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Loading Dental Implants in Augmented Bone

To place an implant, a minimum bone dimension is required. Bone grafting has been one treatment modality used to overcome shortages in bone dimensions. Timing of implant placement and restoration is critical to the success of implants in grafted bone. This issue of Report on Prosthodontics reviews the literature to determine when implants should be placed and/or restored in bone-grafted sites.

Loading Protocols: A Systematic Review and Meta-analysis

Although immediate loading and immediate implant placement to improve esthetics have become popular, the literature regarding loading protocols for sinus-augmented sites is limited. Given the lack of long-term data and the absence of randomized controlled trials (RCTs) or studies with large numbers of patients, clinicians must look to the literature about nonaugmented bone for predictors that could help them decide whether a site might be acceptable for immediate loading.

In a systematic review and meta-analysis, Benic et al from the University of Zurich, Switzerland, examined immediate, early and conventional loading implants. An electronic and manual search identified 11 RCTs comprising 597 implants. Of these, 10 studies directly com-

pared immediate and conventional loading protocols, and 1 compared immediate loading and early loading. The authors noted that a high degree of implant stability was required for successful outcomes in immediate and early loading protocols. The reviewed studies evaluated implants with insertion torques of 20 Ncm to 45 Ncm or an implant stability quotient (ISQ) of 60 to 65.

In a study of immediately restored single implants, 9 of 10 immediately restored implants placed with an insertion torque of only 20 Ncm failed vs 1 of 10 inserted with a torque of 32 Ncm. The implant survival was

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“independent of implant length, site, bone quality, and quantity.” The authors concluded that an insertion torque of 32 Ncm was necessary to achieve osseointegration.

In another study examining insertion torque, where implants were placed with a torque either between 25 Ncm and 35 Ncm or >80 Ncm, there was significant difference in the survival rates of the 2 groups. Implants placed at the lower torque values were more likely to fail than were those placed at the higher torque values.

However, reports have also shown that immediately placed implants restored with low insertion torques (≤ 25 Ncm) have high survival rates. ISQ measurements from resonance frequency analysis have shown mixed results as well, leading to a lack of correlation between insertion torque and ISQ readings.

The authors concluded that the results regarding the minimum insertion torque and ISQ values necessary to achieve osseointegration were inconclusive. More research is needed in this area to find a predictor for osseointegration and establish clinical recommendations.

Benic GI, Mir-Mari J, Hämmerle CHF. Loading protocols for single-implant crowns: a systematic review and meta-analysis. Int J Oral Maxillofac Implants 2014;29(suppl):222-238.

Implant and Provisional Placement Protocols in Augmented Bone

As treatment protocols develop, it is important to determine how these procedures might influence implant success. To reduce treatment times and improve esthetic outcomes, the treatment strategy of early loading dental implants in non-augmented sites has gained popularity.

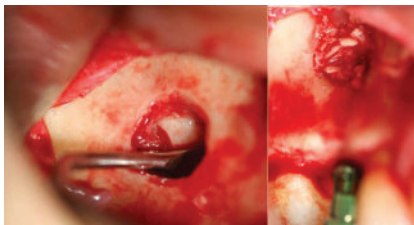


Figure 1. A sinus lift procedure. Left, sinus lift; right, implant placed and Puros graft in place. (Images courtesy of Dr. Lisa Lang.)

In augmented sites, the question arises as to when an implant can be placed and loaded. Lang et al

from Case Western Reserve University School of Dental Medicine, Ohio, examined the time of implant placement and restoration in sinus elevated augmented bone.

The 62 participants had had a previous extraction in the maxilla; none of the implants were placed immediately after extraction. All had opposing occlusion, and all received a single 13-mm implant. They were assigned to 1 of 4 groups depending on the amount of native bone, to allow for outcomes to be examined based on a ratio of native to augmented bone: G1 (<50%:>50%), G2 (>50%:<50%), G3 (100%:0%) and G4 (<50%:>50%). The authors employed the following 4 treatment protocols:

- **G1:** Sinus grafting, 6-month healing period, implant placement and immediate provisional crown ($n = 4$)
- **G2:** Simultaneous sinus grafting, implant placement and immediate provisional crown ($n = 19$)
- **G3:** No bone augmentation, implant placement and immediate provisional crown ($n = 20$)
- **G4:** Sinus grafting, 6-month healing period, implant placement, 6-month healing period, restoration ($n = 19$)

A lateral window approach was used for the sinus lift (Figure 1). A 35-Ncm insertion test evaluated whether an implant could be immediately provisionalized with a non-occluding crown. If the implant did not reach this threshold, it was not immediately provisionalized. Figure 2 shows a patient preoperatively, after immediate provisionalization at implant placement and the definitive restoration.

Crestal bone height was measured and recorded to determine mean bone changes, and success rates were verified. Two implants in G1 did not meet the 35-Ncm insertion test, 1 implant failed within 1 month of implant placement and 1 patient withdrew from the study. Mean bone levels were not statistically different among patients in G2, G3 or G4. Neither the timing of loading nor the timing of implant placement in relation to bone augmentation surgery affected mean bone loss.

The 1-year implant survival was 86% (12/14), 95% (19/20) and 100% (16/16) for G2, G3 and G4, respectively. There was no statistical difference in survival among these groups ($p < .05$); however, a nonsignificant trend suggested that timing of sinus augmentation and implant placement



Figure 2. (A) Preoperative oral condition. (B) Provisional made on day of surgery. (C) Definitive porcelain-fused-to-metal implant crown. (Images courtesy of Dr. Lisa Lang.)

in relation to the timing of crown placement did affect implant survival. Implants restored immediately, regardless of the timing of bone augmentation, showed greater failure rates than did implants in augmented bone with delayed restoration protocols or those restored immediately in sites without bone augmentation.

Lang LA, Edgin WA, Garcia LT, et al. Comparison of implant and provisional placement protocols in sinus-augmented bone: a preliminary report. *Int J Oral Maxillofac Implants* 2015;30:648-656.

Outcomes of Immediately Placed Implants in Augmented Bone

Various healing guidelines exist for implant placement and restoration after sinus bone augmentation. Because such guidelines have been based on different variables, it can be difficult to determine the standard of care. Kim et al from Seoul National University Bundang Hospital, South Korea, compared the survival of implants loaded 4 months vs 6 months after simultaneous sinus elevation and implant placement surgery.

All surgeries were performed by 1 oral maxillofacial surgeon. The 28 patients were nonsmokers in good general health with no parafunctional habits such as bruxism. The patients were assigned randomly to the 4-month or 6-month healing groups ($n = 14$ each). However, 1 patient dropped out of the 6-month group prior to implant placement. A total of 61 implants were placed in the 27 patients.

Surgery was performed under local anesthesia or intravenous sedation. Sinus elevation surgeries were performed using a lateral window approach with xenogenic bone graft material. After the implants were placed, they were measured for primary stability using an Ostell Mentor. Implants with implant stability quotient (ISQ) <60 re-

ceived a cover screw, while those with ISQ ≥ 60 received healing abutments. After the implants were placed, additional grafting material was deposited through the lateral window, a resorbable collagen membrane was laid and the wounds were sutured.

One implant failed and was removed and immediately replaced. The replaced implant and all other implants survived until the final recall. One year after restoration, crestal bone losses between the 2 groups were not statistically different. The width of keratinized tissue, gingival index, plaque index and pocket depth were also not statistically different. The primary stability was not statistically different; however, the secondary stability was statistically higher in the 4-month group ($p = .026$). The authors concluded that loading could be performed 4 months after sinus bone grafting and simultaneous implant placement with results equivalent to those obtained with loading at 6 months.

Kim Y-K, Kim S-G, Park J-Y, et al. Comparison of clinical outcomes of sinus bone graft with simultaneous implant placement: 4-month and 6-month final prosthetic loading. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2011;111:164-169.

Immediate Provisionalization Of Immediate Implants

In a prospective case series of immediate provisionalization of immediately placed implants in the esthetic zone, Levin from the University of Pennsylvania School of Dental Medicine and Wilk, a private practitioner from Pennsylvania, examined implant survival, esthetics and bone maintenance of 27 consecutively treated patients (29 implants). All implants were placed in the anterior esthetic region of the mouth (first premolar to first premolar region). All patients required ≥ 1 tooth extractions.

After atraumatic extraction and debridement of the site, an osteotomy was performed. The surgeon attempted to engage the palatal/lingual and apical bone for primary stability. Bone grafting was performed in all cases. Provisional restorations were made either directly or indirectly, with the restorations placed out of occlusal function. All provisionals were placed the day of immediate implant surgery and were not removed for ≥ 8 weeks.



Final restorations consisted of custom zirconia or titanium abutments and cement-retained restorations.

The authors reported a 100% survival rate with no restorations lost. After a loading period of 1 year, there was no bone loss >1 mm. Radiographically, the proximal bone level was at or above the head of the implant in 25 of the 29 implants. No periapical pathologies or need for revision surgery were noted. All patients were satisfied with the esthetics of their restorations.

The authors concluded that the planning of all cases is critical to achieving success. To obtain primary stability and function, prosthetically planned and positioned implants must be adjunct procedures. The implant and provisional restoration should be undisturbed for ≥8 weeks. These 2 basic principles were used in the treatments, and the authors believed them to be the keys to their success.

Levin BP, Wilk BL. Immediate provisionalization of immediate implants in the esthetic zone: a prospective case series evaluating implant survival, esthetics, and bone maintenance. Compend Contin Educ Dent 2013;34:352-361.

Sinus Floor Elevation with Immediately Loaded Postextraction Implants

Alveolar ridges with reduced vertical bone volume often require sinus augmentation surgery before dental implants can be placed. When 5 mm of residual bone exists, the osteotome technique may be used. In a 2013 case report, Mandelli et al from the University of Milano, Italy, described the treatment of a patient with 2 compromised maxillary posterior teeth that were replaced postextraction with 2 immediately loaded implants following transcrestal sinus floor elevation.

Their patient, a 50-year-old woman, presented with a chief complaint of pain in the left first premolar and mobility in the second premolar. Both teeth had been endodontically treated previously. Examination and radiographs revealed class II mobility on tooth #13, periapical radiolucencies at the apices of both teeth, widened periodontal ligaments and an unfavorable crown-to-root ratio.

The agreed-upon treatment plan was to extract both teeth and place dental implants.

Under local anesthesia, both teeth were atraumatically extracted. After inspection for fenestration or dehiscence, the sites were drilled for implant placement to 1 mm from the Schneiderian membrane. Using osteotomes, the sinus floor was raised and a xenograft was inserted into the osteotomy, followed by the placement of the 2 dental implants. Primary stability was evaluated to ensure a torque >40 Ncm.

With primary stability obtained, the clinicians proceeded with the fabrication of provisional crowns. The crowns were out of occlusion; loading occurred only during clenching or with a bolus between the opposing teeth. After 5 months of healing, the final restorations were fabricated. The healing period was uneventful. Radiographic images after final restoration showed maintenance of the bone levels around the implant platform. The intrasinus areas exhibited graft remodeling. The treatment was deemed successful.

Mandelli F, Ghensi P, Vinci R, Mandelli G. Sinus floor elevation with crestal approach and immediately loaded post-extraction implants. J Indiana Dent Assoc 2013;92:22-24.

In the Next Issue:

- Bar vs ball attachment
- Locator vs bar attachment
- Evaluation of mandibular implant overdentures
- Patients' quality of life after implant-supported mandibular overdentures

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