

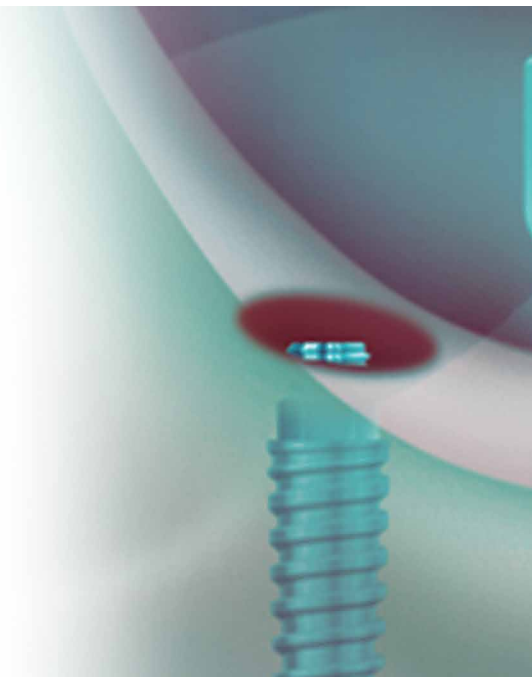
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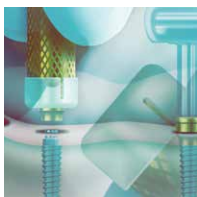
The use of narrow-diameter dental implants to support mandibular overdentures:
A prospective clinical study

Francesco Amato, MD, DDS, PhD and Giorgio Polara, DDS

The use of narrow-diameter dental implants to support mandibular overdentures: A prospective clinical study



Francesco Amato, MD, DDS, PhD† and Giorgio Polara, DDS



The aim of this study was to investigate the performance of and patient satisfaction with immediately loaded narrow-diameter implants used to anchor mandibular overdentures. Two or four narrow-diameter implants were placed, abutments were connected, and existing dentures were modified and immediately inserted. No complications or failures occurred among the 24 implants that were placed to support 10 mandibular overdentures, and patients reported being highly satisfied.

Key Words: implants, edentulous, narrow-diameter implants, clinical study

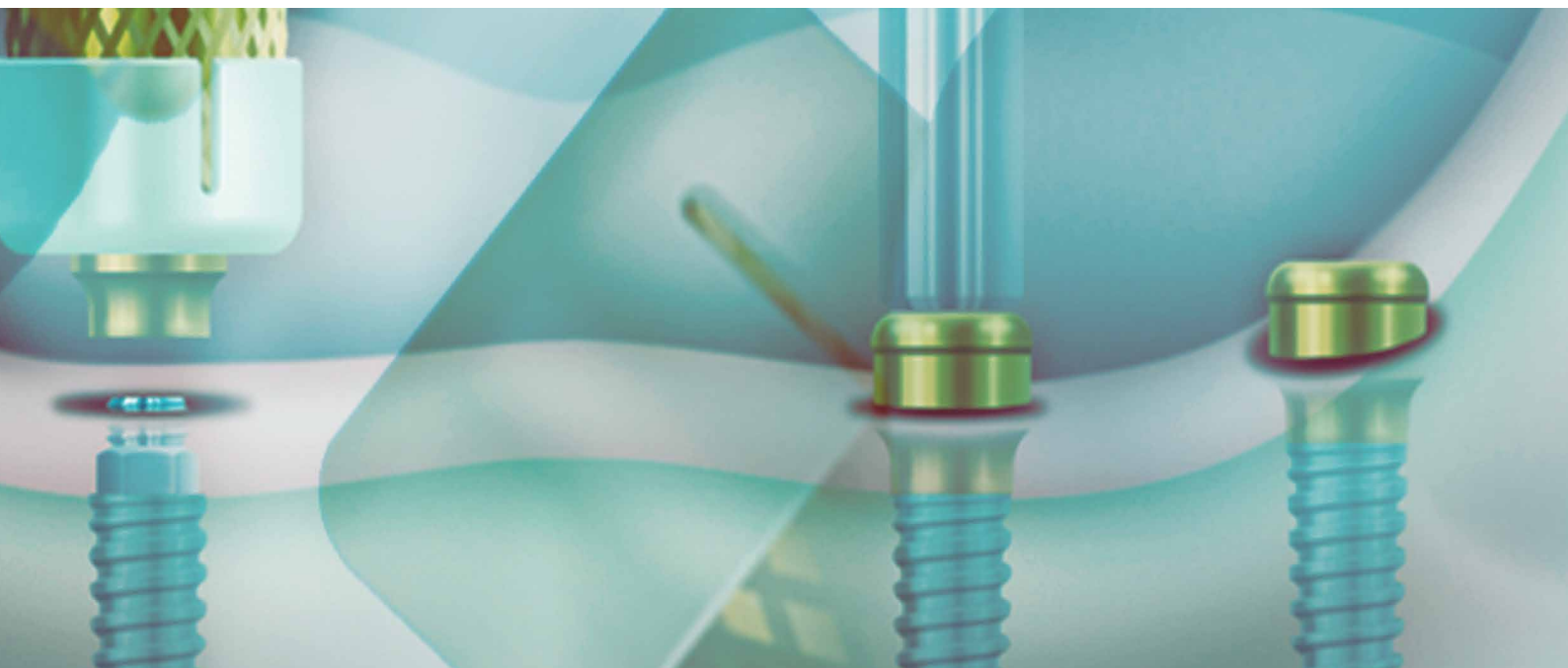
Introduction

It has been estimated that by the year 2035, more than 20% of the U.S. population will be 65 or older.¹ Marcus et al documented a close relationship between age and complete edentulism.² While the standard therapeutic option for rehabilitating complete edentulism has been the conventional denture, in a large number of cases this does not satisfy patient expectations.³ Problems related to the lack of stability of mandibular dentures often have a negative effect on patients' quality of life.⁴

A valid alternative to conventional mandibular dentures is the use of implant overdentures, which are more stable, functionally efficient, and comfortable.⁵⁻⁷ However, patients who have worn complete dentures for several years often develop a severe degree of alveolar atrophy that makes placement of standard-sized implants impossible unless regenerative procedures are also employed. Such

procedures typically require multiple invasive surgeries. This often discourages patients from receiving treatment. Elderly patients in particular may have economic and/or psychological issues impeding treatment acceptance.⁸ They also often develop chronic systemic diseases (such as diabetes, osteoporosis, cardiovascular disease, etc.) requiring specific medications that may be contraindications for surgeries.⁹

The possibility of shortening treatment time and having implants placed with less invasive surgery thus represents a valuable opportunity for these patients.^{10,11} The use of small-diameter implants (also known as mini or narrow-diameter implants) offers one way to achieve this. Root-form implants with a diameter of less than 3mm were first introduced in the early 1990s as a transitional measure, supporting provisional prostheses while standard-



diameter implants healed.^{12,13} However, the immediately loaded small-diameter implants themselves often osseointegrated,^{14,15} suggesting that they might be used to support definitive restorations.¹⁶⁻¹⁸ In 1997, the Food and Drug Administration cleared their long-term use.

The smaller diameter offers several advantages. Placement is simpler, less invasive, and more cost-effective as compared to standard-diameter implants. Small-diameter implants can be used to rehabilitate atrophic edentulous mandibles with a single surgery, enabling treatment to be completed in one day.¹⁹⁻²¹ The present study was undertaken to evaluate the ability of narrow-diameter implants to support mandibular overdentures and improve the quality of life for patients in a clinical practice.

Materials and Methods

Between December 2012 and September 2014, ten consecutive edentulous patients who were experiencing significant discomfort due to unstable mandibular dentures were enrolled in the study. The main inclusion factors were insufficient posterior bone height (less than 7mm) and inadequate ridge thickness (less than 5mm) in the intraforaminal region. Neither smoking nor severe systemic disorders were exclusion criteria.

Each patient received a complete intraoral examination and a cone-beam computed tomographic (CBCT) scan. Bone quality was categorized as one of four types according to

Lekholm and Zarb.²² Impressions were made, and interarch relationships were recorded in order to mount study casts in an articulator. If possible, the existing complete mandibular dentures were to be re-used by picking up the attachment housings (denture caps) chairside.

Twenty-four hours before surgery, each patient was instructed to start systemic antibiotic prophylaxis (amoxicillin 1g twice a day for six days) and rinse with mouthwash (0.20% chlorhexidine). Local anesthesia was induced with articaine 4% with adrenaline (1:100,000) in the vestibular and lingual areas and adrenaline (1:50,000) on the incision line.

The implants were 2.4mm or 2.9mm in diameter and 10mm, 12mm, or 14mm in length. When the crest was wider than 4mm, and there was an adequate band of keratinized tissue, a flapless approach was preferred. Either two or four narrow-diameter implants (ZEST LOCATOR® Overdenture Implant (LODI) System, distributed by BIOMET 3i, Palm Beach Gardens, Florida) were inserted in the intraforaminal area. All implants were inserted with a minimum distance between the implants of 10mm. They were placed in the mandible, at least 7mm anterior to the mental foramen to avoid the mesial loop of the mental nerve.²³

All osteotomies were prepared using a piezoelectric surgical unit first and then following the drilling protocol

Study Duration		Average Follow-Up	
27 Months		15.2 Months	

No. of Implants	24	Bone Quality	10 Cases	Insertion Torque	No. of Implants	Survival Rate	100%
2-implant cases	8	Type I	6	A (50–70Ncm)	14	maxilla	N/A
		Type II	3	B (30–<50Ncm)	10		
4-implant cases	2	Type III	1	C (<30Ncm)	0	mandible	100%
		Type IV	0				

Table I. Results of the narrow-diameter implant treatment after an average of 15.2 months of follow-up.

suggested by the manufacturer; taking care to underprepare the diameter by at least 0.5mm. The implants were inserted using the motor unit. Final seating was achieved using a calibrated torque hand ratchet to a final insertion torque between 30 and 70Ncm.

LOCATOR® Abutments were connected to the implants and torqued to 30Ncm, following the manufacturer’s protocol. The cuff height of the abutment (2.5mm or 4mm in height) was chosen depending upon the mucosal thickness and available interarch space.

The attachment housings (denture caps) were picked up in the denture with autopolymerizing acrylic resin. The patient was asked to close and was guided into centric occlusion, holding the position until complete setting of the resin. The occlusion was adjusted, and the patient’s function with the denture was assessed. The denture was then removed, adjusted, polished, and returned to the patient’s mouth.

Patients were instructed to consume a liquid diet for the first week. After that, no limitation or restriction in the diet was required.

Patients were checked once a month in the first three months and then once every six months. At the follow-up visits, peri-implant health was checked for bleeding on probing or any sign of inflammation. Radiographs were taken to evaluate bone loss. Implants were considered to be successful if they were stable, with no signs of mucositis, and if the bone levels were stable.

One month after delivery of the prosthesis, patients were asked to complete a standardized evaluation form assessing the efficacy of overdentures retained by narrow-diameter implants. Questions assessed such areas as eating and speaking ability, facial appearance, and satisfaction during daily social life.

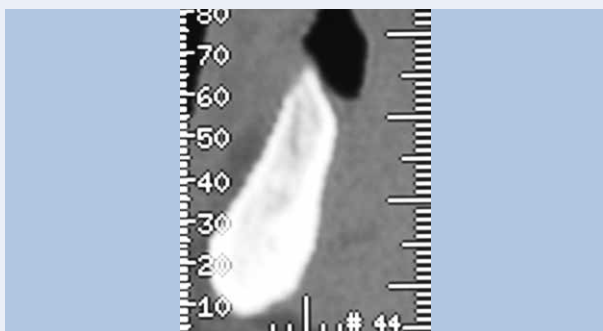


Fig. 1. A cross-sectional slice of the CT scan in the planned locations of the implants revealed inadequate crestal bone width for a standard-diameter implant.



Fig. 2. Intraoral occlusal view showing a severely resorbed edentulous mandible.

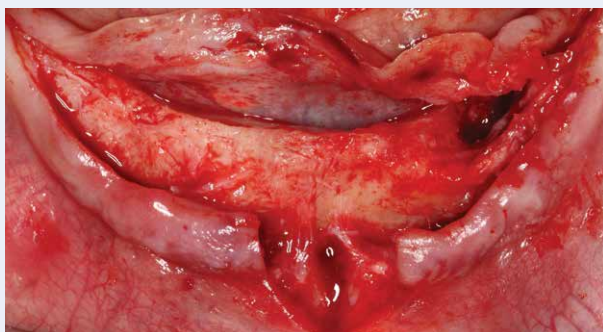


Fig. 3. A midcrestal incision with vertical releasing incisions was made to expose the ridge.

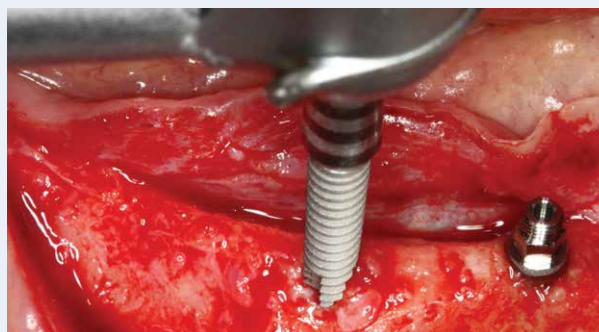


Fig. 4. The osteotomies were prepared following the manufacturer's protocol, and two LODI Implants (2.9mm D x 12mm L) were placed.

Figures 1-12 illustrate typical use of LODIs to treat a patient who presented with a severely resorbed edentulous mandible.

Results

The ten patients (two males and eight females) ranged in age from 65 to 80. Because of the investigators' initial lack of experience with the LODI system, the first two patients received four narrow-diameter implants to minimize the risk of failure due to overloading. After that, only two narrow-diameter implants were placed in each patient. A total of 24 mandibular narrow-diameter implants were thus inserted.

The bone quality in six patients was judged to be Type 1, in three patients it was Type 2, and in one patient it was Type 3. Insertion torque for 14 of the implants was between 50 and 70Ncm. For the other ten implants, the insertion torque was between 30 and 49Ncm (Table 1).

For all ten patients, it was possible to use their existing dentures. No signs or symptoms of postoperative complications were observed.

After an average follow-up period of 15.2 months (range: 3 to 27 months), the success rate was 100%. All ten patients replied that they were "very satisfied" with the degree of improvement in their dentures' stability and mastication force. The full results of the patient responses are shown in Table 2.

Discussion

The use of narrow-diameter implants can overcome a number of impediments to implant-supported overdentures, such as anatomical limitations, psychological resistance, and other contraindications for surgery.²⁴ Shatkin et al, in their retrospective analysis of 2,514 mini implants placed over a five-year period and supporting both fixed and removable prostheses, found a cumulative survival rate of 94.2%.¹⁴ While this was lower than that for standard-

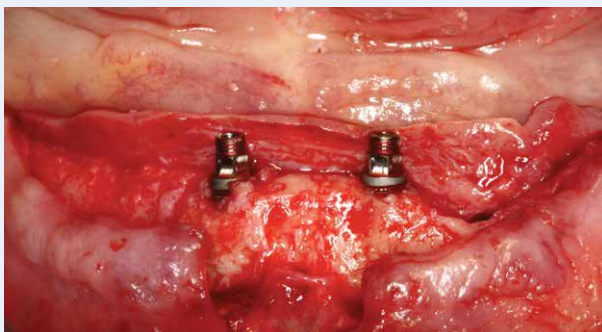


Fig. 5. View of the two LODIs in position, which were placed at the same height.

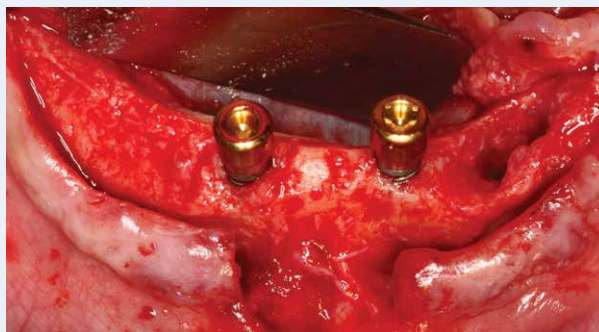


Fig. 6. LOCATOR® Abutments (2.5mm Cuff Height) were placed onto the implants.

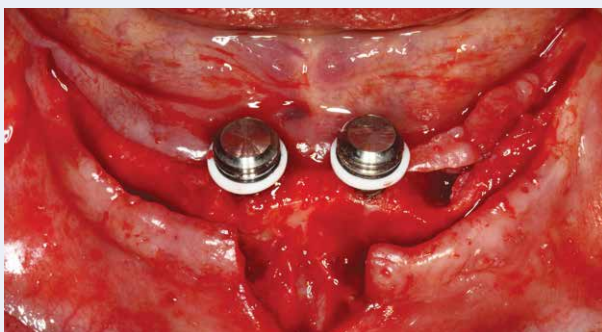


Fig. 7. A Block-Out Spacer Ring (white) was placed around each abutment. A Denture Cap with a Black Processing Male inside was placed onto each abutment.



Fig. 8. The intaglio surface of the pre-existing denture was hollowed out in the locations of the Denture Caps.

diameter implants, the authors attributed the difference to the learning curve for the procedure and concluded that the mini implant survival rate improved with experience.

Tu et al showed how denture fracture could be avoided by including a lingual cast-metal reinforcement in a new mandibular denture. If the patient preferred to use his or her existing denture, the authors stated that a metal framework should be incorporated into the overdenture, and the denture should be relined.²⁵

A literature review published by Klein et al in 2014 included ten articles about narrow (<3.0mm) diameter implants that were followed for between 12 and 96 months.²⁶ In these studies, the implants were placed using both flapped and flapless techniques. In most of the studies, the implants were loaded immediately, in both edentulous arches in lateral incisor positions. Survival rates ranging from 90.9% to 100% were reported.

Similar conclusions were reached by Griffiths et al in a study including 116 mini implants. The final success rate of 97.4% was comparable to standard sized implants.²⁷ Ertugrul and co-workers compared the stress resistance of a narrow-diameter implant to that of a Brånemark standard root-form implant. They found that although the narrow-diameter implants were less stable under the same *in vitro* conditions, they were advantageous because they could be inserted in ridges with sub-optimal bone quantity, using minimally invasive surgery and simpler protocols, and resulting in less morbidity and comparable patient satisfaction.²⁸

When placing narrow-diameter implants, a flapless surgery is preferred whenever possible. Flapless insertion minimizes complications such as swelling, pain, and postoperative discomfort.²⁹ Several authors have reported success rates for flapless implant insertion that are comparable to conventional techniques,³⁰



Fig. 9. An autopolymerizing acrylic resin was applied to the Denture Caps, and the denture was seated with the patient in centric occlusion until the resin set.



Fig. 10. The patient left the clinic with the mandibular implant-retained overdenture in place opposing a maxillary denture.



Fig. 11. The soft-tissue healed nicely around the LOCATOR® Abutments. The patient was pleased with the increase in retention for the denture.

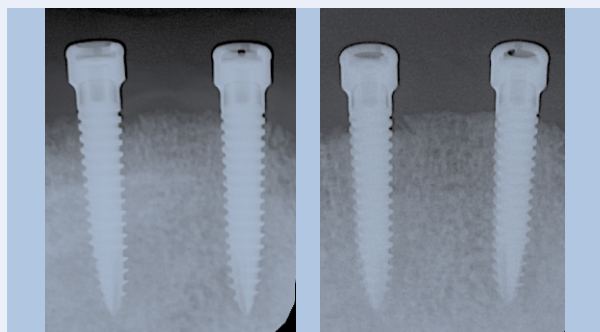


Fig. 12. The periapical radiograph on the left was taken at the time of implant placement to serve as a baseline. The radiograph on the right was taken at the two year follow-up.

with a lower incidence of inflammation and earlier re-epithelialization.³¹ When the amount of available bone is limited, however, flap elevation facilitates implant placement, optimizing bone exposure and reducing the risk of implant fenestration.

All the patients recruited in the present study accepted treatment with LODIs to improve their function and comfort. The results regarding their satisfaction with the functional and aesthetic results were similar to those reported by other authors.³²⁻³⁴

Clinical Relevance

Within the limitations of this study, the use of immediately loaded LODIs to support mandibular overdentures appeared to be a valuable option for treating edentulous patients with severe mandibular atrophy. The use of narrow-diameter implants can simplify the treatment of challenging cases such as those in which

severe bone atrophy is present. Such implants can be placed with minimally invasive surgical procedures and can enable patients to be rehabilitated with immediately loaded implant-retained, tissue-supported overdentures in a single visit. Providing patients with an immediate improvement in comfort and function can improve their quality of life and social relationships, leading to an increase of implant-treatment acceptance by the elderly population.

References

1. Projection of the population by selected age groups and sex for the United States: 2010 to 2050. Washington, DC: US Census Bureau Population Division; August 14, 2008.
2. Marcus SE, Drury JF, Brown LS, et al. Tooth retention and tooth loss in the permanent dentition of adults: United States, 1988-1991. *J Dent Res* 1996;75 (spec issue):684-695.
3. Thomason JM, Lund JP, Chehade A, et al. Patient satisfaction with mandibular implant overdentures and conventional dentures 6 months after delivery. *Int J Prosthodont* 2003;16:467-473.

How do you feel about:	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
The improvement in your denture's stability?					10
The improvement in your chewing force?					10
The improvement in your social life?				4	6
The improvement in your ability to chew food?				1	9
Your overall experience with the surgery?		1	1	3	5
Your overall satisfaction after one month of denture wearing?				2	8

Table 2. Patient evaluations.

4. Redford M, Drury TF, Kingman A, et al. Denture use and the technical quality of dental prostheses among person 18-74 years of age: United States, 1988-1991. *J Dent Res* 1996;75 (Spec. no.):714-725.
5. Adell R, Lekholm U, Brånemark PI. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. *Int J Oral Surg* 1981;10:387-416.
6. Feine JS, Clarsson GE, Awad MA, et al. The McGill consensus statement on overdentures. Mandibular two-implant overdentures as first choice standard of care for edentulous patients. *Int J Oral Maxillofac Implants* 2002;17:601-602.
7. Feine JS, Maskwi K, de Grandmont P, et al. Within-subject comparisons of implant-supported mandibular prostheses: evaluation of masticatory function. *J Dent Res* 1994;73:1646-1656.
8. Kiyak HA, Beach BH, Worthington P, et al. Psychological impact of osseointegrated dental implants. *Int J Oral Maxillofac Implants* 1990;5:61-69.
9. Bornstein MM, Cionca N, Mombelli A. Systemic conditions and treatments as risks for implant therapy. *Int J Oral Maxillofac Implants* 2009;24 (Suppl):12-27.
10. Flanagan D, Mascolo A. The mini dental implant in fixed and removable prosthetics: A review. *J Oral Implantol* 2011;37:75-83.
11. Zadeh HH, Daftary F. Minimally invasive surgery: An alternative approach for periodontal and implant reconstruction. *J Calif Dent Assoc* 2002;93:42-46.
12. Flanagan D. Implant-supported fixed prosthetic treatment using very small-diameter implants: A case report. *J Oral Implantol* 2006;32:34-37.
13. Davarpanah M, Martinez H, Tecucianu JF. Small-diameter implants: Indications and contraindications. *J Esthet Dent* 2000;12:186-194.
14. Shatkin TE, Shatkin S, Oppenheimer BD, et al. Mini dental implants for long-term fixed and removable prosthetics: A retrospective analysis of 2514 implants placed over a five year period. *Compend Contin Educ Dent* 2007;28:92-99.
15. Chopra P, Chopra P, Grover HS. Mini dental implants-The same day implants. *Int J Contemp Dent* 2011;2:89-94.
16. Vigolo P, Givani A, Majzoub Z. Clinical evaluation of small-diameter implants in single-tooth and multiple-implant restorations: A 7-year retrospective study. *Int J Oral Maxillofac Implants* 2004;19:703-709.
17. Vigolo P, Givani A. Clinical evaluation of single tooth mini-implant restorations: A five-year retrospective study. *J Prosthet Dent* 2000;84:50-54.
18. Christensen GJ. The mini implant has arrived. *J Am Dent Assoc* 2006;137:387-390.
19. Flanagan D. Fixed partial dentures and crowns supported by very small diameter dental implants in compromised sites. *Implant Dent* 2008;17:182-191.
20. Gibney JW. Minimally invasive implant surgery. *J Oral Implantol* 2001;27:73-76.

21. Campelo LD, Camara JR. Flapless implant surgery: A 10-year clinical retrospective analysis. *Int J Oral Maxillofac Implants* 2002;17:271-276.
22. Lekholm U, Zarb GA. Patient selection and preparation. In: Branemark PI, Zarb GA, Albrektsson T (eds.) *Tissue Integrated Prostheses: Osseointegration in Clinical Dentistry*. Chicago: Quintessence, 1985:199-209.
23. Greenstein G, Tarnow DP. The mental foramen and nerve. Clinical and anatomical factors related to dental implant placement: A literature review. *J Periodontol* 2006;77:1933-1943.
24. Vojvodic D, Celebic A, Mehulic K, et al. Prosthetic rehabilitation of a patient with mandibular resection prosthesis using mini dental implants (MDIs) - Case report. *Col Antropol* 2012;36:307-311.
25. Tu C-Y, Lin L-D, Wang T-M, et al. Using mini dental implants to improve the stability of an existing mandibular complete denture in a patient with severe ridge resorption. *J Prosthodont Implantol* 2012;148-152.
26. Klein MO, Schiegnitz E, Al-Nawas B. Systematic review on success of narrow-diameter dental implants. *Int J Oral Maxillofac Implants* 2014;29(suppl):43-54.
27. Griffiths TM, Collins CP, Collins PC. Mini dental implants: An adjunct for retention, stability, and comfort for the edentulous patient. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2005;100:e81-e84.
28. Ertugrul HZ, Pipko DJ. Measuring mobility of 2 dental implant fixtures of different configurations: An in vivo study. *Implant Dent* 2006;15:290-297.
29. Sohrabi K, Mushantat A, Esfandiari S, et al. How successful are small-diameter implants? A literature review. *Clin Oral Implant Res* 2012;23:515-525. doi: 10.1111/j.1600-0501.2011.02410.x. Epub 2012 Feb 7.
30. Berdougou M, Fortin T, Blanchet E, et al. Flapless implant surgery using image-guided system. A 1- to 4-year retrospective multicenter comparative clinical study. *Clin Implant Dent Relat Res* 2010;12:142-152.
31. Naert I, Koutsikakis G, Duyck J, et al. Biologic outcome of implant supported restorations in the treatment of partial edentulism. Part I: A longitudinal clinical evaluation. *Clin Oral Implants Res* 2002;13:381-389.
32. Preoteasa E, Marin M, Imre M, et al. Patients' satisfaction with conventional dentures and mini implant anchored overdentures. *Rev Med Chir Soc Med Nat Iasi* 2012;116:310-316.
33. Locker D. Patient-based assessment of the outcomes of implant therapy: A review of the literature. *Int J Prosthodont* 1998;11:453-461.
34. Muller F, Hasse-Sander I, Hupfaut L. Studies on adaptation to complete dentures. Part I: Oral and manual motor ability. *J Oral Rehabil* 1995;22:501-507.

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[†] *The contributing clinician has a financial relationship with BIOMET 3i LLC resulting from speaking engagements, consulting engagements, and other retained services.*

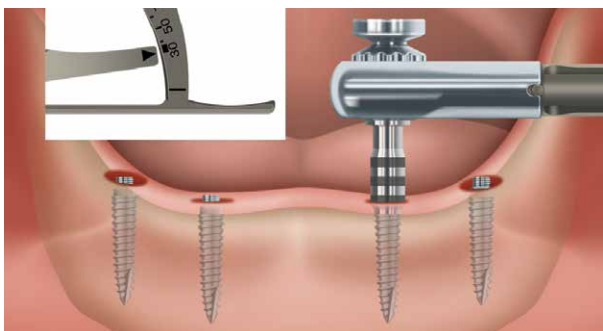
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Technical Insights

Implant Placement and Direct Technique: Chairside Processing

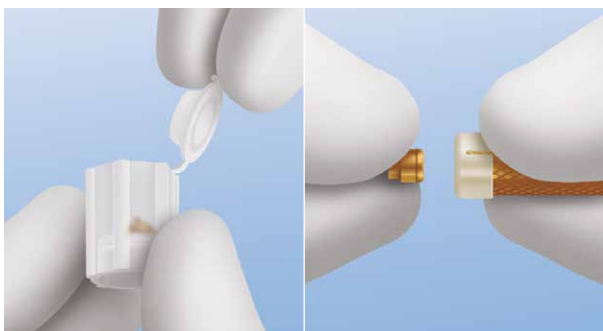
The LOCATOR® Overdenture Implant (LODI) System is comprised of narrow-diameter dental implants with a detachable LOCATOR Abutment. LODIs are used to restore masticatory function for the patient and may be suitable for immediate function if sufficient primary stability of the implants is achieved at the time of placement. Excerpts from the Technique Manual are illustrated below.*



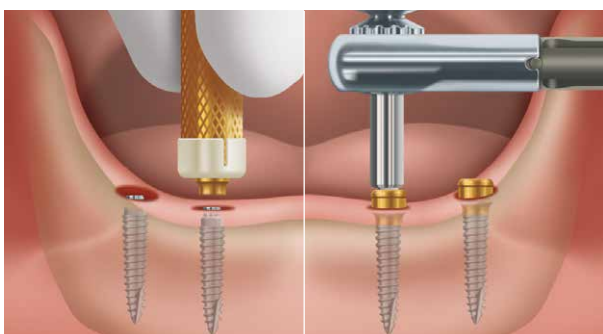
Position the Implant Driver onto the hex on the top of the implant, and verify that it is fully engaged.

Slowly ratchet the implant to full depth. If the final seating torque measures 30Ncm or above, the implant may be immediately loaded.

NOTE: If the final seating torque measures below 30Ncm, the denture acrylic should be relieved and a soft liner should be placed around the LOCATOR Abutments during the integration period.

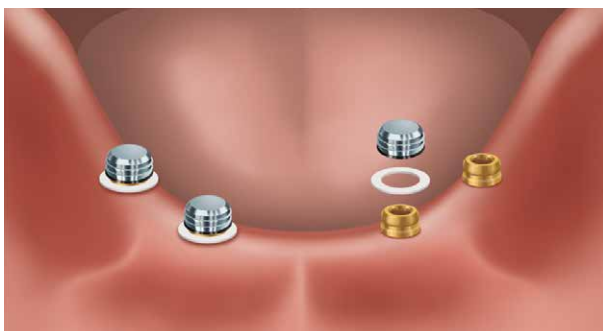


Open the flip top on the vial cap and remove the LOCATOR Abutment. Place the Abutment Holder Sleeve onto the LOCATOR Abutment Driver. Place the abutment into the Abutment Holder Sleeve to securely carry it to the mouth.

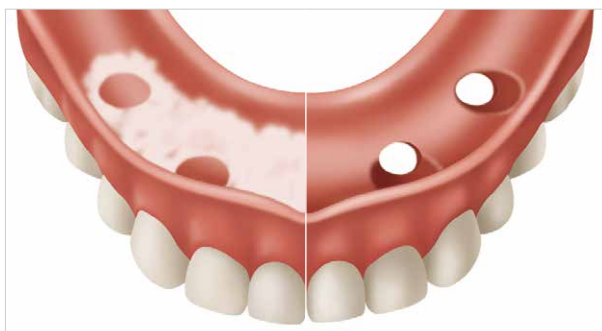


Thread the LOCATOR Abutment onto the implant. If the implant-placement torque was 30Ncm or greater, the abutment may be tightened using the LOCATOR Abutment Torque Driver insert. Place the insert into the Torque Ratchet Wrench, connect the driver to the abutment, and verify it is fully engaged. Torque the abutment to 30Ncm.

NOTE: If the implant placement torque did not reach 30Ncm, the abutments should only be hand tightened.

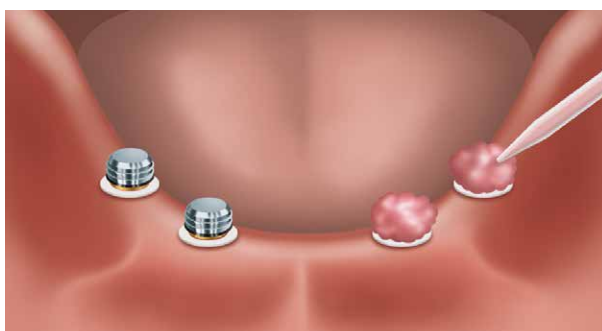


Place a White Block Out Spacer Ring around each abutment, and press down until it stops. Place a Denture Cap with a Black Processing Male inside of it onto each abutment, and press down firmly.



Apply fit-check marking paste to the intaglio surface of the denture. Insert it into the mouth in position over the Denture Caps to mark the areas where the denture will need to be relieved to allow space for the Denture Caps to be picked up.

Relieve the areas marked, and try-in the denture to verify that the Denture Caps are not in contact with the acrylic. Drill lingual/palatal vent holes in the denture to visualize full seating and allow excess acrylic to vent.

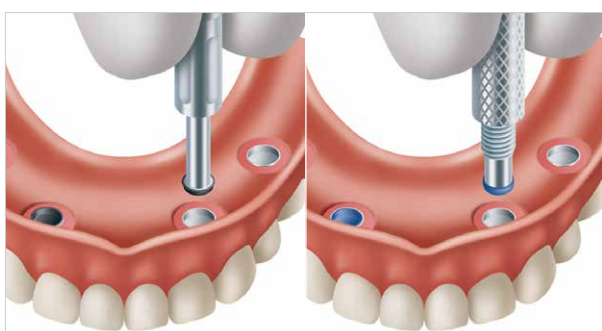


Dry the Denture Caps and apply a small amount of CHAIRSIDE™ Abutment Processing Material around the circumference of each Cap. Fill the recesses in the denture two-thirds of the way with the CHAIRSIDE Material, and seat over the Caps. Have the patient close into light centric occlusion while the material sets.

NOTE: Do not allow the patient to overcompress the denture on the soft tissue. Excessive occlusal pressure during the setting time may cause tissue recoil against the denture base and could contribute to dislodging and wear of the LOCATOR® Males.



Remove the denture from the mouth, and verify that the Denture Caps have been securely processed into the denture. Fill any voids, cure, and polish.



Utilize the Male Removal portion of the LOCATOR 3-in-1 Core Tool to remove the Black Processing Male. Place the selected Final Male into each Denture Cap using the Male Insertion Tool (also included with the LOCATOR 3-in-1 Core Tool). Insert the lowest retentive option during try-in.



Seat the denture in the mouth, and press down to engage the Males on the LOCATOR Abutments and verify the occlusion. Instruct the patient on how to remove and insert the denture. If the retention is not satisfactory, remove the Males and replace with the next level of retention. Instruct the patient on proper home care maintenance and required recare visits.

* To view the detailed Technique Manual, please refer to INST1247 at www.ifu.biomet3i.com