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Eight-year clinical and radiologic results of maxillary and mandibular implant-retained bar overdentures carried out on Oxidized (TiUnite™) Replace Select Implants placed in regenerated bone: A clinical case

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This article describes the clinical and radiologic long-term results of a healthy, nonsmoker women aged 62 at the time of treatment, with severely resorbed edentulous jaws in which bar and clip supported complete dentures were delivered in both jaws and followed for 8 years after prosthesis delivery. The patient had been edentulous in both arches since she was 50 years old. Treatment included the placement of four mandibular implants with maximum spacing anterior to the mandibular nerve, and four maxillary implants anterior to sinus wall without tilting the posterior implants, because of the insufficient bone quantity necessary to angulate implants. Guided bone regeneration was required in the maxilla, due to a bone atrophy that limited the placement of conventional dental implants. After 4 months, a second-stage surgery was per-

formed, and after 1 month of healing time the patient received definitive restorations. Implant survival rate, patient satisfaction, marginal bone maintenance, and soft tissue conditions at the modified titanium surface of the dental implants were evaluated after 8 years of function. A multifactorial approach, clinician-patient relationship, and vigilant maintenance of oral hygiene were needed in order to ensure an optimal treatment and a long-term successful result. Positive results regarding bone maintenance in the long-term perspective, also on regenerated bone, were observed using implants with implant-retained bar overdentures, when adequate levels of oral hygiene and prosthodontic adjustments are maintained. (*Quintessence Int* 2014;45:135–140; doi: 10.3290/j.qi.a31012)

Key words: bone regeneration, dental implants, implant surface, long term, overdenture bar

Following tooth extraction, the residual alveolar ridge resorbs. Most of these patients wear complete dentures for long periods, resulting in a cumulative, progressive, and irreversible bone resorption caused by loss of functional stimulus. When this occurs in the posterior regions, bone resorption, sinus pneumatization in the

maxilla, and superficialization of the inferior alveolar nerve in the mandible may limit conventional placement of dental implants to support fixed prostheses.¹ Patients suffering from this problem usually have unstable and nonretentive complete dentures, that generally result in constant trauma to the oral mucosa, pain, functional limitations (ie, mastication and speech), and esthetic facial decay.² In patients with severe bone atrophy and in locations previously considered unsuitable for implants, many different vertical bone augmentation protocols, involving hard and soft tissue

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Fig 1 Maxillary surgical stent in place.

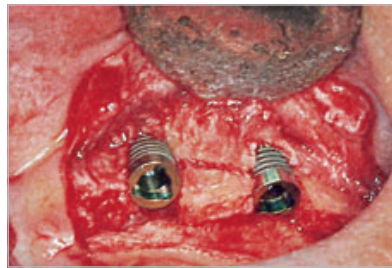


Fig 2 TiUnite Nobel Replace Select implants placed in the maxilla.

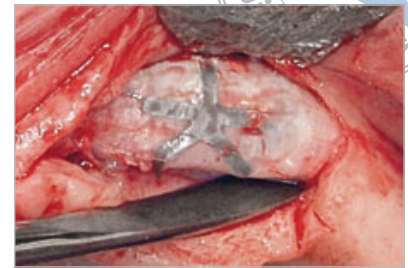


Fig 3 Nonresorbable membrane held with pin system.

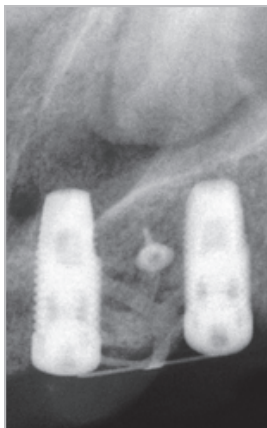


Fig 4 Periapical radiograph showing regenerated bone.

handling, have been proposed in order to maximize the prosthetic procedures. Due to invasive procedures, increased risks of morbidity, and high costs, patient acceptance of such procedures could diminish. A recent Cochrane systematic review³ reported that it is unclear which are the most efficient bone augmentation techniques. It is seen that osseous grafting, ridge augmentation, and sinus floor elevation are surgical options that enable acceptance of standard sized dental implants but have serious morbidities, and complications are very common.³ Recently, Malò approached this problem with an innovative concept.⁴ This procedure, called All-on-4, permits rehabilitation with fixed⁴ or removable⁵ dentures of a fully edentulous arch with only four implants placed in the anterior area of both the maxilla and mandible. Despite good results in the mid-term,⁶ the long-term predictability of tilted implants is still pending.⁷ This case report describes the 8-year follow-up of the surgical and prosthetic treat-

ment of atrophic edentulous jaws by means of removable implant-bar-supported dental prosthesis.

CASE REPORT

The present case report describes the clinical treatment of a healthy, nonsmoker women aged 62 at the time of treatment, with severely resorbed edentulous jaws in which bar-and-clip-supported complete dentures were delivered and followed 8 years after prosthesis delivery. The patient had been edentulous in both arches since she was 50 years old. With 12 years of complete removable denture use, the mandibular arch presented severe resorption resulting in denture instability, associated with impairment of masticatory function, chronic trauma, and pain. The patient stated she was interested in fixed prosthetic rehabilitation and she was scheduled for a comprehensive examination by an oral surgeon and prosthodontist to establish her candidacy for implant therapy. The radiographic examination highlighted severe bone resorption in the maxilla, which precluded rehabilitation based on standard osseointegrated implants in the absence of bone augmentation. All treatment options were discussed and evaluated together with the patient. Conventional complete mandibular and maxillary dentures were excluded because they would not solve chronic trauma to the oral mucosa. Implant-supported fixed-removable restorations were considered the best scenario for both the maxilla and mandible as there was insufficient bone in the posterior area for fixed restorations.

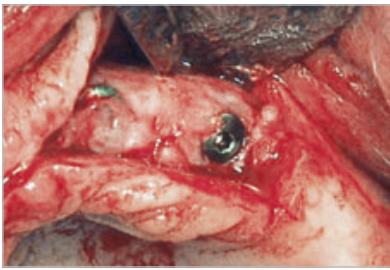


Fig 5 Regenerated bone around implants.

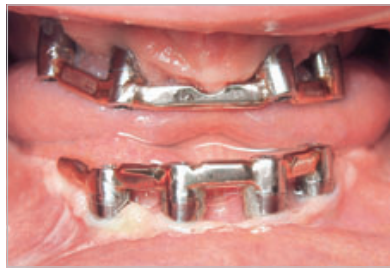


Fig 6 Clinical photograph after 8 years in function.

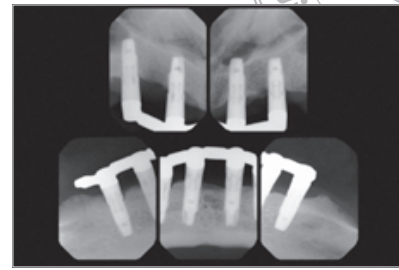


Fig 7 Radiographs after 8 years in function.

In the maxilla, four maxillary implants were placed anterior to the sinus wall, by means of a surgical stent (Fig 1), without tilting the posterior implants because of the insufficient bone quantity necessary to angulate implants. Approximately 3 to 5 mm of the vertical height of the implants were outside the buccal alveolar housing (Fig 2), requiring the use of nonresorbable membrane (WL Gore) held with a pin system (ACE Surgical Supply Company), and autogenous bone graft planned simultaneous to the implant placement. A periosteal release incision and horizontal mattress sutures were used to ensure full passive closure of the flap. The buccal flange of the maxillary denture was fully removed and the denture was placed after 10 days to ensure no impact of primary closure during the initial postoperative swelling period. In the mandible, four implants were placed with maximum spacing anterior to the mandibular nerve. The mandibular ridge was a knife edge but had less vertical loss, so it was planned to use the knife edge bone reduction as donor for the maxillary arch. Postoperative prescription consisted of amoxicillin 500 mg three times a day for 7 days, and diclofenac 50 mg three times a day prn for pain control. Healing was uneventful with no infection, no membrane exposure, and no significant discomfort, other than reported difficulty with maxillary denture stability that required adhesives in the palatal area for retention.

After 4 months, a second-stage surgery was performed using a mid-ridge incision to expose the implants and remove the Goretex membrane (WL Gore) (Fig 3). At this time we noted good bone formation with full coverage even to the most exposed implants

(Fig 4). The bone had even grown over the top of the implants in most sites. The implants were also radiographed to ensure appearance of bone integration (Fig 5), and a forward torque test up to 35 Ncm was performed to ensure the implants were stable and ready for integration. The flap was then replaced with minimal margin recontour of the buccal keratinized tissue in place, effectively leaving the flap in a slightly buccal pedicle position to maximize buccal soft tissue volume and the keratinized band.

After 1 month of healing, the case was returned to a prosthodontist (CP) for final restoration with a soldered bar clip arrangement (Swiss NF Metals). The patient was recalled on an annual basis for radiographs and probing, as well as performance of an oral hygiene review and minor scaling, if needed. Clinical (Fig 6) and radiographic (Fig 7) examinations were performed over 8 years after implant placement.

DISCUSSION

The treatment of totally edentulous patients is very different from that of partially edentulous patients because of the absence of teeth and limited bone. Rehabilitation with dental implants has been demonstrated to be a good tool to improve the quality of life of edentulous patients.^{8,9} However, rehabilitation of severely atrophic totally edentulous mandible and maxilla by placement of standard implants is very challenging, since it presents anatomical limitations for conventional implant placement.⁸ Patients with severely resorbed edentulous jaws often suffer from

problems with their dentures such as insufficient retention, intolerance to loading of the mucosa, pain, difficulties with eating and speech, loss of soft tissue support, and altered facial appearance.^{8,9} Traditionally, these patients have been treated with dentures, but this approach may not meet the functional, psychological, and social needs of the individual.

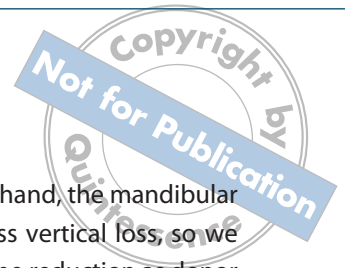
In the present case, the placement of implants in the anterior region of both jaws made the prosthetic rehabilitation possible without major augmentation procedures. Today, one proven option for the rehabilitation of the edentulous jaws is the All-on-4 concept.⁴ This procedure consists of placing only four implants to provide edentulous patients with a fast, cost-effective cross-arch fixed restoration. Recent published data on the All-on-4 concept show cumulative survival rates between 92.2% and 100%.¹⁰ The high implant survival rates and the low marginal bone resorption demonstrate the viability of this technique; however, there is still a lack of medium- and long-term follow-up studies. On the other hand, the reported procedure was performed in 2002, and maxillary bone grafting was also required. Tilted implants have been proposed as an alternative to traditional protocols in the rehabilitation of fully⁶ as well as partially¹¹ edentulous patients. Tilted implants demonstrated a favorable short-term prognosis; however, more randomized long-term trials are needed to better elucidate long-term success of tilted vs upright-positioned implants. Moreover, patient selection and the learning curve are critical and may determine success of the surgery.

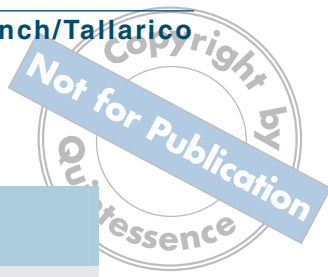
In the present case, the final treatment plan for both jaws included removable dental prostheses supported by four upright-positioned implants, splinted by a custom-milled bar, to provide the patient with the stability of a fixed dental prosthesis combined with the ability to remove the prosthesis, conducive to attend to oral hygiene and maintenance. Augmentation procedures to reconstruct the missing bone volume in the maxillary arch were unavoidable. Computer tomography was not performed as this was not the standard of care in 2002, and we had planned simultaneous bone graft in the maxilla so that the ridge would be modified at

the time of surgery. On the other hand, the mandibular ridge was knife edge but had less vertical loss, so we planned to use the knife edge bone reduction as donor for the maxillary arch. This had a dual benefit of providing vertical restorative clearance as well as obtaining a mix of cortical and cancellous bone. This degree of bone grafting required a nonresorbable membrane; in 2002 and still today the material of choice was titanium reinforced Goretex membrane (WL Gore). Nobel Biocare Replace Select Straight implants (Nobel Biocare) were chosen as the ideal "flat top" design for joining multi-unit structures. The machined collar of 1.5 mm also represented an advantage as the case was performed with simultaneous bone graft, and typically the tissue just under the membrane does not form bone but rather a 1 mm dense connective tissue layer, so the TiUnite surface was situated in the bone about 0.5 mm below this connective tissue layer. The relatively stable average bone score suggests the loss is not progressive despite long-term exposure of about 0.5 mm of TiUnite surface.

Though the number of longer term follow-ups over 7 years is small,^{12,13} it is favorable, and it contradicts a short-term animal study that stated that the porous anodized surface (TiUnite, Nobel Biocare) is more susceptible to progressive peri-implant loss once established.¹⁴ The radiographs showed initial remodeling to the level of the first thread at most sites, this being quite common, and likely to be related to remodeling from the microgap of the abutment connection during healing.¹⁵ Furthermore, Pozzi et al¹⁵ showed that the new implant design with a conical connection and built-in platform shifting showed statistically lower marginal bone loss than straight neck configuration with flat-to-flat implant-abutment interface.

It should be noted that the bone remodeling remained remarkably stable in this case and it did not significantly change over 8 years. This is indeed our normal finding with this implant design from a larger database review of 952 Nobel Biocare Replace Select implants (Nobel Biocare) with machined collar at our center. Changes in marginal peri-implant bone level were evaluated using intraoral periapical radiographs





Time point	Mean ± SD (mm)	Number of implants
Stage 2*	0.14 ± 0.44	952
1 year†	0.45 ± 0.68	799
2–3 years	0.50 ± 0.62	655
4–5 years	0.55 ± 0.77	378
5–7 years	0.58 ± 0.41	90
7–8 years	0.42 ± 0.70	20

*Between implant placement and healing abutment connection, or Stage 2 (4 months later). †Between Stage 2 and 1-year follow-up. SD, standard deviation.

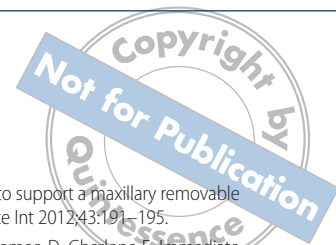
taken perpendicular to the long axis of the implants with the parallel technique by means of a standardized 90-degree film holder (Dexis) in order to ensure reproducible and good-quality radiographs with a clear thread profile. The distance measured on radiographs with a digital caliper was defined as bone crest level (BCL). The greater of either radiographic values of mesial and distal measurements were taken for each implant from the implant platform to the most coronal bone-to-implant contact. One assessor involved in the study performed all radiographic measurements at the time of the stage 2 surgery and then every 1 to 2 years up to 8 years. The results were reported at implant level and rounded off to the nearest 0.1 mm. After initial bone remodeling, after 1 year there was no progressive bone loss trend noted, with the average bone score remaining stable at measurement intervals over the 1- to 8-year period (Table 1).

The results of the present case report seem to be in agreement with prospective studies with a large cohort of patients and comparable, long-term follow-up.^{12,13} To the best of our knowledge, this case is the first 8-year follow-up case of implants placed in regenerated bone to support a bar-retained removable dental prosthesis in both the maxilla and mandible. However, one point raised in the study warrants additional discussion. Prosthodontic long-term maintenance requirements associated with implant-retained overdentures are a direct consequence of the attachment system, together with differing numbers and distributions of implants. A few long-term studies on overdentures have compared

various overdenture attachments.¹⁶⁻²⁰ The results have been inconsistent, with some studies finding little or no difference among the various attachments,^{19,20} while others studies came to the opposite conclusion.¹⁶⁻¹⁸ However, the overdenture attachment mechanisms have changed in design and material composition over time and are not compatible among the various implant manufacturers. Thus, comparisons of studies performed at various time points using diverse components are difficult to interpret. Good prosthetic results, as reported in the present study, were previously described for mandibular and maxillary implant overdentures, but maintenance and service were regularly required to ensure proper function.¹⁶⁻²¹

Last but not least, studies comparing various attachment mechanisms found more problems with clip bars and ball anchors compared to rigid (U-shaped) bars.²² The global dental implant market will continue to grow considerably due to increasing patient demand for dental implant therapy and progressive expansion of the number of general practitioners offering this therapy. The presented case report was completed prior to the advent of new dental implant technologies such as CAD/CAM systems, so a prefabricated soldered bar system (Swiss NF Metals) was used as it offered good strength and low profile, as well as ease of future repair options or added implant options by resoldering.

Nevertheless, the goal is always to restore the dentition to a state of maintainable physiologic health that satisfies the patient's goals and objectives in the most economical, most predictable, and least invasive man-



ner. Implant-supported overdentures require only limited surgical intervention, benefit from predictable prosthodontic management, permit oral hygiene procedures to be easily carried out, and have a favorable price point in comparison to fixed implant-supported restorations.

Numerous studies of implant-retained overdentures in mandibles with good results but short follow-up periods have been reported. Patients with implant-retained overdentures are likely to present in general dental practice. Practitioners should be aware of issues associated with the design, treatment planning, and maintenance of these prostheses.

CONCLUSION

In conclusion, implant-retained bar overdentures, opposed to each other, can be considered an effective, easy to clean, and predictable option for success in the long-term treatment of edentulous patients, in the regenerated bone. Positive results in terms of bone maintenance and prosthetic success in the long term are to be expected when adequate levels of oral hygiene and prosthodontic adjustments are maintained.

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