Unsplinted Implants Retaining Maxillary Overdentures with Partial Palatal Coverage: Report of 5 Consecutive Cases

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Purpose: *It is believed that maxillary dental implants must be splinted when used to retain removable overdenture prostheses in order to maintain osseointegration. This paper presents clinical cases to demonstrate that contemporary implants can function in an unsplinted manner to retain maxillary removable overdentures with partial palatal coverage.* ***Materials and Methods:*** *Five consecutive patients were treated using a specific surgical and prosthodontic protocol. Twenty-five textured-surface implants were placed to retain overdenture prostheses in five patients, with a minimum of 4 implants per patient. These patients were followed for 12 to 48 months postloading.* ***Results:*** *To date, none of the implants have lost osseointegration, and radiographic marginal bone levels are stable. Patients have been able to maintain soft tissue health around the unsplinted implants. The patients have verbally indicated that they are comfortable and that their maxillary overdentures function well.* ***Conclusion:*** *This preliminary report presents 5 consecutive cases in which unsplinted implants maintained osseointegration when used to retain removable overdenture prostheses with limited palatal coverage. It appears that unsplinted maxillary implants can be used to retain a maxillary overdenture.* (Case Series) INT J ORAL MAXILLOFAC IMPLANTS 2007;22:808–814

Key words: *maxilla, partial palatal coverage, unsplinted dental implants*

Osseointegration is an established biomechanical phenomenon with predictable implant and prosthesis survival rates.[1–4] Implant-retained overdentures in the mandible demonstrate survival rates equivalent to those for fixed implant-retained prostheses.[5–8] However, maxillary overdentures have not been as successful as other implant-retained prostheses.[9–11] Many authors have reported that short, machined dental implants supporting overdentures show higher failure rates compared to cases where the anatomy permitted the use of longer implants.[12,13] Such results have been noted with splinted and unsplinted implants and regardless of whether the palate was covered by the prosthesis. Additionally, type 4 bone has been associated with a higher failure rate than better-quality bone.[5] Neither bar splints or full palatal coverage have been able to compensate for the deficiencies of short, fully machined implants in low-density maxillary bone.

Quirynen et al[14] reported contradictory results, with more implant failures among fixed restorations than overdentures, and attributed these results to more favorable anatomy in the overdenture treatment group. Better anatomy enabled more and longer implants to be placed with a favorable anteroposterior (AP) spread. This affected forces transferred to each implant by the prosthesis. Kramer et al[15] demonstrated less force per implant when additional implants were placed more posteriorly to help distribute occlusal forces.

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Previously, maxillary removable overdentures were often retained by machined implants splinted together by a bar to avoid deosseointegration. However, the literature indicates that implants with textured surfaces are superior to machined-surface implants with respect to bone-implant contact (BIC) and the forces needed to remove them.[16–19] If contemporary implants can function without splinting, then the biologic, prosthetic, esthetic, phonetic, and maintenance difficulties associated with bars can be circumvented.[10,20–22]

At present, there are no studies specifically comparing implant survival with partial or full palatal coverage by the overdenture prosthesis. From a patient's perspective, partial palatal coverage is generally requested.

In view of this information and the advantages offered by textured-surface implants, it was decided to test the hypothesis that unsplinted, textured-surface implants of a specific minimum length and width could be used to retain maxillary overdentures with partial palatal coverage.

MATERIALS AND METHODS

Five consecutive patients were selected who met the following criteria: the patient had to present with maxillary bone sufficient to place a minimum of 4 textured implants greater than or equal to 10 mm long and a minimum of 3.75 mm in diameter. Computerized tomographic scans were requested when necessary to confirm that the patient's anatomy would meet these requirements. The implants had to be placed into bone types 1, 2, or 3; bone type was determined by tactile perception at the time of osteotomy preparation.[23] The positions of the most posterior implants had to correspond to the premolar region of the alveolus bilaterally, and the positions of the anterior implants had to be within the premaxillary region of the alveolus bilaterally. This was required to ensure that the AP spread of the implants was favorable. Implants were placed into healed maxillary ridges. The opposing arch in each patient was required to have at least second premolar occlusion. The patients were required to have worn an immediate maxillary complete denture for a minimum of 6 months before implant placement.

The implants received individual prefabricated abutments per the preferences of the restorative practitioner. Relative parallelism of the implants was required by the physical limitations of the individual abutment-attachment systems used. Three female patients (ages 53 to 72 years) and 2 male patients (ages 49 and 74 years) met these requirements.

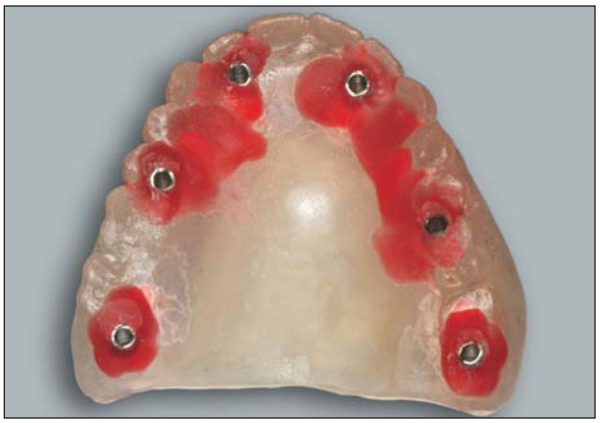


Fig 1 Surgical template for overdenture.

The selected patients were systemically healthy and nonsmokers. All implants were placed and restored by the primary author (JC), except for 1 patient for which the prosthesis was fabricated by another restorative practitioner.

A surgical template was fabricated by duplicating each patient's existing maxillary complete denture. Cutouts or tubes were placed in locations that corresponded to the denture base just palatal to the cingulum of anterior teeth or beneath the palatal cusp of posterior teeth (Fig 1).

Two grams of amoxicillin was prescribed an hour before surgery. Postoperatively, patients took one 500-mg tablet of amoxicillin 3 times a day for 7 days. Full-thickness mucoperiosteal flaps were reflected. Implant osteotomies were undersized from 0.3 to 1.0 mm less than the final diameter of the selected implant depending upon the clinician's tactile perception of bone quality. A minimum of 4 implants were placed for each patient. Patient 4 manifested signs of very heavy occlusal function/parafunction; therefore, 6 implants were placed to ensure that all areas of the prosthesis were supported by implants (Fig 2).

Suturing was accomplished with 4-0 chromic gut sutures. None of the implants were countersunk. All dentures were relieved over the sites of the implants on the day of surgery and then relined with a resilient material after 3 weeks. Patients were seen at 1 week, 3 weeks, 8 weeks, and 12 weeks. Implants were submerged beneath the soft tissue and permitted to integrate for at least 12 weeks. Patients were instructed to take ibuprofen (600 mg) every 4 to 6 hours as needed for pain after surgery.

At stage-2 surgery, mucoperiosteal flaps were reflected, procedures were utilized to preserve the zone of attached keratinized tissue circumferentially, and healing abutments were attached to the

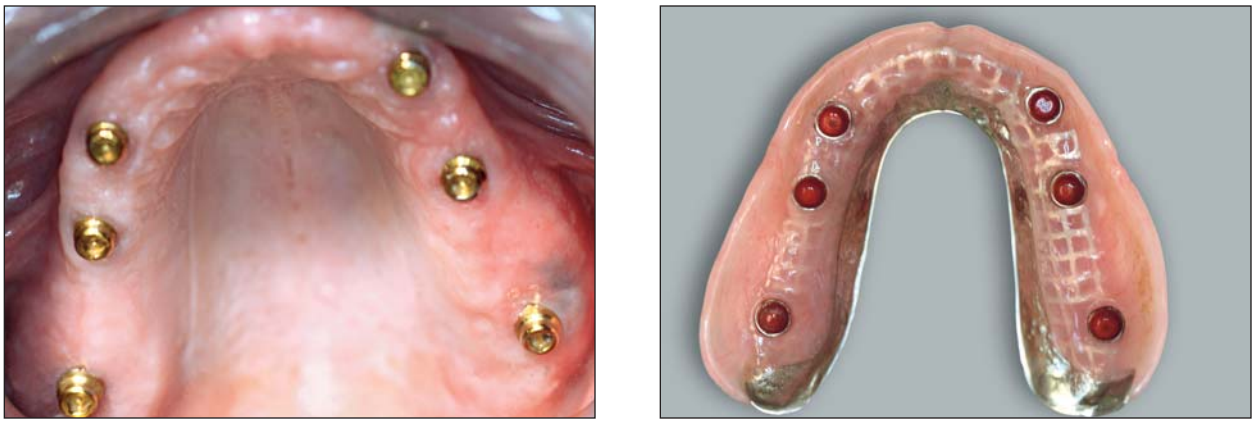


Fig 2 Patient 4 with 6 Locator abutments with optimal AP spread to support all areas of the prosthesis.

implants. Patients received brushing instruction 1 week after uncovering surgery. The soft tissue was allowed to heal for 6 weeks.

Subsequently, standard prosthodontic protocols were followed for overdenture fabrication. Individual attachments were screwed into their respective implants using torque wrenches as recommended by the manufacturers. The overdentures were reinforced with a chromium-cobalt horseshoe-shaped framework. All overdentures were fabricated with acrylic resin teeth and a methyl methacrylate denture base. Retentive attachments were processed into the denture base or connected to the dentures in an intraoral procedure. A lingualized occlusal scheme was utilized. All patients were seen at least twice after prosthesis insertion.

Radiographs (periapical or bitewing) were obtained at implant placement, stage-2 surgery, placement of definitive abutments, and annually thereafter. Soft tissue examinations were performed at definitive abutment connection and at recall appointments, which were arranged at 6-month intervals. The presence of plaque was visually assessed as either present or absent. Bleeding upon probing was assessed by running a plastic probe across the gingival margin, and bleeding was noted as present or absent. Mobility of the implants was assessed by pressing on the abutments with 2 metal instruments.

RESULTS

The number of implants placed; their positions; implant type, length and diameter; attachment type; status of the opposing arch; and loading period are summarized in Table 1. Bone quantity was sufficient to place implants completely within the alveolus in 24 of 25 locations. One implant required a grafting procedure to repair a small apical fenestration.[24] All 5 patients demonstrated bone quality type 2 or 3.

To date, no implants have lost osseointegration, and marginal bone levels, as assessed by intraoral radiographs, have remained stable for all 25 implants. The osseous crest is located at the first or second thread of the implants. All 5 patients consistently demonstrate good oral hygiene around their individual attachments (Fig 3).

All implants are nonmobile, and probing depths assessed circumferentially around the implants are less than 5 mm and have not changed since definitive abutment connection. The gingival tissues surrounding the implants do not manifest any signs of inflammation (redness or bleeding upon probing). Visible accumulation of plaque has not been present.

Patient 1 required repair of an acrylic resin denture tooth during the first year of prosthesis use. Patient 3 required repair of the resin denture base during the first year. Patients 2, 4, and 5, in which the least space-consuming attachments were used, have not needed any prosthetic maintenance. The attachments have maintained their retentive force for at least 1 year in all cases.

All the patients expressed verbal satisfaction with the transition from a complete denture to an overdenture. No patients have been lost to follow-up.

DISCUSSION

This pilot study indicated that textured-surface implants can be used to retain a maxillary overdenture without the use of a bar to splint the implants together. The success of this type of treatment can be attributed to case selection, use of at least 4 textured-surface implants of a specific minimum length and diameter, and a favorable AP spread of the

Table 1 Description of Implants and Abutments Used

Patient	No. of implants	Implant position by tooth no.	Implant lengths	Implant widths (mm)	Attachment type	Opposing jaw	Time postloading (mo)
1	4 (6 total; 2 implants 2 implants in reserve)	5(14), 6(13), 7(12), 10(22), 11(23), 12(24)	13 mm (n = 2) 11.5 mm (n = 2) 10 mm (n = 2)	4.0	Stern-Era 2-piece, angulated	Dentate, teeth 19 to 30	48
2	4	5(14), 7(12), 10(23), 12(24)	10 mm (n = 4)	4.0	Locator	Fixed partial denture, teeth 18 to 30	36
3	4	5(14), 7(12), 10(23), 12(24)	10 mm (n = 4)	4.0	Stern-Era 2-piece, angulated	Dentate, teeth 18 to 31	30
4	6	2(17), 4(15), 6(13), 11(23), 13(25), 15(27)	11.5 mm (n = 2) 10 mm (n = 4)	4.0 (3i) 4.7 (TSV)	Locator	Fixed partial denture + natural teeth 19 to 31	20
5	4 (+ 1 added later)	5(14), 7(12), 10(23), 13(25); 2(17) added later	10 mm (n = 4) 8.5 mm (n = 1)	4.0	Locator	Implant-assisted overdenture (n = 5)	12

*Universal (FDI).
†Held in reserve.
Manufacturers: Biomet/3i, Palm Beach Gardens, FL; tapered screw vent (TSV), Zimmer Dental, Carlsbad, CA; Sterngold Dental, Attleboro, MA; Zest Anchors, Escondido, CA.

implants.[25,26] Previous difficulties with maxillary overdentures can be attributed to the use of implants that were short or had a machined surface. In contrast, textured-surface implants demonstrate increased BIC, even in poor quality bone.[17,18]

Several surgical and prosthetic procedures incorporated into the protocol may have contributed to the positive results in this preliminary study. In general, osteotomies were undersized to accept self-tapping implants; this assisted in establishing improved implant stability.[27] Furthermore, countersinking was avoided to ensure that the crestal cortical bone could be engaged to enhance primary stability.[28] The interim removable denture base was made slightly thicker where implants were to be placed, thereby allowing these areas to be relieved without risk of denture perforation or fracture. This prevented the transmucosal transfer of load to the implants during the healing period. Additionally, these implants were placed more axially to the palate, which helped maintain the integrity of the labial plate of bone and allowed for maintenance of the attached buccal gingiva (Fig 3). This facilitated good oral hygiene by patients.

Hygiene around individual implants was very good. The literature shows that significant inflammation can develop around bar splints.[20,29,30] Visual and probing assessments around the implants indicated there was no peri-implantitis around implants that were not splinted. This is important, since several authors have demonstrated that implants are unlikely to demonstrate progressive marginal bone loss in the absence of inflammation.[31–33]

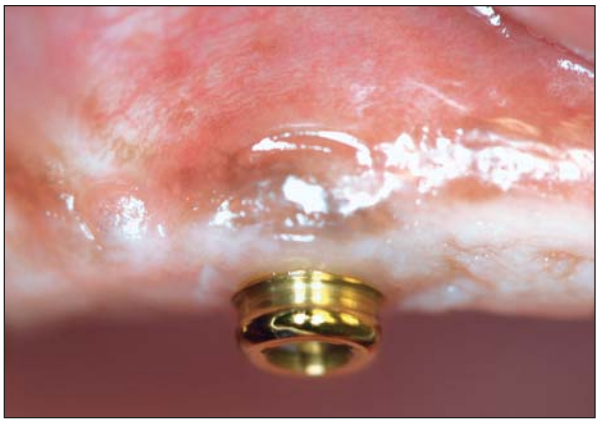
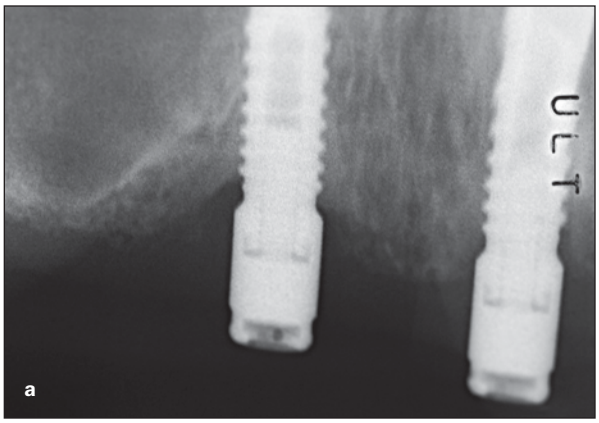
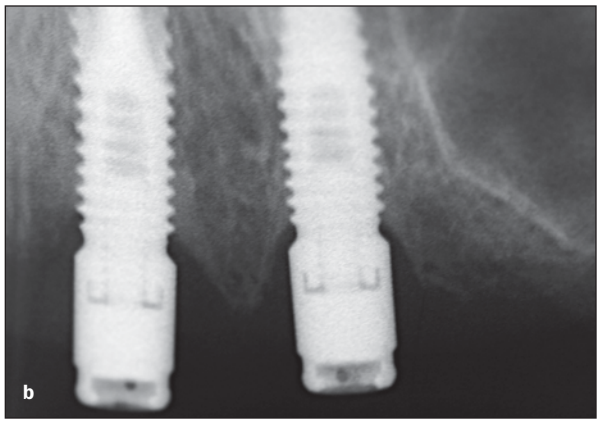


Fig 3 Healthy peri-implant tissue.

The lack of mobility indicated that the implants remained osseointegrated and validated that it was unnecessary to splint implants together in the maxillary arch.[34] With regard to osseous levels around the implants that retained the overdentures, the expected bone changes of 1.5 to 2.0 mm were noted from abutment connection to first annual follow-up. Thereafter, radiographic marginal bone levels remained stable (Figs 4a and 4b). This finding is comparable to results obtained with fixed implant-retained prostheses as well as mandibular implant-retained overdentures.[1–8]

Currently, no studies have been carried out to assess the ability of textured-surface implants with an unsplinted attachment to retain a removable





Figs 4a and 4b Patient 2. Implants in the right and left maxilla at sites 5(14), 7(12), 10(23), and 12(24) at 36 months postloading.

Fig 5 Four Locator abutments with favorable AP spread.

Fig 6a Partial palatal coverage: Occlusal view of finished overdenture.

Fig 6b Tissue side of finished overdenture.

overdenture with partial palatal coverage. The results of this study suggest that a minimum of 4 textured-surface implants at least 10 mm long and 3.75 mm wide may be sufficient to retain overdentures via individual attachments (Fig 5).

No published studies have specifically compared the fate of implants under overdentures with respect to complete or partial palatal coverage. However, from a clinical perspective, patients prefer to decrease palatal coverage by a prostheses in the maxilla. It provides them more room for their tongue and exposes additional palatal tissue so that they can better appreciate the texture of their food (Figs 6a and 6b).

Application of this protocol, which uses textured-surface maxillary implants in an unsplinted manner, provides the following clinical advantages:

- Enhancement of esthetics. Esthetics was enhanced because the positions of the implants and the attachments did not interfere with the setting of denture teeth. Individual attachments on properly placed implants needed reduced horizontal and vertical space compared to bar structures. This may be a critical issue, especially for the recently edentulous patient whose bony ridge is still substantial.[21]
- Enhanced phonetics. Phonetics was enhanced because the overall palatal bulk was reduced. The denture base did not have to be extended to encompass a bar structure.
- Decreased cost. Cost factors were decreased, because the need for gold cylinders, bar structures, and the laboratory fees associated with them were eliminated.
- Ease of placement with respect to attachments. Placing individual prefabricated attachments is easier for the clinician and does not impart insertion stress to the implants compared to precisely relating a bar splint to multiple implants.[26]
- Elimination of the need for arduous impression techniques. Unwieldy open impression trays were unnecessary, since there was no splinting between implants.[35] Often it was possible to select abutments by intraoral visual inspection. These procedures simplified overdenture fabrication.
- Enhanced prosthesis durability. Prosthesis durability was enhanced because low-profile individual attachments require less space, enabling the overdenture resin base to be thicker in areas of stress.
- Ease of maintenance/repair. Maintenance or repair of the overdenture is straightforward, because individual attachments can be removed and replaced with ease. Other repairs do not require removal of a screwed-retained superstructure, and it is likely that a previous interim denture can be used as a back-up prosthesis in an emergency.
- Prosthesis maintenance in cases of implant failure. A failed (deosseointegrated) implant does not condemn a portion of the superstructure. The overdenture can remain functional utilizing the remaining individual attachments while healing, reimplantation, and reconnection take place. If another implant location is appropriate, it is possible that the metal reinforcement and resin base of the overdenture can be modified and that a new implant can be incorporated into the prosthesis.
- Simplification of hygienic procedures. With individual attachments, hygienic procedures were simplified. Previous reports have demonstrated less tissue hyperplasia around individual attachments and improved Plaque and Gingival Index scores compared with implants connected by bar splints.[20,29,30]
- Bone preservation. Residual ridge atrophy under a complete denture continues over time.[36–38] The presence of osseointegrated implants has been shown to slow this process.[1–4] This bone-preserving effect is a significant benefit to patients.

Limitations of this preliminary study, which was done in a private practice, include a small sample size and the lack of controls. Prospective controlled clinical trials with larger treatment groups will elucidate the prospect for widespread application of this specific surgical and prosthodontic protocol for patients who are edentulous in the maxilla.

In addition, other modifications of the protocol should be evaluated. These may include immediate implant placement at the time of extraction, nonsubmerged implant placement, implant survival in grafted bone (including sinus augmentation), the use of shorter or narrower implants, and reduced time frames for osseointegration. Validated information of this type will have positive implications for clinical practice.

CONCLUSION

On the basis of this study, which demonstrated the consecutive treatment of 5 patients with completely edentulous maxillae, it appears that freestanding contemporary implants may be used to retain maxillary removable overdentures with partial palatal coverage.

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