

Rehabilitation of a Severely Atrophic Mandible Using Soft Tissue Matrix Expansion (Tent-Pole) Technique, Implants, and a Fixed Dental Prosthesis: A Clinical Report

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INTRODUCTION

In the past 30 years, dental implants supporting prosthetic rehabilitations of edentulous jaws have become one of the most significant breakthroughs in dentistry,¹⁻⁸ and several clinical studies have showed high implant survival rates.⁵⁻⁸ Dental implants provide a successful and predictable means of support and retention for edentulous patients, and implant-supported restorations have enhanced quality of life for millions of patients.¹⁻⁴

However, in some edentulous patients with severely resorbed mandible the bone volume is so insufficient that implant placement is impossible. Mandibles with bone height no greater than 6 mm usually do not allow implant placement without considerable bone grafts.⁹⁻¹¹ In 2002, Marx et al⁹ presented a technique, soft tissue matrix expansion, in which dental implants were used as "tent poles." The novel strategy of this approach was to allow iliac bone grafts to consolidate and maintain their volume with dental implants that create a tenting effect. During the same operation, a surgical procedure using autogenous bone grafts from the iliac crest and implant placement was performed with an extraoral approach underneath the tip of the mandible at the chin.⁹ The reported osseointegration success rate was 99.5%, and the mean bone height gain was 10.2 mm for the 64 patients in the study by Marx et al.⁹

Only a few clinical reports⁹⁻¹² using soft tissue matrix expansion technique have been published. This report aims to describe the rehabilitation of an extremely resorbed mandible using the soft tissue matrix expansion technique, implants, and an implant-supported screw-retained fixed dental prosthesis (FDP).

CLINICAL REPORT

A 79-year-old woman with an edentulous maxilla and mandible presented to the Implant Clinic. The patient had been using complete dentures for about 40 years. The patient's chief complaints were that her dentures were worn, created sore spots, and that the mandibular denture lacked retention. The patient indicated a desire for a fixed implant-supported prosthesis.

The patient was taking medication for high blood pressure, which was under control. She had no other major health problems.

Clinical examination of the patient revealed a maxilla with adequate retention, support, and stability for a complete denture as well as a mandibular residual ridge with significant resorption (Figure 1). However, the cone-beam computerized tomography (CBCT) scan (Master 3-D CBCT machine, Geeing-Do, Republic of Korea) indicated about 6-7 mm vertical bone height in the anterior mandible, which does not allow any implant placement without extensive bone grafting. After other options were discussed, such as maxillary and mandibular complete dentures and mandibular implant-retained overdenture, the patient accepted the proposed treatment plan, which included a new maxillary complete denture and an implant-supported screw-retained FDP in the mandible after soft tissue matrix expansion using autograft from the iliac crest. The patient signed an informed consent form before the treatment.

Surgical procedure

After general anesthesia was achieved, a scalpel was used to make a 10-cm anterior, low submental incision through skin and subcutaneous tissue in an existing skinfold (Figure 2). Using monopolar electrocautery, hemostasis was obtained and blunt dissection in all directions was performed in the subcutaneous plane with scissors. Superior sharp dissection then ensued until the anterior inferior mandibular border was identified (Figure 3). The crest of the atrophic mandibular ridge was dissected and the mental neurovascular bundles identified bilaterally at the alveolar crest superior border.

The mandible was severely atrophic, measuring 6 mm in vertical height. Under copious normal saline irrigation, the

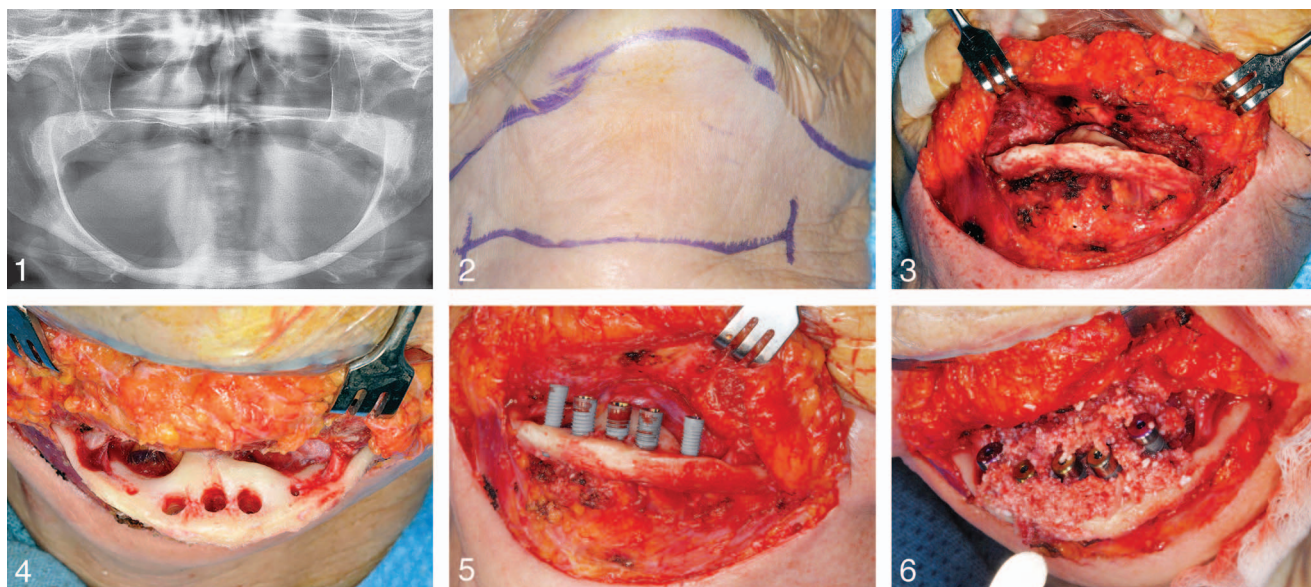
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FIGURES 1–6. **FIGURE 1.** Panoramic radiograph taken before treatment. **FIGURE 2.** Extraoral view of the surgical area determined by blue markings. **FIGURE 3.** A low submental incision through skin and subcutaneous tissues was made to access the mandible. **FIGURE 4.** Mental neurovascular bundles were identified bilaterally, and implant osteotomies were prepared. **FIGURE 5.** Five implants were placed without any complications. **FIGURE 6.** Anterior mandible was grafted to submerge implants in the bone graft.

implant osteotomies were prepared (Figure 4). Tapping was performed so as not to generate excessive pressure during implant placement. Five 13-mm-long implants (4.3 × 13 mm [n = 3], 3.5 × 13 mm [n = 2]), Nobel Replace Tapered Groovy; Nobel Biocare, Yorba Linda, Calif) were then placed extraorally using a tent-pole technique (Figure 5). All healing abutments (3-mm long, Nobel Biocare) were placed on the implants.

The left hip was isolated, and the landmarks were identified for a standard anterior iliac crest bone-graft harvest. The anterior superior iliac spine was palpated and marked with a surgical marker. After administering local anesthetic (2% lidocaine with 1:100 000 epinephrine; Dentsply Pharmaceutical, York, Pa), a 4-cm incision was made 2 cm lateral to the iliac crest and 2 cm superior to the anterior superior iliac spine using a scalpel. A periosteal incision was made and the abdominal oblique, transversus abdominus, and iliacus muscles were dissected medially, exposing the medial ileum. A 4 × 5 cm corticocancellous block was harvested with a reciprocating saw under copious irrigation. Then, cancellous bone was harvested. An absorbable gelatin compressed sponge (Gelfoam, Pfizer Inc, New York, NY) was placed on the site after copious irrigation and placement of bone wax and hemostasis was confirmed. The surgical incision was closed in layers with the deep tissue approximation using sutures (3.0 vicryl suture, Ethicon Inc, Somerville, NJ). The subcutaneous tissues and skin were then closed using sutures and staples.

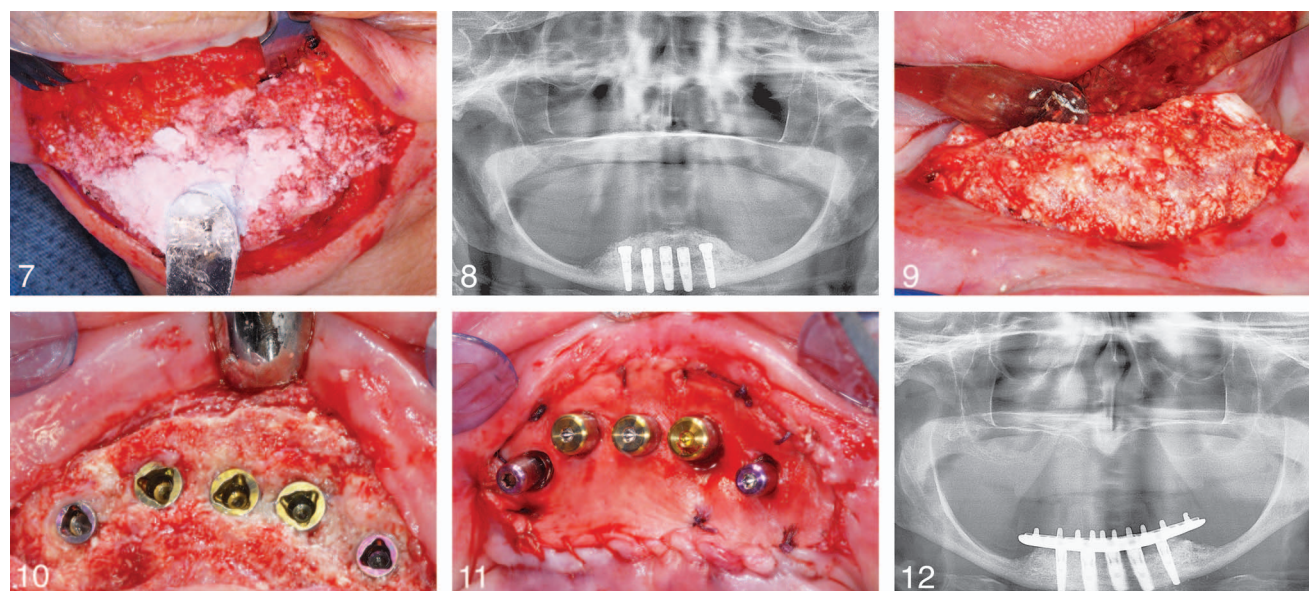
The autogenous bone graft was prepared by using the bone mill and mixed with a bone growth stimulator (OsteoGen, Biomet Inc, Warsaw, Ind) and an alloplastic material (CaSO₄, ACE Surgical Supply Co, Brockton, Mass). Then the anterior mandible was grafted to submerge the implants in the bone graft (Figures 6 and 7). Approximately 7–8 mm of each implant remained out of native bone prior to grafting. The oral cavity

was inspected and no perforations were observed. The patient was extubated and then transferred to the recovery room.

Five months later, the patient presented for phase 2 implant surgery under local anesthesia. The preoperative panoramic radiograph was reviewed and revealed that excellent bone levels (15–18 mm gain in vertical bone height) had been maintained in the anterior mandible (Figures 8 and 9). All implants remained submerged without intraoral mucosal perforation. A mandibular midcrestal incision was made with a scalpel. The grafted mandible was exposed, and an alveoplasty was performed with an acrylic bur, thereby reducing the bone height to uncover all implants. All healing abutments were removed uneventfully (Figure 10). Then, a strip of a regenerative tissue matrix (Alloderm, BioHorizons Inc, Birmingham, Ala) was placed and contoured to the surgical site. The margins of the regenerative tissue matrix (Alloderm, BioHorizons Inc) was sutured to the remaining buccal and lingual tissues to immobilize the graft. The implants were then exposed through the regenerative tissue matrix with a tissue punch and new healing abutments were placed (5-mm long, Nobel Biocare) (Figure 11). A thermoplastic splint was then contoured to the surgical site as a stent, and a resilient lining material (Coe-soft, GC America Inc, Alsip, Ill) was used to relin the intaglio surface. Two holes were drilled; screws were then used to immobilize the splint.

Restorative procedure

The following steps were taken to fabricate the implant-supported screw-retained FDP. The healing abutments were unscrewed. The impression copings were screwed on the implants and splinted to each other with autopolymerizing acrylic resin (GC America Inc). An implant-level impression was made using impression copings and polyether impression



FIGURES 7–12. **FIGURE 7.** Alloplastic material was used over graft material to promote wound healing. **FIGURE 8.** Panoramic radiograph taken 5 months after implant placement. **FIGURE 9.** New bone formation 5 months after implant placement. **FIGURE 10.** Alveoloplasty was performed to uncover all implants with an acrylic bur. **FIGURE 11.** Implants were exposed through regenerative tissue matrix with tissue punch, and healing abutments were placed. **FIGURE 12.** Panoramic radiograph of the restoration taken at insertion.

material (Impregum Penta soft medium body, 3M ESPE, St Paul, Minn). After implant replicas were connected to the impression copings, the definitive cast was poured using Type IV dental stone (ResinRock, Whip Mix Corp, Louisville, Ky). Maxillary and mandibular trial dentures (Ivoclar, Vivadent Inc, Amherst, NY) were fabricated using traditional prosthetic methods. A trial denture insertion was performed, and centric occlusion, esthetics, phonetics, and occlusal vertical dimension were confirmed. A titanium metal framework was fabricated using CAD/CAM (computer-aided design/computer-aided manufacturing) technology. After confirming the fit of framework on the definitive cast, it was intraorally verified using radiographs. The denture teeth were transferred from the previously fabricated trial denture to the framework. The implant-supported, screw-retained FDP was processed, finished, and polished in the laboratory. Then the prosthesis was screwed on the implants. Screw access holes were covered using cotton pellets and composite resin (Figure 12).

DISCUSSION

Although dental implant treatment has been one of the most predictable options to restore edentulous mandibles, this option may not be possible for some edentulous patients with severely resorbed mandible and insufficient bone volume. The soft tissue matrix expansion, in which dental implants are used as tent poles, is an alternative to increase bone height before implant placement for these patients.

Korpi et al¹² investigated the outcomes of patients with severely resorbed fractured mandibles who were managed with a modified tent-pole procedure. Four edentulous patients with a severely atrophic fractured mandible and less than 10 mm of vertical height in the body of the mandible were treated with

an immediate or a delayed protocol. Implants were loaded at 3 months as the patients were fitted with healing caps, and the dental implants were loaded using provisional screw-retained acrylic resin prostheses and bar-retained overdentures afterward. The average alveolar augmentation was 7.5 ± 1.17 mm. In the present case report, over 15 mm of vertical bone height was gained. The extraoral approach used in this patient was one of the most crucial parts of the treatment and contributed to successful bone gain because there was no communication between the surgical site (implants and graft) and the intraoral environment during the osseointegration and bone healing processes. If we had used an intraoral approach, it would have been almost impossible to keep the graft material in place and maintain an uncompromised osseointegration process.

The disadvantages of this method include the need for surgery under general anesthesia; the waiting period for bone healing, osseointegration, and restorations; and the relatively high cost. However, the benefits of this technique outweigh the possible disadvantages.

Because this type of case is rarely seen, each person (surgeon, restorative doctor, laboratory technician) involved in the process should possess the appropriate knowledge, which requires advanced training and experience. Otherwise, failures will be inevitable and costly. Although each step was explained and illustrated in this report, readers need to ensure that they have proper knowledge, armamentarium, and experience before attempting this type of treatment.

CONCLUSION

This clinical report describes the rehabilitation of a patient with a mandibular implant-supported FDP after a soft tissue matrix expansion approach.

ABBREVIATIONS

CBCT: cone-beam computerized tomography

FDP: fixed dental prosthesis

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