CONSENSUS

Branemark Osseointegration Center, India: A Consensus Report on Rehabilitation of a Single Anterior Missing Tooth with Dental Implants

Ramesh Chowdhary[1], Bhasmey Srinivas Rao[2], Sunil K Mishra[3], A Kumarswamy[4], Dandapani Arunachalam[5], Uttam Khincha[6], N Srinath[7], Anjan K Shah[8], AV Ramesh[9], Hariharan Ramasubramanian[10], Suresh Ludhwani[11], Manish K Singh[12], Swathi I Singh[13], Deepak K Sangolikar[14], Reethika Gaddale[15], Shahul H Sattar[16], Naveen Raj[17], Ajmal Pasha[18], Akhila[19]

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Introduction

The Branemark Osseointegration Center, India, gathered seven experts for 1 day to discuss the rehabilitation of the single anterior missing tooth with dental implants. Critical assessment of the scientific evidence is required for the evidence-based practice of a particular treatment modality, which can be reviewed from the well-designed randomized clinical trials, cohort studies, observational studies, retrospective data reviews, etc. In order to fulfil the requirement for best patient care, the evidence-based clinical practice is utmost important. It is recommended to follow particular diagnostic strategies and treatments plans with each plan to be individualized so as to reflect the specific characteristics of individual clinical circumstances.

Consensus guidelines have increasingly become an integral part of evidence-based medicine not only in individual and institutional clinical practices but also in serving as a framework with the aim of better patient outcomes and reduce variations, prevent errors, and increase clinicians' accountability in the healthcare practices and help researchers to identify gaps in the evidence and what key research questions have yet to be answered and further discussion and modifications when required by the plenary. The working group also prepared recommendations for future research.

Disclosure

All the group members were asked to reveal any conflicts of interest that could potentially influence the outcomes of the consensus deliberations based on limited scientific evidence and strict inclusion criteria. No such conflicts were identified.

Six topics were discussed, which were as follows:

Topic 1: Radiographic techniques in implant dentistry
Topic 2: Contemporary surgical guidelines
Topic 3: Restorative materials and techniques
Topic 4: Implant loading protocols
Topic 5: Optimizing esthetic outcomes in implant dentistry
Topic 6: Digital-guided solutions

Topic 1: Radiographic Guidelines for the Use of Diagnostic Imaging in Implant Dentistry for Anterior Single Implants

Diagnostic imaging is an essential component of implant treatment planning. The introduction and widespread use of cross-sectional imaging in implant dentistry using cone-beam computed tomography (CBCT) over the last decade has enabled clinicians to

[1]Chief, Branemark Osseointegration Center, Bengaluru, Karnataka, India
[2]Department of Prosthodontics, GITAMS Dental College, Visakhapatnam, Andhra Pradesh, India
[3]Department of Prosthodontics, People's College of Dental Sciences and Research Centre, Bhopal, Madhya Pradesh, India
[4]Department of Oral Implantology, GDC&H, Mumbai, Maharashtra, India
[5]Consultant Periodontist and Implantologist, Chennai, Tamil Nadu, India
[6]Senior Periodontist and Implantologist, Bengaluru, India
[7]Department of Oral and Maxillofacial Surgery, Krishnadevaraya College of Dental Sciences and Hospital, Bengaluru, Karnataka, India
[8]Department of Oral and Maxillofacial Surgery, RajaRajeswari Dental College and Hospital, Bengaluru, Karnataka, India
[9]Department of Periodontics, Oxford Dental College, Bengaluru, Karnataka, India
[10]Department of Prosthodontics, Ragas Dental College and Hospital, Chennai, Tamil Nadu, India
[11]Department of Oral Medicine and Radiology, Karnavati School of Dentistry, Gandhinagar, Gujarat, India
[12,13,19]Consultant Oral and Maxillofacial Surgeon, Bengaluru, Karnataka, India
[14]Department of Oral and Maxillofacial Surgery, SB Patil Dental College, Bidar, Karnataka, India
[15]Department of Periodontology, AME's Dental College and Hospital, Raichur, Karnataka, India
[16,17,18]Consultant Implantologist, Bengaluru, Karnataka, India

Corresponding Author: Ramesh Chowdhary, Chief, Branemark Osseointegration Center, Bengaluru, Karnataka, India, Phone: +91 9845206898, e-mail: drramc@yahoo.com

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diagnose and evaluate the jaws in three dimensions before and after insertion of dental implants, thus replacing computed tomography (CT) as the standard of care.

The aim of the group was to identify and analyze the use of CBCT imaging in pre- and postoperative dental implant therapy, specific indications and contraindications, and the associated relative radiation dose and risks.

Statements

- The rapid adoption of these sophisticated techniques into routine practice might lead to a significant increase in the radiation burden of patients without a proper risk benefit analysis. The decision to proceed to cross-sectional imaging must be based on clearly identified needs and the clinical requirements of the clinicians involved.
- Ensure essential diagnostic information is obtained with as low as reasonably achievable (ALARA principle) radiation exposure—KV: 120, mAs: ≤ 100, slice thickness: 1 mm, pitch: 1–1.5, suggested window: 1250, level: 250. Dose reduction is possible by reducing number of slices, increasing pitch, and/or lowering mAs.
- Slices parallel with hard palate from alveolar crest up to/including hard palate.
- Establish the morphologic characteristics of the residual alveolar ridge. Determine the orientation of the residual alveolar ridge.
- Identify local anatomic or pathologic boundaries within the residual alveolar ridge limiting implant placement. Numerous internal anatomic features of the anterior maxilla such as nasal floor, nasopalatine canal, anterior superior alveolar canal, and specific indications including computer-aided implant planning cases, anterior esthetic zone or regions of suspicious anatomy (e.g., concavities, ridge inclination, inadequate bone volume), pre- and post-bone graft evaluation, history of suspected trauma to the jaws, and evaluation of post-implant complications (postoperative neurosensory impairment, osteomyelitis, acute rhinosinusitis).
- To improve implant positioning and axial direction that will optimize biomechanical, functional, and esthetic treatment results. The diagnostic information can be enhanced by the use of appropriate radiopaque markers or restorative templates. However, this information cannot be transferred exactly to the surgical site as long as no intraoperative navigation is used.

Guidelines

- Principle of orthogonality: The point of view of the viewer should be at a 90° angle to the buccal surface of the alveolus. The panoramic curve that determines the angulation of the buccal views as well as the orientation of the coronal slices through the alveolar ridge has to place the panoramic curve points every 5 mm or so in a curvilinear manner in the center of the ridge and not to take a measurement at an oblique angle across the ridge. Geometry will tell us that an error of 10–15° can yield an error of 0.5–1.0 mm in some ridges, which may be clinically significant.
- The use of a radiographic template in CBCT imaging is advisable to maximize surgical and prosthetic information.
- The field of vision of the CBCT examination should be restricted to the region of interest whenever possible.
- Patient- and equipment-specific dose reduction measures should be used at all times.
- Fully compliant DICOM data export software has to be used.
- Lip retractors should be used to visualize the facial plate and determine the soft tissue phenotype.

Further Research

- The validity and reliability of CBCT bone density measurements as an index of bone quality leads to uncertainty, as use of intensity values in CBCT images is not reliable, because these values are influenced by device, imaging parameters, and positioning.
- MRI for dental implant planning: The potential use of MRI in the area of dental implant planning has reported margin of error, which is within a reasonable level. This may one day be an accepted modality.[1,2]

Topic 2: Risk Assessment, Treatment Planning, and Surgical Guidelines

Esthetic risk assessment is for diagnosis and treatment planning and to reduce the esthetic compromise. Compromised healing, high gingival display, triangular-shaped tooth, high thin scalloped, acute infections, thin facial wall, and bone deficiency often are considered as high-risk factors.[3]

Esthetic risk increased significantly due to gingival tissue display and to analyze the display is classified high, medium, and low smile lines. It requires precise surgical, restorative techniques to develop healthy, symmetrical, and well-contoured tissues; any problems and failures will be readily visible.

The thick gingival phenotype presents low esthetic risks having a thick band of keratinized tissue as it masks the subgingival metallic components reducing the risk of mucogingival discoloration. Whereas contrast findings are seen in thin tissue phenotypes.

Clinical Recommendations

- Smoking is not contradiction but the patient should be aware that failure rates are high.
- The patient with history of periodontal disease has an increased risk of implant failure.

A classification system for timing of implant placement after tooth extraction was therefore proposed, based on desired clinical outcomes during healing rather than on descriptive terms or rigid time frames following extraction.[4]

Various Time Points for Implant Placement after Tooth Extraction

Type I: Immediate implant placement after tooth extraction—used in thick bone wall phenotype, thick gingiva, and in low-risk zones.[5]

Advantages:

- Extraction and implant placement are combined in the same surgical procedure reducing overall treatment time.

Disadvantages:

- Morphology of the site may increase the difficulty of placing an implant in an ideal position and compromise initial implant stability.
- Lack of soft tissue volume makes attainment of tension-free and primary closure difficult, thus increasing the risk of marginal mucosal recession mainly due to facial positioning.
- Inability to predict bone modeling may compromise outcomes.

Type II: Implant placement after 8 weeks of soft tissue healing where no osteoclastic activity is found, soft tissue thickness of 4–5 mm for better vascularity. Requires horizontal bone augmentation to prevent bone loss in thin bone phenotypes, flapless procedure to reduce bone resorption from the bony surface.

Advantages:

- Reduced treatment time.
- Additional soft tissue volume allows for easier attainment of tension-free closure.
- Additional soft tissue volume may enhance soft tissue esthetic outcomes.
- Flattening of facial bone contours facilitates grafting of the facial surface of the bone.

Disadvantages:

- Two surgical procedures are required.
- Morphology of the site may compromise initial implant stability.

Type III: Implant placed before 6 months

Advantages:

- Partial bone healing usually allows implant stability to be more readily attained.
- Additional soft tissue volume allows for easier attainment of tension-free closure.
- Additional soft tissue volume may enhance soft tissue esthetic outcomes.
- Flattening of facial bone contours facilitates grafting of the facial surface of the bone.
- Allows for resolution of pathology associated with the extracted tooth.

Disadvantages:

- Two surgical procedures are required.
- Extended treatment time as compared to type I and type II placement.
- Socket walls exhibit varying amounts of resorption.
- Increased horizontal bone resorption may limit the volume of bone for implant placement.

Type IV: Implant placement after 6 months

Socket preservation is done to reduce ridge alteration during the healing phase.

Advantages:

- Bone healing usually allows implant stability to be readily attained.
- Additional soft tissue volume allows for easier attainment of tension-free closure.
- Additional soft tissue volume may enhance soft tissue esthetic outcomes.
- Allows for resolution of pathology associated with the extracted tooth.

Disadvantages*:*

- Two surgical procedures are required.
- Extended treatment time compared to type I, type II, and type III placements.
- Socket walls exhibit greatest amounts of resorption.
- Greatest chance of increased bone resorption limiting the volume of bone for implant placement.

Surgical Approach: Simultaneous vs Staged Approach

Ridge augmentation by guided bone regeneration (GBR) can be simultaneous with implant placement or staged procedure.

Simultaneous GBR: Sufficient crest width at the implant site that is implant diameter plus 2 mm. Localized two-wall defect with implant within the bony envelope, thus crest width and inter radicular crestal bone is highly important for its success.

Staged GBR: Staged GBR indicated in advanced horizontal atrophy, one-wall and two-wall defect.

Guidelines

- Atraumatic extractions to reduce dimensional alterations.
- Flapless extraction preferred for early implant placement.
- Surgical intervention should be purely prosthodontic considerations.
- Flap designs should be designed to optimize blood supply and tension wound closure.
- One vertical incision outside the esthetic zone—distally to canine or first premolar triangular flap.
- Mid-crestal or slightly palatal incision, sulcular one tooth beyond edge of bone defect.

Correct three-dimensional implant positioning.[6,7]

- A surgical template should consider providing future soft tissue margin mid-facially and location of incisal edge.
- Mesiodistally 1–2 mm of gap between implant neck and periodontal attachment of the adjacent tooth to prevent papillary height and bone loss.
- Implant shoulder should be 1.5–2 mm palatally of the point of emergence of future crown to prevent facial recession. If wide platform implants are placed which can come too facially leading to bone loss or implant exposure, and if it is palatally placed will affect proper emergence profile of future crown.
- Implant shoulder should be 2–3 mm coronoapically or else leading to pronounced bone loss with subsequent soft tissue loss leading to recession of mucosa.
- If implant axis is 1 mm palatal of the future incisal edge, then transocclusal screw retention in cingulum area will be the treatment of choice.

Further Research

- In case of type I implant placement, flapless technique, immediate provisionalization, soft tissue grafts, and platform switch concept may not help in successful outcomes.
- Survival rates of postextraction implants are high when compared to those of implants placed in healed sites but depend majorly upon the type of wall defect.
- For a long-term stability of tissue volume, following factors will influence the success: (a) the presence/absence of the facial bone, (b) dimensions of the socket, (c) thickness of the facial bone, and (d) position of the bone crest.
- Regeneration of the crestal bone is not predictable, which is very much unlikely with the present treatment methods.

Topic 3: Prosthodontic and Restorative Procedures

An esthetic implant prosthesis should be in harmony with the intraoral and extraoral facial structures of the patient, which includes peri-implant structures, dimensions, color, etc. Mimicking natural appearance of the missing dental unit in color, form, texture, size, and optical properties.[8]

The esthetic zone was defined as any dentoalveolar segment that is visible upon full smile.

- Measurement of esthetic outcomes: The following esthetic-related soft tissue parameters are proposed for use in clinical studies:
  - Location of the midfacial mucosal implant margin in relation to the incisal edge or implant shoulder.
  - Distance between the tip of the papilla and the most apical interproximal contact.
  - Width of the facial keratinized mucosa.
  - Subjective measures of esthetic outcomes, such as visual analog scales.
- Use of provisional restorations recommended to guide and shape the peri-implant tissue prior to definitive restoration.
- Location of the implant shoulder: In esthetic areas, the implant platform generally is subgingivally placed, leading to deep interproximal margin; the implant abutment interface makes seating of the restoration and removal of cement difficult. Therefore, a screw-retained abutment/restoration interface is advisable to minimize these difficulties. The transverse screw (TS) abutment also provides a method of angulation correction, using a lingual path of insertion for the hexagonal fixation screw.
- The microgap between the implant and the abutment must be as small as possible and stable.

Implant survival rates are not the only essential consideration when advising the patient on different treatment options. Prosthetic and implant-abutment outcomes need to be considered as well. Different kinds of abutments are available with respect to material (metal and ceramic) and shape (prefabricated and customized, both with various internal designs. Metal abutments are classified as the gold, standard, although high-strength zirconia abutments are being utilized more widely and may be an adequate alternative to metal abutments for the clinical use.

- CAD CAM abutments

  According to their fabrication technique, implant frameworks are of four types:
  - Conventional cast frameworks,
  - Frameworks made from carbon/graphite fiber-reinforced polymethylmethacrylate,
  - Laser-welded titanium frameworks, and most recently,
  - CAD/CAM milled frameworks.

Consensus Statements

- The restorative connection can be either screw or cement-retained. The choices include ease of fabrication, precision, passivity of the framework, retention, occlusion, esthetics, accessibility, retrievability, complications, and costs.

  With respect to CAD/CAM technology for implant abutments, crowns, and superstructures, the following statements can be made:

  CAD/CAM technology has been successfully incorporated into implant dentistry.

  Clinical performance of implant-supported prostheses produced using CAD/CAM and conventional techniques is similar over the short term (mean: crowns, 1 year [1–1.1 years]; abutments, 3.5 years [1–5 years]; frameworks, 4 years [1–10 years]).

  The CAD/CAM software and hardware used in fabricating implant-supported prostheses make comparison difficult.

  Measures and material choices in investigations of CAD/CAM implant-supported prostheses make comparison difficult as the survival rate of individually customized CAD/CAM abutments is similar to that of conventionally fabricated or stock abutments.

- No differences were found between the clinical performances of metal abutments with external or internal connections, based upon esthetic, technical, or biologic outcomes.
- The reported rate of technical complications is higher than either esthetic or biologic complications.
- High survival rates can be achieved with both cement and screw-retained fixed implant-supported prostheses. Neither failure nor complication can be avoided by selecting a prosthesis retention type.
- Cemented all-ceramic prostheses have a higher failure rate than cemented metal-ceramic prostheses. However, no difference was found with screw-retained prostheses. The type of cement used does not influence the failure rate of cemented prostheses.
- The cemented prostheses exhibited a higher rate of technical complication.
- Screw-retained prostheses exhibited a higher rate of ceramic chipping than cemented prostheses.
- Biological complications can be found (estimated annual event rate of up to 7%) with both cemented and screw-retained prostheses. Cemented prostheses exhibit a higher rate of fistula formation and suppuration.[9]

Cement Retention may be Recommended

- For short-span prostheses with margins at or above tissue level to simplify fabrication procedures.
- To enhance esthetics when the screw access passes transocclusally or in cases of malposition of the implant.
- When an intact occlusal surface is desirable.
- To reduce initial treatment costs.

Screw Retention may be Recommended

- In situations of minimal interarch space.
- To avoid a cement margin and thus the possibility of cement residue (this may be particularly important if the prosthetic margin is placed submucosally, since it has been shown to be more difficult to completely remove cement residue from margins placed >1.5 mm submucosally).
- When retrievability is of importance.
- In the esthetic zone, to facilitate tissue contouring and conditioning in the transition zone (emergence profile).
- To facilitate screw retention, it is recommended that the implant be placed in a prosthetically driven position. Screw retention of the interim restoration is considered advantageous for multiple reasons: retrievability, tissue shaping, tissue health and maturation, and ease of modification.

Topic 4: Loading Protocols

Conventional and early loading are well-established protocols. In Cochrane reviews that are recognized as a gold standard in evidence-based health care, Esposito and coworkers published an updated version of their systematic review regarding different times for loading dental implants, and based it on the following definitions have been derived:[10]

Immediate loading was defined as implants in function within 1 week after their placement. No distinction was made between occlusal and nonocclusal loading.

Early loading was defined as putting implants in function between 1 week and 2 months after placement.

Conventional loading was defined as putting implants in function after 2 months.

This report summarizes the statements and clinical recommendations for implant loading. An electronic search of PubMed and Cochrane has been carried out. "Maxillary anterior implant AND loading protocol", "single anterior maxillary dental implant AND loading"—9 systematic reviews, 10 randomized clinical trials out which 1 Cochrane review, 7 RCTs, and 3 systematic review were relevant and have been considered for the consensus.

Statements

- Conventional loading is procedure of choice in the esthetic zone when stability is considered inadequate for early or immediate loading.[11]
- Implants with insertion torque ranging from 20 to 45 Ncm is ideal for immediate loading when microroughened dental implants are used and such treatment is complex and requires appropriate education, experience, and skill.
- High degree of primary implant stability is one of the prerequisites for successful outcomes of immediate or early loading.
- Immediate loading of single-implant crowns renders different results from early and conventional loading with respect to implant survival rate, marginal bone loss, stability of peri-implant soft tissue, esthetics, and patient satisfaction.
- Timing of the restorative procedure does not influence the level of the papillae at single-implant crowns at 1 year of function.

The mean papilla shrinkage at 3 months was about twice as high in the conventional as in the immediate loading group (0.9 mm vs. 0.5 mm). In the following 9 months, papillae at conventionally loaded implants showed a tendency to fill the proximal spaces. At the 1-year follow-up, the mean recession of mesial and distal papillae ranged from 0.3 to 0.5 mm with no significant differences between immediate and conventional loading. In contrast, the other RCT recorded a minimal mean recession of the papillae between 3- and 12-month examinations.[12]

Further Research

- Clinical studies showed similar short-term survival rates of single implants either loaded conventionally, early, or immediately after implant placement.[13–18]
- At the highest level of evidence for answering clinical questions derived from systematic reviews analyzing the results of randomized controlled clinical trials (RCTs) and the meta-analysis of data from the included trials did not reveal differences between immediately and conventionally loaded implants with regards to implant survival and marginal bone loss. The majority of the included studies evaluated implants inserted with a minimal torque in the range of 20–45 Ncm or a minimal ISQ in the range of 60–65.
- Systematic reviews did not find a significant effect of the loading protocol on implant survival and marginal bone loss, so further research is required for the long-term studies.[19]

Statements

- Immediate and conventionally loaded implants are equally successful clinical procedures regarding implant survival and marginal bone loss.
- Studies evaluating implants inserted with a minimal torque in the range of 20–45 Ncm or a minimal ISQ in the range of 60–65 and it requires no simultaneous bone augmentation. In addition, most studies did not include observation periods beyond 1 year of implant function.
- Immediate and conventionally loaded implants do not appear to differently affect the papilla height during the first year of loading.
- Due to the heterogeneity of the time, point of baseline measurements, and the contradictory findings in the studies, it is difficult to draw clear conclusions regarding the recession of the buccal mucosa between immediately and conventionally loaded implants.
- With respect to the assessment of esthetic outcomes, the data available remain inconclusive.
- Patient satisfaction was measured in only very few trials rendering insufficient data to draw conclusions.
- Patient satisfaction with esthetics can considerably differ from that of professionals, with patients usually showing a higher degree of satisfaction. This indicates that concerning the esthetics of implant-supported reconstructions and their surrounding tissues, patients may have different views regarding the factors contributing to a satisfying result.

Topic 5: Esthetic Protocols

The impending loss of a single tooth in the esthetic zone in a patient with an otherwise healthy periodontium can be a distressing experience, and the inevitable loss of soft and hard tissue following tooth extraction often results in a compromised site for implant placement in terms of esthetics. Dimensions of the soft tissues between a tooth and an implant (papilla) or between two adjacent implants (inter-implant mucosa) are influenced by the soft tissue health.

It is with the limited scope to identify factors that may influence papilla height/inter-implant mucosa fill, surgical and restorative protocols: staged vs simultaneous implant placement, flapless placement, incision and flap design, soft and hard tissue augmentation procedures, submerged vs transmucosal healing.

Different esthetic evaluation scores have been suggested to objectively evaluate the peri-implant soft tissue outcomes.

Statement

- Currently no systematic review addressing the influence of the vertical distance between the bone crest and the interproximal

contact point on the papilla height in single-tooth implant placement in the esthetic zone.
- No systematic review addressed the ideal horizontal inter-implant distance in order to ensure an optimal inter-implant mucosa fill and to achieve an ideal esthetic treatment outcome.

Therefore, the aim of the present consensus report was to critically evaluate the scientific evidence regarding the influence of horizontal/vertical implant tissue dimensions on papilla height in single-tooth implants and on the inter-implant mucosa fill of two adjacent implants in the anterior maxilla.[20,21]

Vertical distance from the base of the interproximal contact point to the crestal bone level, at single implants adjacent to teeth, will affect the interproximal papilla height. Periodontal health is a prerequisite for evaluation of the influencing factors on the papilla height. The papilla height between an implant and a tooth is predominantly dependent on the clinical attachment level of the tooth.

The papilla volume and the filling of the interproximal embrasure are also influenced by other factors and they are as follows:[22]

- Tooth and anatomic-related factors (dimension of the tooth gap, bone morphology, tooth anatomy and position, mucosal thickness).
- Implant-related factors (configuration of the collar, implant abutment connection, implant–tooth distance, orofacial implant position).
- Surgical-related factors (staged vs simultaneous, augmentation procedures, submerged vs transmucosal healing).
- Restoration-related factors (contact point/area, abutment design, crown contour).
- Greater the distance from the bone crest to the contact point, the higher the risk for incomplete papilla fill.
- It is not possible to identify a threshold distance that will predict complete papilla fill.

Recommendations

- A comprehensive periodontal examination: interproximal probing before implant placement to assess the clinical attachment level at the adjacent teeth.
- Prevent interproximal crestal bone loss and clinical attachment loss to achieve the best possible esthetic outcomes.
- Identify anatomic risk factors and consider appropriate prosthetic solutions to optimize papilla fill.
- Prior to the initiation of treatment, the patient should be informed about the risk factors for incomplete papilla fill as well as the planned treatment procedures.

Future Research

Further investigations should consider the following:

- To verify whether immediate or delayed provisional restorations render better long-term esthetic.
- Development of surgical procedures to improve bone and/or papilla augmentation for single implants adjacent to periodontally compromised teeth.

Influence of the Horizontal Distance between Two Adjacent Implants Inserted in the Anterior Maxilla on the Inter-implant Mucosa Fill[23]

- Moderate to high risk there for incomplete inter-implant mucosa fill when the inter-implant distance is <3 mm.

The inter-implant mucosa volume and the filling of the inter-implant embrasure are also influenced by other factors and they are as follows:

- Anatomic-related factors (dimension of the edentulous space, mucosal thickness, bone volume on the facial aspect).
- Implant-related factors (configuration of the collar, implant abutment connection, orofacial and apicocoronal implant position, implant angulation).Surgical-related factors (surgical protocols, e.g., staged vs simultaneous, augmentation procedures and submerged vs transmucosal healing).
- Restoration-related factors (contact point/area, abutment design, crown contour).

In the anterior maxilla, the recommendations are as follows:

- Inter-implant bone distance of 3–4 mm to optimize inter-implant mucosa fill.
- No clinical guidelines can be given for the timing of implant placement on the inter-implant mucosa fill.

Morse taper performs better for survival, success, and marginal bone loss. Internal hexagon performed better for esthetic parameters.[24]

Papilla Height in Relation to the Distance between the Bone Crest and the Interproximal Contact Point at Single-tooth Implants

- Vertical distance from the base of the interproximal contact point to the crestal bone level seems to affect the interproximal papilla height; that is, the lower is the distance, the higher is the percentage of papilla fill.
- Complete embrasure fill between an implant restoration and the adjacent tooth seems to be correlated with the integrity of the periodontal ligament of the tooth.
- To reduce the risk of esthetic failures, interproximal probing on the adjacent teeth should be encouraged before implant placement.[22]

Flapless Procedures

- Dehiscence rate of 4.73% with flapless surgery.[25]
- From a biologic point of view, the main advantage of a flapless procedure is preservation of the periosteum and supraperiostal plexus and consequently the blood supply to the alveolar bone is maintained. Some clinical studies suggest that flapless surgery prevents marginal bone loss.[26]
- A recent meta-analysis compared marginal bone loss and implant survival rate between flapless and flapped procedures. They found no statistically significant difference between the two, concluding that the flap design should be chosen for patient comfort, need for access and ridge augmentation, and experience level of the surgeon.[27]
- In three-dimensional planning, a global inaccuracy of 0.85–1.1 mm, before surgery is predicted.

Opportunity to Fill the Gap between the Implant and the Buccal Bone

Spontaneous bone formation occurs only after 4 months with a maximum gap between the implant and the buccal bone of 1–1.25 mm. Paoloantonio et al., in 2001, found the degree of bone–implant contact after immediate placement to be 70% in the mandible and 64.8% in the maxilla.[28]

Soft-tissue Augmentation at Immediate Implants

A combination of immediate loading of the implant and the connective tissue graft allows for better stability of the gingival margin and thickens the peri-implant soft tissues.[29]

- Immediate implant placement postextraction does not reduce bone resorption.
- Postextractive immediate implant placement is a favorable clinical protocol, in terms of esthetics only.

A recent literature review evaluated immediate implant placement and immediate restoration with a single crown in the anterior maxilla; it reported 626 implants with a success rate of 97.96% and a survival rate of 98.25% (medium follow-up: 31.2 months) in accordance with the systematic review of the literature by Del Fabbro et al., in 2013, who reported an overall implant survival rate of 97.62% (range: 78.6–100%) after 1 year of function.[30]

The Osteology Consensus Group stated, in 2011, that the survival rate of postextraction implants in the esthetic area is high but there is also a very high risk of mucosal recession.

The International Team for Implantology consensus statement underlines that, with immediate implant placement, the risk of mucosal recession increases.[31]

- Immediate implant placement and provisionalization (Class I sagittal root position) cases are more technique-sensitive and entail additional attention.
- Class II and Class III sagittal root position are contraindicated for immediate implant placement. Provisionalization, requiring augmentation of hard and/or soft tissue before implant placement in the Class IV sagittal root position.[32]

Buccolingual width and inter-radicular mesiodistal widths of the failing tooth determine the diameter of the implant to be used and can be evaluated using CBCT. The V-shaped defect, which is confined only to the mid-facial portion of the facial bony plate, responds favorably to immediate implant placement and provisionalization with GBR. A failing tooth with a U-shaped or a UU-shaped defect is contraindicated for immediate implant placement and provisionalization.[33]

Primary implant stability is a prerequisite for immediate implant placement and provisionalization and is usually achieved by engaging the palatal wall and the bone 4–5 mm beyond the apex of the extraction socket. Therefore, a Class I sagittal root position, with a considerable amount of bone present on the palatal aspect for implant engagement.

To attain primary stability is optimal for immediate implant placement and provisionalization; and a Class IV sagittal root position, with a limited amount of bone for implant engagement, is a contraindication. Class II and Class III sagittal root positions present compromised and/or challenging conditions for immediate implant placement and provisionalization. In Class III sagittal root positions, implant stability must rely on its engagement with the available bone on the labial aspect, which can potentially lead to facial fenestration or perforation. In Class II sagittal root positions, as available bone on both the palatal and labial aspects is inadequate, implant stability relies primarily on the amount of available bone beyond the apex of the extraction socket.[32] The final implant diameter should be within the confines of the tooth socket but, in order to help prevent perforation, should not engage the usually thin coronal portion of the labial plate. Furthermore, a minimal distance of 2 mm between the implant and adjacent teeth is recommended to minimize marginal bone loss occurring as a result of encroachment.[31]

The final implant position and angulation are in accordance with the following guidelines:

- Mesiodistally: the implant should be placed at the center of the predetermined mesiodistal width of the final restoration with a minimal distance of 2 mm from the adjacent tooth.
- Labiopalatally: the implant should be placed along the palatal wall of the extraction socket for primary stability. At the cervical level, the implant should emerge slightly lingual to the predetermined buccolingual width of the final restoration.
- At the incisal level, the implant should emerge at the incisal edge of the final restoration. With this labiopalatal position/placement, a gap of at least 1.5 mm between the implant and the buccal bone is maintained and the integrity of the labial bone is ensured.
- Apicocoronally: the neck of the implant is placed approximately 3 mm apical to the predetermined facial free gingival margin of the final restoration.

Immediate Provisionalization

Provisional restoration can be screw-retained or cement-retained. A cement-retained provisional restoration is usually more esthetic, especially when the implant access opening is at, or facial to, the incisal edge. However, it also is at higher risk of gingival inflammation at the abutment–cement–restoration interface, as well as cement debonding. Without the bone graft, this usually results in significant horizontal and vertical facial bone loss and subsequently in facial gingival tissue loss.[34,35]

Topic 6: Digital-guided Solutions

Digital technologies are gaining a predominant position in implant dentistry. Cone-beam computed tomography scans provide clinicians with digital imaging and communications in medicine (DICOM) data, which can be aligned with standard tessellation language (STL) files obtained from intraoral scanners in the computer-aided design (CAD) software to plan implant treatment and design drill guides.

There is no contraindication to use s-CAIS instead of conventional implant surgery.

Flapless s-CAIS may lead to implant placement outside the zone of keratinized mucosa; therefore, the quality and quantity of the keratinized mucosa must be assessed before planning s-CAIS.

Recommendations for Future Research

Based on the systematic review and considering the different clinical indications, such as fully vs partially edentulous, using flap vs flapless techniques, the group recommended that there is a clear need for RCTs with appropriate power analysis investigating s-CAIS related to PROMs with standardized protocols, which allow reliable and reproducible assessments of:

- Oral health impact profile (OHIP);
- Standardized use of visual analog scales (VAS) for pain and discomfort;
- Cost-benefit analysis considering virtual planning, surgery, laboratory, and prosthetic work, including required equipment and materials;
- Time efficiency factor analyzing virtual planning, surgery, and the respective prosthetic phase; complication rates.

Accuracy of Different Dental Impression Techniques for Implant-supported Dental Prostheses

Digital impression technology is increasingly used in clinical practice as it is said to have many advantages above, and the potential to substitute for conventional impression techniques. Intraoral scanners use surface capturing technologies to acquire data. Scan bodies are captured by intraoral scanners and can be used to locate the implant positions in a virtual model. The accurate transfer of implant positions in relation to neighboring implants or teeth is paramount for the design and the fit of implant-supported prosthesis.Therefore, this systematic review has evaluated the scientific evidence for the accuracy of optical implant scans compared with scans of stone cast made from conventional implant impressions. The term accuracy refers to trueness, describing the closeness of a measurement to the actual value, and to precision, describing the closeness of multiple measurement results.

Consensus Statement

- Currently, there is limited clinical evidence on the accuracy of intraoral digital impressions of dental implants compared with conventional implant impressions.
- The accuracy of digital impressions is negatively influenced with an increase in the inter-implant span between multiple implants but not significant in single implant.

Clinical Recommendations

- The use of digital impressions for single implant restorations can be recommended.
- To optimize digital implant impressions for each clinical situation, device-specific intraoral scanning protocols must be followed.
- The use of scan bodies is recommended for accurate digital implant impressions.

Recommendations for Future Research

The evolution of software versions goes faster than the process of conducting a study. Major software upgrades may lead to changes in the scanning protocol and the resulting virtual model. The same hardware can produce different results when using the latest software release compared to the previous one. Therefore, there is a need for established study designs considering standardized conditions, and it is crucial to address the software version and used scan protocol for further studies to create a reliable database for accurate statistical analyses. Although in clinical practice, single-unit restorations are being performed using a digital workflow, there is a need for further research to conclude if it is a predictable and reliable procedure when compared to the conventional workflow. There is a lack of literature about the accuracy of different intraoral scan bodies in terms of geometry, dimension, material, and surface characteristics. More studies regarding these aspects should be conducted.

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