LITERATURE REVIEWS

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ENDOSSEOUS IMPLANTS


This article describes techniques employed to improve soft tissue aesthetics around anterior root form implants. Four case reports are presented, which illustrate different methods to achieve soft tissue aesthetics. Common to all procedures discussed is the concept of overbuilding the site.

The first case involved a congenitally missing lateral maxillary incisor. Before implant placement, there was a papilla defect on the distal aspect of the adjacent central incisor. At the time of stage one surgery, a palatally placed full-thickness incision was made, along with mesial and distal vertical releasing incisions. The flap was released periostealetly to ensure a tension-free closure. To recreate papillae, a 2-mm healing collar was placed and the tissues were closed over the healing collar and implant. At the time of stage two surgery, papilla reformation was evident. A punch uncovering technique was used, and a 4-mm healing collar was placed and covered using a gingival graft. A transfer index of the implant was taken at stage one surgery. After 11 months, two root form implants were placed with 2-mm healing collars. The soft tissue was further enhanced at this time using a connective tissue graft placed under the flap. At the time of uncovering, a punch technique was employed and temporary crowns were seated (a transfer index was taken at stage one surgery). After 8 months of temporization, the final crowns were delivered.

The second case involved a central incisor that was scheduled for extraction because of a vertical fracture. Because of a deep labial periodontal pocket, it was assumed that no buccal plate was present. Orthodontic extraction was employed to overerupt the tooth and “overdevelop” the site. The implant was placed at the time of extraction, no bone graft was placed, but the socket was covered with a plug-shaped gingival graft. The implant was placed 3 months after the extraction. At stage two surgery, a palatal incision was employed to allow further soft tissue augmentation. A 4-mm healing collar was placed and the flap was coronally advanced over the healing collar. At 4 weeks, a restoration was placed.

The fourth case involves a region missing a maxillary lateral and canine. Because of significant bone loss, a guided bone regeneration procedure using freeze-dried bone, hydroxyapatite, and a titanium-reinforced membrane was first employed. After 11 months, two root form implants were placed with 2-mm healing collars. The soft tissue was further enhanced at this time using a connective tissue graft placed under the flap. At the time of uncovering, a punch technique was employed and temporary crowns were seated (a transfer index was taken at stage one surgery). After 8 months of temporization, the final crowns were delivered.

The discussion in the article stresses the need to overbuild the site in order to achieve desired soft tissue aesthetics. The use of bone augmentation, orthodontics, and soft tissue augmentation should be employed as required to create the desired result. There was no discussion about the possible deleterious effects of creating soft tissue aesthetics, such as increased periodontal pockets.


The level of the alveolar bone around the implant is the best indicator of implant health. The clinical measure of the bone level is the radiograph. The use of other clinical parameters to measure implant health is investigated in this study and compared with bone levels on radiographs.

Sixteen patients who received two IMZ implants in the mandible with a Dolder bar–supported overdenture 5 years before were volunteers for this study. The clinical parameters studied were plaque index, gingival index, probing depth, and periotest scores (with the bar removed). Each of the results of these studies were then grouped into either a positive result (sign of disease) or a negative result (no sign of disease). The results were then compared with bone levels around the implant (as evidenced on radiographs), where a positive result was taken as bone loss greater than 1.8 mm and a negative result bone loss less than 1.8 mm. Statistical analysis first compared interobserver agreement of the various indexes. All parameters had high interobserver agreement, with the exception of one aspect of the plaque index (mesial). This was discarded from the analysis.

The results indicate that plaque and gingival indexes are unreliable parameters in estimating bone levels. Probing was found to be unreliable in those instances where bone loss was present, but it was found to be fairly reliable in those instances where radiographs indicated that no bone loss was evident. The periotest was found to be an unreliable indicator of bone loss. The conclusions of this article is that none of the clinical parameters studied were useful indicators of peri-implant bone levels.


This article reviews the physical and mechanical properties of currently available implant materials with an emphasis on titanium. The American Society for Testing and Materials (ASTM) defines six distinct groups of titanium-based materials used for den-
tal implants. Titanium is the ninth most abundant element. It is an extremely reactive metal and forms a tenacious oxide layer that contributes significantly to its electrochemical passivity. The ASTM recognizes two grades of titanium alloy Ti-6Al-4V and Ti-6Al-4V extra low interstitial (ELI). There are four grades of cp titanium. Other materials listed include stainless steel (316 stainless steel), which has good mechanical properties but has poor corrosion properties when compared with titanium and is thus not approved as a dental implant material. Cobalt, chromium, and molybdenum (Co-Cr-Mo at 62%, 31%, and 5%, respectively) exhibits good castability and a reasonable degree of corrosion resistance.

Within the cp titanium grades, there is little difference in modulus of elasticity, but grade IV exhibits a 180% increase in yield strength. Similarly, the yield strength increases when progressing from cp IV to titanium alloys. Ultimate tensile strength is also higher in titanium alloys when compared to cp titanium. The modulus increases 10% with the alloys. Within the alloys, the ELI exhibits less strength than the regular alloy. Compared with Co-Cr-Mo, titanium alloy is twice as strong and has half the elastic modulus. Lower elastic modulus transmits forces better to the bone.

Clinical studies indicate that all the cp grades and alloys of titanium exhibit excellent biocompatibility, with no difference in clinical success. Thus, the author states that implant design, size, and material strength should influence the implant selection. Patients with high functional forces (such as bruxism) may be better suited to an implant fabricated from titanium alloy rather than cp grade I. It should be noted that some implant manufacturers’ work the titanium while it is cold to increase strength beyond that indicated by its grade alone. One may also consider the lower modulus of elasticity in cp titanium that transmits forces better to bone.


This study examined implant survival and marginal bone loss in maxillary implants placed with either bicortical or monocortical stabilization. Three hundred fifty-one patients received Branemark implants during 1977–1983 at Gotteborg University. Only patients that received standard Branemark implants 10 mm long and were edentulous in the maxilla were included in this study. Implants of different sizes and those requiring grafting were excluded. As a result of these requirements, only 37 patients were examined in this study.

Clinical and radiographic information was examined from the presurgical period, at abutment connection and at defined intervals up to 15 years. The majority of patients had bone quality 3 and ridge shape C or D. A total of 218 implants were placed in 37 arches. Five implants failed before or at abutment connection, and six were never uncovered. Both of these were excluded from this study, leaving 207 implants. All of these implants were then classified as either monocortically or bicortically anchored on the basis of radiographs. There were 110 monocortical and 97 bicortical implants. Because of patient dropouts, only 30 patients were evaluated at 5 years, 23 at 10 years, and 16 at 15 years. Cumulative survival rates (CSR) were determined for all implants placed, including the five that failed before abutment connection.

The results indicated that of the 207 implants loaded, 8.7% failed during the follow-up period. Including the five lost before abutment connection, there was a total CSR of 88.7%. The bicortical group had a CSR of 84.8% and the monocortical group had a CSR of 96.2%. Five patients experienced failures and two patients experienced total implant loss. All the failures in the monocortical group were due to fracture. Of the 14 failures in the bicortical group, 11 were fractures and the remaining were due to loss of integration. Implant marginal bone loss changed less than 1 mm regardless of the type of anchorage used. Variables such as prosthesis design and smoking were not included in this study.

In their discussion, the authors hypothesized that the increased fractures rates reported may be due to nonpassive frameworks, which were more of a problem at the time the prostheses were fabricated. They also stated that nonpassive frameworks may be more of a problem in bicortically stabilized implants. Stressess were higher in the bicortical group because of the generally poorer bone present compared with the monocortical group. The authors cited several studies that demonstrate the benefits of bicortical stabilization, especially in poor bone. Although this paper suggests that bicortical stabilization is less advantageous than monocortical anchorage, several variables may have affected this outcome that may be controlled in future studies.


The purpose of this study was to assess the efficacy of short implants supporting overdentures in the extremely resorbed mandible. Inclusion criteria included complete edentulism in both arches, anterior height of mandible less than 12 mm, as indicated by lateral cephalometric radiographs, poor retention and stability of an existing complete lower denture, no preprosthetic surgery (ie, vestibuloplasty), no head and neck radiation, and an evaluation period of 5 years. Seventeen patients were included in this study. Initial radiographs included panoramic and lateral cephalometric films.
At the time of abutment connection, a panoramic radiograph was taken and repeated at every 12-month period. Two additional radiographs, which were oblique projections, were also taken every 12 months to further evaluate bone levels. Bone levels were assigned a value using a predetermined index. Three of the patients received one-stage ITI implants, two patients received two-stage IMZ implants, and the remaining 12 patients received two-stage Branemark implants. All patients received 4 implants placed between the mental foramen. In the two-stage systems, the second-stage uncoverlay was performed 3 months postoperatively. All implants were connected by a round bar and connected to the overdenture by Ackermann attachments. In patients with inadequate attached tissues, a free gingival graft was performed around the neck of the implant. Recalls were generally on a 6-month basis. A comprehensive evaluation and statistical analysis was performed using clinical parameters (gingiva, plaque and bleeding indexes, probing depths, and periosteal values), surgical complications, soft tissue complications, presence of chin dysesthesia, prosthetic evaluation, and radiographic evaluation.

Results indicated an 88% implant survival rate, with seven implants lost in the initial healing period and one implant lost after loading. Palatal grafts were placed at stage two surgery in 50% of patients. An additional patient had a graft placed around all four implants to treat severe peri-implant hyperplasia. Plaque and gingival indices did not indicate severe inflammation or plaque levels. The mean probing depth was 3 mm. All dentures received a good rating for retention and stability. Prosthetic adjustments included relining of the dentures (two times) and renewal of the attachment clips (14 times). More importantly, in four patients, the bar had to be remade to a Dolder bar because of inadequate retention with the other system. There were eight cases of teeth or denture fracture. The majority of the sites exhibited slight bone loss (less than one third of the implant), and 7 of 128 implants exhibited serious bone loss (more than one third of the implant and less than one half of the implant). The authors listed two other options in the severely resorbed mandible grafting and transmandibular implants, but failed to mention the subperiosteal implant, which is in some ways superior to endosseous implants in this application.


Previous studies comparing hydroxyapatite (HA)-coated implants to non-coated implants show that HA-coated implants have a higher integration rate and promote faster bone attachment with a higher bone-bond strength. Therefore, HA-coated implants have better prognosis than noncoated implants in type 4 bone, fresh extraction sites, maxillary sinus lifts, and areas where shorter implants must be used. However, there were results contradictory to these findings in both human and animal studies, specifically HA delamination and implant exfoliation.

This study examines two retrieved and two unused HA-coated titanium blade implants by use of stereomicroscopy, scanning electron microscopy, Fourier-transform infrared spectroscopy, and electron probe microanalysis. The objective was to compare the surface morphology as well as the compositional and structural changes of HA coating at different depths and to characterize changes in the retrieved implants due to the in vivo environment. Stereomicroscopic and secondary electron microscopy demonstrated a uniform roughness of HA-coated surface in the unused implants. In the retrieved implants, the authors found partial loss of HA coating and variable thickness in cervical and central areas, with thinning toward apical and mesial-distal edges. Section analysis indicated an uneven thickness of coating and thickening in cervical areas, with gradual thinning toward apical areas in the unused implants.

The retrieved implants demonstrated variation in coating thickness throughout the implant. The unused implants had small amounts of Cl and Mg in the coating. The retrieved implants had increased amounts of Cl and Mg, and the authors also noted the spongy appearances of cancellous bone in the HA coating, suggesting a bond between HA and bone before exfoliation. X-ray diffraction analysis revealed that all samples showed basic apatite structure, with no major structural changes occurring in retrieved implants. Fourier infrared spectroscopy revealed a decrease of OH content on retrieved HA, with increased amounts of Cl and lattice imperfections.

The conclusion of the article was that morphologic changes depend on stress values of the surrounding bone and implant mobility. Long-term implantation did not induce major structural changes in the HA's crystal lattice, but it did induce compositional changes. The HA-to-substrate bond strength may be influenced by increased Cl and Mg, decreased OH, and increased lattice imperfections. However, further studies are needed to clarify the effects of coating to bone and coating to substrate interface. (C. Watson)

Basic Science and Research


Platelet-rich plasma (PRP) gel has received much attention in its use as an adjunct to bone grafting procedures. The traditional method for preparation of PRP involves the use of a cell separator followed by gel formation by use of calcium chloride and bovine throm-
Venous blood was drawn from three subjects into tubes containing either sodium citrate or ethylenediaminetetra-acetic acid (EDTA). These tubes were then spun in a centrifuge at either 100 × g or 200 × g for 2 to 20 minutes. Next, all the plasma was transferred to a second tube and centrifuged at 100 × g, 200 × g, 250 × g, or 400 × g for 2 to 10 minutes. The lower half was then designated as the PRP segment. Platelet counts were performed on both segments. The PRP was then divided into two beakers and the PRP gel was created by either the thrombin/calcium chloride method or the ITA gelling agent (Natrex Technologies, Greenville, NC). The PRP gels created were then compared for levels of PDGF and TFGB using a sandwich enzyme immunoassay technique.

The results indicated that the tubes containing EDTA damaged platelets, whereas those with sodium citrate did not. The ideal centrifuge levels were deemed to be 200 × g for 10 minutes with both cycles. The clots formed by the ITA method and the thrombin–calcium chloride method were similar in size. There was similar levels of PDGF and TFGB using both methods.

A discussion paper following this article criticized the authors’ assertion that the thrombin–calcium chloride is unsafe, citing several references to its safety. It also called into question the safety of the ITA itself, as no safety records were cited in this article.


This study was conducted to examine and compare the host healing response to large allografts using two methods of fixation: locked intramedullary rods and dynamic compression bone plates. The study was done in bilaterally paired canine tibia defects. The effects of each mode of fixation were evaluated by radiograph, mechanical, histologic, and histomorphometric analysis. Six skeletally mature hounds received bilateral grafts in the proximal diaphysis of the tibia. Five dogs had allografts implanted, and one dog, the control, had a bilateral reverse autograft implanted. Each animal had the allograft fixed by intramedullary nails into the left tibia and a nine-hole compressive bone plate on the right tibia. The animals were killed after 3 months. Anatomic alignment was achieved in all cases. The data of one animal were excluded from the results because of bilateral allograft resorption. The remaining five sets of grafts were intact and had a callus bridge. A three-point bending test demonstrated no statistically significant difference in the rigidity between the plate and the nailed fixed tibia in either anterior-posterior or mesial-distal directions. On average, the rigidity of the plated sites were higher.

Paired analysis of experimental groups revealed torsional rigidity and torque at the plated tibia were significantly greater than the intramedullary nail fixed tibias. The control dog showed no difference between the methods of fixation. Although there were no statistically significant differences among the radiographic callus width measurements and histologic scores, the callus width and histologic scores were higher for the plated tibia. Radiographic subjective scores for the fixed allografts were significantly higher than for the nail allograft.

Histologically, a combination of appositional callus healing was observed in both fixation methods. More abundant endosteal and periosteal bone formation was observed with plated limbs. Histomorphometric analysis revealed that the plated limbs generated significantly more new bone than the limbs that received nails. The two most important factors in periosteal callus formation are physiologic loading and fracture gap. In this study, there was good bony contact, but loading was not controlled. The authors believed that the major factor affecting the results of the study was the rigidity of the fixation. There was a significant increase in periosteal and endosteal callus formation, with the less rigid plated fixation. The limitation of torsional and bending strains imposed by the higher rigidity of the nails may have prevented increase callus formation. The conclusion of the study was that bone plated fixation produces greater periosteal and endosteal bone formation than nail fixation. This maybe because of increased motion at the graft-host junction. The traditional concept of “more rigid is better” may need to be revised. (C. Watson)

Implant Prosthodontics


This study evaluated the peri-implant conditions and maintenance requirements of mandibular implant supported overdentures using two implants with either separate ball attachments or connected by a bar. Twenty-six completely edentulous patients participated in the study. Two Astra Tech implants (3.5 mm in diameter) were placed in the anterior mandible by a two-stage procedure. Denture attachments were chosen at random. Fifteen received the ball attachments and 11 received the bar. Patients were examined on a regular basis by radiographic and clinical parameters (plaque and gingival indices and probing depths). Complications and repairs were also monitored. Hygiene visits occurred every 3 months.

Results indicated that one implant
was lost at abutment connection and was later replaced. All parameters were studied at a baseline after prosthetic connection with the overdenture. The clinical parameters demonstrated no difference between the groups. Three patients with the bar attachment demonstrated hyperplasia. Bone levels on the radiographs demonstrated little marginal bone loss, and there were no significant differences between the two groups. A significant number of smokers were included in this study, and results indicated that this did not affect survival rates. Prosthetic complications were higher in the bar group in the first year, yet there was no difference in complication rates in the following years. The ball group suffered an average of 0.6 complications per year, whereas the bar group suffered 1.0 complications per year. The majority of the patients complaints involved reactivation of the matrix (in the ball group) or the clip (in the bar group). Four bar overdentures suffered fractured dentures, compared with two in the ball group.

The conclusion of this study is that both groups offered similar survival rates for implants, but the bar group exhibited increased prosthetic complications. A shortcoming of the study is that no subjective patient results were included.


The accuracy of an implant transfer technique can significantly effect the passivity of the superstructure. The purpose of this study was to evaluate the accuracy of several impression materials using an open tray (direct) transfer technique. This was accomplished by evaluating the amount of torque required to rotate the direct transfer coping and comparing the accuracy of the casts produced by the various materials.

An implant master model was first fabricated from a machined aluminum block with five abutment replicas placed (Nobel Biocare). Impressions were then taken using 10 sets of five direct square impression copings. The materials used for the impressions were polyether, addition, and condensation silicones and polysulfide.

Various levels of consistency were used. Torque displacement was evaluated using a Compudriver device (Consolidated Device Inc), which registered the amount of torque to rotate the abutment in the impression material. These values were then compared statistically. The polyether medium had the highest value, followed by the addition of heavy silicone, which was then followed by the polysulfide medium. These three impression materials were then used to take 10 impressions each of the implant master model. Resin rock material (Whip Mix) was utilized for the stone models after abutment replicas were placed. To analyze model accuracy, steel balls were placed in the screw access holes, after which linear distances were measured between the balls by a traveling microscope and a mathematical formula.

Statistical analysis of the accuracy of the casts were calculated. The results indicated that the casts from the polyether and addition silicone were significantly more accurate than the polysulfide. The results of this study suggest that either heavy addition silicones or medium polyethers are the best material for transferring the position of multiple implants.