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IMMEDIATE LOADING AND CUSTOMIZED RESTORATION OF A SINGLE-TOOTH IMPLANT IN THE MAXILLARY AESTHETIC ZONE:
A CLINICAL REPORT

Abstract
The replacement of a single missing anterior tooth with a dental implant is a demanding therapy. This report describes a treatment in which an anterior maxillary implant was immediately restored with a provisional restoration. During the provisional phase, an optimal emergence profile was created by adjusting the provisional restoration. An impression was made with an individually fabricated impression post for an accurate reproduction of the established emergence profile and finally a screw-retained all-ceramic crown was placed. By implementing this protocol, an optimal definitive result could be achieved together with immediate patient satisfaction. However, cooperation between several disciplines and careful patient selection were required.
**Introduction**

The application of dental implant to restore a missing tooth in the anterior dentition is challenging. In the aesthetic zone, both the appearance of the implant crown and the soft tissue contribute to a successful treatment outcome and should consequently be in harmony with the surrounding dentition (Chang et al. 1999, Belser et al. 2004). To accomplish the desired result, meticulous pre-operative treatment planning is crucial together with cooperation between several disciplines during the restorative phase.

In recent literature, several treatment strategies using dental implants have been reported to replace a missing tooth (Den Hartog et al. 2008). Among these, interest has been attributed to immediate or early loading protocols in which a provisional restoration is placed soon after implant placement. Clinical studies of immediate or early loading have reported favorable treatment outcomes in terms of implant survival, marginal bone resorption, soft tissue level and the incidence of complications for treatment in which implants were inserted in healed sites (Ericsson et al. 2000, Andersen et al. 2002, Cooper et al. 2007, Hall et al. 2007) as well as implants placed in fresh extraction sockets (Crespi et al. 2008, de Rouck et al. 2008). However, a recent systematic review (Den Hartog et al. 2008) showed that well-designed controlled studies that compare these approaches with conventional protocols are scarce and whether or not superior aesthetic outcomes could be achieved remained inconclusive. Immediate or early implant loading provides several advantages for the patient including a shorter overall treatment time, avoidance of a second-stage operation and eliminating the need for a removable prosthesis during the healing phase. However, these protocols require careful pre-operative planning and patient selection. Furthermore, good primary implant stability is a prerequisite (Esposito et al. 2007), in addition to the development of a protected occlusion to create a non-occluding provisional crown.

Another important development has been the introduction of alumina- and zirconia-based ceramic abutments made with computer-aided design/computer-aided manufacturing (CAD/CAM) technology. Ceramic abutments are high-strength (Sundh & Sjögren 2008, Yüzügüllü & Avci 2008,) biocompatible (Welander et al. 2008) and have allowed new options to improve the natural appearance of the implant crown. However, little is known about the long-term clinical performance of these abutments (Linkevicius & Apse 2008).

The purpose of this clinical report was to demonstrate an immediate implant loading protocol for restoration of a missing central incisor. After the provisional restoration phase, an individually fabricated impression post was used and subsequently a definitive screw-retained one piece all-ceramic crown was placed.
Figure 1. Pre-operative view.

Figure 2. Exposure of the alveolar bone.

Figure 3. Screw-retained provisional crown placed same day after implant surgery.
Clinical report

A 47-year-old woman consulted the Department of Oral and Maxillofacial Surgery (University Medical Center Groningen, University of Groningen, Groningen, the Netherlands) with a missing right central incisor (Figure 1) lost due to a traumatic injury. At the time of the consultation she was wearing a removable partial denture and desired a durable and fixed restoration, without involvement of the adjacent teeth. The patient was healthy, did not smoke and intraoral examination revealed a healthy well-maintained dentition. Clinically, adequate bone volume was present at the future implant site. In all dimensions, sufficient space was available for an implant crown with an anatomical design. Radiographically, no pathology of the bone and adjacent teeth was noted. Because of the favorable starting point, it was decided to use an immediate loading protocol.

Preoperatively, diagnostic casts were made with a diagnostic arrangement representing the future implant crown in an ideal position. Next, a transparent acrylic resin template (Vertex Castapress; Vertex Dental, Zeist, the Netherlands) was fabricated and a guide channel was prepared in the template to aid in proper implant placement. Care was taken with the surgical guide so that the guidance channel would direct the implant sufficiently toward the palate to accommodate a screw-retained restoration.

One day before surgery, the patient started taking antibiotics (amoxicillin 500 mg, 3 times daily for seven days) and used a 0.2% chlorhexidine mouthwash (Corsodyl; GlaxoSmithKline, Utrecht, the Netherlands) for oral disinfection. Following local anaesthesia (Ultracaine D-S Forte; Aventis Pharma, Hoevelaken, the Netherlands) a slightly palatal crest-incision was made with extensions through the buccal and palatal sulcus of the adjacent teeth. A minimal mucoperiosteal flap was elevated to expose only the ridge crest (Figure 2). Then, an implant (NobelReplace Tapered RP 16 mm, Nobel Biocare, Gothenburg, Sweden) was placed according to the procedure prescribed by the manufacturer guided by the surgical template. The shoulder of the implant was placed at a depth of 3 mm apical to the buccal and cervical aspect of the prospective clinical crown to provide soft tissue to develop an adequate emergence profile. Good primary implant stability was obtained (> 45 Ncm, determined with Osseocare; Nobel Biocare). Next, an open-tray impression was made at the implant level using a custom resin impression tray (Lightplast base plates; Dreve Dentamid, Unna, Germany) and a polyether impression material (Impregum Penta; 3M ESPE, St. Paul, Minnesota, USA). Finally, a healing abutment (NobelReplace; Nobel Biocare) was placed and the wound was closed with sutures (Ethilon 5-0; Johnson & Johnson Gateway, Piscataway, New Jersey, USA).

In the dental laboratory, a screw-retained provisional restoration was fabricated consisting of an engaging temporary abutment (Temporary Abutment Engaging
Figure 4. View of peri-implant soft tissue after the provisional restoration phase. Note established emergence profile.

Figure 5. Assembly of provisional crown with implant analog and impression of cervical portion of provisional crown.

Figure 6. Customized impression post.
NobelReplace; Nobel Biocare) against which composite resin (Solidex; Shofu Inc, Kyoto, Japan) was modelled. Eight hours post-implant placement, the abutment was removed and the provisional crown was placed and subsequently torqued to 32 Ncm (Figure 3). Special care was taken to prevent any centric and eccentric occlusal contacts with the antagonist teeth. Furthermore, the provisional restoration was contoured so that the peri-implant soft tissue was optimally supported. In particular, the interproximal papillae were given enough space to regenerate. The patient was instructed to follow a soft diet, to avoid exerting force on the provisional restoration and to continue chlorhexidine rinses (Corsodyl; GlaxoSmithKline, Utrecht, The Netherlands) for seven days. For pain control, ibuprofen 600 mg (Brufen Bruis 600; Abott B.V., Hoofddorp, The Netherlands, three times daily for time needed) was prescribed and at two weeks post surgery the sutures were removed.

The patient returned to the prosthodontist once a month for three months for examination of the implant. During these sessions, implant mobility, oral hygiene and occlusion were evaluated. Also, an important objective was the creation of an ideal emergence profile by removing the provisional crown. Extraorally and where needed, composite resin was removed or added to aspects of the crown to create more space or more support for the soft tissue. In this process, special attention was given to the shape of the proximal contour to provide an optimal condition for the papillae to reach maturity.

Three months later (six months post-implant placement) an implant level impression was made using an impression post (Impression Coping Implant Level Open Tray NobelReplace; Nobel Biocare) that was customized in a way that the obtained emergence profile could be transferred to the definitive restoration (Figure 4). To realize this, the provisional crown was assembled with an implant analog (Implant Replica NobelReplace; Nobel Biocare) embedded in type IV dental stone (GC Fuji Rock EP; GC Europe N.V., Leuven, Belgium). An addition silicone impression (Futar D; Kettenbach GmbH & Co KG, Eschenburg, Germany) of the cervical portion of the crown was made (Figure 5). Next, the latter was substituted for an impression post and bis acrylic composite resin (Protemp; 3M ESPE, St. Paul, Minn) was added to the post. After polishing the individualized post (Figure 6) it was inserted into the implant and an open-tray impression was made with a polyether impression material (Impregum Penta; 3M ESPE) and a custom resin impression tray (Lightplast base plates; Dreve Dentamid).

In the dental laboratory, a soft tissue cast was prepared. First, a waxing of the definitive crown was made on a temporary abutment (Temporary Abutment Engaging NobelReplace; Nobel Biocare). The screw access hole was located sufficiently to the palate to create a screw-retained crown and to prepare an appropriate abutment. Therefore, the waxing was cut back to the desired form and scanned
Figures 7 & 8. Application of porcelain to individually fabricated Procera zirconia abutment to create a one-piece screw-retained definitive crown.

Figure 9. Clinical view of definitive implant crown 18 months after implant placement.
for fabrication of an individual zirconia abutment (Procera; Nobel Biocare AB). Porcelain was added directly to the abutment to create a screw-retained one piece definitive restoration (Figures 7 & 8). The restoration was placed and the abutment screw was torqued with 32 Ncm. Finally, the screw hole was filled with a cotton pellet and composite resin (Clearfil AP-X; Kuraray Medical Inc, Okayama, Japan). The restoration has been in service for 18 months without complication (Figure 9).

**Discussion**

This report describes an immediate loading protocol finalized with the placement of a screw-retained all-ceramic restoration. A major prerequisite for immediate loading is a high degree of primary stability in terms of high insertion torque (Esposito et al. 2007). In this treatment, an initial insertion torque of at least 45 Ncm was reached. Although clinical studies on immediate single-tooth implant loading reported varying minimal insertion torques for immediate loading, the authors of this report adopted a threshold of 45 Ncm.

In this patient, a substantial maturation of the papillae occurred during the provisional phase. Care was taken to ensure that the provisional crown did not disturb this process, but served as a natural guide. Regeneration of papillae with time has been reported in several studies (Jemt & Lekholm 2005, Schropp et al. 2005), but the mechanism behind this phenomenon could not validly be explained. Some authors believed that this increase might be attributed to remodelling potential of the soft tissue to establish a proper biological height after the surgical manipulation (Chang et al. 1999). It is widely accepted however, that the interproximal bone level next to the adjacent teeth is important for the future level of the interproximal papillae of the implant (Belser et al. 2004).

Finally, a screw-retained definitive restoration was fabricated. The advantages of this type of restoration compared to a cement-retained restoration include retrievability and no risks for cement remnants thereby excluding possible irritation of the peri-implant tissues. However, the presence of a screw access opening decreases fracture resistance of the porcelain (Torrado et al. 2004). Furthermore, screw-retained restorations necessitate precise implant positioning for a proper palatal position of the screw access hole that does not interfere with the aesthetics.
References


