

Mini-Implants to Reconstruct Missing Teeth in Severe Ridge Deficiency and Small Interdental Space: A 5-Year Case Series

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Dental implants are a valid treatment modality for the completely^{1,2} or partially^{3,4} edentulous patient. A single-tooth implant can be an elegant solution, although not an easy one. Implant treatment for a single missing tooth can potentially lead to a well-functioning and aesthetically pleasing single crown on an implant.⁵⁻⁹ However, to achieve optimal treatment results, resorption defects should be repaired to gain sufficient ridge width in which to place the implant. This requires experience and a high degree of surgical and prosthetic skills. The natural situation can only be approached if all treatment stages are adequately planned and conducted, and if no major complications occur. To prevent disappointments, both dentist and patient should be well aware of all conditions required for an optimal result. Lack of bone width and/or interdental space prevents the placement of implants. Therefore, in these situations, augmentation procedures, as well as orthodontic tooth movement, are prerequisites to implantation.

Numerous augmentation techniques have been reported in the dental literature¹⁰⁻¹³ to facilitate implant placement in the deficient ridge using blocks or particulated grafts, which require several stages before tooth reconstruction. Orthodontic tooth movement is needed before implantation for

Two of the major obstacles for dental implant placement to replace missing teeth are the lack of adequate bone width and interdental space. Overcoming these limitations requires bone augmentation procedures that transform the deficient ridge into a ridge that is capable of receiving conventional tooth-form implants. In the case of inadequate interdental space, orthodontic tooth movement is advocated before implantation. Using narrow-diameter mini-implants allows the clinician to

overcome both of these obstacles without the need for additional grafting procedures or orthodontic tooth movement. The mini-implants are immediately loaded and restored so as to enable the patient to have satisfactory mastication and aesthetic appearance. A 5-year follow up of 32 implants demonstrates the benefit of this treatment modality. (Implant Dent 2004;13:336-341)

Key Words: dental implants, augmentation procedures, orthodontic tooth movement, narrow ridge

inadequate mesiodistal space in between teeth. Lack of interdental space is a common finding in cases of congenitally missing anterior teeth, closure of space after extractions, and after extraction of narrow-diameter teeth such as the lower and upper lateral incisors. Placing an implant in a narrow interdental space without orthodontic tooth movement has the potential risk of bone loss to the adjacent teeth, especially to the root aspect facing the implant. However, these augmentation procedures have some drawbacks such as prolonged time until tooth reconstruction, patient morbidity, and expense.^{14,15} Side effects of bone augmentation include profound edema, pain, and discomfort, and possible risks of nerve and blood vessel injury leading to nerve disturbance and hematoma. The use of mini-implants is a new treatment modality and an alternative to the conventional implantation regimen.

When reconstructing teeth lost resulting from periodontal disease, there

is a great amount of bone loss both vertically and horizontally. Placing an implant/abutment deeper than the bone level of the adjacent teeth is likely to cause further bone loss as a result of the proximity of the implant and the tooth. A 2.4-mm diameter one-piece implant with no implant abutment connection allows greater clearance between the implant and the adjacent teeth so as to decrease the potential for bone loss.

The purpose of this article is to describe the use of mini-implants for fixed restorations (with a follow up of up to 5 years) to enable the practitioner to overcome the anatomic obstacles of ridge width and narrow interdental space by immediate loading and reconstruction. As well, 2 case reports are presented that illustrate the use of mini-implants.

SUBJECTS AND MATERIALS

The study consisted of 32 patients who required single implants for

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single-tooth replacements. Patients were treated in the private offices of the authors. Criteria for inclusion in the study group were alveolar ridge width of up to 4 mm or interdental space of less than 4 mm.

Titanium screw implants, 2.4 mm, 13 mm in length were used (Hi-Tec Implants, Herzlia, Israel). All implants were immediately loaded with temporary crowns for 3 to 4 weeks followed by conventional crown reconstruction made of porcelain fused to metal (PFM).

Clinical and periapical radiographs were taken pretreatment, postoperatively, during rehabilitation, and at follow ups.

RESULTS

Of the 32 implants, 31 were integrated successfully and reconstructed with PFM crowns. One implant was lost 3 months postrehabilitation as a result of mechanical overload. Patients reported complete satisfaction regarding function, aesthetics, and phonetics.

EXAMPLES OF PROCEDURES

Patient No. 1

A 65-year-old woman presented with a missing mandibular left first molar (Fig. 1). The ideal treatment plan was augmentation of the deficient ridge in a buccolingual dimension followed by an implant. Because the patient refused to undergo the augmentation procedure, it was decided to place 2 narrow-diameter (2.4 mm) temporary implants to avoid the need for augmentation.

After reflection of a full-thickness mucoperiosteal flap, the alveolar ridge was exposed revealing 3.5 mm of width (Fig. 2). Two osteotomies for 2.4-mm fixtures were performed with a 2.0-mm drill (Fig. 3). Two Hi-Tec fixtures were inserted and the flap was sutured and closed with primary intention (Fig. 4). An immediate self-curing acrylic temporary crown was fabricated to allow access for cleansing. Impressions were taken 6 weeks later and the final PFM restoration was cemented (Fig. 5). A periapical radiograph, 5 years postoperatively, shows no signs of bone resorption (Fig. 6).



Fig. 1. A 65-year-old woman presented with missing mandibular left first molar.

Fig. 2. Ridge exposure revealing 3.5 mm of width.

Fig. 3. Two osteotomies for 2.4-mm fixtures.

Fig. 4. After suturing.

Fig. 5. Final porcelain-fused-to-metal restoration (occlusal view).

Fig. 6. Periapical radiograph 5 years postoperatively.

Patient No. 2

A 22-year-old woman presented with a congenitally missing maxillary left lateral incisor with an interdental space of 4 mm (Fig. 7). Because the patient refused orthodontic tooth movement to open an adequate interdental space for a conventional fixture, it was decided to use a narrow-diameter implant.

After local anesthesia, a full-thickness mucoperiosteal flap was elevated reflecting the alveolar ridge. The osteotomy was prepared with a 2.0-mm drill (Fig. 8). A Hi-Tec 2.4-mm mini-implant, 13 mm in length, was inserted (Fig. 9). The flap was sutured with primary intention. Healing was uneventful and a periapical radiograph showed perfect alignment of the mini-implant with regard

to the adjacent teeth. The implant was immediately loaded with a temporary acrylic crown followed by a PFM crown at 6 weeks. Clinical and radiographic follow up 3 years postoperatively showed success in achieving aesthetics, function (Fig. 10), and maintaining bony levels (Figs. 11 and 12).

DISCUSSION

Reduction of the alveolar ridge, caused by bone resorption in the edentulous and partially edentulous maxilla, is a frequent problem¹⁶⁻¹⁸ in oral implantology, especially in the maxilla. Augmentation of the resorbed parts of the residual ridges, particularly when autologous bone is used, can be successful.¹⁹⁻²¹ However, clin-

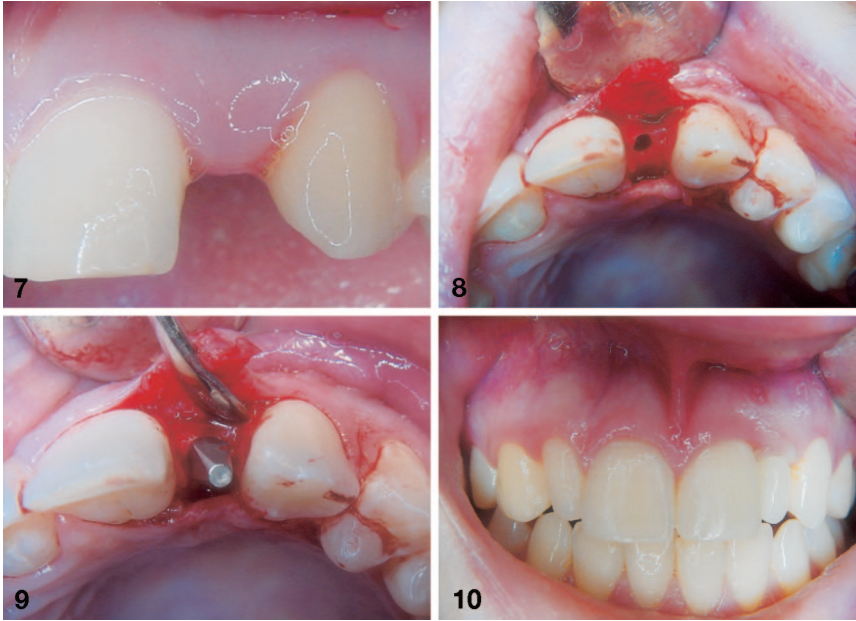


Fig. 7. A 22-year-old woman presented with congenitally missing maxillary left lateral incisor with interdental space of 4 mm.
Fig. 8. Flap reflection and osteotomy preparation.
Fig. 9. Implant insertion (palatal and buccal sides).
Fig. 10. Clinical view 3 years postoperatively.

ically this can be a complicated way of solving the problem. Bone augmentation procedures such as bone-splitting and bone-widening techniques,^{22,23} combined with guided tissue regeneration, onlay bone blocks, or particulate bone grafts, have been used to restore the deficient ridge. In nearly all of these surgical reconstructive proce-

dures, implant placement usually follows at a later stage.

The problem of ridge deficiency and interdental space can be solved with the use of narrow-diameter implants. Placement of mini-implants (1.8–2.4 mm in diameter) that are retrieved is a well-established procedure used to support fixed or removable

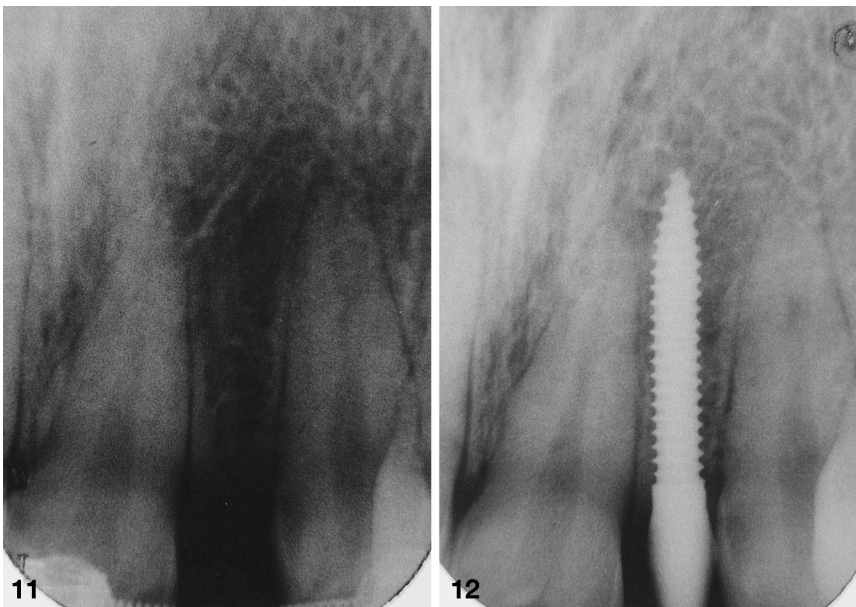


Fig. 11. Preoperative apical radiograph.
Fig. 12. Postoperative periapical radiograph.

protheses.^{24–30} Mini-implants provide immediate fixed provisional prosthesis, avoid premature implant loading, and protect augmented sites. In most patients, the transitional implants were retrieved at the time of implant uncovering, unlike the present clinical study in which implants were loaded immediately, maintaining function up to 5 years.

This clinical study used mini-implants to reconstruct single missing teeth in narrow anterior and posterior ridges and narrow interdental spaces, are loaded immediately, then followed for 5 years.

CONCLUSION

Within the limits of this pilot study, the proposed treatment modality of mini-implants may serve as a useful option to rehabilitate a single tooth in both deficient ridges and in narrow interdental spaces. Future studies should be conducted to evaluate the long-term survival of these implants.

DISCLOSURE

Dr. Roy Leshem claims to have a financial interest in HiTec Implants, whose product, titanium screw implant 2.4 mm, is mentioned in this article. All other authors claim to have no financial interest in any company or any of the products mentioned in this article.

REFERENCES

1. Adell R, Lekholm U, Rockler B, et al. A 15 year study of osseointegrated implants in the treatment of the edentulous jaw. *Int J Oral Surg.* 1981;10:387–416.
2. Lindquist LW, Carlsson GE, Jemt T. A prospective 15 year follow-up study of mandibular fixed prosthesis supported by osseointegrated implants: clinical results and marginal bone loss. *Clin Oral Implants Res.* 1996;7:329–336.
3. Jemt T, Lekholm U, Adell R. Osseointegrated implants in the treatment of partially edentulous patients: a preliminary study on 876 consecutively placed fixtures. *Int J Oral Maxillofac Implants.* 1989; 4:211–217.
4. Jemt T, Patterson P. A 3 year follow up study on single implant treatment. *J Dent.* 1993;21:203–208.
5. Simon RL. Single implant-supported molar and premolar crowns: a

ten-year retrospective clinical report. *J Prosthet Dent.* 2003;90:517-521.

6. Groisman M, Frossard WM, Ferreira HM, et al. Single-tooth implants in the maxillary incisor region with immediate provisionalization: 2-year prospective study. *Pract Proced Aesthet Dent.* 2003;15:115-122.

7. Mayer TM, Hawley CE, Gunsolley JC, et al. The single-tooth implant: a viable alternative for single-tooth replacement. *J Periodontol.* 2002;73:687-693.

8. Haas R, Polak C, Furhauser R, et al. A long-term follow-up of 76 Brånemark single-tooth implants. *Clin Oral Implants Res.* 2002;13:38-43.

9. Gibbard LL, Zarb G. A 5-year prospective study of implant-supported single-tooth replacements. *J Can Dent Assoc.* 2002;68:110-116.

10. Misch CM, Misch CE. The repair of localized severe ridge defects for implant placement using mandibular bone grafts. *Implant Dent.* 1995;4:261-267.

11. Pikos MA. Alveolar ridge augmentation with ramus buccal shelf autografts and impacted third molar removal. *Dent Implantol Update.* 1999;10:27-31.

12. Buser D, Dula K, Belser U, et al. Localized ridge augmentation using guided bone regeneration. I. Surgical procedure in the maxilla. *Int J Periodontics Restorative Dent.* 1993;13:29-45.

13. Buser D, Dula K, Belser U, et al. Localized ridge augmentation using guided bone regeneration. II. Surgical procedure in the mandible. *Int J Periodontics Restorative Dent.* 1995;15:11-29.

14. Balaji SM. Management of deficient anterior maxillary alveolus with mandibular parasymphiseal bone graft for implants. *Implant Dent.* 2002;11:363-369.

15. Nkenke E, Radespiel-Troger M,

Wiltfang J, et al. Morbidity of harvesting of retromolar bone grafts: a prospective study. *Clin Oral Implants Res.* 2002;13:514-521.

16. Wang HL, Al-Shammari K. HVC ridge deficiency classification: a therapeutically oriented classification. *Int J Periodontics Restorative Dent.* 2002;22:335-343.

17. Bernhart T, Weber R, Mailath G, et al. Use of crestal bone for augmentation of extremely knife-edged alveolar ridges prior to implant placement: report of 3 cases. *Int J Oral Maxillofac Implants.* 1999;14:424-427.

18. Tinti C, Parma-Benfenati S. Clinical classification of bone defects concerning the placement of dental implants. *Int J Periodontics Restorative Dent.* 2003;23:147-155.

19. Nevins M, Mellonig JT, Clem DS III, et al. Implants in regenerated bone: Long-term survival. *Int J Periodontics Restorative Dent.* 1998;18:34-45.

20. Corrente G, Abundo R, Cardaropoli D, et al. Long-term evaluation of osseointegrated implants in regenerated and non-regenerated bone. *Int J Periodontics Restorative Dent.* 2000;20:391-397.

21. Bolander ME, Balian G. The use of demineralized bone matrix in the repair of segmental defects. Augmentation with extracted matrix proteins and a comparison with autologous grafts. *J Bone Joint Surg [Am].* 1986;68:1264-1274.

22. Oikarinen KS, Sandor GK, Kainulainen VT, et al. Augmentation of the narrow traumatized anterior alveolar ridge to facilitate dental implant placement. *Dent Traumatol.* 2003;19:19-29.

23. Lustmann J, Lewinstein I. Interpositional bone grafting technique to widen

narrow maxillary ridge. *Int J Oral Maxillofac Implants.* 1995;10:568-577.

24. Leshem D, Mazor Z, Leshem R, et al. A simple technique for fabrication of immediate interim removable prosthesis supported by transitional implants. *Implant Dent.* 2003;12:227-231.

25. Bohsali K, Simon H, Kan JY, et al. Modular transitional implants to support the interim maxillary overdenture. *Compend Contin Educ Dent.* 1999;20:975-983.

26. Mazor Z. Using transitional implants for immediate fixed temporary prosthesis. *Dent Implantol Update.* 2000;11:29-31.

27. Mazor Z, Brosh I. Use of transitional implants for fixed interim prosthesis. The ability to protect freshly augmented sinus graft. *Can J Dent Technol.* 2002;1:14-18.

28. Petrungraro PS, Windmiller N. Using transitional implants during the healing phase of implant reconstruction. *Gen Dent.* 2001;49:46-51.

29. Froum S, Emtiaz S, Bloom MJ, et al. The use of transitional implants for immediate fixed temporary prostheses in cases of implant restorations. *Pract Periodontics Aesthet Dent.* 1998;10:737-746.

30. Brown M, Tarnow D. Fixed provisionalization with transitional implants for partially edentulous patients: a case study. *Pract Periodontics Aesthet Dent.* 2001;13:123-127.

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Miniimplantate zur Rekonstruktion fehlender Zähne bei schwerwiegender Kammdefizienz und geringem Zahnzwischenraum: eine Langzeitfallstudie mit 5 Jahren Laufzeit

ZUSAMMENFASSUNG: Bei der Zahnimplantierung zum Ersatz fehlender Einzelzähne sieht man sich hauptsächlich zwei Schwierigkeiten gegenüber: die Knochenbreite reicht häufig nicht aus und der Raum zwischen den Zähnen ist zu eng. Um diese die Zahnimplantierungsoptionen einschränkenden Faktoren zu umgehen, muss eine Knochengewebsanreicherung durchgeführt werden, um den mangelhaften Zahnkamm so vorzubereiten, dass in ihm normale zahnförmige Implantate Platz finden. Sollte der Platz zwischen den einzelnen Zähnen nicht für eine Zahnimplantierung ausreichen, ist vor Implantierungseinsatz eine regulierende Zahnverschiebung durchzuführen. Verwendet der behandelnde Zahnarzt Miniimplantate mit geringerem Durchmesser, kann der diese Schwierigkeiten umgehen, ohne dabei zusätzlich mit Transplantaten oder Zahnverschiebungen arbeiten zu müssen. Die Miniimplantate sind zur sofortigen Belastung und Funktionalisierung vorgesehen und eröffnen damit dem Patienten direkt nach dem Eingriff alle Möglichkeiten für problemloses Kauen und ein überzeugendes Erscheinungsbild. Eine an insgesamt 32 Implantaten durchgeführte 5-Jahresstudie zeigt die Vorteile der geschilderten Behandlungsweise.

SCHLÜSSELWÖRTER: Zahnimplantate, Aufbaubehandlungen, Zahnregulierung, flacher Zahnkamm

Miniimplantes para la reconstrucción de dientes perdidos y deficiencia severa de la cresta y espacio interdental pequeño: Una serie de casos de 5 años

ABSTRACTO: Dos de los principales obstáculos para la colocación de implantes dentales para reemplazar dientes perdidos son la falta de un ancho adecuado de hueso y espacio interdental. Superar estas limitaciones requiere procedimientos para aumentar el hueso que transformen la cresta deficiente en una cresta que sea capaz de aceptar implantes con forma de dientes convencionales. En el caso de un espacio interdental inadecuado, se sugiere el movimiento ortodóntico del diente antes de la colocación del implante. El uso de miniimplantes de diámetro reducido permite al clínico superar ambos obstáculos sin la necesidad de procedimientos adicionales de injertos o movimiento ortodóntico del diente. Los miniimplantes se cargan y restauran inmediatamente para permitir que el paciente logre una masticación satisfactoria y apariencia estética. Un seguimiento de 5 años de 32 implantes demuestra el beneficio de esta modalidad de tratamiento.

PALABRAS CLAVES: implantes dentales, procedimientos de aumento, movimiento ortodóntico del diente, cresta angosta

Miniimplantes para Reconstruir Dentes Ausentes em Deficiência Grave de Crista e Pequeno Espaço Interdental: Série de Caso de 5 Anos

RESUMO: Dois dos principais obstáculos para a colocação de implantes dentários substituir os dentes ausentes são a falta de largura óssea adequada e de espaço interdental. Superar essas limitações exige procedimentos de aumento do osso que transformam a crista deficiente em uma crista que é capaz de receber implantes de forma de dente convencionais. No caso de espaço interdental inadequado, advoga-se o movimento ortodóntico do dente antes da implantação. Usar miniimplantes de diâmetro estreito permite que o clínico supere esses dois obstáculos sem a necessidade de procedimentos adicionais de enxerto ou movimento ortodóntico do dente. Os miniimplantes são carregados e restaurados imediatamente a fim de possibilitar que o paciente tenha mastigação satisfatória e aparência estética. Uma seqüência de 32 implantes em 5 anos demonstra o benefício dessa modalidade de tratamento.

PALAVRAS-CHAVE: implantes dentários, procedimentos de aumento, movimento ortodóntico do dente, crista estreita.

重症の歯槽堤損傷と狭い歯間の症例における損歯修復のためのミニインプラント：5年間の追跡調査報告

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概要：損歯修復のためにデンタルインプラントを設ける場合にしばしば出会う問題に、骨幅の不足と歯間の狭さの問題がある。これらの問題を解決するためには骨増大処置を行い歯槽堤損傷部を通常の toothform インプラントの設置に十分な歯槽とする必要がある。歯間の狭さが問題となる場合には、インプラントの設置にさきがけて矯正を行うことが望ましい。

直径が小さいミニインプラントを使うと、移植や矯正の必要がなく、上記の2つの問題を避けて通ることができる。ミニインプラントは即時加重修復され、患者に望ましい咀嚼能力と審美的効果を与えることができる。32人の患者の5年間の追跡調査は、この処置の効力をよく示している。

キーワード：デンタルインプラント、増大処置、矯正歯移動、狭い歯槽堤

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