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PROSTHODONTIC Insights
A Digest of Recent Trends, Techniques and Clinical Concepts of Dental and Facial Esthetics

Retreatment: Fractured Implants Due To Biomechanical Overload

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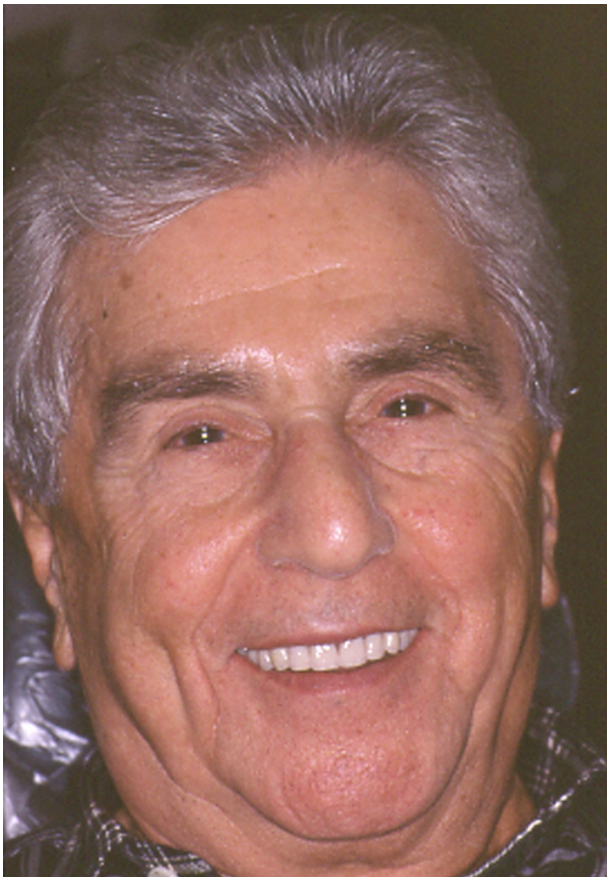
The strength of osseointegration, the biologic and biomechanical union of bone to alloplastic materials such as titanium, is well known and thoroughly documented in the dental literature. From early clinical trials to the present modes of implant treatment, a high success rate has been published for implant and prosthesis stability in the anterior mandible. Long term successful function of this prosthodontic reconstruction has been reported for both the two-stage protocol as well as immediately loaded implants such as the TEETH IN A DAY protocol.

The long-term function of an implant-supported prosthesis is dependent on numerous biomechanical factors. From the biologic perspective, these factors include the quantity and quality of bone, current and anticipated bone metabolism, and systemic factors that may influence that metabolism.

The mechanical factors to consider in such rehabilitations include the number, length, diameter, and alloy of the implants, as well as their position in the jaw relative to the anticipated occlusal scheme. Leverage factors that are generated by cantilevers can place enormous stress on the implant as well as the bone implant interface. Leverage forces on implants also increase in proportion to the vertical height of the prosthesis. In patients with minimal bone loss, multiple long implants will easily support a prosthesis that has a relatively normal coronal height. However, with severely advanced alveolar bone atrophy, the prosthetic height, from the top of the implant to the incisal or occlusal table, has been measured in excess of 30 mm. This volume of prosthetic material is generally required in order to fulfill functional performance and restore vertical dimension to the lower third of the face.

The engineering design for the implant prosthesis in cases with severe alveolar atrophy must consider the potential for parafunctional loading, the off axis loading forces that are applied to the



implants and bone by a variety of cantilevers, and the intense muscular force generated on "prosthetic levers" during normal masticatory function. The catastrophic outcome of

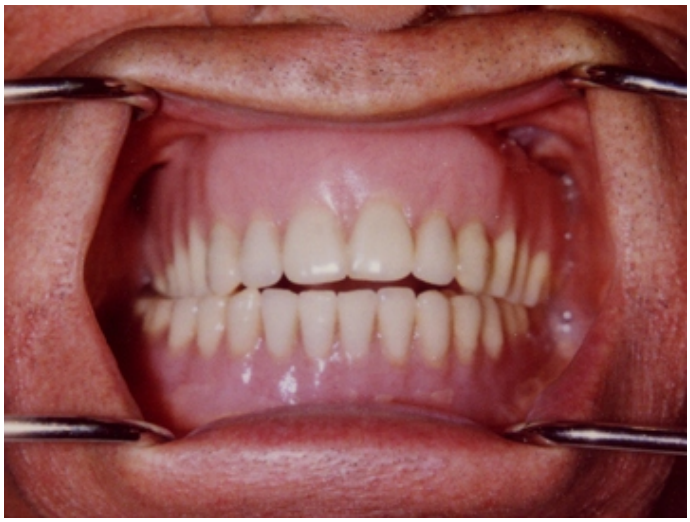


Fig 1
Protruded mandibular Prosthesis with no retention

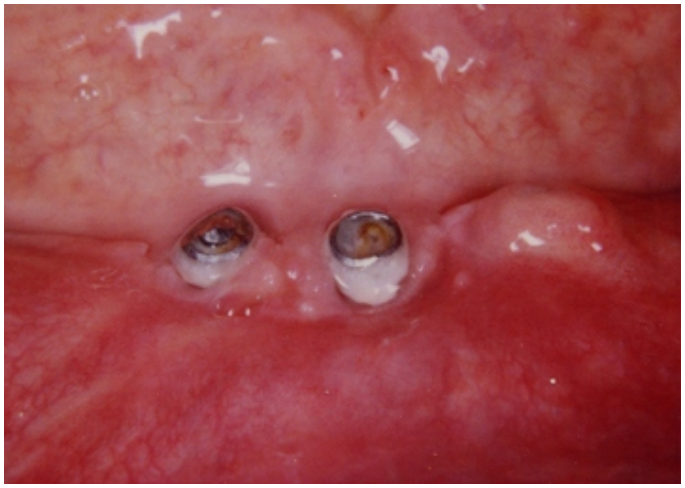


Fig. 2
Clinical View of Fractured Implants

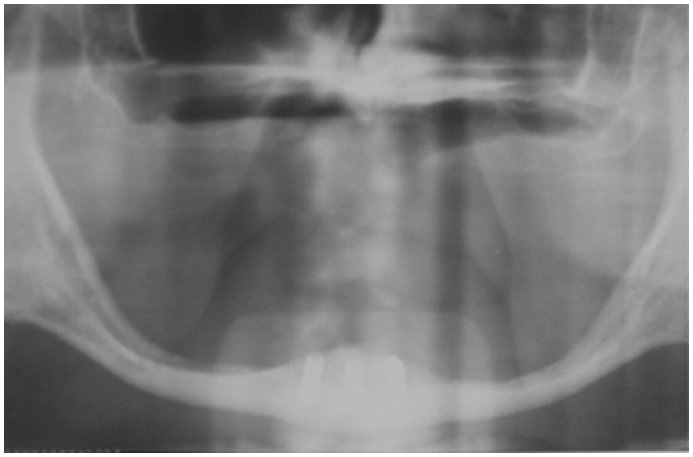


Fig. 3 Panorex radiograph at Initial Exam with 3 fractured implants

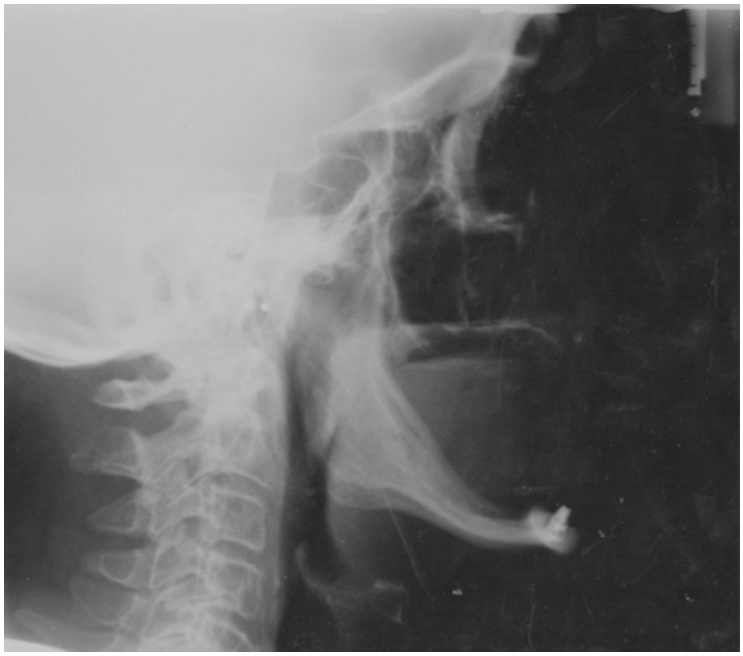


Fig 4 Pretreatment Lateral Cephalometric Radiograph showing fractured implants in extremely thin bone

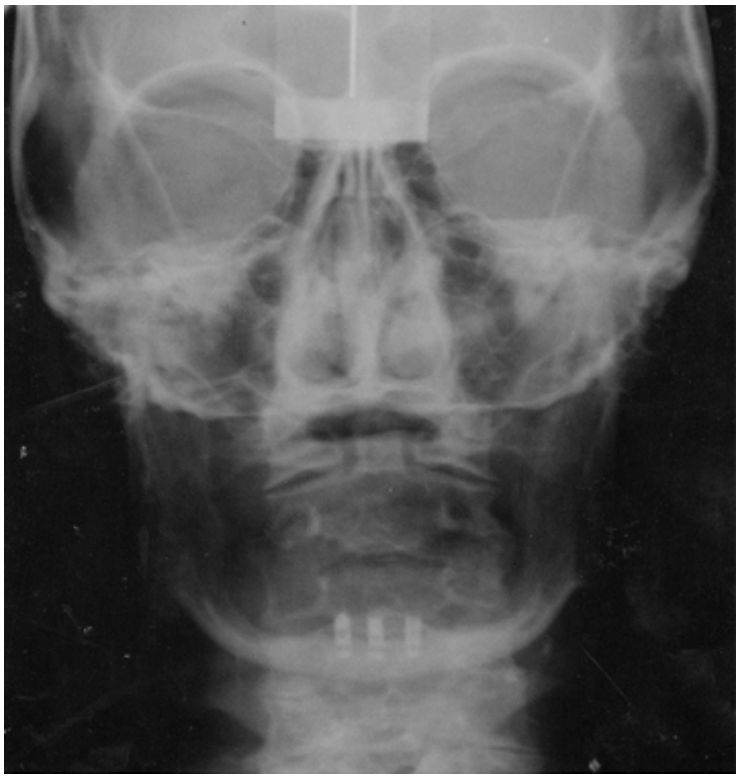


Fig 5 Pretreatment A-P Cephalometric radiograph with fractured implants evident

nadequately engineered implant supported prostheses can have enormous negative effects on both the patient and the treating doctor. Functional overloads on implants can be generated by both fixed detachable as well as overdenture prostheses. Such overloads may lead to prostheses fracture, abutment loosening or fracture, implant fracture, or loss of osseointegration.

Warning signs of impending catastrophe can be observed clinically in the form of prosthetic screw loosening, abutment loosening, and occasionally excessively rapid attrition of the incisal and occlusal tables.

A reassessment of the number and distribution of the supporting implants is important in these situations and supplemental implant support may be required.

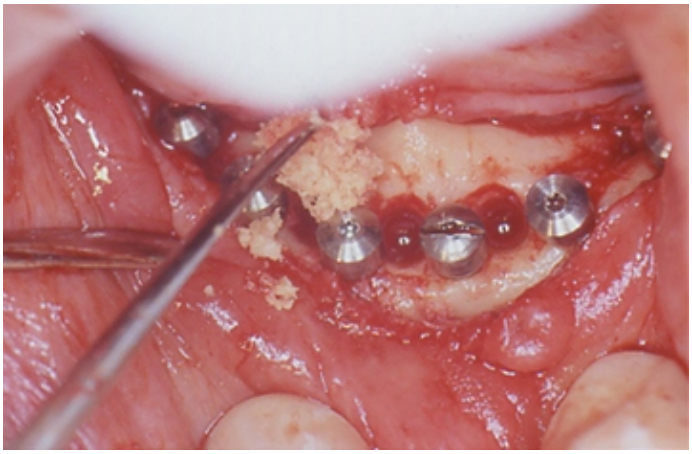


Fig 6
Soft tissue debridement around fractured implants.

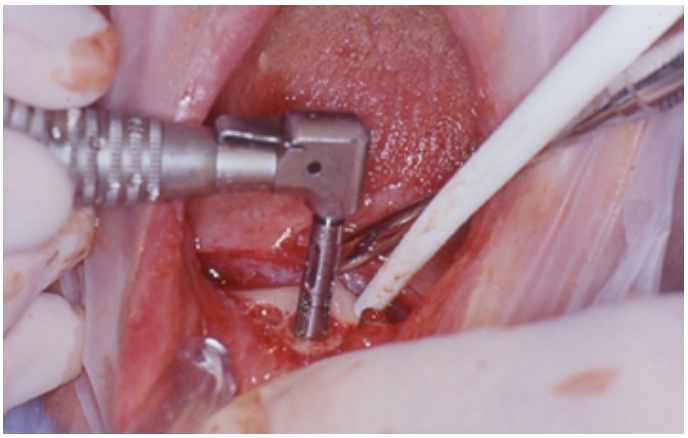


Fig 7
Trephine removes bone around fractured implants.

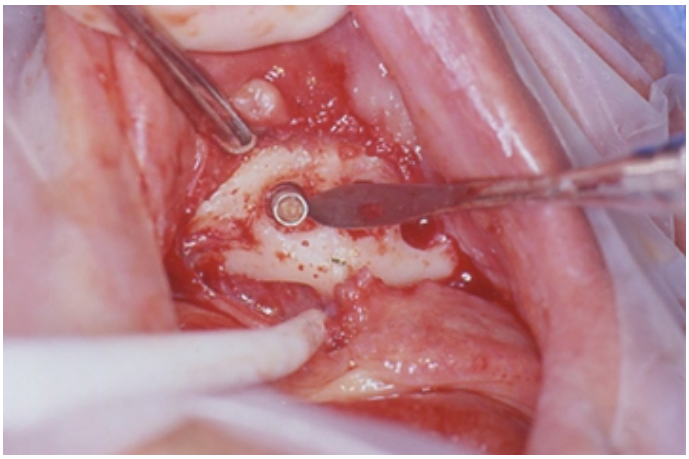


Fig 8
Loosening and removal of fractured implants.

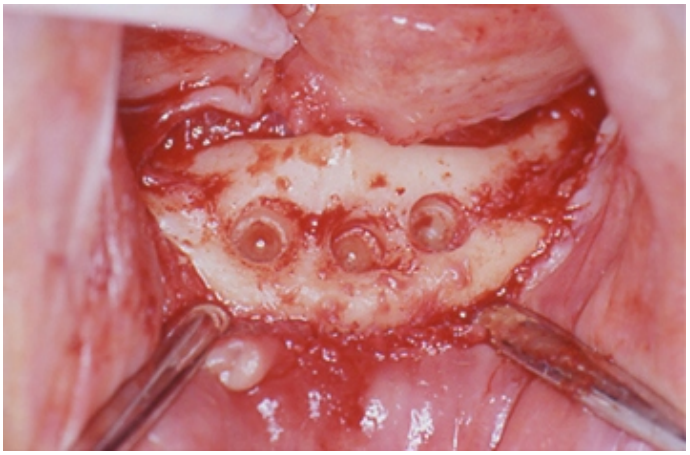


Fig 9
Dense cortical bone exposed at apex of implant site.

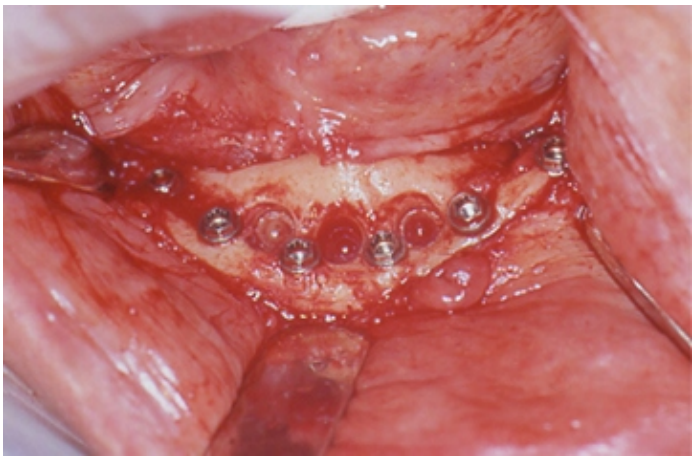


Fig 10
Seven Brånemark Implants placed in extremely thin

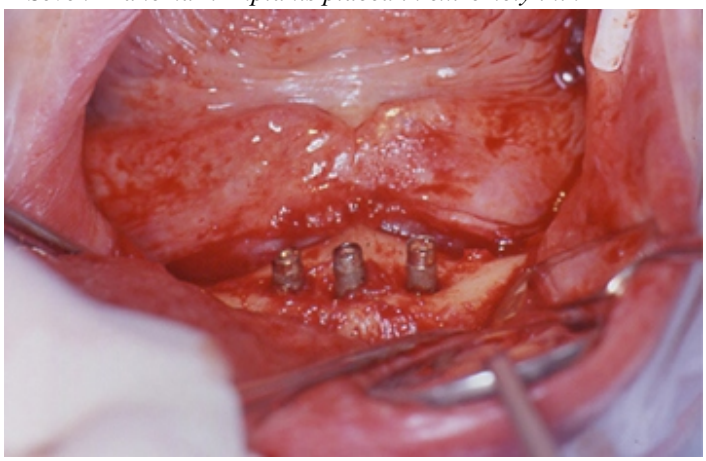


Fig 10
Seven Brånemark Implants placed in extremely thin mandible.

Inadequately engineered implant prostheses that lead to implant fracture are among the most difficult clinical conditions to manage. Understandably, implants are initially placed in the optimal bone sites, leaving the less desirable locations for the placement of new implants. The removal or retention of fractured implants also poses a dilemma. If the implants are removed, additional bone is lost in the process. And if the fractured implants are allowed to remain, they may become a source of irritation, inflammation or infection, and can seldom be used to provide any support for a new prosthetic rehabilitation.

The following clinical example demonstrates the complications and difficulty of retreatment when an inadequate number of implants is used to support a prosthesis that exceeds the biomechanical limits.

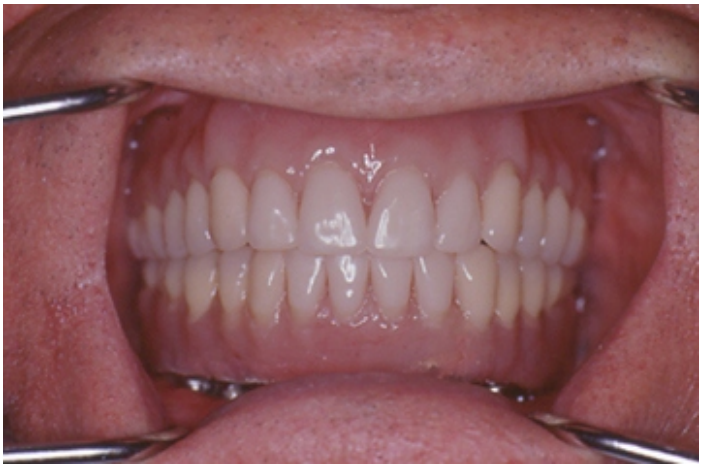


Fig. 12 Stage II -
Estheticone and Standard Abutments placed on implants

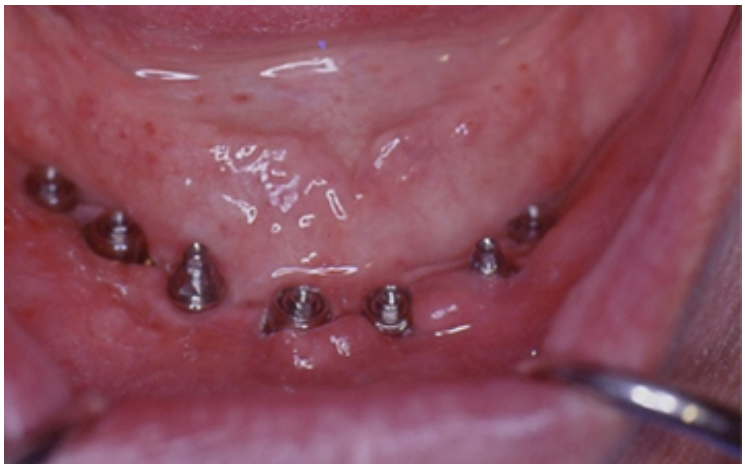


Fig. 13
Final mandibular non-removable implant supported fixed prosthesis

PATIENT HISTORY

The patient is a very healthy 77-year-old retired general dentist. He has no known allergies to drugs or medications, has never smoked, and does not drink alcoholic beverages. The patient had been totally edentulous for the past 30 years and was wearing the same denture that he had made for himself three decades ago. Because of continued severe atrophy of the mandible, the denture had poor stability and continuously migrated anteriorly (Fig 1). It inhibited his ability to chew and detrimentally affected his speech. Facial esthetics were also affected by the severe loss of vertical dimension.

Six years prior to our initial examination, a dental colleague and friend of the patient placed three press fit cylinder implants in the greatest bone volume of the anterior mandible to function as retentive support for an overdenture. All three implants osseointegrated; however, the extreme mechanical overload eventually led to their fracture (Fig 2). At the time of our examination, the mucosal tissue surrounding the fractured implants was highly inflamed, hyperplasic and painful.

Radiographic evaluation was accomplished with panradiographs (Fig 3), lateral cephalometric films (Fig 4) and anterior-posterior cephalometric films (Fig 5). The three fractured implants visible on these radiographs used only half the available vertical height of bone in the symphasis area. The severe atrophy of the body of the mandible, especially in the area of the mental foramina, ranged from 5 to 8 mm in height. The inferior alveolar canal was partially deteriorated due to advanced atrophy of the alveolus, exposing the neurovascular bundle on the crest of the alveolar ridge.

DIAGNOSIS

According to the American College of Prosthodontists classification of edentulous conditions, this dentist patient had a Class IV mandibular condition, with failed fractured implants in the symphysis region, and serious potential for pathologic fracture.

TREATMENT OPTIONS

Few options are available when considering the treatment of a Class IV severely atrophic totally edentulous mandible with fractured implants in the anterior. Vertical bone height is certainly a concern, even if a traditional removable denture prosthesis is the only available treatment. Bone grafting to increase the vertical height of the mandible could be considered. However, onlay bone grafting in the mandible has had poor treatment outcomes with the majority of the grafted bone resorbing in the first three years. This form of grafting is also contraindicated in light of the highly inflamed and hyperplasic mucosa around the fractured implants.

Another option would be inferior border bone grafting using a cadaver mandible as a carrier for autogenous bone. This requires hospitalization and the associated morbidity of the hip as the donor site. Additionally, this protocol requires the graft to mature a minimum of one year prior to the placement of endosseous implants. Then the implants should be permitted to remain submerged and unloaded for an additional 8 to 10 months.

A third option would be the careful removal of the fractured implants and the placement of multiple short threaded implants, in conjunction with the lateral repositioning of portions of the neurovascular bundle.

TREATMENT

The patient elected to proceed with the third option after careful consideration of the above options and full realization of the potential for mandibular fracture. Written consent for treatment forms were reviewed and signed.

Preparation for surgery:
The patient was prepared for surgery using the standard sterile protocol, appropriate cleansing of the mouth, and antiseptic cleaning of the perioral

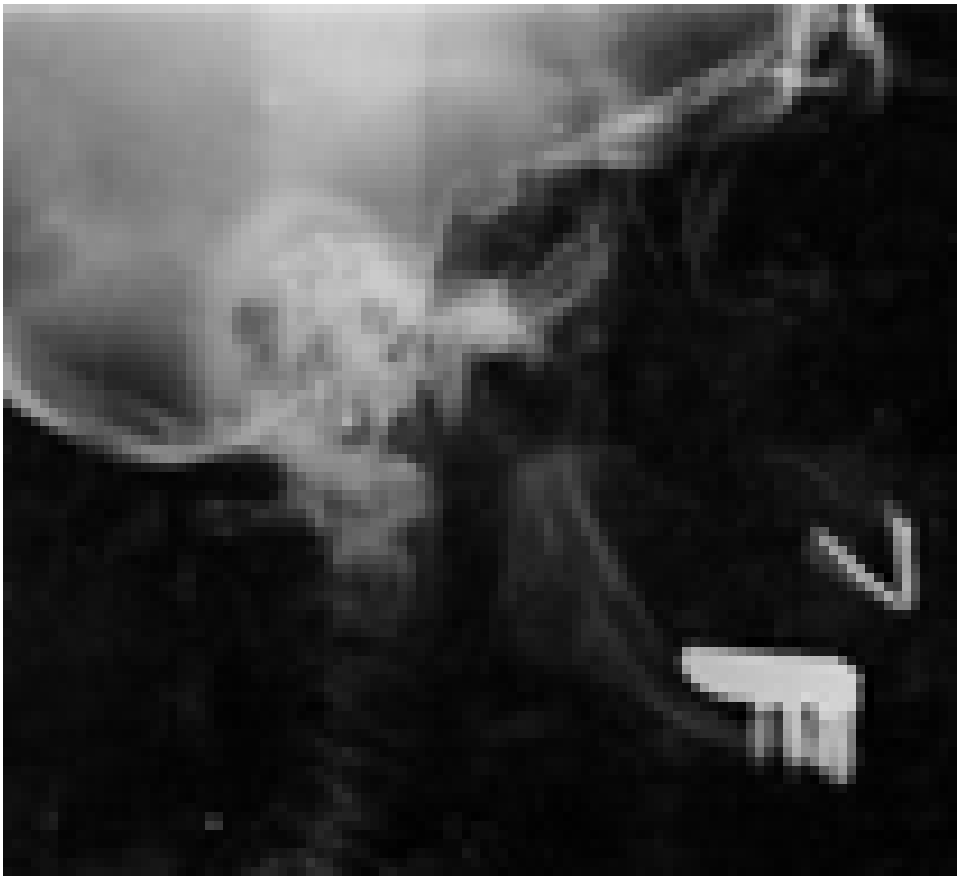


Fig. 15
Lateral cephometric view of post-op incisal relationship

tissues. Complete sterile drapes were used to cover the patient and an adhesive sterile plastic drape was applied to the lips and face.

Anesthesia:
Local anesthesia using both Marcaine 1:200,000 epi and Lignospan 1:50,000 epi was administered throughout the mandible.

Surgery:
A full crestal incision from the right to left first bicuspid region was made with buccal and lingual full thickness flaps elevated. Once the neurovascular bundles were identified and dissected, the incision was extended posteriorly to the region of the second molars.

Implant Removal:
Inflamed and hyperplasic tissue was debrided from around the fractured implants (Fig 6). Using a trephine drill (Fig 7) and copious sterile saline irrigation, bone was removed from the area immediately around the three fractured implants. The thickness of the trephine was 0.75mm, removing a minimal amount of bone. All bone "dust" was collected for future autogenous grafting if required. The trephine was taken to the depth just short of the implant apex. Elevators (Fig 8) and extraction forceps were used to loosen and remove the implants. Dense cortical bone was noted at the apex of the implant socket (Fig 9).

The neurovascular bundles were identified bilaterally. Using a small dissecting probe to protect the superior aspect of the bundles, a diamond drill was used to remove the thin layer of bone above the canal. The exposed bundles were carefully lifted out of the canals and moved bucally.

IMPLANT PLACEMENT
Seven implant sites were selected based on the biomechanical principle of broad load distribution. These sites were uniformly distributed from the area of the first molars bilaterally. The implant osteotomies were prepared using a series of graduated sized drills. The threads were then tapped through the inferior border of the mandible to accommodate the Brånemark implants. Seven 3.75 mm diameter implants of three lengths were placed: one 7mm, two 8.5mm and four 10mm (Fig 10). Autogenous bone gathered from the implant sites was placed in the area of the three fractured implants that were removed (Fig 11). Titanium healing abutments were placed on all implants and the mucosal flaps were irrigated with a tetracycline solution prior to closing with vicryl sutures.

POST-SURGICAL CARE
The patient was not permitted to wear his denture for two weeks after the implant placement surgery. Postoperative medications included antibiotic therapy for ten days, steroid and analgesic medications, and a Chlorhexidine mouth rinse.

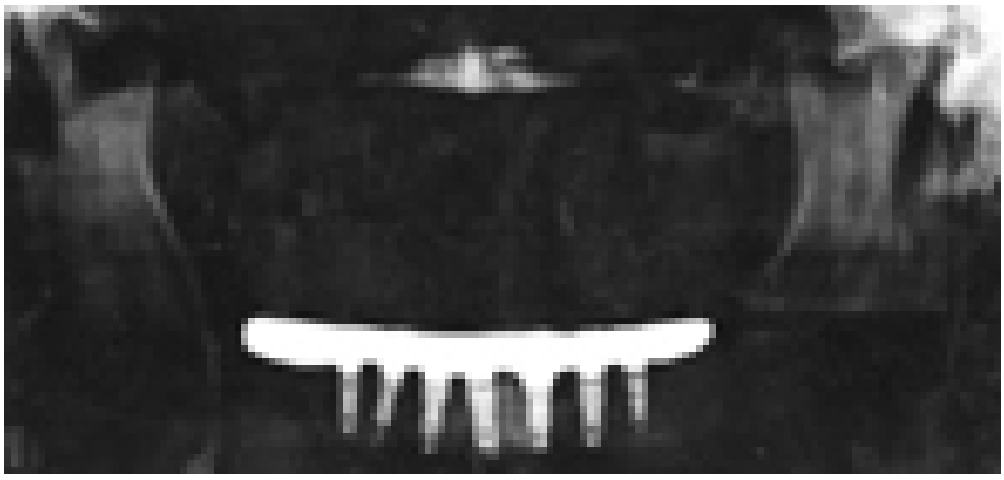


Fig. 16
Post-op panoramic radiograph

Suture removal occurred two weeks post surgery. The construction of new interim dentures also began at that time. The patient experienced a transient paresthesia for four months following surgery and manipulation of the inferior alveolar nerve.

FINAL PROSTHESIS

Following an extended healing period of six months (three months is considered adequate healing for the anterior mandible) the healing abutments were removed and a combination of five standard and two EsthetiCone abutments were fastened to the osseointegrated implants (Fig 12). A conversion prosthesis was constructed at the previously determined vertical dimension using the interim denture. This prosthesis was then transferred to the master cast for articulation. Two additional visits for a casting try in and delivery of the final prosthesis (Fig 13, 14) completed the doctor's treatment.

LONG TERM EXPECTATION

Based on numerous similar treatments over an 18-year experience, we anticipate positive bone remodeling around the implants and in the body of the mandible. Frequently, bone density increases in the posterior mandible and is often accompanied by an increase in bone height distal to the last implant (Fig 15). The patient reports complete comfort and full function. Expectation for continued bone remodeling and maintenance of oral function is excellent.

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Glenn J. Wolfinger, DMD, FACP
Robert Winkelman, CDT, MDT

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