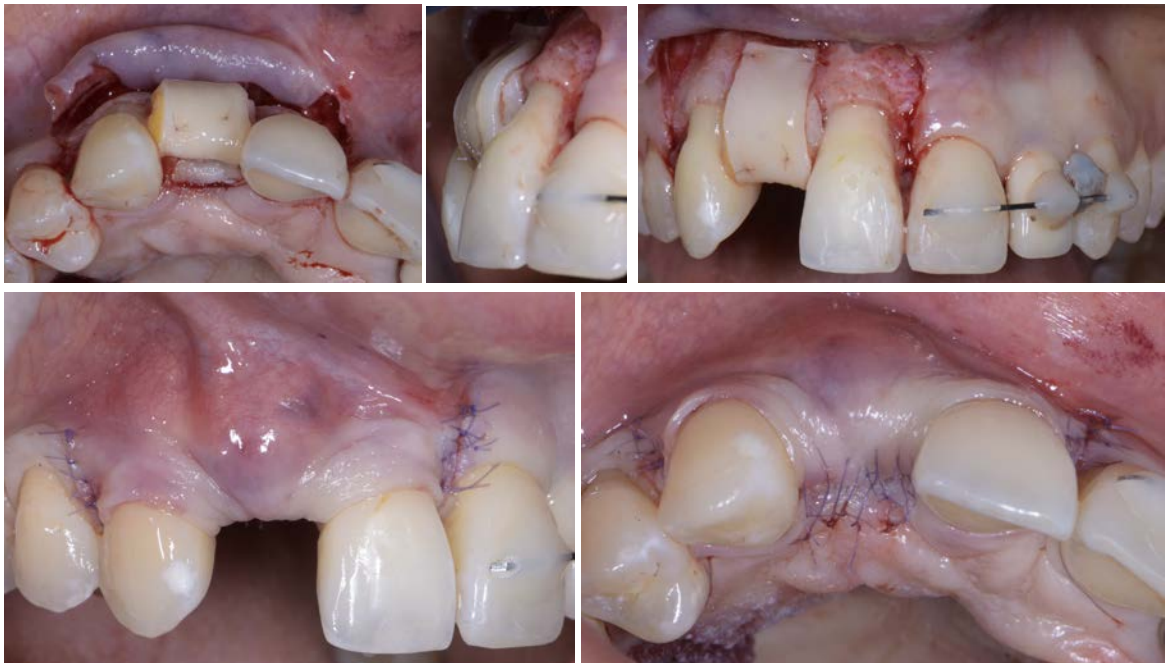
The second phase of surgery involves reopening the site by elevating a flap on the buccal side. An angled abutment is placed to correct the improper angulation of the implant.

In mesio-distal errors, when the distance between the implant and either the adjacent teeth or another implant is less than 1.5mm, nothing can be done to gain tissue. The only solution is to consider removing the implant in order to improve aesthetics for the patient. When the space is greater than 1.5mm, treatment can proceed based on the dimension of the papilla. **Submerged healing** must be performed to recreate the missing interproximal tissue.

In implants placed too buccally, if the angle of the implants is larger than 40° there is no solution available. Where there is an angulation error of less than 40°, the first step is to assess the dimensions of the papilla, then apply the combined approach using an angulated abutment that provides correction of up to 40°.

When addressing angulation errors of less than 40°, the implant must be submerged to increase the soft tissue. Placing a connective tissue graft on the buccal aspect will address the buccal fenestration. It is then necessary to wait for the maturation of the tissues. Afterwards, the implant must be uncovered again and the angled abutment placed to correct the buccally displaced implant angulation. However, if there is a papilla of less than 1mm no solution is available.

SOFT TISSUE AUGMENTATION WITH SUBMERGED HEALING



EAO Congress Scientific Report; Milan 2024, Session 10

Full arch reconstructions: the surgical approach. When is it time to keep the dentition?

Tiziano Testori

Minimally Invasive Full Arch Protocol in fully edentulous patients

Implantology follows a 'top-down' approach, beginning with the prosthetic design and moving to the surgical plan. Treatment must fulfil three primary prosthetic objectives: function (mastication and phonetics), aesthetics, and maintainability. Digital technology enables a minimally invasive approach to full arch reconstructions, optimising workflow efficiency.

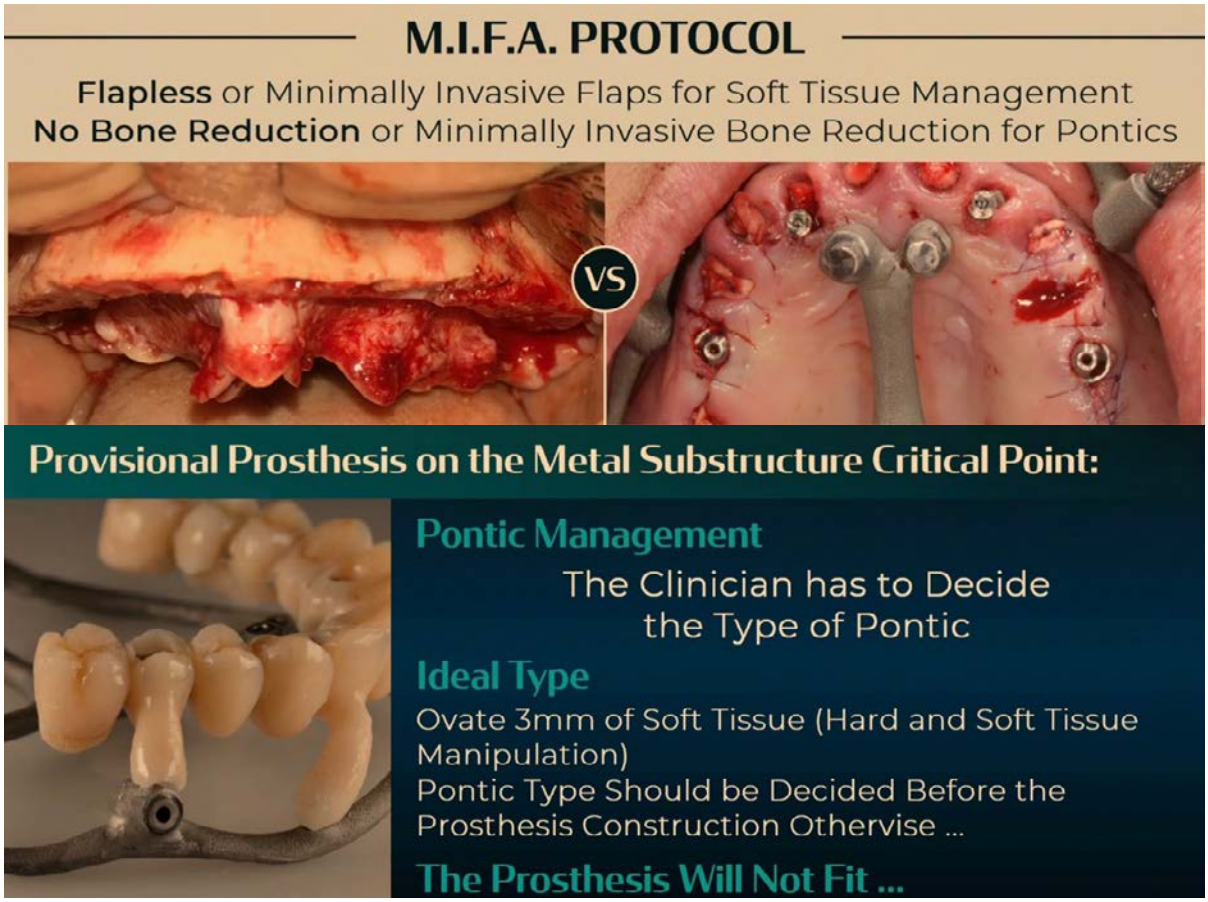
The speaker introduced the Minimally Invasive Full Arch (MIFA) protocol. Key aspects of this include:

- Flapless or minimally invasive flaps for soft tissue management
- Limited or no bone reduction for pontic sites
- Little or no use of pink gum material
- Preservation of attached keratinised tissue around implants, avoiding alveolar mucosa

Implant treatment has the potential to address altered skeletal relationships and enhance facial aesthetics. Thus, for totally edentulous patients, or patients who are edentulous in at least one arch, treatment should be guided by facial aesthetics. Cone beam CT (CBCT) scans should be taken at the correct vertical dimension of occlusion (VDO) in centric relation.

Digital technologies enable the following parameters to be tested:

- **Primary parameters:** jaw relationship and VDO
- **Secondary parameters:** occlusal plane corrections, incisal edge position and labial corridors



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Georg Mailath-Pokorny Jr.

Are there indications to bone resection?

The author divided his presentation into three parts:

1. Minor bone reduction
2. Major bone reduction
3. Major bone reduction (possible consequences)

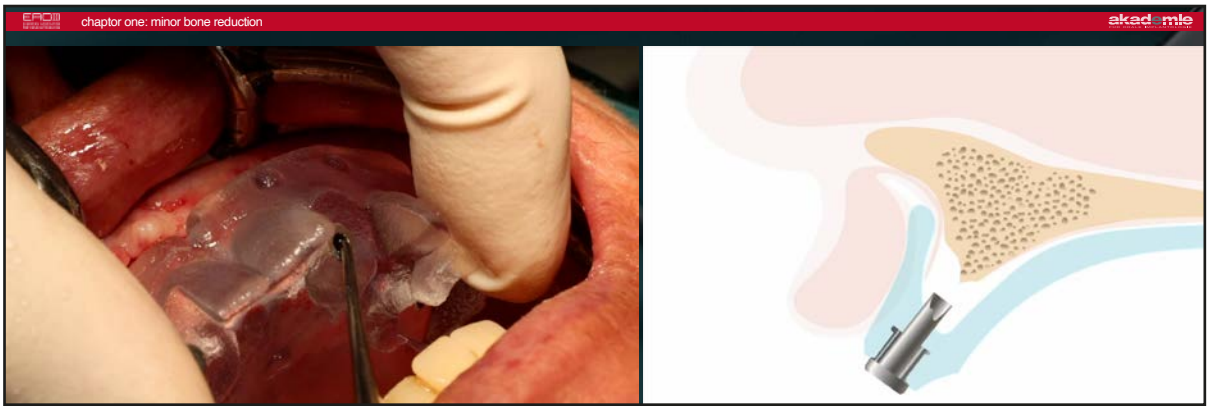
1. Minor bone reduction

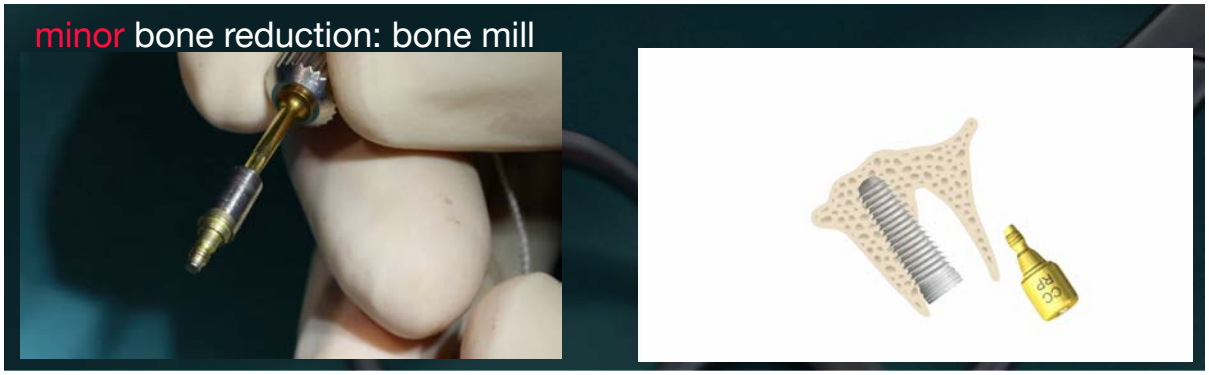
It is important to be aware that there are potential pitfalls when using guided or navigated implantology. One of them is when a very sharp alveolar ridge is encountered. When inserting the 2 mm drill, it may not fit perfectly and may deviate. The risk is even greater if the cortical bone is very hard. The problem can be solved by flattening the ridge by a few millimetres with a drill. This reduces the risk of deviation.

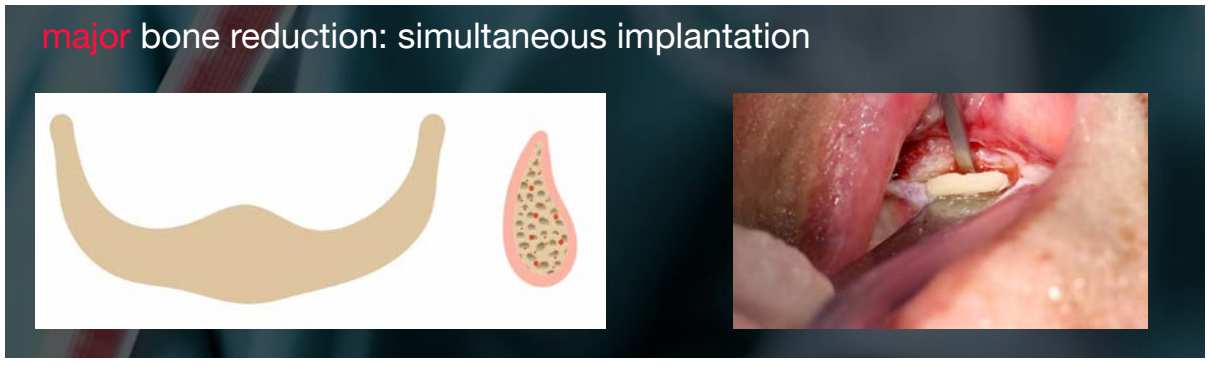
Another issue can occur in cases involving immediate placement of implants post-extraction. When the abutments are placed they can bump against the edges of the bone. This is because these implants are placed a little deeper in the socket. It is therefore necessary to remove this small edge of bone so that the abutments fit perfectly. Bone mills that are specifically designed for this purpose are available.

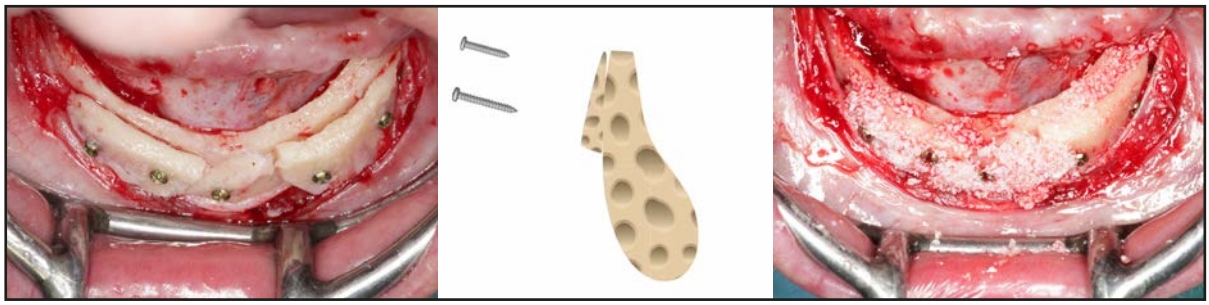
2. Major bone reduction

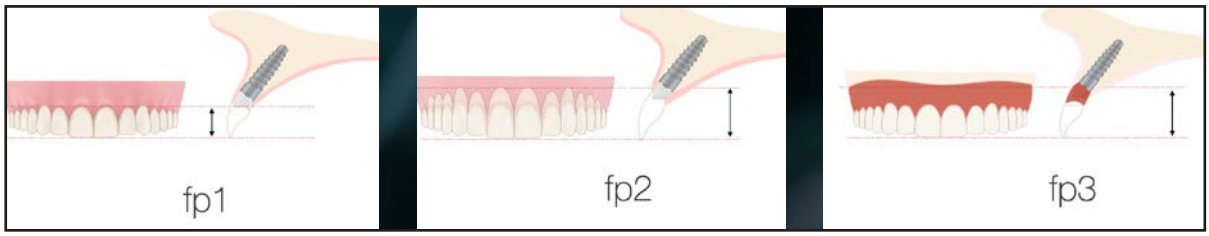
In the author's experience, only 3% of full arch reconstruction cases involve major bone reduction procedures, although in those cases it is beneficial to the patient. A typical case features a reduction in height of the posterior mandible with a very narrow ridge at the anterior mandibular level. In these cases there is usually enough bone in the lower part to place 4 mm diameter implants. A reduction of the crestal bone can be carried out with a piezoelectric device, based on an exact measurement of the bone that needs to be resected. Digitally designed tools are very useful for this purpose.











In cases where there is an extremely thin bone crest, resection can also be performed with a piezoelectric device. The resected bone is used as an onlay graft and is fixed with several screws. Implant placement must be postponed for a few months until the bone graft has healed.

Finally, in cases featuring a thin, unstructured ridge, extractions, bone resection and implant placement can be performed at the same time. The resected bone can be made into chips, which are mixed with bone substitute and placed in the gaps where the implant spires are exposed.

3. Possible consequences of major bone reduction

Changes of the sagittal dimension

When performing a bone reduction, care must be taken regarding the axis and angle of implant placement. If the implant is only oriented to the available bone there is a risk of placing it too lingually which reduces the space for the tongue in the oral cavity. There is also a risk of perforating the lingual plate and injuring the sublingual artery. Therefore implant placement should always be based on the appropriate prosthetic position.

Changes of the transversal dimension

There are cases where the bony ridge is very thin, especially in the upper jaw. Theoretically, a bone resection could be carried out and an implant placed. However, this would risk a series of negative consequences for the patient due to the implant being placed too palatally. These consequences include reduction of the space in the oral cavity, and impairment of function, aesthetics and speech. And of course it would affect the ability to clean the prosthesis. As a result, this is not an option for this type of patient. In such cases a bone augmentation must be performed, with a variety of techniques available to carry this out.

Changes of the vertical dimension

According to Misch there are three prosthetic options in implant dentistry: fp1, fp2 and fp3.

Whenever possible, it is preferable to use an fp1 type prosthesis as it mimics the natural dentition both functionally and aesthetically. If a bone reduction is carried out, the vertical space created can only be compensated for by elongation of the teeth, or a gingival mask. This has an effect on cleanability, as well as speech and function. When bone reduction is more accentuated, maxillary retrusion occurs. The prosthetic compensation can lead to food impaction and lip retraction.

Loss of vertical space

In cases where the posterior maxillary prosthetic space has collapsed, an ostectomy can be performed to gain space for the crowns to fit. This often requires a sinus lift, and the resected bone fragment can be used for this. In cases involving the whole maxilla, it's first necessary to determine how much space is needed for the prosthetic rehabilitation. For a fixed restoration, a distance of at least 10 mm from the implant platform to the occlusal plane is required. If verticalisation is prosthetically possible, and the verticalisation is well tolerated by the patient, implants can be placed, and the patient can be provided with a fixed restoration. If verticalisation is not possible, one should also consider a LeFort I osteotomy with resection of the required amount of bone to gain the prosthetic space and adjust the sagittal position accordingly.

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Dominik Gross

Ethical issues

The benefits of implant treatment are indisputable, and include excellent functional results in many patients; improved aesthetics and phonetics; and boosted self-confidence. However, like every treatment option, implant restoration has limitations and can pose challenges, including ethical ones. This presentation explored ethical questions in implant therapy in general, rather than specifically focusing on full-arch reconstructions.

Unclear responsibility (more than one dentist involved)

The surgical placement of dental implants and the subsequent prosthetic restoration of those implants are sometimes carried out by two different practitioners. Surgeons with well-established treatment routines (high case numbers per year) are likely to achieve significantly better results. However, risks increase if the implantation and subsequent prosthetic restoration are not planned together and closely coordinated. Furthermore, if the final treatment result is poor (potentially resulting in a claim for malpractice) it will be unclear who is responsible. This means that from an ethical point of view:

- The surgical and subsequent prosthetic care has to be coordinated.
- There should be a shared responsibility between the dentists involved.

Unclear or insufficient evidence

While there are some long-term studies into implant systems that span periods of 30 or more years (such as for some Branemark/ Nobel Biocare systems, and ITI/Straumann systems), there is still a lack of long-term evidence to underpin many products. This is complicated by the fact that there is no recognised gold standard in implantology against which testing is carried out. Instead, testing involves numerous different systems and therapeutic preferences that depend on the individual practitioner. Furthermore, many clinical studies are only based on small numbers of cases due to the large number of competing systems.

Another complicating factor is that implant types are often changed or modified by manufacturers over short time cycles. This means that some important long-term studies refer to products or implant systems that are no longer available by the time they are published. In other cases the implants have already been replaced by successor models, significantly limiting the value of the study results.

Ethical considerations:

- Based on the ethical principle of beneficence, the practitioner is obligated to provide the patient with the best possible benefit to the best of their knowledge. That means relying on the best possible evidence they can obtain.
- This argues in favour of using proven and well-tested systems instead of new but potentially promising ones.

- When new implant systems are used, the lower level of evidence must be carefully explained to the patient and the patient must give their consent.

Clinical complications and late effects

The indications for implant therapy are now broader than used to be. However, this has increased the frequency of risks, side effects, complications and long-term consequences. These can be of a mechanical or biological nature.

Ethical considerations:

- Risk assessment is of great importance, especially in high-risk patients.
- If implant therapy is carried out on high-risk patients, close monitoring and specific follow-up care should be planned.

Risks, complications and side effects associated with dental implants

Biological complications and side effects (general diseases, poor oral hygiene, poor bone condition)	Mechanical complications and side effects (poor implant position, loading problems, insufficient bone bed, bruxism)	Technical complications and side effects (overloading, parafunction, material weaknesses)
Bacterial infections	screw loosening	framework fracture
peri-implantitis	screw/ implant fracture	abutment fracture
sensory disturbances	problems with cementation/ decementation	chipping or fracture of the veneering ceramic
progressive bone loss	implant loss	
implant loss		

Overstretching the indication for implant treatment

Preserving vs extracting teeth. There are hints in the literature that the growth in implant treatment has led to a decline in the preservation of compromised teeth. There are also implant therapy concepts, such as 'All-on-4', that are based on the completely edentulous jaw. However, several studies have shown that even compromised teeth sometimes last longer than implants.

Ethical considerations:

- It is contrary to the principle of non-maleficence to sacrifice teeth that are worth preserving.
- Even where teeth are diseased, a case-by-case decision about preserving or extracting them should be made.
- When deciding whether to extract a tooth or preserve it, the consideration should be medical, not economic.

There are a number of scenarios where **overtreatment** (in other words maltreatment) occurs, such as when teeth that are suitable abutments for a prosthetic restoration are extracted and then replaced by implants. Other scenarios include more implants being placed than are necessary or required for the restoration, and implants being inserted in places where they are not necessary (or even inappropriate).

Ethical considerations:

- Overtreatment harms the patient and is a violation of the non-maleficence principle
- It also has a negative economic impact on the patient.
- It may also violate the patient's autonomy (inadequate patient education provided regarding the number of implants required)

Dealing with vulnerable patients. Old age and/or limited life expectancy are no longer general contraindications for implant treatment, and this makes it all the more important to scrutinise the cases of patients who are considered to be vulnerable. There are three criteria that are useful for doing this:

- assessing the patient´s ability to undergo therapy
- assessing their ability to perform oral hygiene
- assessing their self-sufficiency

Problem areas (issues) discussed	
Issues:	**Ethical principle adressed:**
Unclear responsibility (more than one dentist involved)	*Ethics of responsibility*
Unclear/ insufficient evidence	*Principle of beneficience*
Clinical complications and late effects	*Principle of non-maleficence („do no harm")*
Overstretching the indication for implant therapy	*Principle of non-maleficence, respect for patient auton*

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EAO Congress Scientific Report; Milan 2024, Session 11

Beyond the limits of re-osseointegration

The session began with a review of advanced treatments for peri-implantitis. The two speakers then discussed strategies and protocols for managing peri-implantitis, particularly in cases with severe bone loss.

Frank Schwarz

Surgical treatment of peri-implantitis at its limit

Prof Schwarz discussed differences in bone loss management for implants versus natural teeth, emphasising that implants often remain stable even following substantial bone loss, unlike teeth which may become mobile. Faced with the degree of bone loss that would destabilise a tooth, an implant can often remain stable, requiring minimal bone support (1–1.5 mm). This is due to bone density adaptation in response to pressure at the implant's base Figure 1.[1]

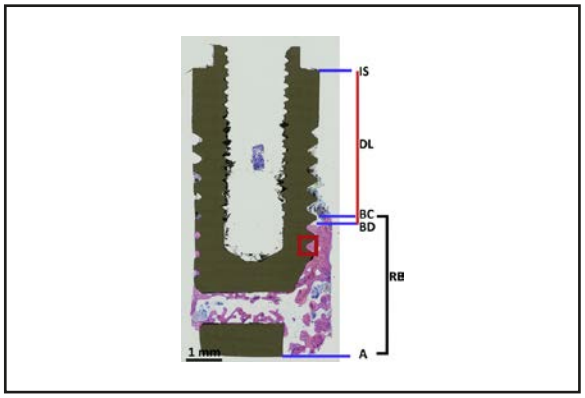

Figure 1: An implant can remain stable despite having lost 90% of its support.

A range of surgical procedures for managing peri-implantitis was presented, based on defect type and severity. Figure 2 illustrates the main types of defects:[2]

- **Class 1 contained defects.** A bone defect that surrounds the implant but preserves its bony corticals as a 'crater'.
- **Class 1 non-contained defects**. Where bone is missing on the buccal (outer) side while intact on the lingual or palatal sides.
- **Class 2 supracrestal defects**. Located above the bone level and often managed with implantoplasty (reshaping of the implant).
- **Class 3 defects**: a combination of class 1 and class 2 defects, where bone is missing on multiple sides.

The discussion then shifted to clinical guidelines and treatment outcomes for peri-implantitis. The speaker emphasised that success is not based on achieving re-osseointegration, but rather on controlling inflammation through clinical measures such as reducing bleeding, addressing suppuration, and lowering probing depths.[3] Radiographic bone fill is desirable but not required for a successful treatment outcome. Clinical evaluations of success are generally conducted at six months, then through radiographs after a year or more.

Prof Schwartz focused on Class 1 (non-contained) and Class 3 (combined) defects. Reconstructive treatment of these defect types commonly includes bone grafting and the use of supportive membranes. Inflammatory environments around implants require special graft materials with low resorption rates to provide a combination of durability and containment. Autogenous bone is less favourable here due to high resorption rates.[4]

The Modified Reconstructive Protocol is recommended for Class 1 defects and involves using a 'combination flap' technique – a microsurgical approach that combines a full-thickness and split-thickness flap.[5] This allows precision in separating tissue layers, thereby preserving flap integrity and supporting graft stability. The concept of a 'sticky bone' was introduced. This uses graft materials that bind well and prevent particle migration, qualities that are crucial for achieving stability in non-contained defect areas.

Effective decontamination is critical to treatment.[2,6] A titanium brush was identified as an effective tool to clean the implant surface, and is supported by evidence. Additional chemical agents like EDTA can

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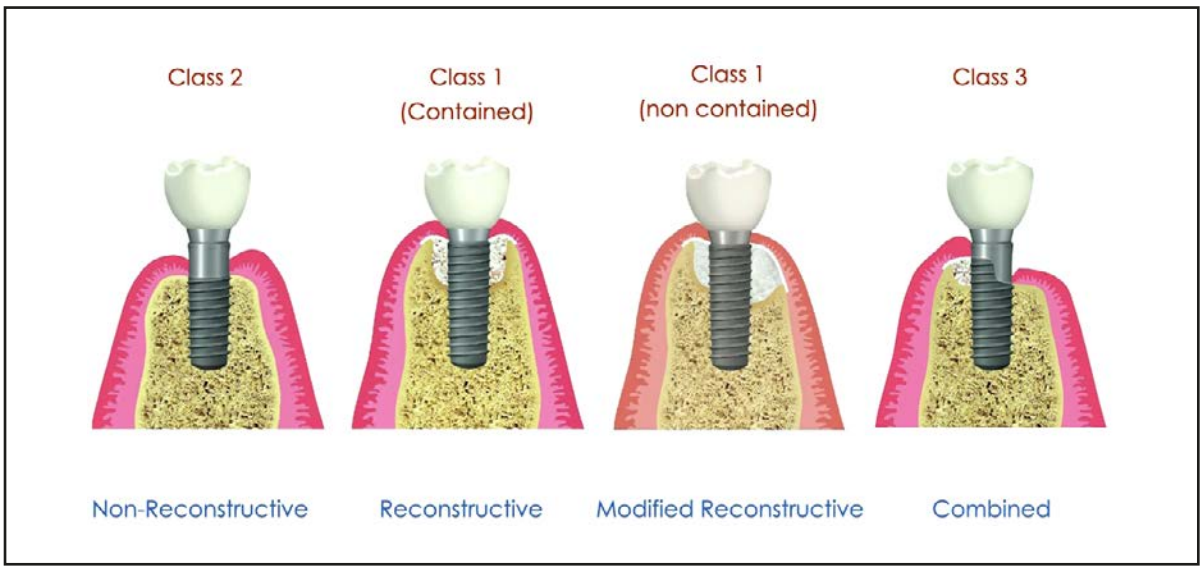


Figure 2: Classification of peri-implant defects according to bone support.

be used, but are considered secondary for surface cleanliness and may primarily aid in reducing bleeding during surgery. Using this protocol, Prof Schwartz obtained a peri-implantitis resolution rate of 86% after a year of follow-up.[5]

For Class 3 defects, a combination approach is often used, involving implantoplasty in non-contained areas and bone grafting in contained regions. This strategy provides a balance between achieving structural stability and managing inflammation.[2] Studies indicate a success rate of over 80% in controlling disease symptoms (bleeding, suppuration and probing depth) over a seven-year period.[7,8] Starting treatment with a non-surgical approach is recommended to reduce inflammation. This protocol has been studied by a number of authors, as shown in Figure 3.

However, the aesthetic outcomes, such as minimising mucosal recession, remain challenging.[9] To manage aesthetics in visible areas, volume grafting (using collagen or connective tissue grafts) is recommended. This helps to maintain the gum line, compensating for soft tissue volume loss that occurs post-surgery.

When an implant has to be removed, immediate bone grafting is recommended to prevent tissue collapse and facilitate future procedures. However, success rates for osseointegration decline significantly with each subsequent implant placement in the same site, underscoring the importance of carefully considering implant removal and replacement.

In summary, the management of peri-implantitis combines structural reconstruction with rigorous decontamination and adapted surgical protocols. Achieving clinical success involves controlling inflammation rather than full re-osseointegration. The Modified Reconstructive Protocol and combination therapies are effective for complex cases, providing a high rate of disease resolution over long-term follow-up.

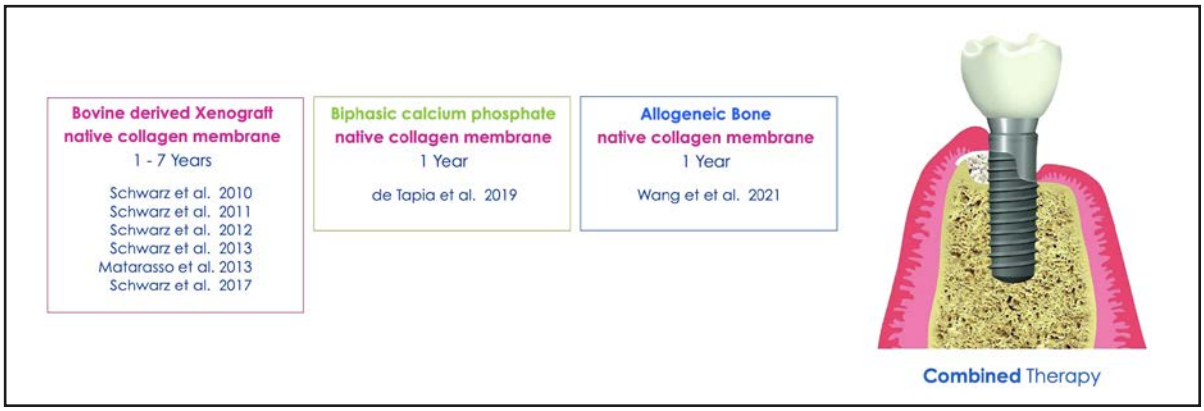


Figure 3: Results of combined treatment reported by different authors with different follow-up periods.

7 Schwarz F, John G, Schmucker A, Sahm N, Becker J. Combined surgical therapy of advanced peri-implantitis evaluating two methods of surface decontamination: a 7-year follow-up observation. J Clin Periodontol [Internet]. 2017 Mar 1 [cited 2024 Nov 8];44(3):337–42. Available from: https://pubmed.ncbi.nlm.nih.gov/28101947/

8 Schwarz F, John G, Becker J. Reentry After Combined Surgical Resective and Regenerative Therapy of Advanced Peri-implantitis: A Retrospective Analysis of Five Cases. Int J Periodontics Restorative Dent [Internet]. 2015 Sep [cited 2024 Nov 8];35(5):647–53. Available from: https://pubmed.ncbi.nlm.nih.gov/26357694/

9 Galarraga-Vinueza ME, Obreja K, Magini R, Sculean A, Sader R, Schwarz F. Volumetric assessment of tissue changes following combined surgical therapy of peri-implantitis: A pilot study. J Clin Periodontol. 2020 Sep 1;47(9):1159–68.

Hom-Lay Wang

Re-osseointegration in failed implant sites

Professor Wang discussed critical aspects of managing peri-implantitis, with a focus on when to save implants and when to remove them (potentially in order to place a new implant). His key considerations included understanding the aetiology of implant issues; checking implant mobility; assessing bone loss; and determining the presence of infection. These factors shape the approach to implant care, especially with regard to peri-implantitis. They determine whether an implant can be saved or must be removed and reconstructed.

Professor Wang has developed a decision tree based on several pillars,[1,2,3,4] illustrated in Figure 4:[5]

1. **Aetiology**. The primary consideration is identifying the root cause of complications, as untreated underlying issues will lead to recurrent problems. If you cannot address the aetiology, it doesn't matter how good your regeneration skills are, as the underlying issue will recur.
2. **Implant mobility.** If the implant is loose, removal and replacement are often the best options.
3. **Amount of bone loss beyond initial biological bone remodelling.** Normal biological bone remodelling should leave about 3 mm of soft tissue above the bone (the soft tissue transitional zone). Additional bone loss beyond this might indicate peri-implant issues.
4. **Type of bone loss (horizontal and vertical).** What kind of bone loss is present?
5. **Keratinised mucosa and mucosal thickness**

Professor Wang outlined different treatment protocols depending on the extent of bone loss. Early peri-implantitis (up to 25% bone loss) can be managed with non-surgical techniques, whereas advanced

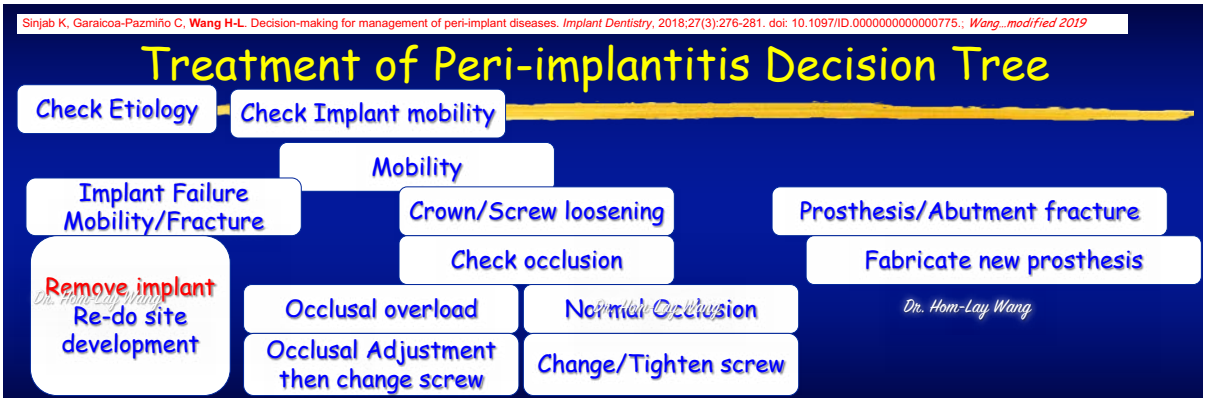


Figure 4: Initial decision tree for treating peri-implant disease. Modified in 2019 by Dr Wang

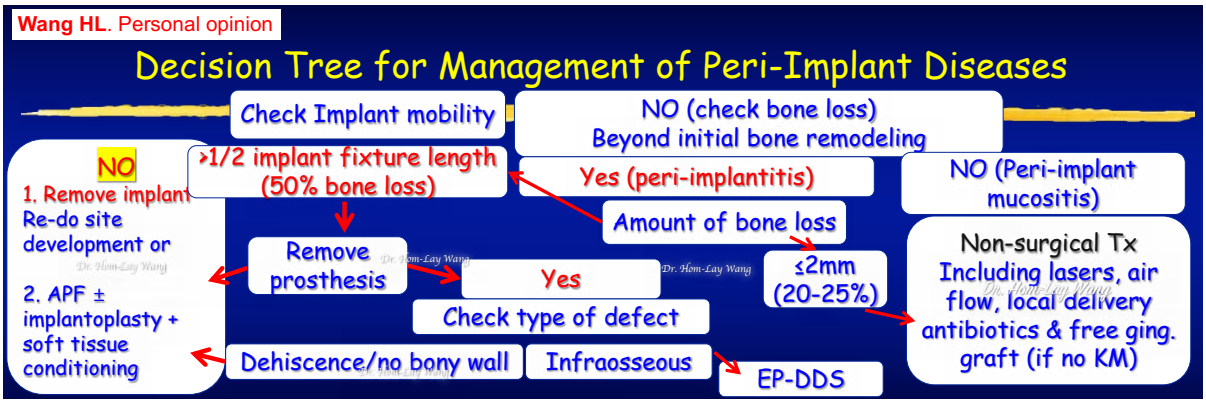


Figure 5: Decision tree for treating peri-implant diseases

1 Okayasu K, Wang HL. Decision tree for the management of periimplant diseases. Implant Dent [Internet]. 2011 Aug [cited 2024 Nov 8];20(4):256–61. Available from: https://pubmed.ncbi.nlm.nih.gov/21778886/

2 Aljateeli M, Fu JH, Wang HL. Managing peri-implant bone loss: current understanding. Clin Implant Dent Relat Res [Internet]. 2012 May [cited 2024 Nov 8];14 Suppl 1(SUPPL. 1). Available from: https://pubmed.ncbi.nlm.nih.gov/21985674/

3 Padial-Molina M, Suarez F, Rios H, Galindo-Moreno P, Wang H-L. Guidelines for the diagnosis and treatment of peri-implant diseases. Int J Periodontics Restorative Dent [Internet]. 2014 Nov [cited 2024 Nov 8];34(6):e102–11. Available from: https://pubmed.ncbi.nlm.nih.gov/25411744/

4 Fu JH, Wang HL. Can Periimplantitis Be Treated? Dent Clin North Am [Internet]. 2015 Oct 1 [cited 2024 Nov 8];59(4):951–80. Available from: https://pubmed.ncbi.nlm.nih.gov/26427576/

5 Sinjab K, Garaicoa-Pazmino C, Wang HL. Decision Making for Management of Periimplant Diseases. Implant Dent [Internet]. 2018 Jun 1 [cited 2024 Nov 8];27(3):276–81. Available from: https://pubmed.ncbi.nlm.nih.gov/29762186/

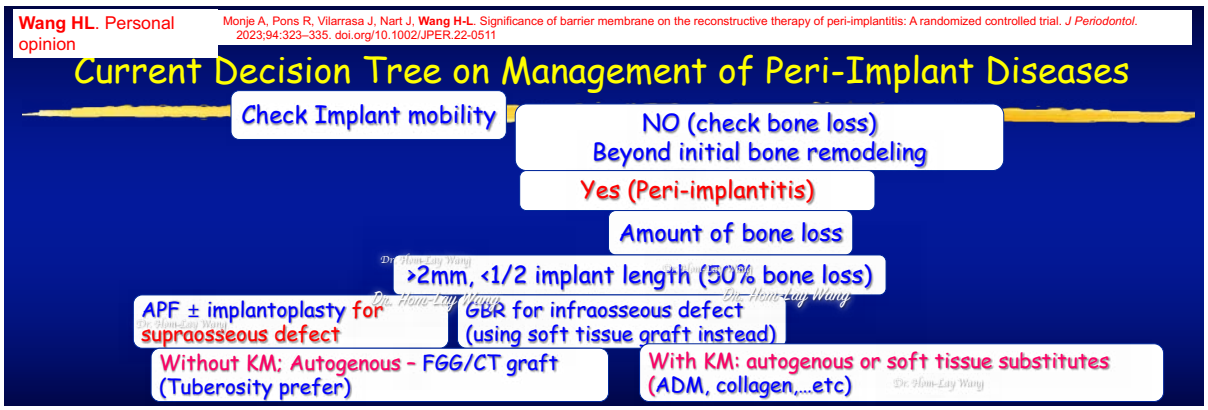


Figure 6: Decision tree for treating peri-implant diseases

cases often require removal of the implant or more extensive procedures such as implantoplasty and guided bone regeneration (GBR).[6] Figures 5 and 6 reflect these approaches.

Professor Wang used the acronym EPDDS to summarise the key concepts underpinning the treatment of peri-implant defects:

- E: Etiology identification
- P: Primary wound closure
- D: De-granulomatous tissues
- D: Decontamination
- S: Space and stability

For infraosseous decontamination, he recommended using titanium brushes, laser, airflow, or saline irrigation prior to GBR treatment. Electrolytic cleaning is an option that requires further evaluation.

He suggested changing the prosthesis if it does not meet the requirements of a balanced occlusion and presents an added difficulty for hygiene, coining the term periprosthodontitis.

His preference is for submerged healing, with removal of the prosthesis and primary closure, contrary to that illustrated by Prof Schwartz. He has found that this procedure delivers optimal results, with bone gain of 3.47 mm ± 0.41 mm.[7]

Regarding the proportion of cases in which re-osseointegration can be achieved, he referred to a study carried out by Prof Sanz involving rhBMP-2 or saline, with re-osseointegration rates of up to 40%. Despite this, none of the treatment groups achieved complete defect resolution or re-osseointegration to the level prior to the onset of peri-implantitis.[8]

When considering whether to remove the implant, the relevant factors, based on the findings of the Pisa Consensus Conference, are as follows:[9]

- Pain on function
- Mobility
- Radiographic bone loss exceeding 50% of the length of the implant
- Uncontrolled exudate
- No longer in mouth

The loss of more than 50% of bone over the length of the implant has also been shown to be a predictor of implant loss[10] and represents a relative risk 20 times higher than for implants that have lost <20%.

Professor Wang described how he typically removes an implant that has lost more than 50% of its bone, then regenerates and places a new implant in a better position and with a better prosthesis. There are risk factors to consider, such as the patient's age and whether they are a smoker (although antithrombotic treatment has been demonstrated to have a beneficial effect on treatment outcome).[11] His approach is also informed by studies conducted by other authors that have assessed reimplantation in failed versus pristine sites, as well as examining multiple failures.[12,13]

There are still some questions to be answered:

- What percentage of re-osseointegration is typically achieved at the site of a previous failed implant?
- Do different biomaterials, such as a bone graft or membrane, or the technique used in the reconstruction, influence the outcome (for instance with regard to the degree of osseointegration, the extent of marginal bone loss, and the frequency of recurrence of peri-implantitis or peri-implant mucositis)?

6 Monje A, Pons R, Vilarrasa J, Nart J, Wang HL. Significance of barrier membrane on the reconstructive therapy of peri-implantitis: A randomized controlled trial. J Periodontol [Internet]. 2023 Mar 1 [cited 2024 Nov 8];94(3):323–35. Available from: https://pubmed.ncbi.nlm.nih.gov/36399349/

7 Wen SC, Barootchi S, Huang WX, Wang HL. Surgical reconstructive treatment for infraosseous peri-implantitis defects with a submerged healing approach: A prospective controlled study. J Periodontol [Internet]. 2022 Feb 1 [cited 2024 Nov 8];93(2):195–207. Available from: https://pubmed.ncbi.nlm.nih.gov/34050529/

8 Sanz-Esporrin J, Blanco J, Sanz-Casado JV, Muñoz F, Sanz M. The adjunctive effect of rhBMP-2 on the regeneration of peri-implant bone defects after experimental peri-implantitis. Clin Oral Implants Res [Internet]. 2019 Dec 1 [cited 2024 Nov 8];30(12):1209–19. Available from: https://pubmed.ncbi.nlm.nih.gov/31514229/

9 Misch CE, Perel ML, Wang HL, Sammartino G, Galindo-Moreno P, Trisi P, et al. Implant success, survival, and failure: the International Congress of Oral Implantologists (ICOI) Pisa Consensus Conference. Implant Dent [Internet]. 2008 [cited 2024 Nov 8];17(1):5–15. Available from: https://pubmed.ncbi.nlm.nih.gov/18332753/

10 Ravidà A, Siqueira R, Di Gianfilippo R, Kaur G, Giannobile A, Galindo-Moreno P, et al. Prognostic factors associated with implant loss, disease progression or favorable outcomes after peri-implantitis surgical therapy. Clin Implant Dent Relat Res [Internet]. 2022 Apr 1 [cited 2024 Nov 8];24(2):222–32. Available from: https://pubmed.ncbi.nlm.nih.gov/35320880/

11 Park YS, Lee BA, Choi SH, Kim YT. Evaluation of failed implants and reimplantation at sites of previous dental implant failure: survival rates and risk factors. J Periodontal Implant Sci [Internet]. 2022 [cited 2024 Nov 8];52(3). Available from: https://pubmed.ncbi.nlm.nih.gov/35775698/

12 Oh SL, Shiau HJ, Ashour I, Chen H, Cruz C. Early crestal bone loss around implants placed at previously failed sites compared with initially integrated implants: A retrospective cohort study. Clin Implant Dent Relat Res [Internet]. 2022 Apr 1 [cited 2024 Nov 8];24(2):233–41. Available from: https://pubmed.ncbi.nlm.nih.gov/35320613/

13 Onclin P, Meijer HJA, van Minnen B, Vissink A, Raghoebar GM. Retreatment of multiple failing maxillary implants after full arch rehabilitation: a retrospective, observational cohort study. Int J Oral Maxillofac Surg [Internet]. 2020 Nov 1 [cited 2024 Nov 8];49(11):1481–8. Available from: https://pubmed.ncbi.nlm.nih.gov/32249035/

EAO Congress Scientific Report; Milan 2024, Session 12

Beyond the limits of prosthetic materials

Sven Reich

Current developments from the dental material side, what are the hot topics?

This presentation explored the materials used for dental implants and their components. The speaker began by acknowledging that a variety of suitable materials already exist, ranging from non-precious alloys to monolithic zirconia. However, there are risks of biological and technical complications depending on the type of retention method used. For example, screw-retained restorations are susceptible to screw loosening and chipping, while cemented restorations are associated with marginal bone loss and peri-implantitis. The presentation went on to look at materials from the perspective of what part of the implant they were applied to: the transmucosal section, the oral section and the occlusal-incisal section.

The transmucosal part of the implant is completely different to a natural tooth, so it is essential to pay attention to both the biological seal and the shape of the restoration. Fortunately, using digital dentistry the shape can be achieved perfectly. The materials used – polymers, ceramics, metal alloys and hybrid materials – all undergo processing prior to being ready for use. The methods of production (additive and subtractive) are important, but so are post-processing techniques. Sometimes additive and subtractive manufacturing methods are seen as equal, but there is an ongoing discussion about monomer release in the case of additive processes, and the impact of this on the mucosa.

Achieving a passive biological seal is essential for preventing peri-implantitis. To obtain this, it's recommended that restorations have an emergence angle of less than 30 degrees, combined with a concave emergence profile to support the gingival thickness on the buccal aspect of the implant. Digital processes enable the design of the optimal emergence profile, even in the case of immediate restorations. According to the literature, 'concave is more important than the emergence angle, and the emergence angle is more important than the material you use'.[1]

In the transmucosal area, a roughness of 0.2 microns has been determined as being optimal. This can be achieved by following the correct polishing methods for each type of material. A future development is likely to be the enhancement of the properties of the materials used in the transmucosal area with coatings (active bio-substances) to improve the passive biological seal.

Returning to digital dentistry, most planning programs provide choices for the supra-structure and retention mode, and enable the implant to be placed virtually. This defines the entire workflow for preparing whatever kind of material has been selected. Intraoral scanners also feature colour measurement and caries detection tools.

Nowadays it is possible to produce 3D printed restorations using lithium disilicate and zirconia, combining different translucency and colours to reach a kind of biomimetic result. However, the result is still some way from a truly biomimetic restoration because it's not possible to rebuild the dentin-enamel junction or even minimise this transition zone in restorations.

Turning to the CAD/CAM manufacturing process, a publication from 2014 demonstrated that it's possible to produce very accurate full-arch restorations using CAD fabrication, in comparison with cast results.[2]

Intraoral scanners still pose challenges in edentulous jaws, but there is another approach, called stereo photogrammetry, that can help in these situations. This uses a system of extraoral cameras combined with scan bodies with dots on them. The dots are two-dimensional and the system knows the distance between them. When taking pictures from different angles, the position of the scan bodies relative to each other can be calculated precisely. While this is a promising approach, it relies on extraoral cameras as well as the intraoral scanner. A novel system that allows all the measurements to be taken intraorally, eliminating the need for an additional extraoral device, is now on the market, but has not yet been thoroughly evaluated. Face scanners are also useful for defining the occlusal plane in full-arch restoration cases.

Systems are available that record the three-dimensional movements of the lower jaw and transfer them into design software so that the patient's functional movements can be taken into account during the design of the prosthesis. It's also possible to assess how strong the patient's occlusal activity is using tools such as EMG (electromyography). These devices can detect episodes of bruxism and sleep bruxism. There are now also systems that use artificial intelligence to optimise occlusion.

Bringing together all these data sets (facial scan, EMG, perfect occlusion movement) means it's now possible to design the optimal restoration for each individual patient with respect to material properties, implant-abutment connection and retention.

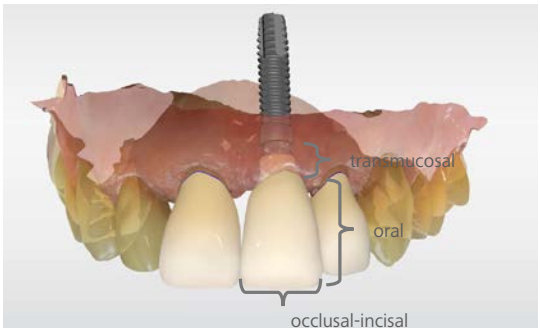
Taking this approach one step further, it's now practical to collect all these data types across patients and combine them with their medical records, plus intraoral scans from follow-ups. This can create a big data tool that is essentially a reference database for calculating the best possible restorations for our patients using artificial intelligence.

1 Lops D, et al. Association between Peri-Implant Soft Tissue Health and Different Prosthetic Emergence Angles in Esthetic Areas: Digital Evaluation after 3 Years' Function. J Clin Med. 2022 Oct 23;11(21):6243.

2 Katsoulis J, et al. Precision of fit of implant-supported screw-retained 10-unit computer-aided-designed and computer-aided-manufactured frameworks made from zirconium dioxide and titanium: an in vitro study. Clin Oral Implants Res. 2014 Feb;25(2):165-74.

To summarise, excellent materials for implant suprastructures are already available. Furthermore, biological improvements can be made using established techniques such as optimising the shape using digital dentistry and polishing, although in the future manufacturers will offer tailored surface modifications. Digital dentistry tools mean it's practical to manufacture individualised restorations that provide optimal mechanical properties and aesthetics.

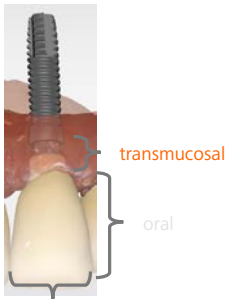
Complications

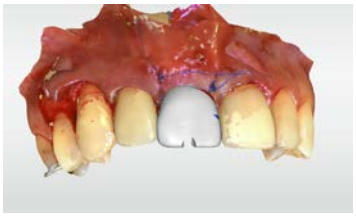


	screw retained vs. cemented abutments
complications	screw retained: screw loosening & chipping[1]
biological	cemented: more marginal bone loss [1,2]
technical	cemented: periimplant diseases 1,9% - 75% [3, 4]
	must be relativised [5]

[1] Sailer et al., 2012. [2] Lemos et al., 2016. [3] Staubli et al. 2017 [4]Linkevicius et al., 2012 [5] Wolfart et al. 2021

Transmucosal section: 'passive' biological seal



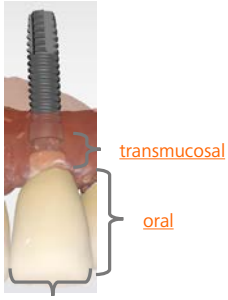


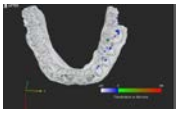
emergence angle < 30 degrees
concave emergence profile
gingiva thickness

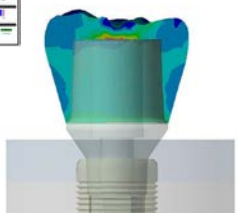
concave more important than EA
EA more important than the material

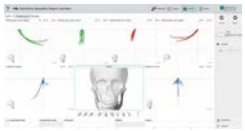
Neckel N et al. Int J Implant Dent. 2024;10(1):13. Lops D et al. J Clin Med. 2022;11(21).

From data collection to material's choice









Source: Epifania E, di Lauro AE, Ausiello P, Mancone A, Garcia-Godoy F, Mendes Tribst JP. Effect of crown stiffness and prosthetic screw absence on the stress distribution in implant-supported restoration: A 3D finite element analysis. PLoS One. 2023;18(5):e0285421

Benedikt Spies

Where do we have evidence for new materials – a clinical and ethical dilemma?

This presentation explored the evidence-base for new materials, and asked whether we are using materials without sufficient evidence, and if so whether this is creating clinical or ethical dilemmas. The speaker divided the topic into three areas:

1. Available clinical evidence
2. Laboratory evidence, with a focus on the strength and biological response of materials
3. Current and future perspectives

1) Available clinical evidence

The materials discussed were lithium disilicate and the different generations of zirconia. There was a focus on both the materials and their processing routes, because when the same material is processed, manufactured or post-processed differently, this can change its characteristics.

There are several derivates of lithium disilicate ceramics on the market that appear to show improved characteristics which are supported by clinical data. However, a closer look at the literature reveals that all the data relates to a single manufacturer, which was the biggest stakeholder in the materials. As such this cannot be considered to be robust clinical evidence for lithium disilicate derivatives from other manufacturers.

Turning to zirconia, there are several generations available, although the existing literature mostly refers to the most stable and earlier tetragonal type, 3Y-TZP (Yttria-stabilised tetragonal zirconia polycrystal). But in daily practice clinicians are using new generations (4Y-PSZ, 5Y-PSZ) that are more translucent and more aesthetically pleasing, but with decreased mechanical stability leading to reduced fracture resistance. Moreover the clinical data for these new generations is very limited. Basing decisions on the expected outcomes for 3Y-TZP zirconia when working new generations risks misinterpretations and potential failures,[1] particularly when the clinical evidence is extremely limited.

2) Laboratory evidence, with a focus on the strength and biological response of materials

Zirconia is polymorphic, and by tailoring stabilising agents it can be driven towards more aesthetically pleasant or more fracture resistant generations. The original 3Y-TZP material exhibits a behaviour called phase transformation toughening, which meant that if a crack occurs within it, a kind of self-healing process takes place, ensuring it remains stable. (Separately, a concept called low temperature degradation, sometimes referred to as 'aging', can also occur in this material, but is not typically relevant to restorative dentistry.)

Other zirconia generations, especially 5Y-PSZ, have greater translucency but also exhibit reduced phase transformation toughening. As a result, their fracture resistance decreases significantly, and in this respect 5Y is behaves more like lithium disilicate ceramics. 5Y is however less susceptible to low temperature degradation, so less prone to aging than 3Y. In terms of roughness and wear (both material and antagonist) there seem to be no differences between zirconia generations.

Another experiment involving zirconia generations 3Y, 4Y and 5Y tested for aging, wear, fracture resistance and the effect of transformation procedures. It concluded that the fracture resistance of 5Y bridges was significantly lower, and the speaker did not recommend using 5Y for clinical applications involving large bridges.[2] He summarised by noting that all these materials are called zirconia, but they each have very different behaviours, which can increase the risk of failure.

Different processing and post-processing techniques have the potential to alter the biological response to dental materials. The speaker compared the cytotoxicity of three different materials used for provisional crowns that had been produced using additive and subtractive techniques. He concluded that additive-processed materials were associated with a significantly reduced cell index for gingival cells, and an upregulation of the genes for apoptosis and inflammation.

Another investigation compared the response of gingival fibroblasts from human donors to provisionals manufactured using additive and subtractive procedures, with zirconia used as the reference material. This concluded that for PMMA materials, surfaces produced using subtractive techniques led to superior soft tissue integration in laboratory settings.[3]

Turning to permanent materials (hybrid ceramics, lithium disilicate ceramics and zirconia generations) the researchers evaluated whether fibroblasts preferred a surface that had been machined, glazed or polished, and concluded that polished or glazed surfaces were preferable whenever possible. This indicates that both the initial processing route and post-processing choices have the potential to influence soft tissue integrity, although it was noted that literature on this topic is scarce.

3) Current and future perspectives

Returning to the topic of zirconia generations, it was noted that all manufacturers use blanks that incorporate both different colours of the same material and different generations of zirconia within a single blank. This has the potential to affect the stability of the final restoration.

1 Pjetursson BE, et al. Systematic review evaluating the influence of the prosthetic material and prosthetic design on the clinical outcomes of implant-supported multi-unit fixed dental prosthesis in the posterior area. Clin Oral Implants Res. 2023 Sep;34 Suppl 26:86-103. doi: 10.1111/clr.14103. PMID: 37750526.

2 Spies BC, et al. Reliability and aging behavior of three different zirconia grades used for monolithic four-unit fixed dental prostheses. DentMater. 2020 Nov; 36(11): e329-e339.

3 Rabel K, et al. Analysis of soft tissue integration-supportive cell functions in gingival fibroblasts cultured on 3D printed biomaterials for oral implant-supported prostheses. J Biomed Mater Res A. 2024 Sep;112(9):1376-1387.

The speaker expressed his view that 3D printing of zirconia will be the future. It is currently possible, but the process needs to be improved. In terms of published data, the dimensional accuracy of printed materials, including printed zirconia bridges, is adequate. However, fracture strength is not yet reliable and doesn't currently compare with subtractive manufactured zirconia, even if the material itself is the same. This is a reminder that sometimes it's not just the material that is significant, but also the processing route.

In conclusion, the clinical evidence for new materials is very limited and most is lab-based. And to answer the speaker's opening question, yes, this does lead to ethical dilemmas.

Where do we have evidence for new materials

A clinical and ethical dilemma?

CLINICAL EVIDENCE

Permanent materials

Lithium disilicate derivates

Zirconia generations

LABORATORY EVIDENCE

Permanent / temp. materials

Zirconia generations (fracture resistance)

Printed PMMA materials (biological response)

Permanent ceramic materials (biological response)

PERSPECTIVE

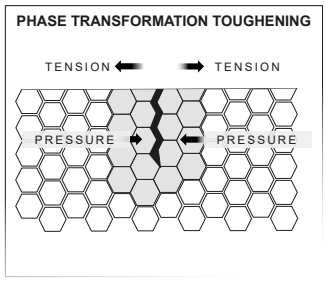
Current / future

Layered Zirconia Blanks

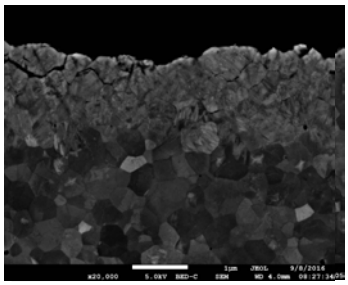
Printing Zirconia

Laboratory evidence: Zirconia generations

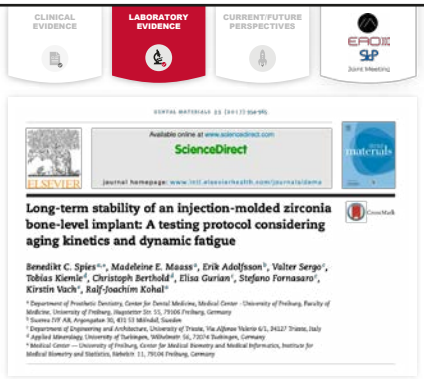
- Polymorpheous character



GARVIE ET AL. 1975, CUPTA ET AL. 1978



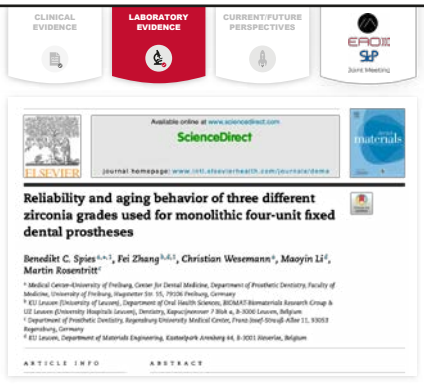
KOBAYASHI ET AL. 1981, CHEVALIER ET AL. 1999



Dental Materials 33(2017) 954–965. Spies, Maass, Adolfsson, Sergo, Kiemle, Berthold, Gurian, Fornasaro, Vach, Kohal. Long-term stability of an injection-molded zirconia bone-level implant: A testing protocol considering aging kinetics and dynamic fatigue.

Laboratory evidence: Zirconia generations

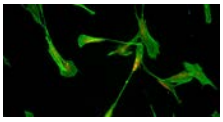
- Chewing simulation



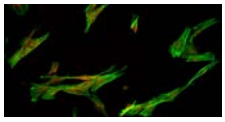
Dental Materials 36(2020) e329–e339. Spies, Zhang, Wesemann, Li, Rosentritt. Reliability and aging behavior of three different zirconia grades used for monolithic four-unit fixed dental prostheses.

Laboratory evidence: Printed PMMA materials

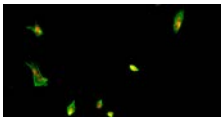
- Processing technology



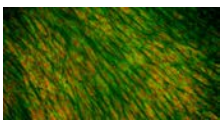
3Y-TZP 1 day



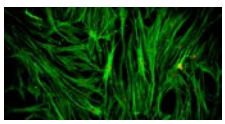
MA-based subtractive 1 day



MA-based additive 1 day



3Y-TZP 7 days



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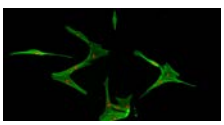

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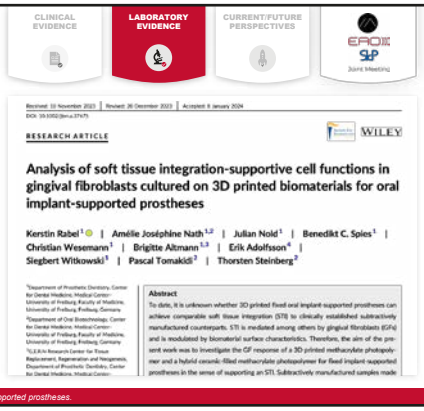

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Piero Venezia

Monolithic full arch restorations (within the full digital workflow)

The speaker, who is a prosthodontist, began by discussing digital scanners and digital materials, noting that the accuracy of intraoral scanners is good, and almost at the same level as conventional impressions. Implant angulation of up to 15° does not affect the accuracy of digital impressions. Thus it's possible to use a digital workflow to finalise cases in daily practice, although it's important to note that a digital workflow isn't just about the scanner. It also includes the scan bodies and the scanning technique.

The advantages of intraoral scanning include:

- elimination of patient gagging
- elimination of tray selection
- increased efficiency as a result of the electronic transfer and storage of data
- the ability to capture the position of teeth, soft tissue and implants in 3D
- shortening of the impression time, leading to increased patient comfort
- perhaps most importantly, the ability for digital cross-mounting, whereby all the information about the temporary restoration can be transferred to the final one

There are a lot of intraoral scanners on the market, and according to the literature some are more accurate than others.[1] Furthermore, as both software and hardware change quickly, the published data is likely to go out of date quickly.

In prosthodontic therapy, scan bodies are an important factor in achieving successful outcomes. Both metallic and PEEK scan bodies are available. According to the literature, having a rough metallic surface is important for achieving high levels of accuracy.[2]

The scanning technique is very important, especially when treating edentulous patients. Furthermore, scanning the fully edentulous mandible is more challenging than the maxilla. Issues occur when there is a long inter-implant distance and an absence of solid landmarks. To perform a good digital full-mouth impression, the speaker suggested using the Continuous Scan Strategy (CSS). This involves connecting the scan bodies with a thermoplastic resin to eliminate the jumping distance between them. In some cases, it's possible to project a surgical template and transform it into a prosthetic one that is fixed with pins. This allows a good impression of the implants to be taken, and provides landmarks, as well as information about the ideal position of the teeth in the patient's mandible and the vertical dimension of occlusion. Another tip is to perform a reverse extraoral scan to capture the position of the implants outside the mouth using scan abutments. The information can be combined in the lab to provide the precise position of the implants in the patient's mouth. For full-arch intraoral scanning, the speaker emphasised the importance of the following factors:

- using the appropriate intraoral scan bodies
- using fiducial markers to aid the intraoral scanner in data acquisition
- selecting the appropriate scanning strategy
- using a verification jig

Turning to materials, Professor Venezia commented that monolithic zirconia is an ideal digital material, as it's possible to plan the final restoration without losing any of the information from the temporary, leading to great aesthetic results. Monolithic zirconia also has biological benefits (it's less aggressive against the opposing teeth than, for example, lithium disilicate), mechanical benefits (it's not susceptible to chipping) and a high survival rate. Despite these benefits, in order to be used successfully, there are important clinical recommendations:[3]

- always use an interface (Ti-base or metallic)
- avoid cantilever designs
- use monolithic zirconia (sometimes with facial veneering limited to non-functional areas)
- prototype before creating the final prosthesis
- always go for screw-retained restorations

The speaker then presented a clinical case involving a full upper jaw rehabilitation using this protocol. He concluded by saying that technology offers significant opportunities to improve prosthodontics, and the future will undoubtedly be monolithic. Despite this, in his opinion the ideal material for full-arch restorations doesn't exist yet.

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2 Mizumoto RM, et al. Accuracy of different digital scanning techniques and scan bodies for complete-arch implant-supported prostheses. J Prosthet Dent. 2020 Jan;123(1):96-104.
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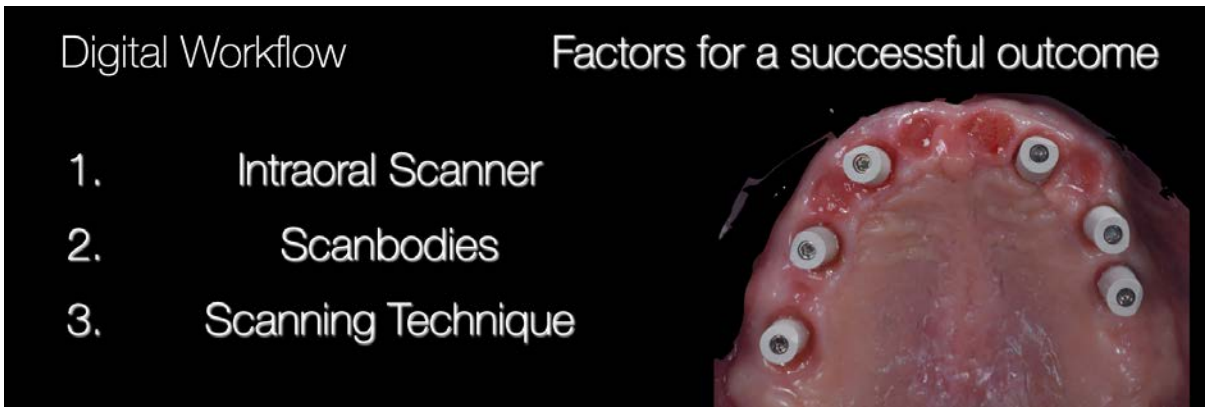
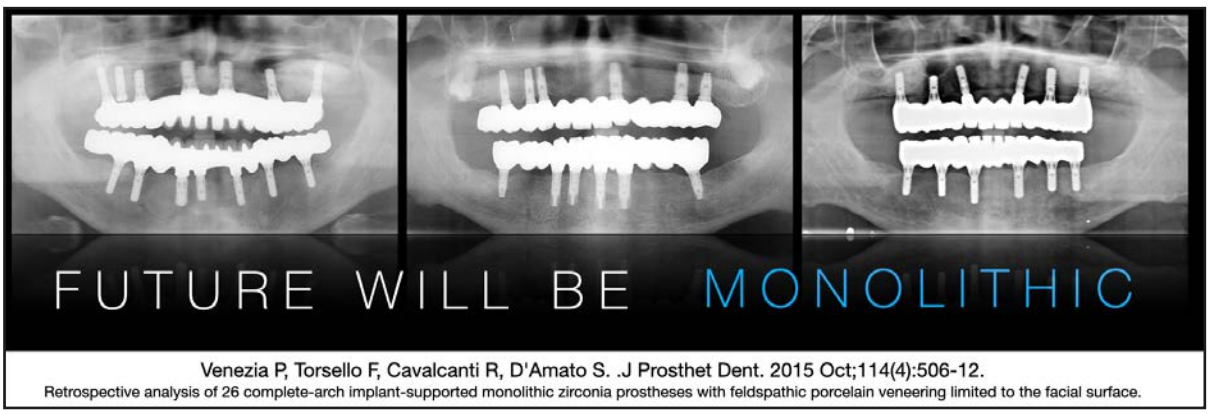

Digital Workflow
Factors for a successful outcome
1. Intraoral Scanner
2. Scanbodies
3. Scanning Technique


Extra oral reverse scanning
Extraoral technology, not affected by intraoral factors
Effective at all indications and resorbed mandibles
Capture teeth, soft tissue & 3D implant positions
Reverse scan body: The scan pattern affects the fit of complete-arch prototype prostheses
Papaspyridakos P. Et al - Journal of Prosthodontics 32 (52) - September 2023


FUTURE WILL BE MONOLITHIC
Venezia P, Torsello F, Cavalcanti R, D'Amato S. .J Prosthet Dent. 2015 Oct;114(4):506-12.
Retrospective analysis of 26 complete-arch implant-supported monolithic zirconia prostheses with feldspathic porcelain veneering limited to the facial surface.

EAO Congress Scientific Report; Milan 2024, Session 13

Beyond the limits of digital technologies

Bilal Al-Nawas

Innovations in 3D printing

Introduction to 3D printing

The presentation began by highlighting the transformative impact of 3D printing in maxillofacial surgery and dentistry. The speaker outlined the ability of this technology to create both intricate and large structures with precision, making it invaluable for patient-specific applications. Dentistry, which has been identified as a major driving force behind 3D printing innovations, continues to leverage technologies like selective laser sintering (SLS), stereolithography (SLA), and fused deposition modelling (FDM) to advance clinical practices.

Technological evolution and workflow

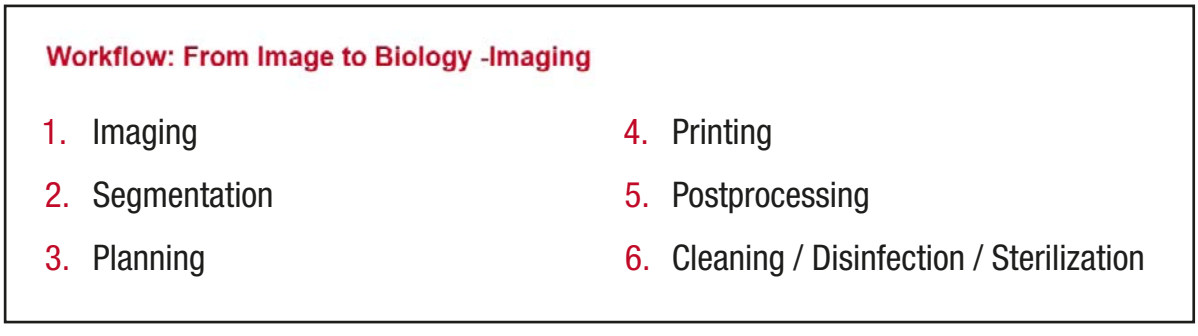
The evolution of 3D printing has been closely tied to industrial advances and regulatory changes, leading to broader accessibility. The typical workflow starts with image acquisition, such as DICOM data from CT scans, followed by segmentation to produce a 3D surface model. Software challenges were noted, particularly the lack of a unified platform covering the entire workflow. Following segmentation, the printing process begins, but requires meticulous post-processing, cleaning and sterilisation to ensure biocompatibility. Achieving greater integration and automation in the workflow remains a priority for clinicians and researchers.

Emerging imaging techniques

Imaging for 3D printing applications is evolving to reduce radiation exposure and enhance accuracy. Techniques like MRI with black bone protocol and ultrasound are becoming more widely available, providing detailed images without the risks associated with traditional CT scans. These innovations aim to improve multi-mode imaging and streamline processes such as segmentation, which artificial intelligence is increasingly optimising.

Applications in surgical planning and training

3D printing has revolutionised surgical planning by making simulations and backward planning possible. In tumour surgery, for instance, 3D models facilitate simultaneous resection and flap harvesting, reducing operating times and improving precision. The speaker described a case involving a maxilla reconstruction with fibula grafts, demonstrating how such planning leads to faster patient recovery and better functional outcomes. Additionally, printed models are widely used for training surgeons in complex procedures, such as stent placement in vascular surgeries, offering a hands-on learning experience.



Patient-specific solutions in paediatric and orthognathic surgery

The speaker discussed applications of 3D printing in paediatric cases, such as helmet therapies for skull deformities, which provide minimally invasive solutions that contrast sharply with invasive surgical procedures. Orthognathic surgery was also highlighted as a field where 3D printing achieves outcomes that are almost 100% patient-specific. By combining virtual reality and cutting guides, these technologies allow precise surgical execution, reducing errors and enhancing post-operative results.

Advances in restorative dentistry

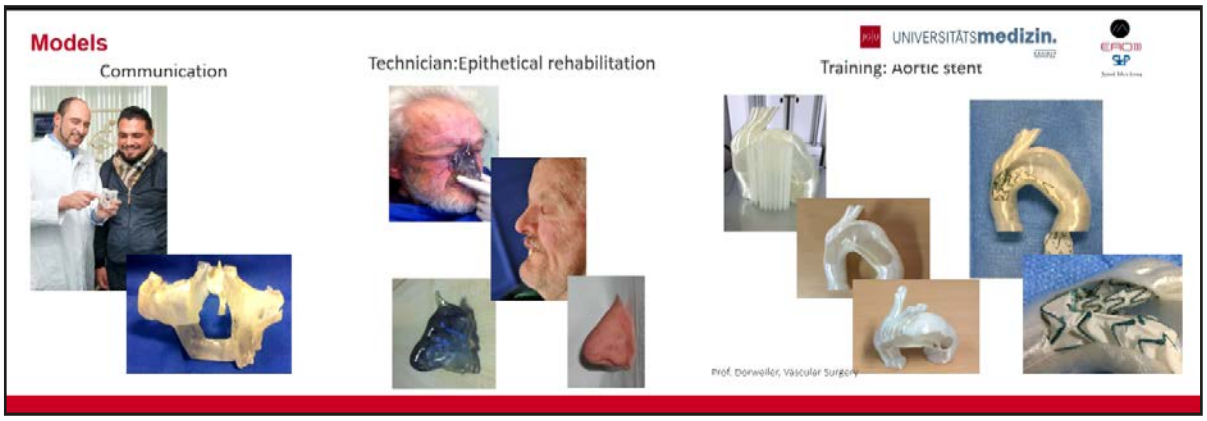
In the field of restorative dentistry, 3D printing is advancing beyond temporary solutions. Researchers are exploring sintered metal frameworks and denture bases that integrate printing and milling technologies, thereby providing durability and precision. The speaker emphasised the potential for printed restorations to become a long-term alternative to traditional milling methods, as ongoing materials innovations enhance mechanical properties and biocompatibility.

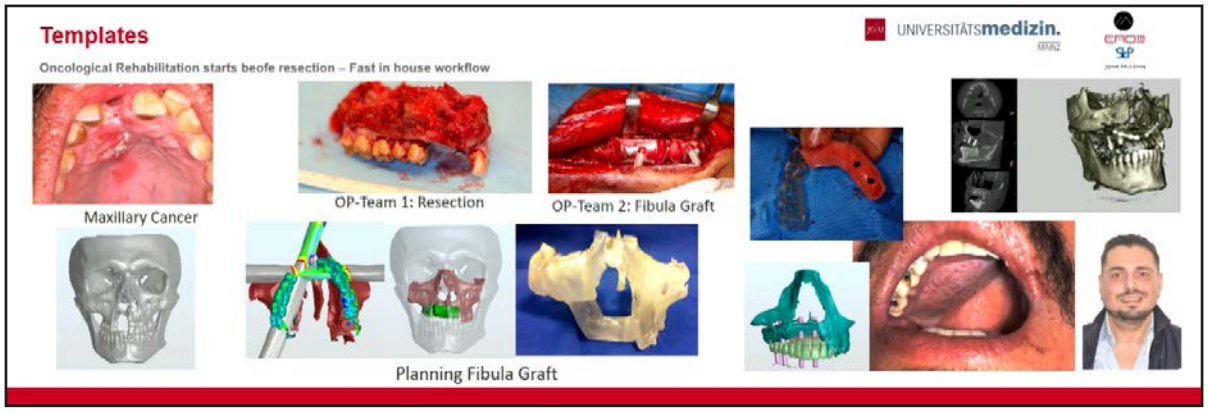
Bioprinting and tissue engineering

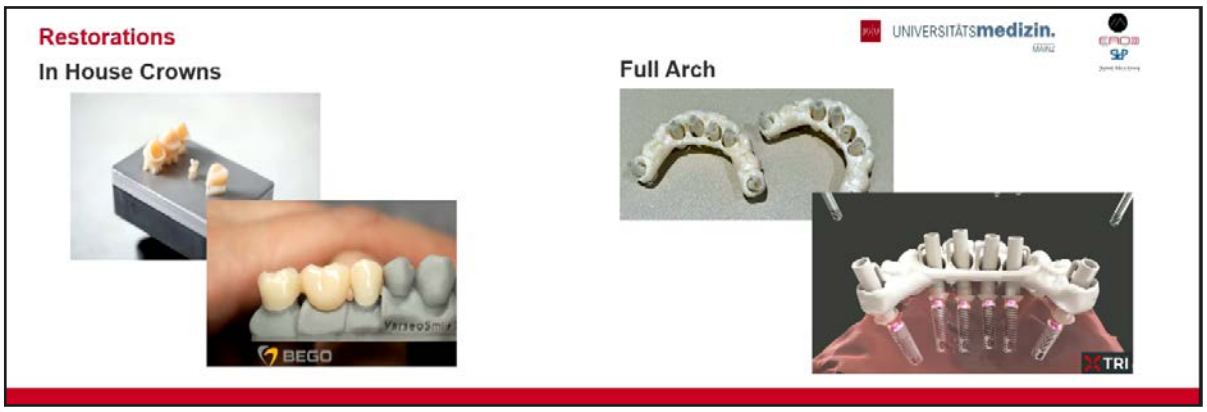
One of the most exciting developments is the integration of bio-inks and bioprinting for tissue regeneration. While challenges remain, such as ensuring ink stability and addressing biological responses, early applications are promising. For example, printed scaffolds combined with calcium phosphate cement and PRF (platelet-rich fibrin) have shown encouraging results in promoting bone regeneration. The potential for 3D-printed blood vessels and organ reconstruction was also discussed, marking a significant step towards personalised medical solutions.

Regulatory and practical challenges

Regulatory compliance is critical for 3D printing applications, particularly where they are used in clinical settings. The speaker highlighted the importance of quality-control and adherence to medical device standards, especially for custom-made implants. Despite these challenges, collaborations between clinicians and researchers are fostering innovative solutions to streamline regulatory processes.







Future directions, including space exploration

The presentation concluded with a forward-looking perspective including an exploration of the use of 3D printing in space exploration. The ability to produce spare parts, tools, and even replacement tissue during long-duration missions could overcome logistical challenges and help support self-sufficiency in extreme environments. These advances reflect the broader vision of 3D printing as a tool for solving complex problems across diverse fields.

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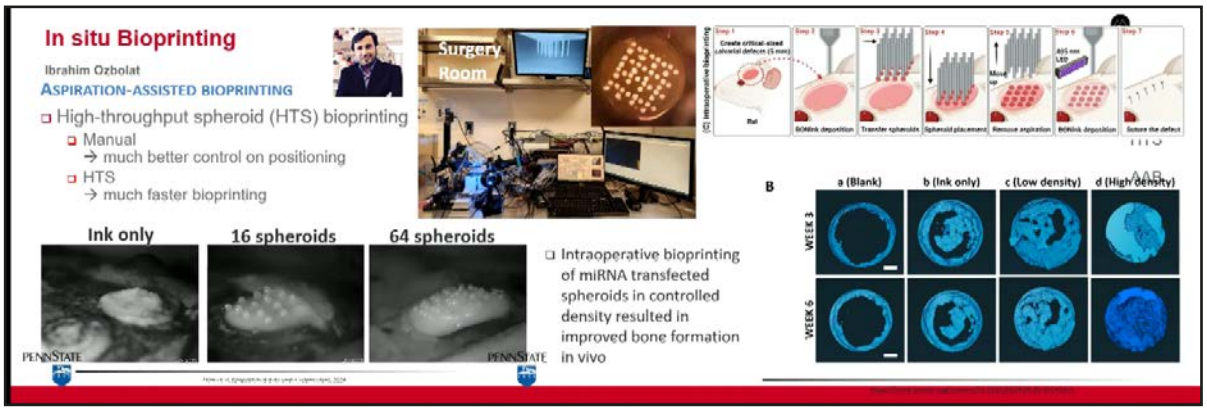


Federico Hernández Alfaro

Personalised surgery in maxillofacial and orthognathic procedures

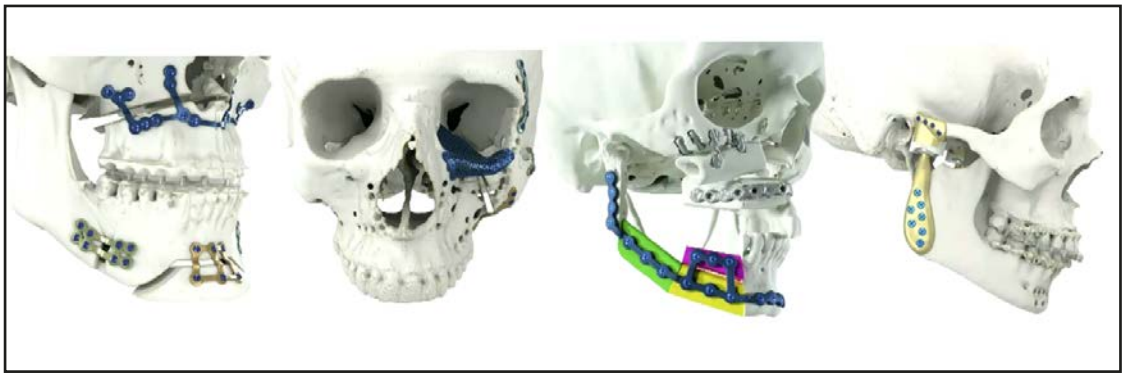
Dr Federico Hernández Alfaro opened his presentation by emphasising the importance of personalised surgery in modern medicine, particularly in the field of maxillofacial and reconstructive surgery. Highlighting examples from trauma, cancer and pre-prosthetic cases, he illustrated how customised approaches enhance functionality, aesthetics and patient quality of life. He presented a case involving a patient with a severe mandibular resection who received a fully personalised bionic mandible that restored both joint and biting function.

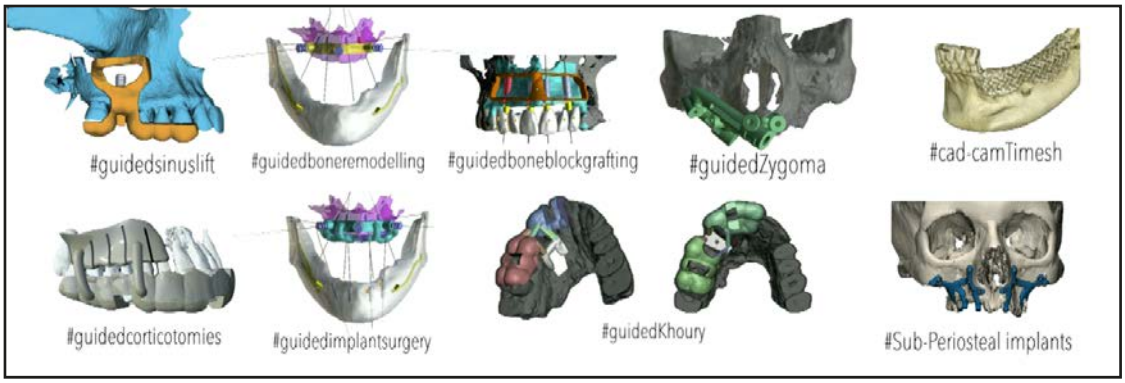
Technological integration in atrophic jaw management

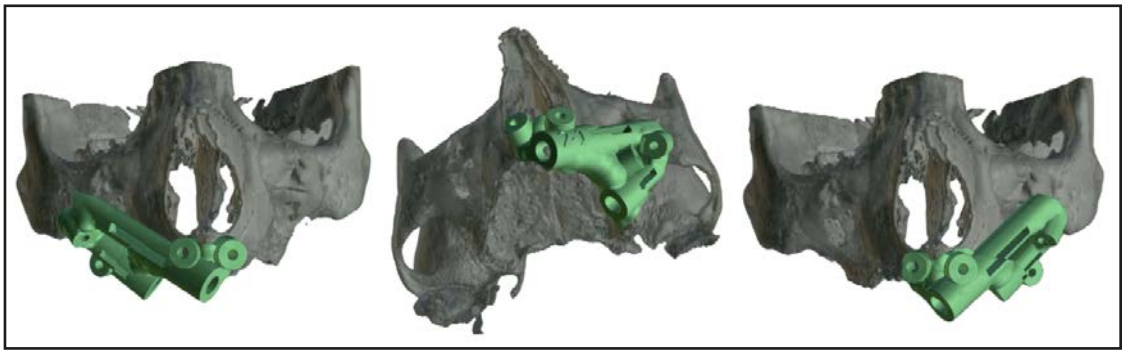
Dr Hernández Alfaro focused on three personalised solutions for atrophic jaw reconstruction: zygomatic implants, supra-steel implants, and titanium mesh reconstructions. He acknowledged the challenges of earlier approaches, particularly the unpredictability of zygomatic implants before the advent of digital planning and 3D printing. The introduction of guided surgical splints has transformed this process, reducing surgery times and improving precision by ensuring that implants are placed in the optimal bone areas.

Zygomatic implants

Traditionally considered one of the most complex surgical scenarios, zygomatic implant placement has been revolutionised by 3D planning. By transferring pre-surgical stress to the digital planning phase, surgeons can now ensure precise implant positioning followed by immediate loading with prostheses. The speaker explained how the use of buccal fat pads to cover implants reduces peri-implant alterations, reinforces soft tissue stability, and enhances long-term outcomes.







Supra-steel implants

Supra-steel implants represent a newer technology that builds on digital planning to overcome the limitations of earlier approaches. They are fixed in areas of high bone density with monocortical screws, ensuring immediate stability. Dr Hernández Alfaro expressed optimism that they may eventually replace zygomatic implants due to their simpler surgical protocol, combined with reduced barriers to accessibility for less experienced surgeons. Despite limited follow-up data, initial results from 19 cases suggest promising outcomes, with minimal complications.

Titanium mesh reconstructions

Titanium mesh technology has streamlined the reconstruction of extensive bone defects, eliminating the artisanal aspect of shaping bone grafts. Instead, engineers design patient-specific meshes, which are filled with a combination of autogenous and synthetic graft materials. Dr Hernández Alfaro highlighted the vascular delay technique, adapted from maxillofacial surgery, as a method to enhance soft tissue quality before reconstruction. After placement, the mesh supports the regeneration of bone, allowing implants to be placed in well-formed tissue months later.

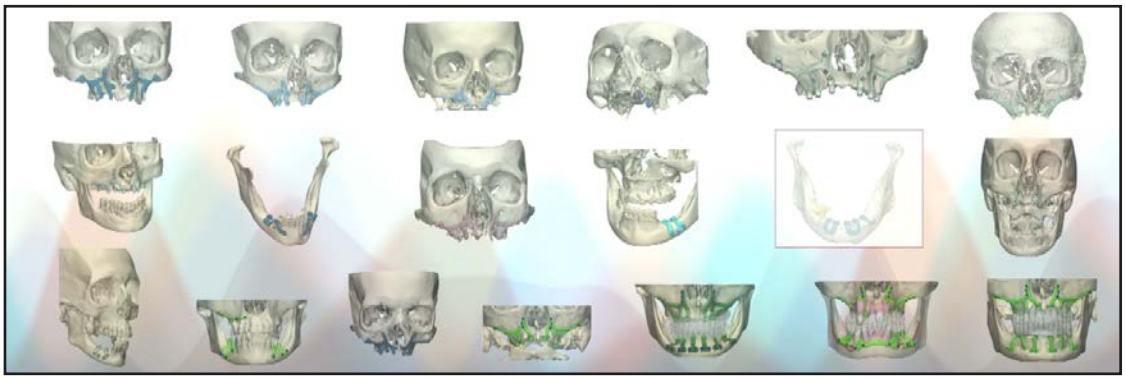
Orthognathic surgery and the 'Barcelona line'

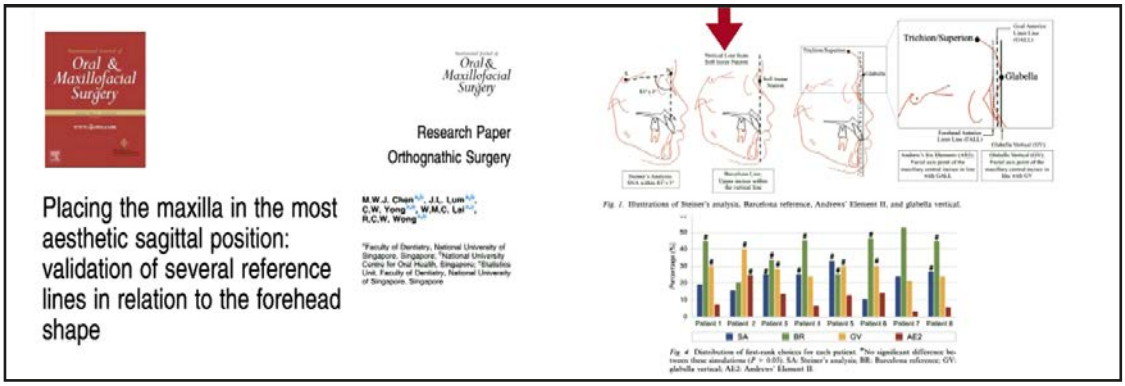
In orthognathic surgery, digital planning allows for precise maxillomandibular repositioning based on a facial reference known as the Barcelona line. Developed by Dr Hernández Alfaro's team, this guideline ensures that the upper incisors align with the ideal aesthetic plane, providing optimal functional and facial outcomes. The methodology has been validated across different ethnicities, including studies conducted in Asia, confirming its universal applicability.

Using 3D planning, Dr Hernández Alfaro moves beyond traditional approaches, repositioning the maxilla and mandible into Class I relationships guided by the Barcelona line. This 'face push' concept prioritises pushing the facial bones forward rather than stretching the skin, achieving proportional aesthetics and functional occlusion.

Patient-specific implants in orthognathic surgery

Advances in patient-specific implants have further enhanced minimally invasive orthognathic surgery. Customised cutting guides and prefabricated plates allow for precise osteotomies and





repositioning through smaller surgical accesses, reducing operative times by 30%. Dr Hernández Alfaro cited recent studies confirming the accuracy of these techniques, which have significantly improved outcomes and efficiency.

Future directions

Dr Hernández Alfaro concluded by emphasising the transformative potential of personalised surgery. He urged clinicians to leverage digital technologies to prevent complications and avoid unnecessary reconstructions. Highlighting advances like resorbable meshes and customised joint reconstructions, he stressed the importance of combining innovation with rigorous pre-surgical planning to achieve predictable, high-quality results.

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Wael Att

Limitations in digital technology – prosthodontics

The speaker introduced the session by emphasising the importance of details in achieving perfection within digital dentistry workflows. Drawing inspiration from the Rolls-Royce philosophy, he explained that the precision of every step in digital processes is critical to delivering optimal patient outcomes. Errors during execution often arise due to inaccuracies in earlier stages, such as data acquisition, processing, or planning, underscoring the need for a seamless workflow.

Challenges in data integration

One of the primary limitations discussed was the fragmentation of data across multiple platforms. Imaging data, such as CT scans, intraoral scans and patient photographs, are often stored separately, making it difficult to consolidate and manage efficiently. This fragmentation creates silos between multidisciplinary teams, hindering collaboration and compromising workflow continuity. The speaker stressed the importance of a centralised system, referred to as the 'blueprint,' which integrates all data sources to streamline planning, execution, and communication.

Unpredictability in smile design and workflow disconnects

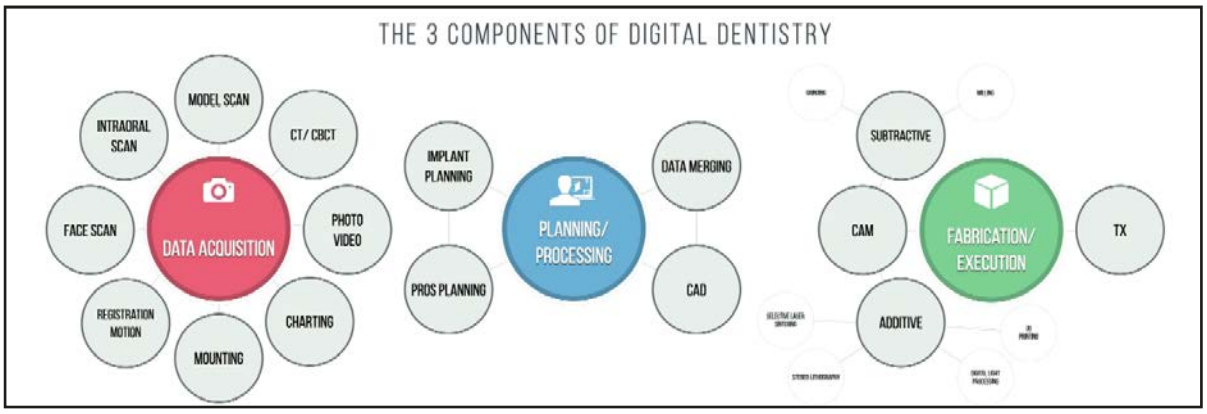
The speaker highlighted challenges in smile design, noting that while digital technology can produce aesthetically pleasing simulations, these do not always translate predictably into clinical results. Furthermore, disconnects between surgical, prosthodontic and laboratory teams exacerbate workflow inefficiencies. For example, implants placed without alignment to the initial smile design or restorative goals can compromise the final outcome. A unified workflow is essential to ensure all disciplines work towards a common objective.

Importance of the blueprint in workflow integration

The blueprint concept was presented as a centralised planning model that aligns restorative, implant and soft tissue goals. The speaker demonstrated how this approach begins with a 2D smile design that transitions to 3D models using advanced software powered by AI. These models incorporate intraoral scans, CT data and layered patient photographs, allowing for precise segmentation and visualisation of soft tissue, hard tissue and tooth structures. This multi-layered data integration enables comprehensive planning that accounts for both tissue remodelling and implant positioning.

Soft and hard tissue considerations in implant placement

The session delved into the dynamics of soft tissue remodelling following tooth extraction, emphasising the need to account for horizontal and vertical tissue shrinkage during planning. Horizontal shrinkage typically ranges between 0.5 and 1 millimetre, while



vertical changes can extend up to 1.5 millimetres. Using the blueprint, clinicians can anticipate these changes and design restorations that align with future tissue contours, ensuring long-term stability and aesthetics.

Guided surgery and immediate temporisation

Guided surgery, supported by 3D-printed surgical guides, was highlighted as a game-changer in implant placement. The workflow involves acquiring data, creating surgical guides, and manufacturing temporary prosthetics based on pre-planned designs. This process allows for precise implant placement and immediate temporisation, reducing surgical time and improving patient satisfaction. A case study demonstrated how this workflow resulted in a predictable outcome for a patient with failing upper teeth, highlighting the accuracy and efficiency of guided surgery.

Challenges with stackable approaches

While discussing full-arch rehabilitation, the speaker cautioned against over-reliance on stackable approaches, which often lack proper pre-surgical planning. Extracting all teeth before implant placement can lead to the loss of critical anatomical references, resulting in inaccuracies. Instead, leaving a few teeth in place as reference points was recommended to enhance guide stability and improve implant positioning. This step helps bridge the transition from the surgical to the prosthetic phase, ensuring better outcomes.

Material limitations in full-arch restorations

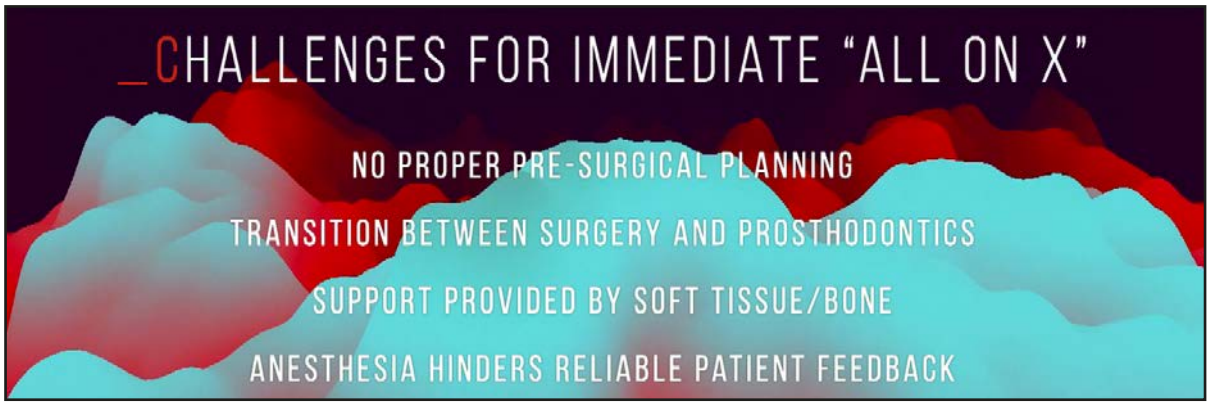
The limitations of monolithic zirconia in full-arch restorations were also discussed. Despite its popularity, zirconia is prone to fractures in complex rehabilitations. The speaker acknowledged the lack of a gold standard material for long-term full-arch solutions and encouraged ongoing research to develop more reliable options.

Final results and long-term predictability

Case studies showcased successful outcomes achieved through the blueprint-guided workflow. The speaker presented examples of patients with stable soft tissue and implant positions, reinforcing the importance of meticulous planning and execution. He stressed that guided prosthetics combined with guided implants provide superior results compared to guided implants alone.

Conclusion

The session concluded with a summary of the advantages of digital workflows in overcoming the limitations of current technologies. The blueprint approach enables better visualisation, planning and communication, ensuring predictable outcomes. However, the speaker emphasised the importance of clinician expertise and team collaboration, as no technology can replace human skill and judgment. Perfection, as he reiterated, lies in the details.



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EAO Congress Scientific Report; Milan 2024, Session 14

Beyond the limits of hard and soft tissue augmentation: the next level

In this session, Egon Euwe and Alexandra Rendón presented their approaches to vertical bone augmentation and soft tissue augmentation in challenging cases.

Egon Euwe

Limits of vertical augmentation

The limits of vertical bone augmentation are the anatomical envelope (bone can be created beyond this threshold) and other anatomical barriers such as the nerve, sinus, roots and interdental peaks, that potentially create challenging situations. Before continuing, the speaker emphasised that these techniques are invasive, expensive and can be contraindicated in patients with a range of systemic diseases.

Dr Euwe shared an early case that involved addressing a failing immediate implant. Vertical bone augmentation was performed using an autogenous bone block plus bone chips, covered with non-resorbable membrane. During a second stage a paracrestal palatal incision was made to restore the soft tissue. Although the case was successful and provided long-term stability, some interdental bone peaks were lost. However, new implant and abutments designs can help with this issue. Soft tissue management is also crucial and can determine the success or failure of the case.

Interdental bony peaks are critical, and in selected cases and patients what the speaker called 'the prosthetic shortcut' is a potential approach. This involves treating a vertical bone augmentation case in the aesthetic zone with a horizontal bone augmentation, combined with a prosthesis made up of white and pink porcelain. The procedure is less invasive, cheaper and faster, but requires a talented dental technician and a patient with good commitment to hygiene.

The presence of the papilla between an implant and a tooth is due to the presence of the tooth (*Figure 1*). The most difficult cases to treat are those that feature a loss of periodontal tissue around the teeth adjacent to a vertical defect. The speaker described how he used a combination of periodontal regeneration for the teeth, plus vertical bone augmentation for the implant site, in these cases. They are extremely challenging and treatment includes deep cleaning of the teeth surface, amelogenin, autogenous bone, a xenograft, a resorbable membrane and a soft tissue graft delivered in a one-step protocol. *(Figure 2)*

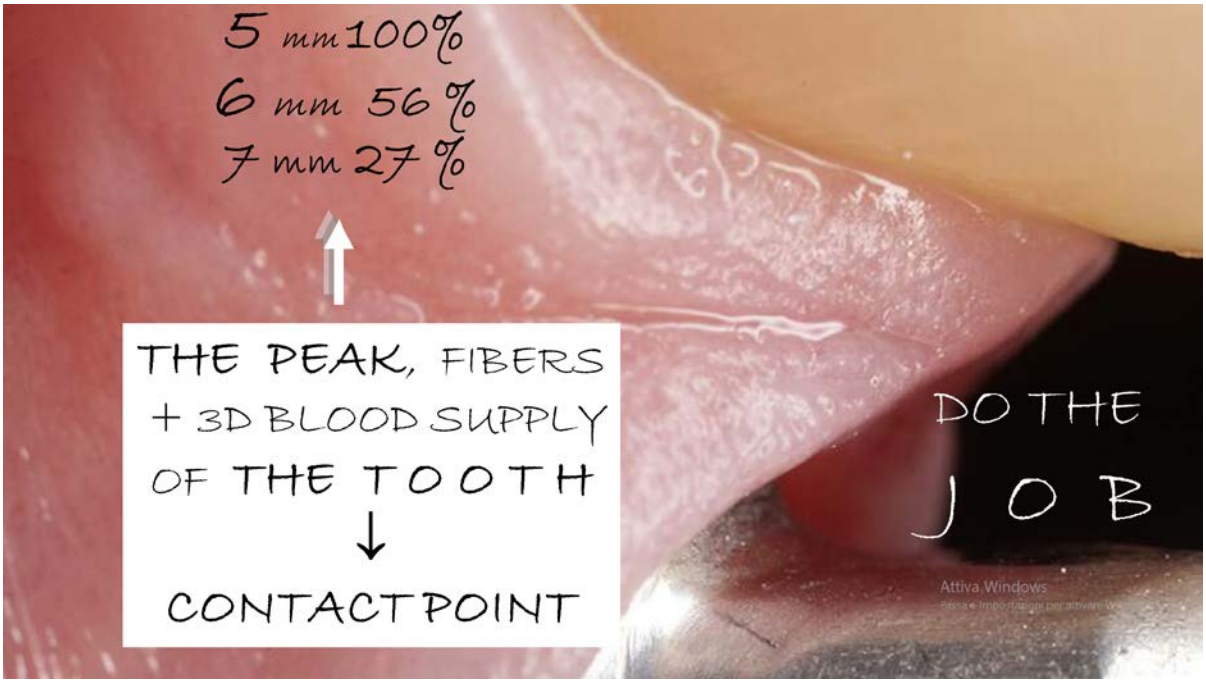

Figure 1

Grafting innovations like the disk trephine can be used to collect soft tissue, obtaining a disc that can be situated on top of the implant to create vertical soft tissue augmentation. Another innovation is the 'bottleneck' emergence profile, which involves the use of a narrow abutment to create more space for tissue regeneration and maturation. The goal is to transform an inter-implant site to a pontic site. According to Salama et al, this supports the presence of papilla with more distance to the bone peak compared to implant sites. The speaker's take-home message was that 'GBR can push the limits, providing we don't forget the soft tissue'. *(Figure 3)*

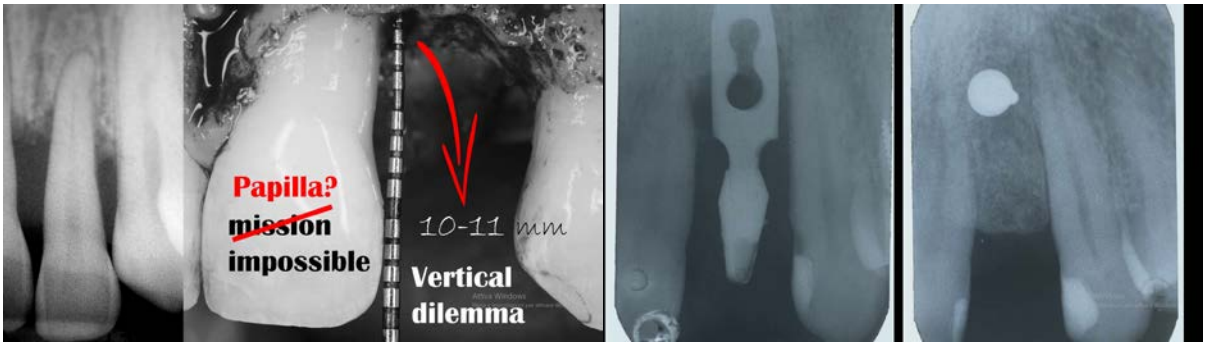

Figure 2

Figure 3

Alexandra Rendón

Limits of soft tissue augmentation

Some cases that feature residual ridge defects, but still have sufficient bone to place implants, can be solved with soft tissue techniques. Classically, the limitations of soft tissue augmentation have included donor tissue, predictability, reproducibility and stability. Of these, stability is the only objective limitation, as the others relate to the skill of the operator. *(Figure 4)*

With regard to **donor tissue**, the lamina propia contains a high proportion of collagen fibres, and as a result demonstrates less resorption than submucosa. Its thickness varies from 0.8–2mm, which avoids the need for deeper grafts removing the epithelium extraorally. Tissue from the maxillary tuberosity is rich in high-quality collagen fibres, but the volume can be limited or even absent. In these cases, the hard palate is the area of choice for harvesting. The thickest part of the lamina propia is closest to the teeth, and the graft obtained is approximately 2 mm thick. Obtaining the lamina propia involves removing the epithelium extraorally and separating it from the submucosa and adipose tissue. Where thicker layers of tissue are required it can be bent or applied in several layers and the palate will regenerate within 6 months. Grafts of this type receive similar patient PROM scores based on the VAS scale to other regenerative or resective surgeries.

Predictability is obtained through use of a standardised procedure, namely the connective tissue platform technique. This was originally developed in 2012 for pontic sites and has been posteriorly adapted for implant sites. *(Picture 5).*

The use of a fixed provisional restoration (a Maryland or conventional bridge) that doesn't apply pressure on the tissues is crucial to allow sufficient healing and maturation time, and to support patient compliance. Following healing time of a minimum of 4 months (more than 6 months in periodontal patients), the soft tissue graft ridge augmentation is performed, followed by a healing period of another 4 months. Following this step, in cases where there is adequate bone, a guided implant placement is performed. The next step is the soft tissue conditioning, which is achieved over 4–6 months in conjunction with the provisional, which is used to obtain the desired result in the tissues for the final restoration.

To be considered **reproducible**, the technique has to be shown to be successful in different scenarios. Confirming this, the speaker shared multiple cases with a follow-up of 5 years that had involved the same protocol. *(Figure 6)*

At present, data on **stability** beyond 5 years is still absent, although the existing 5-year follow-up results illustrate that the tissue not only remains stable, but under the right conditions increases with time.

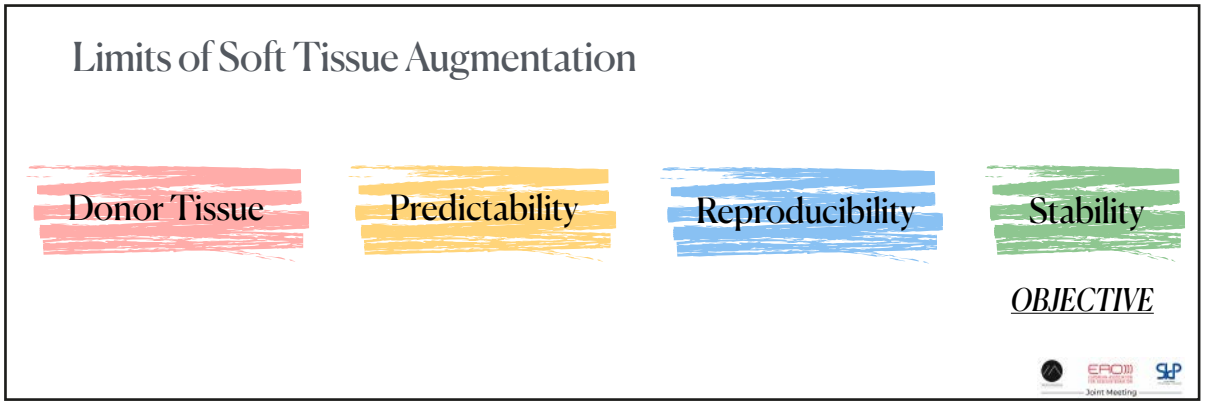

Figure 4

Figure 5

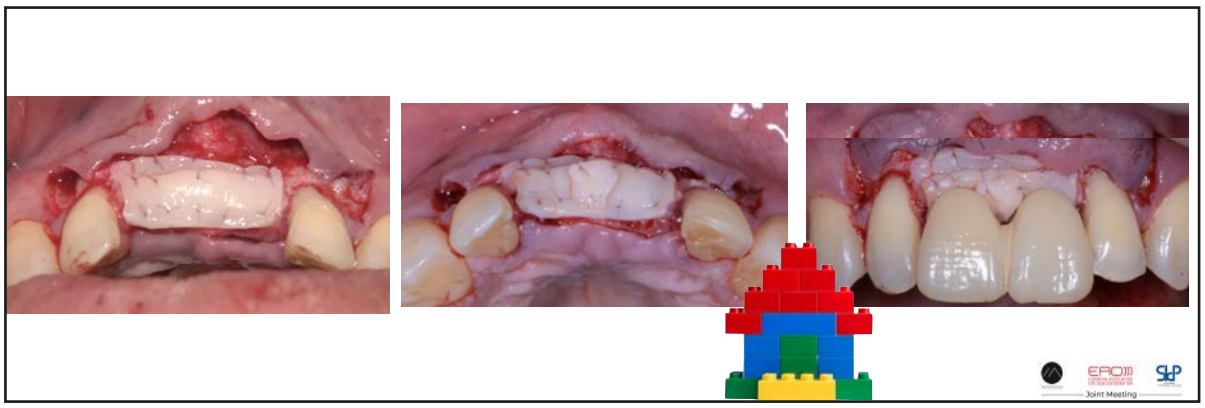

Figure 6

The speaker concluded with the following comments:

- undisturbed healing periods should be sufficient to allow maximum growth and maturation
- guided implant placement and tissue conditioning are crucial
- soft tissue augmentation techniques can be applied as the sole therapy for implant site development on edentulous sites

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EAO Congress Scientific Report; Milan 2024, Plenary 1

The challenge of multiple missing teeth in the aesthetic zone

In this session, Anne Benhamou, Luca De Stavola and Carlo Monaco presented their approaches to addressing the challenge of multiple missing teeth in the aesthetic zone.

Anne Benhamou

Identifying the surgical and prosthetic challenges of multiple missing teeth in the aesthetic zone

Implant therapy in the anterior zone of the maxilla presents unique challenges. Treatment must restore function, while achieving an aesthetically pleasing, long-lasting, natural-looking restoration that seamlessly integrates with the patient's smile and facial features. Critical factors influencing the success of aesthetic implant therapy include timing of implant placement, implant positioning, design of the restoration, and hard and soft tissues management.

Among the factors to be taken into account in these cases, the timing of tooth extraction and implant placement both play a critical role. Immediate implant placement can be advantageous for minimising bone resorption and preserving the alveolar ridge. In addition, the use of flapless techniques can reduce trauma to the surrounding tissues, thereby enhancing soft tissue healing and reducing the risk of recession. Separately, the number of implants, their positioning, and the inter-implant distance are also considered crucial. Indeed, a minimum of 3mm between adjacent implants, and 2mm between implants and teeth, is essential to avoid the risk of bone loss and ensure sufficient blood supply to the surrounding tissues. Moreover, the contact points should be located 5mm from the crestal bone for optimal aesthetics, while referring to residual bone levels and the natural position of neighbouring teeth.

In many cases, soft and/or hard tissue augmentation, by means of a connective tissue graft and/or guided bone regeneration, is necessary to achieve the desired aesthetic result. Temporary restorations and abutment designs that ensure an optimal emergence profile can also help shape the soft tissues during early healing. For instance, a concave abutment that is 1–1.5mm wide, combined with space of 1–2mm, is recommended for crestal bone and junctional epithelium maintenance respectively. Additionally, the crown should have 1mm of convexity at the emergence point to mimic the natural convex contour of the tooth (Figure 1)

Two clinical cases —involving patients missing teeth 11 and 21— were used to illustrate two viable implant-based solutions. In the first case, two implants were placed, while in the second, a single implant with a cantilever restoration was used, providing satisfactory aesthetic results. The key to success in these cases was accurate implant planning, with a 3mm space between implants, a 2mm space between the implant and the adjacent tooth, and a narrow implant diameter to minimise bone loss. In cases of extensive tooth loss in the aesthetic zone, such as the loss of four adjacent teeth, multiple strategies can be considered when planning implant positions to ensure proper spacing, complemented by management of the surrounding soft and hard tissues. (Figure 2)

By adhering to these principles, clinicians can achieve long-lasting, functional and aesthetically pleasing results that meet patient expectations. As demonstrated through the clinical cases shared, the flexibility of implant therapy in the aesthetic zone offers a range of solutions, from single implant restorations to more complex multi-implant strategies, offering optimal outcomes for a variety of patient needs.

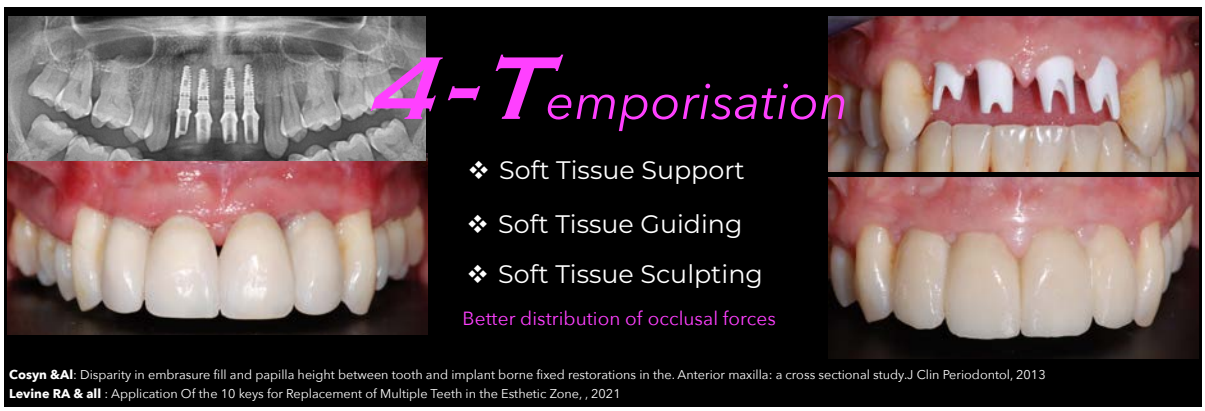

Figure 1

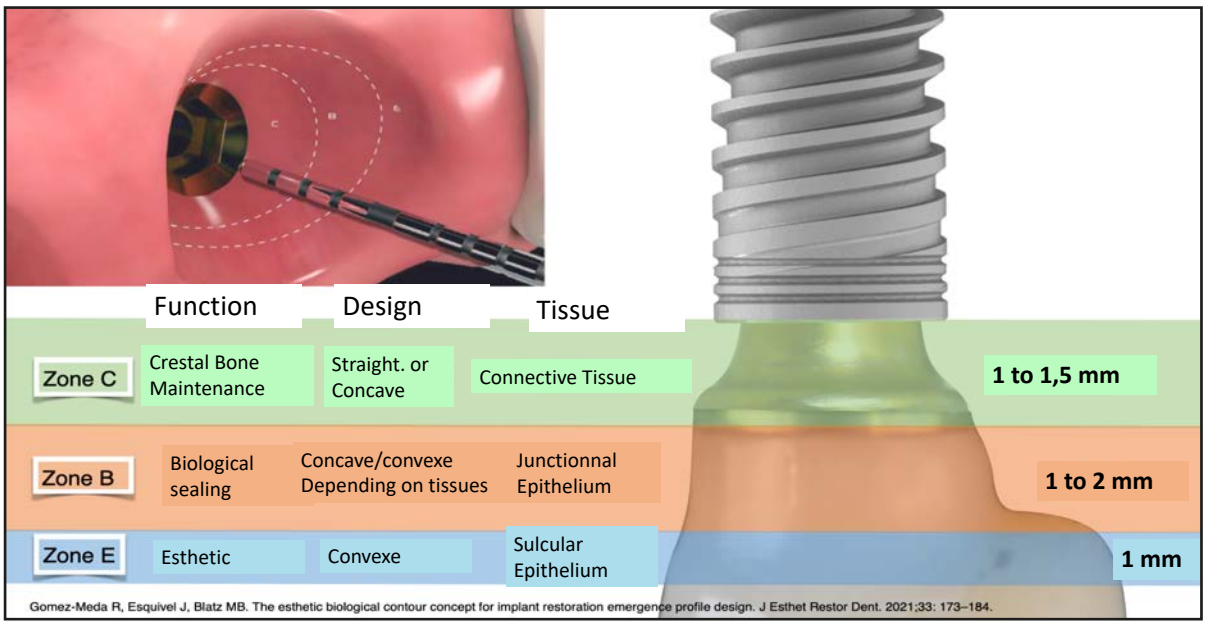

Figure 2

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Luca De Stavola

Key factors in surgical management

In the arena of implant dentistry, achieving a natural, functional and aesthetic result requires careful attention to both hard and soft tissue management. This begins with implant positioning planning that assures appropriate spacing between the bone and the emergence profile, based on the position of the final restoration.

When planning an implant, two main areas require attention: the bone defect and the supracrestal soft tissue defect. It is important to choose techniques that respect the patient's anatomy and provide long-term stability, for example the Khoury or the shell techniques for restoring vertical bone defects using autogenous bone grafting. These have been shown to achieve results that remain stable and predictable even after 18 years. Supracrestal connective tissue grafting remains the gold standard for soft tissue restoration. (Figure 3)

Advances in fully guided surgical techniques have enhanced predictability, precision and safety. For instance, guided bone harvesting allows the exact amount of bone to be safely recovered, while being easy to apply. Similarly, guided bone block management and the guided shell technique offer high precision, ensuring that bone grafts are accurately positioned and that the augmentation follows the genetically determined architecture of the jaw. (Figure 4)

Successful outcomes also depend on effectively managing flap design and tension to ensure wound stability and prevent complications. In particular, in the upper jaw, the palatal flap can be too short and difficult to elongate. In such cases, the incision line should be shifted buccally to compensate for vertical augmentation techniques like buccal shifted flaps. Combined with platform connective tissue grafts, as described by Zucchelli, these have been shown to yield excellent results. Moreover, the use of low-tension sutures is critical in minimising ischemia, the risk of complications and promoting stable tissue integration.

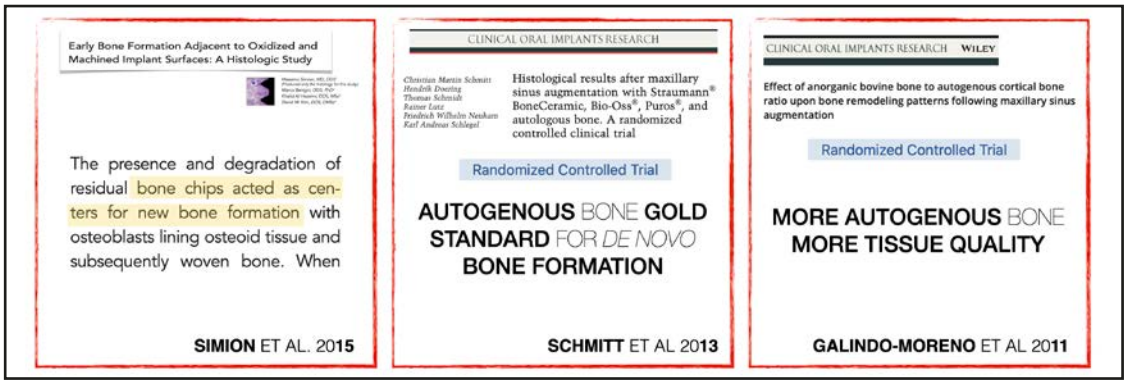

Figure 3

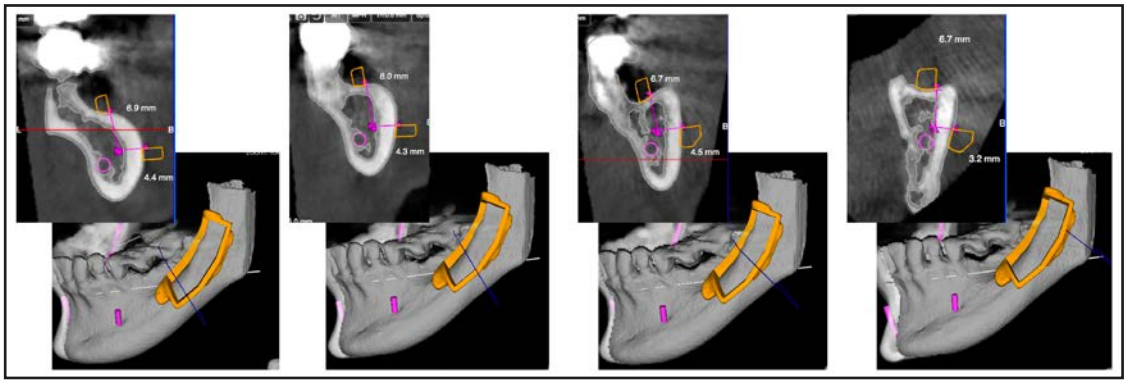

Figure 4

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Carlo Monaco

Key factors in prosthetic management

A coordinated workflow between periodontics, prosthodontics and the lab is essential for achieving success in the aesthetic zone. When placing multiple contiguous implants in the anterior zone (Figure 5), selection of the correct type of implant and abutment are essential for case management, while the presence of soft tissue is a key determinant for aesthetics.

The first step to creating optimal papillae between multiple implants involves a combination of onlay soft tissue grafting with a coronally advanced flap. This is followed by a second soft tissue graft during implant placement. Then, to begin the prosthetic adaptation of the papillae, implants should be uncovered using a 'punch' flapless approach, complemented by narrow abutments which will support soft tissue formation and adaptation to the provisional restoration. Restoration of the position of the mucogingival line is achieved without over-pressing the papillae, taking care to avoid ischemia and pressing gently on the vestibular emergence profile with a concave provisional. In some cases, the use of a bur for abrasion of the pontic site, with placement of a second provisional restoration that is adapted for a period of 2–3 months, is necessary to reach the final position and conical architecture of the gingiva. At that stage the data is sent to the laboratory for the digital fabrication of the final restoration (Figure 6).

To achieve this, the speaker developed a fully digital approach in 2015 which uses a triple scanning technique to replicate the peri-implant soft tissue contours and emergence profile. Called the 'prototype' concept, it is applied to cases with multiple implants in the aesthetic area. It uses a PMMA provisional that defines the position and shape of the teeth and determines the smile line, but without compressing the gingiva. After 2–3 months of healing with the PMMA restoration, digital impressions are made, and a zirconia final restoration is delivered. This further promotes the maturation of the gingival contour and papillae (Figure 7). The approach also takes into account the management of complications, highlighting that those associated with soft tissue grafting are easier to resolve compared with those associated with bone augmentation. To illustrate this, a case involving the loss of the papillae during the healing phase was presented. This was addressed with the use of a final zirconia restoration that left enough space for the soft tissue growth process during the maturation of the gingiva.

In conclusion, the first step in treating cases like these involves thorough digital planning to determine the aims of the subsequent procedures. The planning is followed by a connective tissue graft to ensure appropriate initial soft tissue conditioning. This is combined with a provisional restoration that is designed to avoid putting excessive pressure on the papillae, and proceeds with a slow conditioning process with several modifications in order to reach an ideal soft tissue architecture. Lastly, digital impressions that replicate the shape of the provisional restoration and transfer the data so it can be reflected in the final zirconia rehabilitation will lead to the final aesthetic outcome.

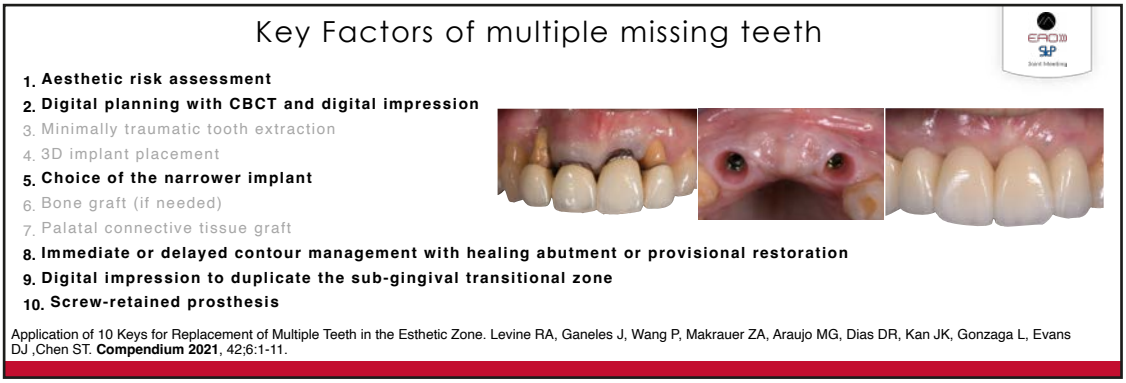

Figure 5

Figure 6

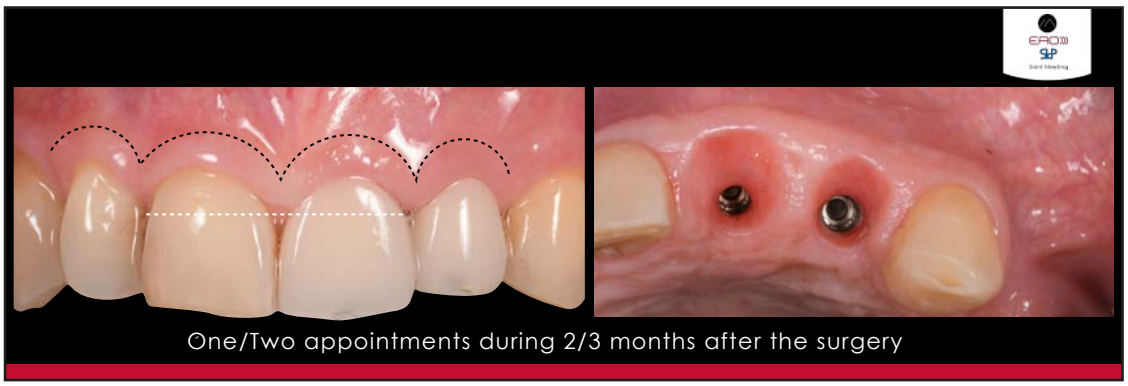

Figure 6

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EAO Congress Scientific Report; Milan 2024, Plenary 2

Borderline cases regarding failing implants: keep and treat or remove?

In this session, clinical cases involving implant failures were discussed by three speakers with surgical, prosthetic and periodontal approaches. The three lecturers shared three clinical cases and the treatments they implemented.

The first speaker, José Nart, presented the case of a young patient who had received a dental implant at an early age due to agenesis of the upper lateral incisors and upper right canine. The patient's smile exhibited asymmetry both at the gingival and dental levels. Notably, the implant had a gingival margin positioned too apically, with a lack of buccal volume.

The case was resolved by placing an implant-supported temporary prosthesis modifying the CEJ position and above it generating a buccal concavity for the gingival margin to be naturally displaced coronally, and after some weeks placing a connective tissue graft on the buccal aspect of the implant.

During the discussion, the possible advantages of orthodontic treatment were raised, which the patient had rejected, primarily due to the time commitment involved. As often happens, patients who have undergone multiple treatments from a young age prefer faster, more predictable solutions – such as the prosthodontic approach – which in this case required only one surgery.

Concerns regarding the durability and the surgical technique used for the connective tissue graft were also discussed. The speaker confirmed that certain areas, such as the anterior lower, tend to have a higher risk of recurrence. In such cases, thicker connective tissue grafts are required, accompanied by careful detachment of the related musculature. This issue is less common in the anterior upper region. Regarding the surgical technique, while a more extensive graft into the papilla area might have allowed better management of the papilla, the associated risks would have been higher. Given that the patient had previously experienced complications, a more predictable and accurate treatment approach was ultimately chosen.

The second speaker, Vivianne Chappuis, presented a case involving a 54-year-old patient with a failed implant in the upper left canine region, who also exhibited a high smile line.

The speaker had extracted the failed implant and the adjacent lateral incisor, and after spontaneous healing proceeded with regenerative treatment using the block technique and the placement of a new implant in two separate surgical procedures. A screw-retained prosthesis was placed directly on the implant in the canine position, extending in cantilever to the lateral incisor. The total treatment duration was one year, and ten-year follow-up records were shown.

A discussion arose regarding the management of soft tissues following bone regeneration, and in particular whether soft tissue grafting could enhance aesthetics and long-term stability in the regenerated area. The speaker confirmed that, had the case been

performed today, she would have definitely included soft tissue grafting.

Concerning the decision to remove the lateral incisor, she explained that an excessive periodontal defect on the distal side, combined with apical impaction of the implant apex into the root, indicated a poor prognosis for the tooth.

Regarding the use of a non-resorbable membrane for regenerative purposes, the speaker acknowledged that she found this technique less predictable. Considering the patient's initial complications, the block bone technique had been selected.

Finally, she concluded that, had the case been performed now, she would have taken a different approach, attempting to preserve the lateral incisor and employing alveolar preservation techniques.

The third speaker, Martijn Moolenaar, presented the case of a young actress who had lost her upper left central incisor in an accident. The tooth was replaced with an implant following orthodontic treatment. The main challenges were the loss of papilla after the initial treatment and the poor vertical positioning of the implant.

After outlining his implant planning protocol, the speaker presented the approach chosen in collaboration with the patient. This focused on prosthetic management with provisional restorations to assess how much papilla could be regenerated. After re-evaluation, it was decided to use orthodontic extrusion of the adjacent teeth to improve papilla formation and achieve a more natural appearance. The situation improved, and following another evaluation, veneers were placed on the adjacent teeth, and a new crown was placed on the implant.

During the discussion with the chairs, it was confirmed that time is a critical factor in managing and consolidating such cases. Key aspects of their prosthetic management include using a narrower abutment in the subgingival zone and the critical contour of the provisional prosthesis to allow vertical tissue growth, which can then be further managed.

In conclusion, it was noted that extensive experience is needed to manage the various techniques involved in cases like these. Given that the patients being treated have often experienced multiple complications, the cost-benefit ratio of the treatments should be carefully considered, with a focus on predictability and long-term success.

EAO Congress Scientific Report; Milan 2024, Plenary 3

Digital tools in full arch rehabilitation: computer game or game changer?

This session, which was moderated by Luca Cordaro and Luca Landi, focused on the true utility of novel technologies aimed at the digitisation of implant-supported therapies. Bearing in mind the costs associated with these technologies, it is important to understand whether they offer benefits that truly make them a 'game-changer,' or if in fact they are more akin to a 'computer game'.

The first speaker, Sergio Piano, began his presentation by highlighting the benefits offered by guided surgery, particularly for completely edentulous patients. He noted that when combined with tools such as facial scanners and virtual planning software, guided surgery leads to a smoother and more precise workflow between the clinician and the laboratory. This in turn leads to greater reproducibility and increased patient satisfaction. However, the simplification that comes with digitisation may lead to treatment standardisation between patients, which instead should be replaced by the concept of individualisation.

The second speaker, Lukas Fürhauser, reinforced the importance of customisation and referred to a study which had found that the main concerns of patients were, in order: treatment success predictability, avoiding full dentures, and cost-effectiveness.[1] With regard to the predictability of outcomes, research has shown that patients prefer to either maintain their individual appearance or make minimal changes. When patients require full dentures, immediate loading is perceived as being less painful than early loading, as well as more functional and aesthetic.[2] Moreover, flapless surgery is also reported as being less painful and more comfortable for patients,[3,4] while leading to improved hard[5,6] and soft tissue preservation.[7] Turning to the choice between overdentures and fixed prostheses, no clinical differences were found, even though fixed prostheses seem to be better accepted from the patient's perspective.[8]

The speakers then presented two clinical cases involving residual dentition that underwent full-arch rehabilitation with immediately placed implants using digital planning tools. In the first case, Sergio Piano emphasised that even though digital smile design can be considered a game-changer, it should not be used in a standardised way, but instead personalised for each patient's prosthetic set-up. It is particularly suitable for patients for whom a mock-up is not possible, such as those with protruded dentition. However, where an analogue in-mouth trial or mock-up can be performed, this has more impact for patients than showing them the virtual results on a computer screen. Moreover, an in-mouth trial also allows clinicians to dynamically test the feasibility of the rehabilitation by instructing the patient to smile, chew or speak, then adapt the mock-up in real time. During the presentation, Lukas Fürhauser highlighted two key points for planning: the evaluation of pronunciation before and after treatment, and the complementary use of a facial scan. In his opinion, this is a game-changer that facilitates laboratory and clinician workflow.

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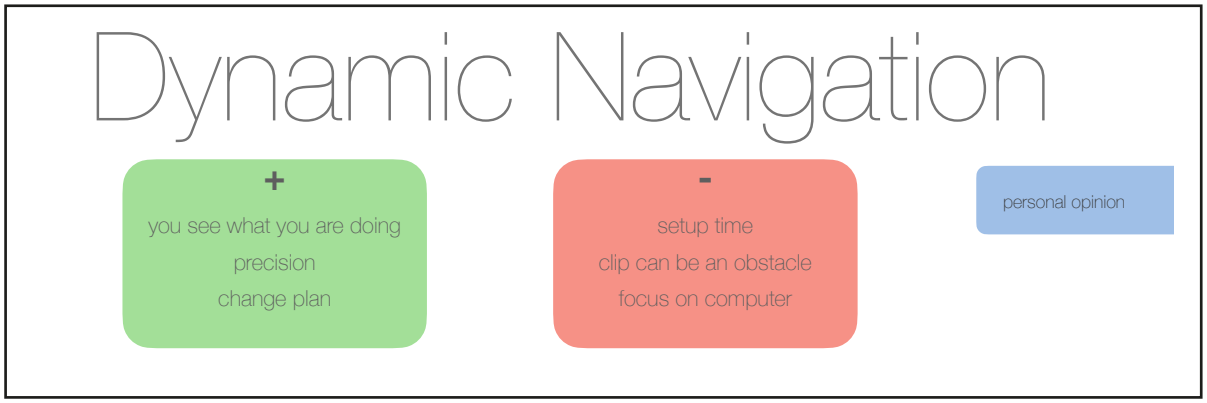
Dr Piano then moved to the surgical planning stage and described how the use of stackable guides makes surgery more comfortable and reliable. Discussing the technique, Dr Fürhauser talked about the importance of prosthetic considerations for surgical planning, including appraising the choice of material and occlusal load distribution, while also bearing in mind patient morbidity.

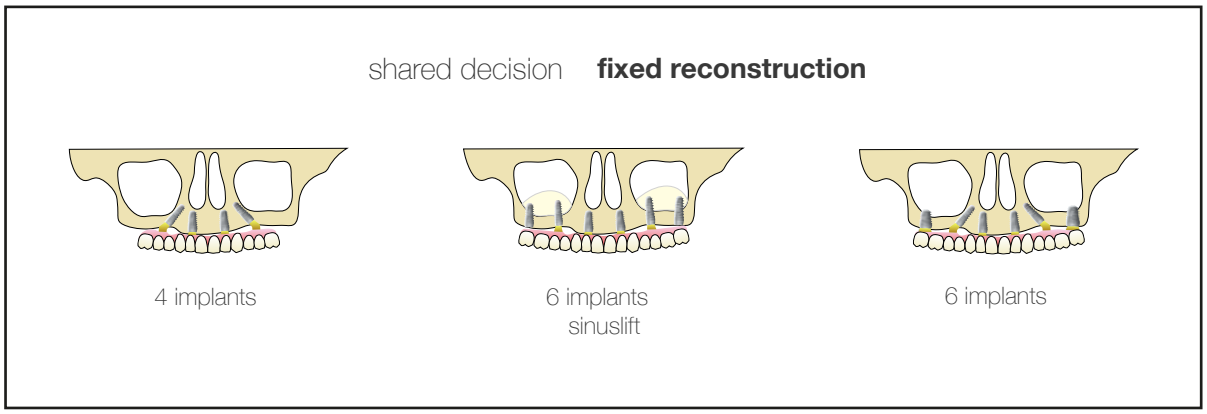
Returning to surgery, it was noted that dynamic navigation significantly improves on-site drilling positioning, angulation and depth, enhancing (for instance) live distance estimation during transcrestal sinus lift procedures. Although there doesn't seem to be any difference in precision compared to static guides, dynamic navigation is still significantly better than freehand implant positioning.[9] The major advantages of using it relate to the possibility of changing the plan during surgery and clearly seeing what surgery you are performing and where. However, the need for a complex set-up and the accompanying long learning curve may mean it does not yet qualify as a game-changer.

Turning to the prosthetic stage, Dr Fürhauser noted that the use of abutments, rather than directly connecting the superstructure at the implant level, is both more comfortable for the patient and leads to better peri-implant health.[10] He added that even though there is conflicting evidence for the use of intraoral scans for full-arch rehabilitation planning, the combination of multiple STL files with different references taken at different times can make the procedure easier for both the laboratory and the clinician.

With regard to this, he recommended leaving one tooth during the extraction phase as a scan reference, then, following extraction of the final tooth, maintaining a scan flow that originates from the middle of the palate. Further scans should include a pre-treatment scan, an emergence profile scan, and an implant scanbody scan. Dr Piano gave some useful tips and tricks for these, including using composite balls attached to the soft tissue,[11] linking scan bodies together (for example with a rubber band), and using different types or shapes of scan bodies, and/or screw scan body 'clips'. All these techniques will enhance the scanning workflow by augmenting the fixed references. Stereophotogrammetry was also mentioned as an add-on to scanning or virtual dynamic planning, but wasn't considered to be a potential game-changer.

Finally, the choice of materials was highlighted. This is a fundamental consideration that partly depends on the space available for rehabilitation and can affect chipping rates and phonetics, which can sometimes be impossible to resolve. The speakers noted that the novel combination of translucent monolithic zirconia with a titanium infrastructure,[12] has the advantage of combining the rigidness of titanium with the aesthetics of zirconia, while allowing segmentation of the prosthesis. Modular reconstruction architecture can be a game-changer, as splitting the ceramic reconstruction may favour repair and modification. To conclude, Dr Piano stated that digital planning is not limited to treatment plans involving the removal of all failed dentition, but gives space for individualisation and modification, for instance when guided bone regeneration is also needed.





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