

Mini-Implants, Mega Solutions: A Case Series

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Abstract

Dental implants have evolved as a standard of care for replacement of missing teeth. Though this treatment modality promises a high level of patient satisfaction and success, it cannot be performed in all cases. Apart from medically compromised patients, implant use is also restricted whenever there is limited available bone volume at the edentulous site. An example includes the mandibular incisor, the maxillary lateral incisor region, and other sites with reduced interdental spacing and atrophic edentulous maxillary and mandibular ridges. Bone volume at some of these sites can be increased by suitable augmentation procedure for placement of a regular diameter implant (3.75 to 4.2 mm). But many a times such procedure cannot be undertaken either due to financial constraint, risk of subjecting the patient to additional surgical procedure, added time factor, or guarded prognosis of the grafted site. In such cases, mini-implants can be used. In this case series, mini-implants (2.5 to 3 mm) were used to replace teeth in all mouth quadrants and to retain a mandibular overdenture in a compromised case. The implants served well at all the sites with minimal bone loss and a high level of patient satisfaction. Mini-implants hold the potential to serve as an alternate to regular diameter implants in certain situations. Preferably they should be used in multiples to retain fixed dental prostheses and might serve as an efficient, low-cost solution for retaining overdentures in selected cases.

Rehabilitation of missing teeth can be a challenging task in certain clinical situations. Several treatment options currently exist for tooth replacement. These include removable partial dentures, full veneer fixed dental prostheses (FDPs), resin-bonded FDPs, and dental implants. The amount of available bone might act as a limiting factor in treatment planning if implants are the treatment of choice. Replacement in certain areas like maxillary lateral incisors or mandibular incisors with standard diameter implants might be difficult either due to the anatomical features of these teeth or the space available. A reduced buccolingual and mesiodistal dimension may not allow the placement of a standard diameter implant without the risk of implant thread exposure,¹ a hazard to the neighboring teeth, or altering the interproximal bone.² Also, placement of an implant closer than 1.5 mm to the adjacent tooth may result in loss of proximal bone height during healing.³

Standard diameter implants are available in the range of 3.75 to 4.2 mm. Some very thin residual ridges will not accept these implants without site development. Often, grafting procedures can be accomplished if the patient desires this form of treatment. If bone grafting is planned, then there is some debate regarding the true supportive quality of grafted bone.⁴ Implant support depends on cortical bone. Extracortical grafted bone has been

known to resorb after placement. Bone formed in grafted areas can become trabecular, but there is no evidence that grafted bone progresses to cortical bone.⁴

When anatomical limitation of the edentulous site precludes standard diameter implant placement and the added surgical procedure, cost, and time along with the questionable outcome of grafted bone is of concern, then a narrow diameter implant may be considered as an alternate. These include small diameter implants available in a range from 3.0 to 3.3 mm and very small or “mini” 1.8 to 3 mm diameter implants.⁵

Mini-implants are indicated in situations with reduced amount of interradicular bone, narrow ridges, or reduced mesiodistal prosthetic space,⁶ which is often found in clinical situations such as congenitally missing incisors, lost retained primary incisors, space collapse in anterior area with a lack of orthodontic therapy, missing mandibular incisors, or reduced interdental space after orthodontic movements.⁷ Though these mini diameter implants serve as a treatment option in compromised sites, the smaller surface area and volume of these implants places more force per square millimeter against the encasing bone than larger diameter implants, and occlusal force control is needed.⁵ They should be used in low force areas like the mandibular incisor region or maxillary lateral incisor



Figure 1 Missing mandibular incisors. Edentulous ridge is deficient in width.

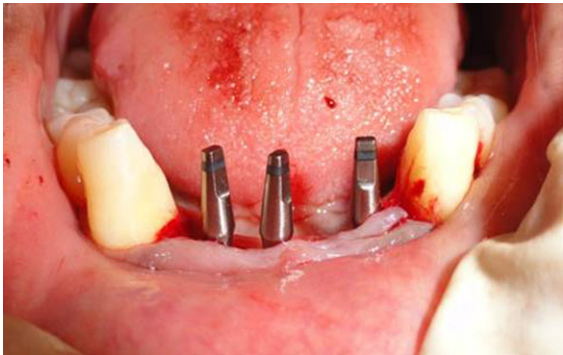


Figure 2 Three one-piece mini-implants placed in relation to missing #31, 41, 42 (FDI notation).



Figure 3 Radiograph showing the mini-implants in place after 14 weeks of placement. There is no evident bone loss around the implants.



Figure 4 Definitive PFM FPD cemented in place.



Figure 5 Two mini-implants placed in maxillary anterior region after 5 months of insertion.



Figure 6 Occlusal view of prepared implant abutment in relation to #24.



Figure 7 Occlusal view after cementation of PFM crown in relation to #24.

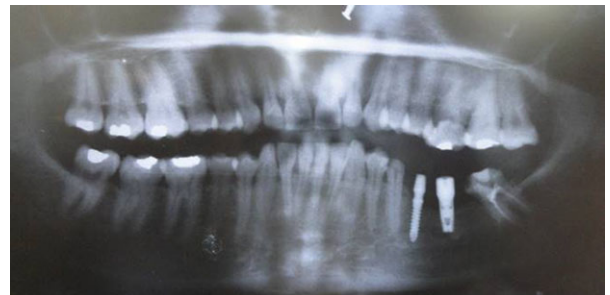


Figure 8 One mini-implant placed in relation to #36, and one regular diameter implant placed in relation to #37 after 5 months of healing phase.

region, or they should be splinted together to reduce the occlusal stress.

According to Flanagan,⁵ “these implants have been used primarily in multiples to retain complete removable overdentures in the maxilla and mandible. These very small diameter mini-implants, when used individually or in multiples or in combination with larger sized implants, may also offer adequate support for crowns or FDPs in selected circumstances.”

This case series describes a compilation of cases where mini-implants were used to retain a mandibular overdenture and to restore missing teeth at compromised sites in different quadrants of the maxilla and mandible. The indications and advantages along with associated complications related to mini-implants are discussed in brief.

Case descriptions

Replacement of teeth in mandibular anterior region: Case 1

A 38-year-old man reported with missing mandibular incisors due to trauma 10 months prior (Fig 1). There was adequate bone height, but the width was less than 5 mm in relation to the edentulous span. Standard diameter implants would not fit in the space available without some ridge augmentation procedure. The patient wanted a fixed prosthesis, but was not willing to have a conventional FDP to avoid preparation of the lower canines or for additional surgical intervention needed for ridge augmentation. With the patient’s approval, an FDP supported over three one-piece mini-implants of 2.5 mm diameter and 13 mm length was planned to replace the missing mandibular incisors.

The surgery was carried out under infiltration anesthesia, and a full thickness flap was raised using a mid-crestal incision in the edentulous region. A lateral crevicular incision was made in relation to canines. A vacuformed surgical guide was used to secure the osteotomy sites in relation to missing teeth #32, 41, and 42 (FDI notation) using a lance drill. Osteotomy was completed using a 1.8 mm diameter pilot drill. Rotary insertion of mini implants (MS System; Osstem Implant, Mumbai, India) was done till a torque of 40 Ncm was reached (Fig 2). A torque-controlled ratchet device was used to complete the placement. The gap was approximated with sling suture using 3-0 silk. As the implants were one-piece, they were immediately loaded after preparing the abutment for parallelism. Provisionalization was carried out using the indirect technique with the help of a template made over the diagnostic wax-up using resin-based temporary material (Tempron; GC America, Alsip, IL). An interim prosthesis was cemented and relieved of all centric and eccentric contacts. The patient was instructed in after-care and about the use and maintenance of the interim FDP in the healing phase. An integration phase of 14 weeks was observed, whereupon a radiograph was made to assess the implants. No associated bone loss was evident around the implants (Fig 3). Abutments were refined again, and a direct abutment level impression was obtained. A splinted cement-retained porcelain-fused-to-metal (PFM) FDP was fabricated and cemented over the abutments (Fig 4).

Table 1 Site and dimensions and of various mini-implants placed

Region	Implant diameter (mm)	Implant length (mm)	No of implants placed
Mandibular anterior	2.5	13	3
Maxillary anterior	3	13	2
Maxillary posterior	3	13	1
Mandibular posterior	2.5	10	1
Mandibular anterior (overdenture)	2.5	10	1
	2.5	13	2
Total number of implants placed			10

Replacement of teeth in maxillary anterior region: Case 2

A 22-year-old woman lost her maxillary central incisors due to trauma 2 years prior. She was wearing a removable prosthesis and was not satisfied with it. She refused the option of an FDP. Because of very minimal bone width, implant placement without augmentation was not possible. Instead of augmentation, the patient opted for mini-implant placement. Two one-piece 3 mm × 13 mm (MS; Osstem) mini-implants were placed and immediately loaded. After 5 months waiting for osseointegration (Fig 5), splinted crowns were given. The marginal bone level was well maintained as seen in the follow-up radiograph made after a period of 3.5 years using periapical standard radiographic film technique.

Replacement of teeth in maxillary posterior region: Case 3

A 40-year-old man reported with missing maxillary left first premolar. The site at #24 was adequate in width and height, but the interdental space was very limited (6 mm), precluding normal diameter implant placement. A mini-implant (3 × 13 mm) was placed using flapless technique, and the implant was immediately nonfunctionally loaded. After observing an uneventful healing phase of 5 months, the definitive prosthesis was fabricated (Figs 6 and 7).

Replacement of teeth in mandibular posterior region by splinting mini-implant with regular diameter implant: Case 4

A 46-year-old woman reported with missing #36, 37, endodontically treated #38, and vital but prepared #35. Radiographic examination showed one implant placed in relation to #37. The patient reported that it was placed 5 months prior. The previous treating dentist gave the patient the option of a splinted FDP involving #35, an implant at #37 and endodontically treating #38. The patient was not satisfied with the treatment done so far, so she reported for a second opinion and further treatment to our institution. The implant placed at #37 was of dimension 3.75 × 8 mm (DFI-Dual Fit Implant; AlphaBio Tec, Petach Tikva, Israel). The edentulous site in relation to #36 was compromised in width. After assessment of cone beam computed tomography scan data, the width in the region of #36 was found to be 4.8 mm, and the height was 12.5 mm. With the patient’s



Figure 9 Radiograph showing three mini-implants placed in relation to B, C, and D position. Width of the implants was 2.5 mm, and height at site B was 10 mm, and at sites C and D were 13 mm.

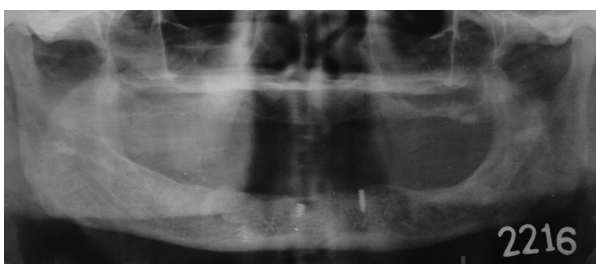


Figure 10 Radiograph showing mid-body fracture of the two mini-implants used to retain mandibular overdenture.

consent, placement of a one-piece mini-implant of dimension 2.5×10 mm (Osstem) was planned in the region of #36. The mini-implant was placed at the edentulous site, and simultaneously, second-stage surgery was performed for the previously placed implant. Immediate loading protocol was followed for the mini-implant and a splinted temporary prosthesis with both the implants kept barely out of occlusion was delivered on the day of surgery itself. After observing a healing phase of 5 months (Fig 8), a definitive cement-retained splinted prosthesis was fabricated over the implants, and individual crowns were cemented on #35 and 38. Because of limited interocclusal space in the #37 and 38 regions, metal occlusal surfaces with buccal ceramic facing were chosen for the crowns.

Mini implants used to retain mandibular overdenture: Case 5

The patient, a 69-year-old edentulous woman wearing dentures for the previous 13 years presented with the complaint of looseness of her mandibular denture. On examination, the mandibular residual ridge was found to be highly resorbed with deficiency of bone width. A mini-implant-retained overdenture was planned to augment the retention of the mandibular denture. The placement of 2.5 mm diameter implants (MS; Osstem) in B, C, and D positions was planned. Duplicated dentures were modified to be used as a radiographic stent and later as a surgical guide for implant insertion. The flap was raised, and three mini-implants (2.5×10 mm at B; 2.5×13 mm at C and D positions) were inserted as planned followed by suturing. The mandibular denture was generously relieved to seat

over the ball abutments and lined with soft-tissue conditioner (Visco-Gel; Dentsply, York, PA) in the same appointment.

After 4 months, the retentive components (nylon O rings and metal housings) were picked up in the denture in a chairside procedure using self-cure acrylic resin. The patient has successfully functioned with the prosthesis with no complications for 3.5 years (Fig 9).

Discussion

Because bone volume and quality can present the implantologist with a challenge for restorative treatment, creative but effective solutions may need to be considered. Implant diameters are available from 1.8 to 7 mm.⁵ As discussed previously, not all edentulous sites are capable of receiving standard dimension implants. In such cases, mini implants (1.8 to 3 mm) come to the rescue. Though having a smaller surface area, the survival rate reported in all screened studies was over 90%.⁸

These implants can be used alone in selected cases or in multiples to support a fixed prosthesis. They can also be used in conjunction with standard diameter implants (3.75 to 4.2 mm), where there is an area of thin bone next to or near an area that will accept a standard diameter implant. They have been successfully used in completely edentulous cases having poor bone volume to retain overdentures when bone grafting is either not feasible or is not performed due to associated dilemmas.⁴

In the cases discussed here, mini-implants were used to replace missing teeth at various sites in different patients (Table 1). In almost all the cases, mini-implants were chosen due to limitation of available bone required for placement of regular diameter implants. These mini-implants are a good treatment option in replacement of missing mandibular anterior teeth (case 1), as the bone width encountered here is usually limited along with the available mesiodistal space. Another favorable factor is the reduced occlusal force observed in this region.

When used in force areas (posterior region), the cyclic loading characteristic of human occlusion may induce metal fatigue in the mini-implants due to their smaller surface area leading to concentration of more force per unit area of the implant body. If they are to be used in other areas of the mouth, then precaution needs to be observed, and occlusal force should be controlled either by modifying the cusp or by splinting multiple mini-implants as performed in most of the above discussed cases. Additionally, they can be used in conjunction with larger diameter implants, and a splinted prosthesis can be given to distribute the load¹⁴ as described in case 4. Though the associated follow-up period is short (around 3.5 years), the results were found to be satisfactory from the perspective of patient comfort and limited marginal bone loss.

Physiologic advantages of mini-implants over wider implants have been proposed. These advantages include the ability to place mini-implants in reduced interradicular spaces, such as the edentulous ridge of the mandibular incisors and maxillary lateral incisor.⁵ They have also found application in thin atrophic edentulous maxilla and mandible for implant-retained overdentures. Due to the use of flapless procedure, which is recommended for these implants, and avoidance of an additional surgical procedure related to bone augmentation, placement of

mini-implants is much less traumatic and may be useful for medically compromised or elderly patients. There is less linear or circumferential percutaneous exposure of the implant. This leads to exposing less of the implant gingival attachment to bacterial attack.⁵ The characteristic resorption to first thread phenomenon seen with regular diameter implants does not seem to be prevalent with these implants, because the angiogenesis is not remarkably compromised due to the very small osteotomy prepared.^{5,9,10}

Mini-implant-retained overdentures and crowns are naturally subjected to immediate gradual bone loading due to the one piece nature of the implant and abutment. According to Wolffs' Law, gradual bone loading is associated with superior bone healing.^{11,12} In the presented cases the bone loss around the implants as evident from the radiographs was found to be almost negligible. These findings are in accordance with the observations of other authors.¹³ The cost of very small diameter implants can be about 20% to 50% less than standard diameter implants, making the treatment less expensive.

Physiological limitations or disadvantages of mini implants

The smaller surface area and volume of mini-implants places more force per square millimeter against the encasing bone than larger diameter implants, so dense bone at the recipient site is required. Bone density of type I, II, or III, bone width of at least 4 mm, height of at least 10 mm, and at least 1 mm of attached or augmentable gingiva are favorable prognostic factors for success of these implants.⁵ Because of the smaller surface area of the implant body, metal fatigue leading to implant fracture can happen if insertion torque is too high.⁵ Additionally, installation of too few implants may not resist chronic occlusal forces or cyclic loading, and cause fracture of the coronal shaft or body of the narrow implant if occlusal forces are not controlled (Fig 10). Therefore, they are ideally not indicated in high force areas.

Conclusion

Within the limits of the cases presented, mini-implants appear to be a viable treatment option in selected cases. Owing to their smaller surface area, which results in smaller bone/implant contact area, the case selection is of prime importance for a successful outcome. Mini-implants' application should not be generalized to all narrow ridges and whenever used, force factors should be given due consideration. Though the associated follow-up period is relatively small, the clinical success achieved so far was found to be satisfactory. Studies with a

longer follow-up period to further assess the longevity and success rate of mini-implants are needed.

References

1. Romeo E, Ghisolfi M, Rozza R, et al: Short (8-mm) dental implants in the rehabilitation of partial and complete edentulism: a 3- to 14-year longitudinal study. *Int J Prosthodont* 2006;19:586-592
2. Cardaropoli G, Lekholm U, Wennstrom JL: Tissue alterations at implant-supported single-tooth replacements: a 1-year prospective clinical study. *Clin Oral Implants Res* 2006;17:165-171
3. Tarnow DP, Cho SC, Wallace SS: The effect of inter-implant distance on the height of inter-implant bone crest. *J Periodontol* 2000;71:546-549
4. Esposito M, Grusovin MG, Coulthard P, et al: The efficacy of various bone augmentation procedures for dental implants: a Cochrane systematic review of randomized controlled clinical trials. *Int J Oral Maxillofac Implants* 2006;21:696-710
5. Flanagan D: Fixed partial dentures and crowns supported by very small diameter dental implants in compromised sites. *Implant Dent* 2008;17:182-191
6. Davarpanah M, Martinez H, Tecucianu JF, et al: Small-diameter implants: indications and contraindications. *J Esthet Dent* 2000;12:186-194
7. Froum SJ, Cho SC, Cho YS, et al: Narrow-diameter implants: a restorative option for limited interdental space. *Int J Periodont Rest Dent* 2007;27:449-455
8. Sohrabi K, Mushantat A, Esfandiari S, et al: How successful are small-diameter implants? A literature review. *Clin Oral Implants Res* 2012;23:515-525
9. Comfort MB, Chu FC, Chai J, et al: A 5-year prospective study on small diameter screw-shaped oral implants. *J Oral Rehabil* 2005;32:341-345
10. Tarnow D, Elian N, Fletcher P, 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
11. Roberts WE, Garetto LP, DeCastro RA: Remodeling of devitalized bone threatens periosteal margin integrity of endosseous titanium implants with threaded or smooth surfaces: indications for provisional loading and axially directed occlusion. *J Indiana Dent Assoc* 1989;68:19-24
12. Misch CE: Density of bone: effect on treatment plans, surgical approach, healing, and progressive bone loading. *Int J Oral Implantol* 1990;6:23-31
13. Abrahamsson I, Berglundh T, Lindhe J: The mucosal barrier following abutment dis/reconnection. An experimental study in dogs. *J Clin Periodontol* 1997;24:568-572
14. Vigolo P, Givani A, Majzoub Z, et al: 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