Replacement of congenitally missing teeth with orthodontics and osseointegration

Congenitally missing teeth or partial anodontia occurs in about seven percent of the population, frequently accompanied by aberrant or diminished tooth size. Traditional orthodontic treatment for congenitally missing maxillary lateral incisors often required complete orthodontic movement to position the canines mesially, filling the position of the lateral incisors. This treatment approach requires the removal of enamel and extensive reshaping of the facial, lingual, incisal, and proximal surfaces of the canines. Generally, the esthetic results of canine reshaping to mimic lateral incisors, termed “lateralization”, leaves unnatural telltale signs of the congenital defect. Functional changes in the occlusion should also be considered, especially the requirements for canine guidance when bicuspids are moved.
anteriorly. There is concern for the added forces imposed on bicuspids with shorter and thinner roots. Moving the canine into the lateral position will effect the entire occlusal scheme.

With improvement of prosthodontic methods for replacing congenitally missing teeth, modern orthodontics is significantly changing its treatment philosophy. The goals of this new approach in orthodontics are the establishment of an ideal occlusal relationship, the best possible masticatory function, and the most aesthetic appearance.

Current prosthodontic methods for replacing congenitally missing teeth include traditional fixed prosthetics, resin bonded (Maryland) bridges, removable partial dentures, or osseointegrated implants to support an independent anatomically contoured crown. Proper execution of the first three methods requires varying degrees of tooth preparation.

The most biologically conservative approach for the replacement of congenitally missing teeth is the osseointegrated implant (figure 1a, b). Use of Bränemark implants to replace congenitally missing lateral incisors requires a coordinated team approach. The orthodontist takes the lead role in establishing the ideal position of the dentition, especially the teeth immediately adjacent to the anticipated implant site (figure 2a, b). Factors to consider when planning osseointegrated implant replacement of congenitally missing teeth are:

1. Root position: A minimum of 1 mm. of bone should be available between the implant threads and the adjacent root surfaces.
2. Interdental space: Minimal interdental space of 7 mm, provides sufficient osseous support to maintain the interdental papilla.
3. Esthetic aspects: The crestal aspect of labial bone and the top of the implant should be 2-3 mm. apical to the CEJ of the adjacent teeth. The CeraOne abutment system is ideal for the single tooth restoration and provides a variety of titanium collar lengths to accommodate various anatomic conditions (figure 3).

4. The alveolar ridge: A minimum of 6 mm. of facial-lingual bone is required for placement of the standard 3.75 mm. diameter Bränemark implant. If the alveolus is narrower than the diameter of the implant body, several methods of guided osseous generation are available to build a wider ridge.

5. Loading the implant: Loading of the single implant and the crown appear to be well tolerated in spite of the load not being applied directly to the long axis. When a deep overbite condition exists, a custom ceramic/metal crown may be required to provide adequate support for the incisal porcelain.

6. Implant length and angulation: Maximum implant length provides the best initial stability and establishes precise conditions for future implant survival.

7. Post-orthodontic retention: Osseointegrated Bränemark implants replacing congenitally missing teeth provide ideal intra-arch stabilization points following active orthodontics.

8. Long term maintenance: Plaque control procedures similar to those recommended for the natural teeth are suitable for healthy maintenance of the surrounding mucosa. Periodic professional care must be part of the treatment plan.

**Conclusion**

**State of the Art Treatment:**

Orthodontic treatment of patients with congenitally missing teeth, especially maxillary lateral incisors, can best be accomplished by positioning the remaining natural dentition in the anatomically correct location. This mandates close coordination of therapy with the osseointegration team members. Use of the Bränemark System® of implant therapy is the treatment of choice for permanent replacement of congenitally missing teeth (figure 4a, b, c).
Placement of Implants into Fresh Extraction Sites Using a Resorbable Collagen Membrane: Two Case Reports

By: Sevor and Meffert

The practice of immediate placement of dental implants into fresh extraction sites can provide several benefits for the patient, including reducing the number of surgical episodes and shortening the time span from surgery to restoration. Alveolar bone can be preserved by eliminating the recommended six-month post-extraction healing phase, during which time bone can resorb significantly. Barriers or membranes can help control osseous defects that often result with this type of root form implant placement.

The use of barrier membranes to repair dehiscence defects surrounding dental implants is known as guided tissue regeneration (GTR). This article describes the clinical and histologic results of endosseous implants placed in maxillary and mandibular fresh extraction sites using a resorbable collagen membrane to function in GTR in order to promote bone growth into the residual defects.

Case report #1 presented with the asymptomatic fracture of an endodontically treated mandibular molar tooth #18. The patient was apprehensive about undergoing an additional surgical experience, so a resorbable collagen membrane was used. After the tooth was sectioned, removed, and the socket debrided, an implant was placed 2-3 mm apical to the alveolar crest. Osseous defects of 3-4 mm and 4-5 mm remained on the buccal and lingual aspects, respectively. Demineralized freeze-dried bone allograft (DFDBA) was condensed into the defects, and the previously hydrated collagen membrane was adapted in a saddle fashion to extend 3-5 mm beyond the bony margins. The surgical site maintained primary closure during the entire integration phase. Tissue response at all times was excellent with no signs of inflammation.

Five months later the implant healing screw was noted to be partially covered with hard, bony-like tissue, which was harvested and submitted for biopsy. The biopsy report indicated that the tissue removed from around the implant was vital bone, with osteoblasts and osteocytes located within lacunae. Clinical evaluation revealed that it was hard, could not be probed, and that it resembled normal bone, although bone maturation and calcification probably were incomplete. After completion of two months of progressive loading, a fixed partial denture was fabricated and placed. The patient is currently on a three month maintenance recall program.

The second case presented with a defective crown restoration on tooth #13 which was deemed nonrestorable. It was treated similarly to the first example, using DFDBA and a collagen membrane. The osseous defect completely healed with bone and osseointegration occurred around the implant.

The most important points for this technique are as follows:
1. The osteotomy is countersunk 2 mm below the osseous defect.
2. DFDBA is placed as a space-maintaining material.
3. A collagen membrane is draped with margins extending at least 2 mm beyond the bony edges of the extraction site.
4. The flaps are released to allow primary closure.
5. Re-exposure of the implant is accomplished 1-2 months later than normal.

These two cases cannot predict the success of this type of modality on a large scale. However, results from animal studies and ongoing clinical studies show that this compressed collagen matrix membrane may function as well as commercially available nonresorbable membranes.

Practical Periodontics and Aesthetic Dentistry, April 1992, Vol. 4, No. 3

Loads and Designs of Screw Joints for Single Crowns Supported by Osseointegrated Implants

Jornerus et al

The single implant is exposed to loads other than those encountered in restorative treatment where more than one implant is used. This difference has become evident in some of the single tooth restorations in which the screws have had a tendency to loosen during function.

Unintentional loosening is a potential problem common to virtually all types of screws. The main probable cause is poor tightening, although the design of the screw is also an important factor. Two mechanisms of screw loosening were investigated: excessive bending on the screw joint and settling effects.

The purpose of this study was to evaluate the load on the single implant screw joint and to test the stability of different designs and materials of abutment screws in a bench test situation. Maximal occlusal force was recorded in four patients with single Brånemark implants. The recorded values were used as a base for calculation of maximal torque and forces acting on the screw joint. The results indicate that significant torque and forces can be created in the screw, never to exceed, however, the maximal material characteristics for different screw material used in a bench test. A gold alloy screw with a flat head and high tightening torque (35 Ncm) produced the best results.

Esthetic Achievements in Partial Edentulism With the Brånemark System

I. Naert

In the early seventies most effort was concentrated on the treatment of the completely edentulous patient by means of oral implants. Today the most rapid expanding group of patients is the partially edentulous patient. On average this group of patients is younger than the completely edentulous one which results in other demands. Most have enough teeth to chew but want to complete the dental arch into its former status. This also implies a greater awareness of these patients towards esthetics.

Five factors determine optimal esthetics when using oral implants: 1) bone morphology; 2) soft tissue disturbances; 3) fixture placement; 4) abutment choice; 5) restorative materials. This enumeration betrays the importance of the surgical part; four of the five factors deal with the surgeon or the system itself.

The preprosthetic considerations are:
1. Improvement of bone and soft tissue dimensional requirements by means of augmentation techniques (co-incidently or preoperatively).
2. Fixture installation requirements as well in the vertical, sagittal, and frontal planes.
3. Emergence profile requirements.

The prosthetic considerations are:
1. Provisional prostheses and the criteria to be met.
2. Abutment selection criteria. This depends on the esthetic requirements and the interocclusal clearance.

The selection of the restorative material is related to the degree of jaw resorption. Porcelain as a veneering material is more advantageous than resin. However the challenge is how can we maintain the integrity of the passive fit?

The challenge of every prosthodontist to combine high esthetic demands with basic biology. Today there is not evidence enough to systematically bring the crown margin subgingival without leading to harmful effects towards the surrounding marginal bone. In the Catholic University in Leuven, Belgium the subgingival margin location is reserved to the anterior maxilla, analogous to the natural dentition.

Conclusion: In the near future surgeons must be trained in handling hard and soft tissues around oral implants to improve the esthetic result. The esthetic result lies in their hands. For the restorative dentist, the use of new techniques which can assure, in a reproducible way, optimal passive fit of the ceramometal reconstructions must be introduced.

Nobelpharma Challenge, San Diego 1992

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Is Osteoporosis a Risk Factor for Osseointegration of Dental Implants?

Dao et al

The objective of this article is to discuss whether osteoporosis should be considered a risk factor for dental implants based on a review of the literature pertaining to osteoporosis and a survey of the patients in the Toronto implant study. The definition of osteoporosis in the literature reviewed in this article refers mostly to the presence of fractures unless otherwise specified.

The sample population included 93 women and 36 men, aged 20 to 76 years at the time of implant placement, having Brånemark implants in function for 2 to 11 years. Inclusion and exclusion criteria related primarily to the dental needs of the patients and therefore were not related to osteoporosis. Implant failure was defined using the criteria of Smith and Zarb (J Prosthetic Dentistry 1989;62:567-572).

The concern that osteoporosis is a contraindication for dental implants presumes that: (1) osteoporosis affects the mandible or the maxilla in the same manner as other parts of the skeleton that serve as diagnostic markers of the disease and (2) the impaired bone metabolism in osteoporotic bone may reduce the healing capacity of bone around implants.

Histomorphometric data shows that bone modeling is focal, varying between skeletal sites at any given time and varying from time to time within one site. In addition, mandibular bone mass does not appear to be related to bone mass of other parts of the skeleton that consist mainly of trabecular bone (e.g. the iliac crest). It would therefore be inappropriate to conclude that maxillary and/or mandibular bones are osteoporotic in patients with spinal or Colles' Fracture, unless the diagnosis is based on the measurement made at the latter sites.

Whether osteoporosis affects bone quality, bone quantity, or both remains a matter of controversy with unclear trends or distinguishing factors evident, however, histomorphometric studies indicate that bone remodeling was normal in a large proportion of patients diagnosed as being osteoporotic.

A review of the literature and a separate descriptive analysis of patient treatment series do not provide a compelling theoretical or practical basis to confirm osteoporosis as a risk factor for osseointegration of dental implants. Denying implant treatment to a patient whose diagnosis of osteoporosis is based on a decrease in bone mass or on the presence of atrophic fracture in a site other than the jaw itself cannot be supported at this time. Treatment planning for dental implant therapy should be based on a local assessment of the potential surgical site.

Int J Oral Maxillofac Implants 1993;8:137-144
A Comparison Of Torsional Ductile Fracture In Implant Coronal Screws
McGlumphy et al

Little data is available on the optimum torque values necessary to assemble an implant prosthesis. The purpose of this study was to calculate the torsional fracture levels of implant coronal screws to facilitate the calculation of optimum torque values. Test screws were placed in split collets and mounted in a screw testing fixture (Greenslade, Inc.). Clockwise torsional forces were placed with a torque driver (DCI, Inc.) until ductile fracture occurred (N=4/sample). Mean ultimate torque values were calculated and compared utilizing ANOVA and Tukey’s Studentized Range Test. Optimum tensioning can be calculated by 75% of torque to yield. The results follow:

<table>
<thead>
<tr>
<th>Screw</th>
<th>Mean Torsional Fracture (N-cm)</th>
<th>Sig Diff</th>
<th>75% Torque to Yield (N-cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core-Vent-TSF</td>
<td>111.8 (10.8)</td>
<td>A</td>
<td>83.8</td>
</tr>
<tr>
<td>Omniloc Retaining</td>
<td>78.2 (1.58)</td>
<td>B</td>
<td>58.7</td>
</tr>
<tr>
<td>Integral Hex</td>
<td>70.1 (3.55)</td>
<td>B</td>
<td>52.6</td>
</tr>
<tr>
<td>Integral Cross</td>
<td>69.0 (0.64)</td>
<td>B</td>
<td>51.7</td>
</tr>
<tr>
<td>Steri-Oss Coping</td>
<td>55.6 (2.38)</td>
<td>C</td>
<td>41.7</td>
</tr>
<tr>
<td>C-V Hexloc</td>
<td>52.3 (4.12)</td>
<td>C</td>
<td>39.2</td>
</tr>
<tr>
<td>31-UCLA</td>
<td>39.7 (2.60)</td>
<td>D</td>
<td>29.7</td>
</tr>
<tr>
<td>Brånemark Single</td>
<td>39.4 (2.11)</td>
<td>D</td>
<td>29.5</td>
</tr>
<tr>
<td>IMZ 11 mm</td>
<td>22.1 (0.46)</td>
<td>E</td>
<td>16.6</td>
</tr>
<tr>
<td>Brånemark Gold</td>
<td>16.6 (0.67)</td>
<td>F</td>
<td>12.4</td>
</tr>
</tbody>
</table>

The results of this study suggest that optimum torque values are dependent on screw alloy and diameter and should be individually calculated for each screw type.

Journal of Dental Research, March 1992

A Retrospective Evaluation of Endosseous Titanium Implants in the Partially Edentulous Patient
Pylant et al

There has been limited evaluation of endosseous implants in partially edentulous patients, despite the finding that the number of completely edentulous persons is declining and the need for prostheses in partially edentulous mouths will continue to increase.

In this study, partial edentulism in 34 patients was consecutively treated using the Brånemark method of osseointegration. A total of 102 implants were tested for mobility, signs and symptoms of infection, and radiographic bone levels. All patients had at least a 6 month, and up to 49 month follow-up of prosthesis function (mean 22.5 months). An overall success rate of 88.2% was observed. Twenty-five of 28 maxillary implants and 65 of 74 mandibular implants were successfully placed and restored. Twelve failures were observed; 7 were not integrated at the time of stage II surgery while 5 occurred after prosthetic reconstruction.

The finding of a slightly lower success rate in this study may be the result of two factors. First, several patients treated by faculty members could be classified as high risk patients based on their bone quality or quantity or on their systemic condition.

Second, the implants were placed and restored by several individuals with a wide range of experience in implant therapy.

The average marginal bone loss in this study of 1.9 mm around implants followed for an average of 2.7 years agrees closely with previous studies.

Success rates in this study were similar for the maxilla and mandible; this may be explained by the fact that more than 70% of all implants were placed in the mandible.

The majority of failures occurred before prosthetic reconstruction. Seven of 12 failures were noted at Stage II surgery. In all seven, access to the posterior regions of the arch was difficult and overinstrumentation of the implant site during Stage I may have occurred. Six of the seven were successfully replaced and restored.

Conversely, fewer failures occurred after prosthetic reconstruction. Five failures, involving four prostheses in four subjects, were noted after prosthetic procedures. Because of the small number of failures after prosthesis insertion, no significant trends were noted with regard to type of prosthesis, length of fixture, or location. No failures were associated with single tooth replacements.

The results of this study suggest that the Brånemark osseointegration procedure can be used to treat partially edentulous patients with a high degree of success.


Effect of Fluoride Prophylactic Agents on Titanium Surfaces
Probstler et al

This study describes titanium surface alterations caused by commonly used prophylactic fluids and gels that contain fluorides. The dental fluoride preparations that damage titanium surfaces either contain hydrofluoric acid or are acidic, hence the combination of fluoride ions (from the fluoride) and hydrogen ions (from the acid) act in a manner similar to hydrofluoric acid.

Fluoride agents must be carefully selected when they are to be used for patients with titanium restorations or titanium implants. The surface defects may cause increased plaque and calculus retention, and may detract from esthetics. Precision attachments and fastening screws may be damaged.

As analyzed with the unassisted eye, the following agents caused no visible alteration of the titanium surfaces: Fluocal (Septodont, Paris, France), Oral B mouthrinse (Oral B Laboratories, Frankfurt, Germany), Elmex fluid (Wybert Co., Lorrach, Germany), Blendamed Fluor-Gel (Blendaz, Mainz, Germany), and Duraphat Iacquer (Duraphat Woeim, Rorer Co., Bielefeld Germany).

Patients with titanium restorations must be instructed in the use of prophylactic agents. Acidic fluoride agents should not be used in patients with titanium implants or restorations. Sodium fluoride preparations with a neutral pH will cause no surface destructions.