

Dental Implant Treatment Planning and Restorative Considerations

Aldo Leopardi, BDS, DDS, MS
Practice Limited to Implant, Fixed and Removable Prosthodontics
Greenwood Village, Colorado
www.knowledgefactoryco.com
www.aldoleopardi.com
email: aldo@aldoleopardi.com

Treatment Planning and Clinical Considerations: Partially Edentulous

Questions that the dentist needs to consider when evaluating the new patient for dental implant therapy:

- patient expectations?
- medical history?
- presence or absence of adjacent teeth?
- aesthetic zone verses posterior?
- tissue biotypes: high, normal or low crest?
- soft-tissue augmentation?
- non-restorable teeth: immediate or delayed implant placement?
- long-standing partially edentulous anterior condition: site preparation - boney and/or soft tissue augmentation?
- surgical guide/emmergence profile?
- implant design?
- implant placement: vertical, horizontal, implant spacing and number?
- biologic width/height?
- platform switching?
- abutment selection?
- provisionalization?
- occlusion?
- screw or cement retained?

Determine the Patient Expectations

Partially Edentulous Key Factors:

- Aesthetics.
- Functional Demands.
- Financial commitment: building perceived value! People typically buy things that they want...not always what they need.
- Treatment phase/time frames:
 - Discuss the number of appointments.
 - Discuss healing time in different areas of the mouth.
 - Total treatment time depends on the type of restoration; adjunctive procedures; and laboratory time needed.

Completely Edentulous Key Factors:

- Functional demands: is minimal movement of their denture Okay (tissue supported implant retained overdenture therapy), or are they expecting the new

overdenture to be very stable (multiple implants for implant supported and retained overdenture therapy)?

- Oral hygiene.
- Financial commitment.
- Treatment phases/time frame.
- Aesthetics.
- Phonetics.

Health History Contraindications:

- Immunosuppression (chemotherapy, HIV, etc).
- Antimetabolic treatment.
- Poorly controlled diabetes.
- Poorly controlled cardiovascular problems.
- Active pharmacodependency.
- Psychiatric disorders.
- Bisphosphonates-intravenous: contraindicated.
- Bisphosphonates-oral: informed consent.
- Smoking: informed consent.

Implant Placement for the Partially Edentulous Patient

Available Bone:

- Minimum implant length 10 mm.
- Ideal length: 13 mm.
- Maximum length: 15 mm.

Bone Quality:

- Type I/II - Mandibular anterior and posterior sites. Require minimum of 1.5-2 mm of bone surrounding the dental implant.
- Type III/IV - Maxillary anterior and posterior sites. Require minimum of 2 mm of bone surrounding the dental implant.

Vertical Placement:

- Measured from the *mid-facial free gingival margin of the future restoration*: surgical guides critical to provide the surgical team member this information, including representation of the facial and incisal aspects of the future restoration.
- Implant platform distance to the mid-facial free gingival margin in the Maxillary aesthetic zone:
 - External hex implants: 3 mm (2-3 mm range).
 - Internal hex/lobe implants: 3 mm (2-3 mm range).
 - Tissue-level Morse-taper implants with a 1.8 mm machined collar: 2-2.5 mm (this design is less than ideal for the aesthetic zone).
 - Narrow diameter (3.0-3.5 mm diameter) implants: 3 to 3.5 mm.

Implant-to-Implant Spacing: 3 to 4 mm. In 8 and 9 sites, minimum 4 mm.

Implant-to-Tooth Spacing: 1.5 to 2 mm.

Facial-Lingual Position:

- Anterior zone: implant long-axis/screw-access chamber to exit the cingulum area.
- Posterior zone: center of occlusal table.

Rotational Position:

Flat of the hex and/or lobe facing facial (tangent to the curvature of the arch), in order to take advantage of pre-manufactured contoured abutments and components.

Surgical Guides, Laboratory Fabricated. For example...

- Occlusal splint (bruxism splint) design, with future tooth form present: CEJ, facial contour and incisal edge reproduced.
- Radiographic markers - for example: 5 mm brass tubes - 1/8 o.d. x .014 wall x 12" long, K&S Metals (ksmetals.com). These tubes accommodate up to a 2 mm surgical twist drill.
- Radiographic marker position verified with conventional 2 dimensional radiographs followed by 3-D computer tomography.

Surgical Guides – Guided Surgery

Recommended approach: CBCT software planning and surgical guide fabrication. E.g., Materialize (Simplant Software).

Implant Biomechanics

- Dental implants tolerate vertical forces well. Lateral forces increase the stress/strain levels at the bone implant interface (exponentially) when compared with vertical loading. Consequently, lateral (oblique/bending moments) forces should be minimized and/or avoided.
- Wider implants provide for increased bone-implant surface area and therefore improved biomechanical advantage, however, in the anterior zone, wider implants may compromise the mesial-distal restorative emergence profile. Consequently, regular (average of 4-4.3 mm) and small (average of 3.5 mm) diameter implants are preferred.

Implant Width:

- Select an implant which is within 1-2 mm of the size of the restoration at the gingival level.
- Small diameter implants (3.0-3.5 mm): Maxillary laterals and Mandibular incisors.
- 3.0 mm diameter implants: Maxillary and Mandibular lateral incisors, when only 6 mm of inter-root space is present.
- Regular diameter implants (4.0-4.6 mm): Maxillary centrals, canines and premolars.
- Wide diameter implants (5.0-6.0 mm): Maxillary/Mandibular molars. Maxillary canines in select cases (no greater than 5.0 mm diameter).

Splinting Implant Restorations - Indications:

- Grafted sites.

- Compromised crown-to-implant ratio - long clinical crowns (minimum desired crown-to-implant ratio is 1:1).
- Multiple regular diameter implants in the posterior zone.
- Implant supported fixed partial dentures.
- Multiple posterior regular diameter implants: splint together to improve stress-distribution and biomechanical advantage.
- Narrow implants.
- Parafunction.

Splinting to Natural Teeth:

- Consider the potential cantilevering effects?
- Avoid when-ever possible.

Implant Site Development

Grafting options:

- Autogenous bone graft (same species and genotype).
- Allogenic (same species, different genotype).
- Xenograft (different species).
- Alloplast (synthetic).
- Collagen.
- PRP - platelet rich plasma.
- Bone Morphogenic Proteins (BMP-2)

Orthodontic therapy:

- Repositioning teeth/roots: require a minimum of 7 mm between roots to accommodate a small diameter root form dental implant (3.5 mm in diameter). If unable to achieve 7 mm, then 6-7 mm for a 3 mm diameter two-piece implant.
- Translation of teeth to generate bone.
- Forced eruption to verticalize boney defects: Once desired extrusion levels have been achieved, the teeth will require further stabilization (brackets and arch-wire maintaining teeth in position) for an additional 3 months. This will allow for the newly formed bone to mature. Teeth can then be removed and implants placed immediately or the sites grafted and implant placement delayed.

Presence or Absence of Interproximal Papillae

The presence or absence of interproximal papillae is inversely related to the distance from the base of the contact area to the underlying crest of bone.

- With natural teeth, at a distance of 5 mm or less - papillae is present 100% of the time; at 6 mm - papillae is present 56% of the time; and at 7 mm or more - papillae is present only 27% of the time (Tarnow et al. The effect of distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla. J Periodontol 1992;63(12):995-996).
- Between dental implants: "2 to 4 mm (3.4 mm average) of soft-tissue height can be expected to cover the interimplant crest of bone." Tarnow DP et al. Vertical distance from the crest of bone to the height of the interproximal papilla between adjacent implants. J Periodontol 2003;74:1785-1788.

- Interproximal soft tissue dimensions measured from the most coronal interproximal height of bone (Salama H. et al. Journal of Practical Periodontics):

Restorative Environment	Proximity Limitations	Vertical Soft Tissue Limitations
Tooth – Tooth	1 mm	5 mm
Tooth – Pontic	N/A	6.5 mm
Tooth – Implant	1.5 mm	4.5 mm
Implant – Pontic	N/A	5.5 mm
Implant – Implant	3 mm	3.5 mm
Pontic – Pontic	N/A	6 mm

Number of Implants:

- Will depend on bone quality, biomechanical factors and aesthetic considerations.
- Anterior zone (5-12 region - type III bone): Implant-Pontic-Implant or Implant-Pontic-Pontic-Implant. Avoid adjacent implants.
- If 8 and 9 are missing, need to provide a minimum of 4-5 mm of space between the dental implants and also expect a reduced papillary height compared with the original tooth-to-tooth papillary height (average of 1.5 mm papillary height loss following completion of restorations under optimal treatment conditions). Patient expectations must be set/limitations accepted and inter-implant distance available prior to considering this treatment option.
- Lower Anterior zone (type I bone): Implant-Pontic-Implant or Implant-Pontic-Pontic-Implant.
- Posterior mandible (type II bone): Implant-Pontic-Implant or Implant per tooth.
- Posterior Maxilla (type IV bone): Implant per tooth.

Biologic Width Around Implants

Bone level is determined by:

- Soft tissue thickness of approximately 3mm (1 mm sulcus and 2 mm biologic width).
- Exposure of the implant-abutment junction to the oral environment.
- Abutment-implant seal.
- Implant design: presence of threads and surface topography.
- Vertical implant placement: location of the implant-abutment junction and of the inflammatory connective tissue infiltrate...emergence profile requirements.

Implant prosthetic connection/design for the anterior zone:

- Internal/external hex implants (with a 1 mm or less machined collar).
- Lobed connection implants (with a 1 mm or less machined collar).
- Indexed friction fit connections (with a 1 mm or less machined collar).
- Conventional/tissue level Morse taper implants with a 1.8 mm machined finished collar: less than ideal in the aesthetic zone. However, an appropriate design for the posterior zone.

Prosthetic Abutment Selection

Conventional Stock Abutments (pre-manufactured).

Following preparation - lack of emergence profile under tissue margin; deep margin position and consequently cement removal challenges.

Custom abutments:

- Laboratory cast (UCLA).
- Computer milled (Atlantis, Compartis, Procera, Encode).
- Both provide custom subgingival emergence profile and marginal positions. Consequently, often needed and required for the anterior zone restoration.

Zirconia abutments:

Pure Zirconia abutments not recommended: risk of fracture at implant/abutment interface.

Recommend a titanium interface with the implant: Zirconium coping cemented to a titanium core.

Pre-Contoured Stock Abutments:

- Anatomical margins follow gingival contours: minimized grinding.
- Straight and angled abutments.
- Contra-indications:
 - When implants significantly divergent.
 - If flat of the external/internal hex and/or lobe not tangent to the curvature of the arch (not positioned mid-facial).

Dental Implant Immediate Implant Placement and Provisionalization.

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Immediate Implant Placement and Provisionalization:

Advantages:

- Preservation of tissue.
- Reduction of sequences (simplification of treatment).
- Enhanced patient and aesthetics and comfort.

Disadvantages:

- Technique sensitive - surgery and provisionalization.
- Failures may provide significant challenges both surgically and restoratively to correct.

Immediate Implant Surgical Placement Criteria:

- Primary implant stability is required for success of treatment: resistance to micromotion of ≤ 30 microns.
- For early loading, require minimum insertion torques of 35 Ncm through to 50 Ncm.
- Require minimal hard and soft-tissue trauma to maximize primary stability and optimize gingival preservation.
- Require knowledge of site anatomy without laying a flap: flapless surgery with a periosteal elevator. Recommend guided surgery.
- Implant platform placement 3 mm apical to the midfacial of the gingival veil (midfacial free gingival margin).
- Maximize engagement of apical bone.
- 1 wall bony defect acceptable.
- 2-3 wall osseous defect: graft only. Immediate implant placement contraindicated.
- Cortical stabilization when feasible, e.g., floor of the nose.
- Maxilla: allow 2 mm distance from outer facial bony profile to facial aspect of the root form implant. Fill any gaps with bony graft material (xenograft) to maintain bony dimensions and future soft-tissue support and profiles following osseointegration.
- Mandible: allow 1.5 mm to 2 mm distance from outer facial bony profile to facial aspect of the root form implant.

Immediate Provisional Options:

1. Removable acrylic partial denture.
2. Provisional fixed partial denture utilizing natural teeth.
3. Provisional Implant Supported Crown: direct or indirect.
4. Custom healing abutment (emergence profile section only of an immediate provisional) plus removable partial denture (no intaglio pressure).

Removable acrylic partial denture:

- Ovate pontic designs unnecessary and undesirable: requires 24/7 wear and increases the potential to transfer adverse forces to the implant platform during integration.
- Adjust the intaglio of the denture pontic to prevent pressure to the underlying tissue and integrating implant.
- Adjust occlusion: no pressure on the pontic.
- Patient to wear the prosthetic only when in public and eating. Not to be worn during sleep.
- Remove for sleeping: clean and place in a container of tap water (cold) with no denture cleaning tablets (these products remove the plasticizer in tissue conditioning materials, rapidly ageing these transitional relines).
- Remove after meal for cleaning.

Custom Healing Abutments:

Custom healing abutments can be constructed from provisional implant components/abutments. These abutments would help to develop/maintain the subgingival emergence profile following tooth extraction and implant immediate placement. A transitional partial denture is still required for social aesthetics. The intaglio of the pontic is adjusted to eliminate force transfer to the healing abutment/implant. Same patient instructions as discussed above.

Provisional fixed partial denture (FPD) utilizing natural teeth:

- Adjust the intaglio of the provisional FPD pontic/s to minimize pressure to the underlying tissue and integrating implant/s.
- *Advantage:* avoids the potential for adverse force transfer to underlying integrating dental implants.

Provisional Implant Supported Crown: direct or indirect.

Objectives:

- Support the soft tissues.
- Develop/maintain the subgingival emergence profile.
- Contain graft.

Provisional Implant Crown:

- Undersize gingival contours to maximize biologic width potential and minimized excessive lateral pressures on immature soft-tissue.
- Zero and/or minimized emergence profile for first 1-1.5 mm then emerge out to desired restorative dimensions at tissue crest.
- Venting: vent the lingual close to the margin and/or double cementing venting technique with a replica/duplicate abutment to minimize the potential for excess cement ingress beyond the margins of the crown, thereby minimizing the potential for bacterial related implant complications and/or failure.
- Single units: take out of occlusion, and no lateral guidance or interfering/non-working contacts.
- Partially edentulous: splinted provisional restorations.
- Completely edentulous: splinted cross-arch stabilization, cement or screw-retained.
- Time frame: deliver up to 1 week from time of surgery. Then leave undisturbed for an additional 6-8 weeks prior to significant modifications.

Indirect Technique: fabrication indirectly on a diagnostic cast. The abutment and crown is then retrofitting intra-orally following implant placement. However, significant adjustments are required, and this may not prove to be an efficient utilization of chair-time. **Consequently, this approach is not recommended**

Direct Technique:

- Transitional/temporary or definitive titanium abutment and fabrication of the provisional crown directly in the patients mouth and completed extra-orally on a laboratory analogue.
- Technique sensitive and significant chair-time required.

Laboratory Fabricated:

- Master cast generated from an implant level impression (use rubber dam to protect surgical site from impression material).
- *Recommended approach.*

Team Approach Protocol/ Recommendations:

- Have an immediate acrylic removable partial denture constructed in advance. This partial denture is to be utilized if implant primary stability is not sufficient for immediate provisionalization, and/or as an interim while the laboratory fabricated provisional is constructed. This way, the patient always leaves the surgical office with transitional tooth replacement.
- Book the patient a few days after the surgery or the following day in the restorative teams office for implant level impressions.

- Take an implant level impression with a rubber dam barrier (utilizing polyvinyl siloxane impression material), opposing, shade and maximum intercuspation record.
- Send to the laboratory for either screw or cement retained provisional fabrication.
- Have up to one week from surgery to delivery the crown (the sooner the more favorable).
- Deliver provisional and have it completely out of occlusion for the partial edentulous and cross-arch stabilization (group function) for the completely edentulous.
- Do not attempt removal during the 2-8 week period.
- At 12 weeks, significant modifications can then be made.
- Following adequate osseointegration, implant level definitive impressions can be taken. Utilize the modified custom impression post technique to transfer the subgingival emergence profile contours/information to the master cast.
- Construct the definitive implant crown/s.

Contraindications:

- Parafunction (Sleep Bruxism).
- Diabetes (uncontrolled).
- Heavy Smokers.
- Immuno-compromised.

Challenges:

- Implant position.
- Implant micromovement.
- Soft-tissue marginal heights/position may not be stable: may experience significant changes during the osseointegration phase.
- Immediate function/loading: if avoidable, still the preference.