Recommendations for Implant-Supported Full-Arch Rehabilitations in Edentulous Patients: The Oral Reconstruction Foundation Consensus Report

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The tasks of Working Groups 1 to 6 at the 4th Consensus Meeting of the Oral Reconstruction Foundation were to elucidate clinical recommendations for implant-supported full-arch rehabilitations in edentulous patients. Six systematic/narrative reviews were prepared to address the following subtopics: (1) the influence of medical and geriatric factors on implant survival; (2) the prevalence of peri-implant diseases; (3) the influence of material selection, attachment type, interarch space, and opposing dentition; (4) different interventions for rehabilitation of the edentulous maxilla; (5) different interventions for rehabilitation of the edentulous mandible; and (6) treatment choice and decision-making in elderly patients. Consensus statements, clinical recommendations, and implications for future research were determined based on structured group discussions and plenary session approval. *Int J Prosthodont* 2021;34(suppl):s8–s20. doi: 10.11607/ijp.consensusreport

The rehabilitation of edentulous patients by means of implant-supported prostheses is still considered to be a major challenge in daily clinical practice.^{1,2} This is due to various potential systemic and site-specific risk factors that may be commonly associated with elderly patients,³ thus complicating implant therapy.

The scope of this consensus meeting was therefore to comprehensively evaluate the available evidence on the following key topics: (1) the influence of medical and geriatric factors on implant survival; (2) the occurrence of biologic complications and anatomical and esthetic considerations; (3) the influence of material selection, attachment type, interarch space, and opposing dentition; (4) different interventions for rehabilitation of the edentulous maxilla; (5) different interventions for rehabilitation of the edentulous mandible; and (6) guidance for treatment choice and decision-making in elderly patients.

GROUP DISCUSSIONS AND CONSENSUS

An international expert meeting was organized and held in Prague, Czech Republic, from March 8–9, 2019. In advance of the consensus meeting, the following six systematic/narrative reviews were prepared:

1. Influence of Medical and Geriatric Factors on Implant Success: An Overview of Systematic Reviews (Fretwurst et al)
2. Prevalence of Peri-implant Diseases in Patients with Full-Arch Implant-Supported Restorations: A Systematic Review (Ramanauskaite et al)
3. The Influence of Patient-Related Factors and Material Selection on the Clinical Outcomes of Fixed and Removable Complete Implant Prostheses: An Overview on Systematic Reviews (Karasan et al)
4. Different Interventions for Rehabilitation of the Edentulous Maxilla with Implant-Supported Prostheses: An Overview of Systematic Reviews (Messias et al)
5. A Comparison Between Fixed and Removable Mandibular Implant-Supported Full-Arch Prostheses: An Overview of Systematic Reviews (Tsigarida and Chochlidakis)

6. Full-Arch Removable vs Fixed Implant Restorations: A Literature Review of Factors to Consider Regarding Treatment Choice and Decision-Making in Elderly Patients (Vazouras and Taylor)

A total of 65 clinicians and researchers with a special focus on implant therapy participated in this consensus meeting.

At the beginning of the meeting, the authors presented the methodology, results, and conclusions of their respective reviews in group sessions. The experts were split into six working groups. Within the group discussions and the formulation of consensus statements, clinical recommendations and implications for future research were each directed by one chairperson and one secretary, who were appointed in advance. All statements and recommendations were presented and discussed in plenary sessions and revised until final approval was obtained.

WORKING GROUP 1

Objectives

The literature review by this working group (Fig 1) addressed the following questions: (1) is age (> 75 years) a risk factor for implant survival?; (2) is diabetes mellitus a risk factor for implant survival?; and (3) is antiresorptive therapy a risk factor for implant survival?

Major Findings and Conclusions

An older age (> 75 years) does not affect implant survival in the short term (follow-up of 1 to 5 years).

Current studies demonstrated that diabetes mellitus is not a risk factor for implant survival in the short term, but there is no information on appropriate perioperative treatment (medication) and wound closure. There is little evidence in the literature on the success of bone grafting and progressive loading protocols in diabetic patients.

Low-dose oral bisphosphonate (BP) treatment for osteoporosis does not affect implant survival in the short term, but can lead to medication-related osteonecrosis of the jaw (MRONJ).

There is no information on implant survival with low-dose antibody therapy (denosumab) for osteoporosis.

Fig 1 Members of Working Group 1 (medical and geriatric factors). From left to right: Tobias Fretwurst (Rapporteur), Tabea Flügge (Secretary), Torsten E. Reichert, Wilfried Wagner, Katja Nelson (Chairperson), Bilal Al-Nawas, and András Huszák.

The same implant healing as in low-dose BP patients is assumed. High-dose BP and antibody therapy leads to the highest incidence of MRONJ. There are no treatment regimens available for patients with peri-implantitis receiving antiresorptive medication.

Consensus Statements

Age

- An older age does not itself affect implant survival in the short term (follow-up of 1 to 5 years), but consideration of health status in these patients is important. Common systemic diseases and concomitant polypharmacy should be carefully addressed in this patient group.

Diabetes mellitus

- Current studies indicate that diabetes mellitus is not a risk factor for implant survival, but there is no information concerning appropriate perioperative management (ie, medication) and wound closure.
- Low-quality evidence exists in the literature for the success of bone grafting procedures and progressive loading protocols in diabetic patients.⁴ Therefore, complex surgical procedures should be regarded carefully.

Clinical Recommendations

BPs and antiresorptive medication

- Low-dose oral BP intake for osteoporosis treatment does not compromise implant survival, but might cause MRONJ.
- No information is available concerning implant survival on low-dose antibody treatment (denosumab) of osteoporosis. The same implant healing as in BP patients is assumed.
- High-dose BP and antibody treatment has led to the highest incidence of MRONJ. Therefore, implant therapy cannot be recommended in these patients.
- No regime for patients with peri-implantitis under antiresorptive medication is available.

Complications

- In patients with comorbidities, the impact of specific, severe, and even rare complications should be considered rather than implant survival.
- Study results should be interpreted cautiously due to patient selection and surgical and perioperative management.
- Careful and targeted patient history is mandatory and might require referral to a specialist.

Fig 2 Members of Working Group 2 (biologic complications/anatomical and esthetic considerations). From left to right: Rémy Tanimura, Ausra Ramanauskaite (Rapporteur), Laurens Wiggers, Frank Schwarz (Chairperson), Florian Beuer, Georgia Trimpou (Secretary), Christian Hammächer, Karl-Ludwig Ackermann,* Ferhan Ahmed, Rae'd M. Abutteen. Not pictured: Pavel Kriz and Vojtech Slezacek. *Dr Ackermann has since passed.

WORKING GROUP 2

Objectives

A search protocol was developed to answer the following focus question: What is the prevalence of peri-implant diseases in edentulous patients rehabilitated with implant-supported fixed or removable restorations? This working group (Fig 2) also had to prepare a narrative review (unpublished data) considering anatomical factors and esthetic outcomes associated with full-arch implant-supported restorations.

Major Findings and Conclusions

A total of 18 studies (3 randomized controlled trials [RCTs], 1 nonrandomized controlled trial, and 14 prospective studies) were included. According to a single study, the prevalence of peri-implant mucositis in fully edentulous patients was 57%, corresponding to 47% of the implants. The prevalence of peri-implant mucositis among patients with at least one edentulous arch ranged from 0% to 13.7% of the patients and from 0% to 20% of the implants. In fully edentulous patients, the prevalence of peri-implantitis was found to range between 1.5% and 29.7% of the patients and between 2.1% and

20.3% of the implants, while the corresponding values among patients with at least one edentulous arch were 0% to 25% and 0% to 7.2%, respectively.

It was concluded that edentulous patients (ie, fully edentulous patients or patients with at least one edentulous arch) restored with either fixed or removable restorations were frequently affected by peri-implant disease.

Consensus Statements

Biologic complications

- Edentulous patients (ie, fully edentulous patients or patients with at least one edentulous arch) were frequently affected by peri-implant disease.
- Fully edentulous patients exhibited a higher frequency of peri-implantitis at the implant level compared to patients with at least one edentulous arch (2.1% to 20.3% vs 0% to 7.2%).
- Maintenance care is also essential in edentulous patients, and their individual requirements must be considered.
- It is not possible to assess whether prosthetic design (removable or fixed), time of loading (immediate or conventional), implant location (maxilla or mandible), implant site grafting, or time of implant

placement have any influence on the occurrence of peri-implant diseases in patients restored with full-arch, implant-supported restorations.

Implant loss

- Implant loss in the edentulous maxilla was influenced by the type of restoration, the number of implants supporting removable prostheses, and surface roughness. Higher rates of implant failure were noted for removable compared to fixed prostheses and for machined compared to rough-surface implants. Removable restorations supported by fewer than four implants were associated with higher rates of implant loss. The loss of machined implants was particularly high at grafted sites.
- Implant loss in the edentulous mandible did not differ between rough-surface and machined implants.

Clinical Recommendations

Biologic complications

- Considering the primary and secondary outcomes assessed in the present review, the clinician may choose between/among different abutment characteristics.
- Peri-implant health or disease is mainly influenced by plaque accumulation rather than abutment characteristics.
- The clinician is advised to support the patient in maintaining oral hygiene procedures. In addition, the design of either prefabricated or customized abutments (and suprastructures) should consider plaque retention as a relevant factor inducing peri-implant mucosal inflammation (ie, bleeding on probing).
- The need for sterilization of the abutment to prevent the onset of peri-implant diseases cannot be substantiated based on the available evidence. However, a proper abutment cleaning protocol is advised to reduce potential contamination from the abutment prior to its insertion.

Implant loss

- Rough-surface implants should be favored for rehabilitation of the edentulous maxilla, especially when bone grafting is needed.
- Removable prostheses should be supported by at least four implants placed in the anterior and posterior positions.

Implications for Future Research

- Prospective clinical data on the potential effects of abutment characteristics on peri-implant soft tissue health or disease need to be established.
- Study designs should carefully consider the exclusion of confounding factors with major clinical relevance to the primary outcomes assessed (eg,

abutment designs, attachment of the prosthesis on the implant/abutment complex, cleaning procedures of the abutments).

- The potential of zirconia to reduce plaque accumulation needs to be further elucidated in well-controlled clinical studies.
- Future clinical trials should focus on appropriate abutment cleaning to maintain peri-implant health.

Further Consensus Statements and Clinical Recommendations

Anatomical factors in the mandible

- The evaluated publications commonly report implant placement in the interforaminal region.
- The interforaminal region is compromised by the presence and extension of the anterior loop, incisive canal, and lingual foramina.⁵
- Preoperative CBCT scans might reduce the risk for anatomical damage and should be part of treatment planning when placing implants in the edentulous mandible.
- From the prosthetic perspective, long cantilevers should be avoided, and posterior implants should be taken into consideration. In the atrophic mandible, this may be accomplished by short implants.

Anatomical factors in the maxilla

- Unlike in the mandible, implants were commonly placed in anterior and posterior positions in the maxilla.
- The ongoing pneumatization of the maxillary sinus necessitates subantral grafting procedures to avoid penetration of the implant in the sinus.
- Short implants might overcome sinus grafting; however, their performance has not been investigated in the edentulous maxilla.
- The proximity to the nasal cavity, as well as the extension of the incisive canal, may also compromise implant placement in the anterior region of the atrophic maxilla.⁵
- Preoperative CBCT scans might reduce the risk for anatomical damage and should be part of treatment planning when placing implants in the edentulous maxilla.

Anatomical factors in the mandible and maxilla

- Bone quality was not assessed prior to or during implant placement in the evaluated studies. It is understood that bone quality has a direct clinical impact on healing periods/loading protocols and on the selection of implant design/dimensions.

Timing of implant placement in edentulous arches

- Implant placement in the edentulous arch was mainly investigated at 2 to 7 months following tooth extraction.
- Data on immediate and early placement protocols are scarce.

Bone augmentation

- Bone augmentation procedures, along with implant placement in edentulous arches, have been rarely investigated (ie, one study on sinus floor elevation, two studies on lateral grafting).
- It is anticipated that bone augmentation/regeneration in edentulous arches may follow the same pattern as noted in partially edentulous areas. Nevertheless, bone augmentation procedures need further investigation to elucidate the most suitable protocols for edentulous patients.

Esthetic outcomes

- There are no data on esthetic outcome measures in edentulous patients with implant-supported restorations.
- There is a need to establish an esthetic index for edentulous patients with implant-supported restorations, with a particular emphasis on specific anatomical features such as lip support, smile line, transition line, and skeletal relations.
- As noted in partially edentulous patients,⁶ a lack of keratinized tissue (< 2 mm) was also associated with a higher rate of biologic complications.
- It is recommended to establish a sufficient amount of keratinized tissue along with full-arch fixed/removable prostheses to maintain peri-implant health.

WORKING GROUP 3

Objectives

The aim of this working group (Fig 3) was to analyze systematic reviews reporting on the influence of material selection, attachment type, interarch space, and opposing dentition on the prosthetic outcomes of fixed and removable complete implant prostheses (FCIPs and RCIPs, respectively).

Major Findings and Conclusions

A total of 22 systematic reviews (FCIP: $n = 11$; RCIP: $n = 10$) were evaluated. High overall prosthesis survival rates for 5 to 10 years were obtained with both FCIPs and RCIPs (93.3% to 100% and 96.9% to 100%, respectively). Chipping/fracture of the veneering material was the most frequent technical complication for FCIPs, and attachment-related complications were the main technical problems for RCIPs. The effect of prosthetic material of FCIPs was revealed as not significant for the technical complications or survival rates. No studies were identified that provided direct information on the effect of interarch space for FCIPs or RCIPs.

It was concluded that both FCIPs and RCIPs obtained high overall survival rates, but technical complications cannot be avoided. No prosthetic material can be considered as the material of choice over another. Attachment type has no influence on the overall clinical

outcomes of RCIPs. The influence of opposing dentition and the required prosthetic space were not investigated sufficiently.

Consensus Statements and Clinical Recommendations for Fixed Complete Implant Prostheses

Prosthetic material selection

- The clinical outcomes in terms of survival and total technical complication rates have proven to be similar for all types of prosthetic materials used for FCIPs. Nevertheless, it should be kept in mind that the follow-up periods for zirconium oxide (ZrO_2) FCIPs are limited (up to 8 years) compared to conventional FCIP prosthetic materials (ie, metal-acrylic resin). Moreover, the technical complication types may differ based on the prosthetic material used.
- FCIPs revealed high survival rates but also high technical complication rates. Chipping was one of the major complications for bilayered prostheses, namely metal-ceramic, metal-acrylic, and veneered ZrO_2 .
- Due to the high chipping rates of veneered ZrO_2 and metal-ceramic FCIPs, monolithic or minimally veneered (only nonfunctional areas, such as facial and pink ceramic veneering) use of high strength ZrO_2 might be a promising alternative for FCIPs. However, the data on their clinical performance remain scarce.
- The prosthetic material selection should be done based on the required mechanical stability of the prosthesis and the workflow that will be adopted (completely or partially digital vs analog).

Prosthetic space

- Reports on clinical requirements for different prosthetic materials, namely required prosthetic space, are lacking. Better quantification and documentation of all possible parameters are therefore required to improve treatment instructions and objective guidelines for a follow-up protocol.
- Limited prosthetic space may be considered as a reason for increased risk of failure.
- Based on the minimum material thicknesses required in order to achieve required mechanical stability, the following estimation can be done for the overall vertical space needed for FCIPs: 10 mm from the implant platform level to the occlusal plane for metal-ceramic/metal-resin FCIPs; and 12 mm from the implant platform level to the occlusal plane for ZrO_2 FCIPs.
- Phonation and esthetics also need to be considered as limiting factors for prosthetic space for rehabilitation of the edentulous maxilla.

Opposing dentition

- With a moderate certainty of evidence, natural maxillary dentitions opposed by FCIPs do not affect long-term survival rates differently than other

Fig 3 Members of Working Group 3 (prosthetic material selection). From left to right: Vincent Fehmer (Secretary), Óvári Zoltán, Duygu Narin-Karasan (Rapporteur), Andreas Kunz, Irena Sailer (Chairperson), Carsten Fischer, Eric Normand, Attila Kámán, Cuneyt Karabuda, Kerem Dedeoglu.

maxillary prosthetic designs, such as removable partial dentures (RPDs) or RCIPs; however, natural dentition or fixed restorations as an antagonist may increase the risk of technical complications.

Consensus Statements and Clinical Recommendations for Removable Complete Implant Prostheses

Attachment types

- Similar survival rates were reported for splinted and free-standing attachment systems. However, the technical complication types differed between the two attachment systems.
- Each attachment system comes with its own clinical prerequisites and has different indications. Existing prosthetic space, interimplant distance, implant position and angulation, and number of implants can be considered as the factors that dictate the implant attachment of preference.
- It was shown that clinicians often make the attachment selection based on subjective criteria, such as expertise, personal comfort, the dental technician's preference, or based on the influence of marketing strategies. These decisions need to be

made based on patient-related factors; otherwise, incorrect selection of an attachment may result in higher maintenance needs and complication rates.

Prosthetic space requirement and opposing dentition.

- There is no agreement in the literature regarding the effect of opposing dentition on complication rates of RCIPs, but it was addressed as an accounting factor for increased complication and failure rates.
- Fixed dentition, either a fixed prosthetic restoration or natural dentition, as antagonist can presumably create higher occlusal forces and may lead to increased complication rates. Moreover, limitations in vertical space for the prosthetic components and matrix are suggested to be more common in the maxilla, which may lead to higher complication and failure rates.
- Amid the statements indicating that interarch space and opposing dentition can be accounting factors for increased risk of failure for RCIPs, no evidence-based results can be obtained from the current literature.
- Based on the minimum material thickness required in order to achieve mechanical stability, the

Fig 4 Members of Working Group 4 (edentulous maxilla). From left to right: Jacques Vermeulen, Stephan Beuer, Ben Derksen, Kimmo Vähätalo, Ana Messias (Secretary), Kristian Thesbjerg, Fernando Guerra (Chairperson), George Pynadath, Stefan Wolfart, Sigmar Schnutenhaus, Frederic Hermann, Pedro Nicolau (Rapporteur), Stefan Ulrici, Jan Klenke.

following estimation can be done for the overall vertical space needed for full-arch restorations; free-standing attachments: 10- to 11-mm vertical distance from the implant platform level to the incisal edge of the RCIP; splinted attachments: 13- to 14-mm vertical distance from the implant platform level to the incisal edge of the RCIP.

WORKING GROUP 4

Objectives

The objective of this working group (Fig 4) was to synthesize evidence derived from systematic reviews on different interventions for rehabilitation of the edentulous maxilla with implant-supported restorations. A protocol-oriented search was established to address the focus question: What is the current evidence regarding rehabilitation of the edentulous maxilla with different implant-supported prostheses in terms of implant and prosthesis survival?

Major Findings and Conclusions

The final selection process led to the inclusion of 34 systematic reviews that were grouped as: (1) addressing

maxillae with sufficient bone to place implants; (2) addressing maxillae with insufficient bone to place implants; and (3) comparing different types of prostheses, number of implants, patient-reported outcomes, and economic evaluations.

The literature indicates that in cases of severe atrophy of the edentulous maxilla, bone augmentation procedures such as onlay bone grafts, lateral sinus floor elevation, vertical distraction osteogenesis, and Le Fort I interpositional grafting are valid procedures. The use of extra-alveolar implants (zygomatic and pterygoid) to overcome severe maxillary atrophies should be prescribed with caution. Short implants can be used in conjunction with standard implants in splinted configurations to overcome situations of moderate atrophy of the maxillary sinus.

The use of mini-implants in the completely edentulous maxilla is not advisable for permanent implant-supported restorations.

No implant-supported rehabilitation of the edentulous maxilla (fixed or removable) should be supported on fewer than four implants. One-piece full-arch fixed dental prostheses can be supported on a minimum of two anterior axial plus two posterior distally tilted implants or on six to eight axial implants symmetrically distributed

Fig 5 Decision tree for prosthetic rehabilitation of the edentulous maxilla—fixed or removable? *Includes the possibility of combining standard-diameter implants (SDI) with axially placed short implants and/or Category III narrow-diameter implants in one-piece (fixed) or splinted (removable) options.

through the posterior and anterior regions of the arch. Four to six implants is the advised number to support an overdenture. Both splinted and free-standing anchorage systems are advocated.

The currently available data do not allow a cost-effectiveness analysis for rehabilitation of the edentulous maxilla.

Consensus Statements and Clinical Recommendations

- General statements about cost-effectiveness are not possible because of many different influencing factors; for example, bone quality and quantity, individual patient characteristics, prosthetic considerations, time of loading, longevity of the restoration and implants, and lack of scientific data.
- Though four is the minimum recommended number of implants for fixed or removable rehabilitation of the maxilla, the lower the number of implants, the higher the risk of a combined implant/prosthesis failure.
- Four to six implants should be considered necessary for both fixed and removable prosthetic options in the edentulous maxilla to achieve support, retention, and stability for predictable longevity.
- Regardless of the prosthetic option, implants should be maximally distributed across the arch (anterior and posterior) according to anatomical situation.
- In cases of a fixed prosthesis and insufficient bone volume (vertical and horizontal) in the posterior maxilla, two to four anterior parallel implants and two posterior distally tilted implants are an alternative to bone grafting.
- Zygomatic implants are another alternative in cases of a fixed prosthesis and insufficient bone volume (vertical and horizontal) in the posterior maxilla. The expected complication rate is similar to the other options, but more severe when either an implant is lost or a prosthesis is compromised or even lost due to implant failure.

Fig 6 Members of Working Group 5 (edentulous mandible). From left to right: Konstantinos Chochlidakis (Rapporteur), Jean-Claude Imber, Gerhard Iglhaut, Florian Kernen (Secretary), Alexandra Tsigarida (Rapporteur), Alex Schär, Robert Sader (Chairperson), Gerald Krennmair, Helfried Hulla, Maciej Stupka.

- Studies that compare the performance of tilted and axial implants placed in regenerated bone are urgently needed.
- In compromised bone situations where a removable prosthesis is the treatment option, the use of more than five splinted implants (for example, short implants in the posterior region, preferably in combination with standard anterior implants) should not be ruled out to reduce the risk of implant loss (Fig 5).
- Regular follow-up appointments should be scheduled for all implant patients. Follow-up intervals should be individualized according to prosthetic and clinical parameters.
- Removable prosthetic options are expected to require more maintenance than their fixed counterparts, particularly during the first year of service (Fig 5).

Implications for Future Research

- RCTs should include more comprehensive clinical evidence, including patient-reported outcome measures (PROMs), in order to conduct cost-effectiveness evaluations to compare treatment options.

WORKING GROUP 5

Objectives

The objectives of this working group (Fig 6) were to evaluate the current literature related to the number of implants, implant characteristics, loading protocols, survival rates, biologic and mechanical complications, patient satisfaction, and financial considerations for mandibular implant full-arch prostheses.

Major Findings and Conclusions

High survival rates for implants and prostheses have been reported with fixed and removable implant full-arch prostheses in the mandible. Immediate loading procedures present with high survival rates for both fixed and removable prostheses. There are differences in the number of implants, implant characteristics, complications, and financial implications between these two types of prostheses, which clinicians need to account for as part of the treatment.

In cases where both treatment options are indicated, patient expectations and cost should be the determining factors for selecting a treatment modality.

Consensus Statements and Clinical Recommendations for Implant Fixed Complete Dentures

Number of implants

- Two-implant fixed complete dentures (FCDs): Not a viable treatment option due to inadequate evidence, short follow-up, and high bias.
- Three-implant FCDs: Literature exists, but more long-term studies are needed for definitive conclusions.
- Four- to five-implant FCDs: Clinically and scientifically documented with high survival rates.
- If four implants are used, an anteroposterior spread should be considered for implant positioning (ie, tilted vs axial implant placement).
- The patient's financial situation dictates the type of prosthesis, and the type of prosthesis dictates the number of implants and the distribution.
- Six (or more)-implant FCDs: It is unclear from the current evidence whether there is an indication for more than six implants. With six or more implants, fixed implant prostheses can be segmented.

Short implants (≤ 8 mm) vs augmentation

- Short-implant mandibular FCDs may be a viable treatment option, but there is insufficient evidence for definitive conclusions.

Loading protocols

- All loading protocols have been clinically and scientifically documented for mandibular implant fixed complete dentures (IFCDs).
- Clinicians should be aware of the influencing factors for immediate loading (case selection, insertion torque, primary stability, rough surface).

Survival/success rates

- Two-implant FCDs: High survival rates ($> 98\%$ at 1 year), but not a viable treatment option due to inadequate evidence and high bias.
- Three-implant FCDs: High survival rates ($> 98\%$ at 3 years); further studies with longer follow-up times are needed for conclusive results.
- Four (or more)-implant FCDs: High survival rates have been reported (implant: 97% at 5.5 years, prosthesis: 99% at 5.5 years).

Complications

- Even though high survival rates have been reported with mandibular IFCDs, prosthetic and biologic complications are still frequent.
- For mandibular IFCDs, the prosthodontic complication rates represented 68% of the total complications. Chipping of veneering material was the most common.
- Biologic complication rates represented 32% of the total complications. Peri-implant inflammation was the most common.

- For mandibular full-arch zirconia IFCDs, more long-term studies are needed for definitive conclusions.
- Complications were not reported according to number of implants.

Patient satisfaction/quality of life

- High patient satisfaction and quality of life (QoL) have been reported for mandibular IFCDs in terms of stability, retention, and ease of chewing.
- There was no significant difference in overall patient satisfaction or QoL when compared to mandibular removable full-arch implant prostheses.

Consensus Statements and Clinical Recommendations for Removable Implant Overdentures

Number of implants

- One-implant overdentures (OVDs) may be used under certain conditions.
- Two-implant OVDs are considered the minimum standard of care treatment. There is adequate evidence for successful outcomes.
- Four-implant OVDs have been successfully used for mandibular implant OVDs (IOVDs).

Mini-diameter implants vs augmentation

- There is no clear evidence of treatment success for mini-implants.
- Mini-implants may be an alternative treatment when standard treatment is not possible due to anatomical or medical issues considering four mini-implants for a mandibular IOVD.

Loading protocols

- Although all three loading protocols provided high survival rates, early and conventional loading protocols are still better documented than immediate loading.

Survival/success rates

- High survival rates ($> 95\%$ at 5 years) have been reported in the literature for implants and prostheses.

Complications

- Most of the prosthetic complications were associated with the attachment system (53%), followed by the need for relines (25%).
- The most common biologic complication was reported as mucosal hyperplasia (31%).
- The implant number and type seem to have no clear effect on complications.

Patient satisfaction/QoL

- There was no significant difference in overall patient satisfaction and QoL when compared to IFCDs.
- The "easy to clean" rating was significantly higher with IOVDs compared to IFCDs.
- Patient satisfaction does not seem to be affected by the number of implants or prosthesis retention system.

Fig 7 Members of Working Group 6 (decision-making). From left to right: Rodrigo Andrés, Fumihiko Watanabe, Hanae Saito, Joaquin Tabuenca, Insa Herklotz (Secretary), Konstantinos Vazouras (Rapporteur), Thomas Taylor (Chairperson), Pieter van Elsas, Frank Leusink, Marzena Dominiak.

WORKING GROUP 6

Objectives

Implant treatment of complete edentulism in elderly people involves removable as well as fixed rehabilitations. The literature is not clear on which option might be better and why. The available literature was therefore reviewed and analyzed by Working Group 6 (Fig 7) in an effort to bring some guidance to the decision-making process.

Major Findings and Conclusions

The decision-making pathway for determining what type of implant-supported prosthesis is preferable for edentulous patients is complicated by many variables that must be considered in treatment planning to provide the maximum benefit for the patient. Detailed explanation of potential outcomes, complications, difficulties, and benefits of therapeutic options is mandatory. Proper assessment of patients' expectations and desires before treatment is critical for a successful outcome.

Consensus Statements and Clinical Recommendations

- Financial means will drive decision-making for treatment choice and long-term maintenance.
- Patient expectations will be paramount in treatment decision-making.
- Prior experience with prosthodontic restorations will influence treatment choices.
- Patient information about complications and treatment options must be accurately presented and discussed.
- Regardless of a fixed or removable decision, prosthesis design must facilitate adequate personal oral hygiene procedures, and patients who receive such restorations must be adequately trained for their particular prosthesis.
- Analysis of the patient's general health is critical (including extreme frailty or mental disability, periodontitis, smoking history, history of snoring and/or sleep apnea, and xerostomia).
- In patients of advanced age, converting a prosthetic solution from fixed to removable may be indicated.
- In elderly patients, severe alveolar atrophy indicates a removable solution.
- Facial esthetics and lip dynamics may drive the decision related to the prosthetic outline.
- Clinical decision-making must not only be based on the survival rate, but rather on the patient's subjective gain in QoL, comfort, and overall

well-being, which should outweigh the associated risks.

- Implant overdentures (IODs) make it easier to maintain oral hygiene. This might be of significance when selecting a treatment for patients with difficulties conducting oral hygiene, such as the elderly and patients with disabilities.
- When comparing IODs and IFCDs, the reported outcomes were inconsistent. The majority of the reviewed studies reported that IFCDs performed better in the aspects of overall satisfaction and oral health–related quality of life, while authors found IODs and IFCDs were similar when comparing PROMs.
- The diversity of PROM measurement tools—with some instruments not being properly validated—may also contribute to this heterogeneity. Standardized tools need to be established.
- On the basis of the current evidence, it is not possible to support a solid conclusion on which type of prosthesis would result in better PROMs.

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