Replacement of mandibular central incisors with implant-supported crowns: a case report

Daniel Bäumer, Dr. med. dent.
Hürzeler/Zuhr, Private Practice/Research & Education Center, Munich, Germany

Otto Zuhr, Dr. med. dent.
Hürzeler/Zuhr, Private Practice/Research & Education Center, Munich, Germany
Department of Periodontology, Johann Wolfgang Goethe University, Frankfurt am Main, Germany

Markus Hürzeler, Prof. Dr. med. dent.
Hürzeler/Zuhr, Private Practice/Research & Education Center, Munich, Germany
Department of Operative Dentistry and Periodontology, Albert-Ludwigs University, Freiburg, Germany

Correspondence to: Dr. Daniel Bäumer
Hürzeler/Zuhr, Private Practice/Research & Education Center, Rosenkavalierplatz 18, 81925 München;
Tel.: 0049-89-1891750; Fax: 0049-89-18917528; E-mail: daniel@dr-baeumer.com
Abstract

Anterior teeth are often affected by accidental dental trauma and may eventually be lost. When the neighboring teeth are unharmed, implant-supported crowns are often the preferred treatment choice. When not only the teeth but also the supporting hard and soft tissue has been lost, surgical reconstruction may be needed. However, in combined horizontal and vertical class III defects, the available augmentation techniques are often not predictable. In this case report, two neighboring mandibular central incisors were replaced by two implants after soft and hard tissue augmentation with the cortical bone plate method. The interdental soft tissue was reconstructed with remarkable success, making this an example of what can be achieved in cases such as this.

CASE REPORT

Introduction

Anterior teeth are often affected by accidental dental trauma.\textsuperscript{1,2} In many cases, a substantial part of the crown is damaged and requires endodontic and restorative treatment, or even extraction of the teeth, with the need for prosthetic replacement.

Missing incisors can be replaced with conventional fixed partial dentures (FPDs), adhesive FPDs, or implant-supported crowns. Often, in cases of accidental damage the neighboring teeth remain unharmed, so their preparation as abutment teeth would be highly invasive and increase the risk of subsequent biological complications such as pulpitis.\textsuperscript{3} In gaps with more than one missing tooth, there may be unfavorable physics for FPDs in the anterior zone. For these reasons, the preferable treatment choice to replace teeth in some cases is implant restorations, which can have satisfying functional and esthetic results.

Not only can accidental trauma cause the loss of teeth, but due to the post-traumatic resorption and remodeling process, a significant reduction of part of the surrounding tissue such as bone and soft tissue can occur.\textsuperscript{4-6} In most cases, this will result in complicated deficits requiring horizontal and/or vertical bone augmentation prior to implant placement. While horizontal defects can be reconstructed predictably,\textsuperscript{7} the reconstruction of vertical defects has an unfavorable prognosis. A classification of tooth gaps can therefore relate to the bone level of the neighboring teeth and the number of teeth to be replaced: A class I defect is characterized by the loss of a single tooth and a bone level of about 1 mm from the cementoenamel junction of the neighboring teeth, while in a class II defect, this distance is more than 1 mm. A class III defect would, in this context, have more than one missing tooth, which has the worst prognosis for a good esthetic outcome.

For single-tooth gaps with tissue defects, many predictable guidelines have been described for implant solutions.\textsuperscript{8-11} However, under current circumstances, the replacement of two neighboring teeth in the esthetic zone is still a major challenge. Different approaches have been described to handle this challenging situation: guided bone regeneration (GBR) with autologous bone particles and/or bone replacement materials, in combination with ePTFE membranes;\textsuperscript{12,13} autologous bone blocks with or without membranes;\textsuperscript{14,15} the cortical bone plate method, introduced by Khoury; the sandwich technique;\textsuperscript{16} and the distraction technique.\textsuperscript{17,18} For class III defects with multiple missing teeth, the documented techniques all have an unfavorable prognosis. In these situations, compared to the single-tooth gap, there is no tooth with a healthy periodontium on the mesial and distal sides of the implants, but on only one of the two sides. None of the techniques have a predictability that is as high as that for single implants.

This article describes a patient case in which the two mandibular central incisors were missing and were replaced with implant-supported single crowns after hard and soft tissue augmentation. The interdental soft tissue could be reconstructed with remarkable success. It is therefore an example of what can be achieved, and what future concepts should strive for.
Case report

A 50-year-old female patient presented at our dental office missing both mandibular central incisors. The teeth had suffered from fracture at the gingival level due to mechanical trauma from an accident. Both remaining roots had been extracted by another practitioner 3 months earlier during an unsuccessful attempt at preservation by endodontic treatment. The patient now requested the replacement of the teeth. The resulting gap had been provided with an adhesive bridge characterized by severely compromised white and red esthetics (Fig 1). The patient worked as a teacher and was a non-smoker with an unremarkable medical history. Intraorally, several conservative and prosthetic restorations were present in good condition. The cleansability in the area of the adhesive bridge was limited due to the defect configuration, but the patient's overall oral hygiene was satisfactory. Her biotype could be described as rather thick.

The clinical examination and radiographic evaluation (Fig 2a,b) revealed a soft and hard tissue defect in both the horizontal and vertical dimensions (Figs 2 and 3). This corresponded to a class III defect, according to the classification by Studer et al., with a poor prognosis for a satisfactory esthetic outcome. A removable partial denture was not an option for the patient. Based on these findings, three treatment options were considered and discussed with the patient: (1) A permanent adhesive bridge, (2) a conventional bridge with soft tissue augmentation only, or (3) an implant-supported solution with

Fig 1  The gap was marked by severely compromised red and white esthetics.

Fig 2  Class III defect with a combined horizontal and vertical component.

Fig 3  Defect formation in the horizontal direction.
bone and soft tissue augmentation. The patient decided on the third option. Although a cantilever solution is the authors’ usual approach in such situations, a solution with two implants was chosen in this special case for two reasons: First, the patient insisted strongly on a solution with two implants, although the possible disadvantages of higher cost, extended surgical time, and excessive site development were explained to her. Second, the patient presented with a deep covered bite, which would have resulted in strong masticatory forces on a potential cantilever. This may have led to early fatigue and prosthetic complications due to the increased mechanical angular moment. Based on clinical experience, and also to lower the patient’s expectations in advance, we informed her that reconstruction of the interdental gingiva would hardly be achievable with two implants.

The first surgical procedure was carried out in accordance with the cortical bone plate method for vertical and horizontal ridge augmentation. The surgical site was disinfected with a 0.12% chlorhexidine solution, with which the patient rinsed for 1 min. After the removal of the adhesive bridge and the administration of local anesthesia, an alveolar ridge incision in the keratinized tissue and an intrasulcular incision at the teeth adjacent to the gap were performed. The papillae lateral to the edentulous area were mobilized. A full thickness flap was raised on the buccolingual side, followed by periosteal slitting to create a mucoperiosteal–mucosal flap for mobilization of the buccal flap. A cortical bone plate was harvested from the angle of the mandible and divided longitudinally with a diamond disc. The two plates were secured over the defect area with osteosynthesis screws (Cortex Screw PlusDrive 1.5 mm, Synthes), providing stable fixation and adequate coverage of the defect (Figs 4 and 5). The space between the cortical bone plates and the niches buccal to the bone plates were filled with a mixture of particulate autogenous bone harvested with a bone scraper (Safescraper Twist, Imtegra), and a deproteinized bovine
bone mineral (Bio-Oss, Geistlich) with the anticipated overcorrection. A non-cross-linked collagen membrane (Bio-Gide, Geistlich) was applied over the defect, and a subepithelial connective tissue graft from the lateral palate was placed to increase the soft tissue volume, to prevent membrane exposure, and to ensure closed healing of the augmentation site even if postoperative wound dehiscence were to occur. For flap closure, horizontal mattress sutures were placed with a nonresorbable suture material (Cytoplast PTFE EP 1.5 C3, Osteogenics Biomedical) to stabilize the flap on the alveolar ridge, and double-loop sutures were placed for primary closure. The vertical incisions were closed with interrupted sutures, and the mobilized papillae were closed with vertical mattress sutures. Gentle pressure was applied to the wound for several minutes to reduce the formation of a blood clot at the soft tissue graft, as this might possibly impede the influx of oxygen and metabolites by plasmatic circulation during the initial phase of healing.²¹,²²

The donor site on the lateral palate was sutured with horizontal sling sutures to exert pressure on the surgical wound in order to promote hemostasis and primary wound healing. Additionally, a wound dressing with a tissue adhesive (Histoacryl, Braun) and a periodontal dressing (Coe-Pak, GC) were applied. Finally, the patient was given comprehensive postoperative instructions and was advised to take prescribed medi-
cation, including an antibiotic (Augmentin, GlaxoSmithKline), an analgesic (Ibuprofen Actavis Granulat 600 mg), a chlorhexidine mouth rinse (GUM Paroex 0.12%), and anti-inflammatory homeopathic substances (Traumeel, Dr. Peithner; Bromelain-POS, Ursapharm).

The provisional restoration was placed with a self-curing composite (Clearfil Core New Bond, Kuraray) at the time of suture removal 1 week later, leaving space for postoperative swelling in the first days of healing. At that time, the wound was slightly open due to swelling, so that the connective tissue graft gleamed through, but the overall healing appeared to be good (Fig 6).

During a second surgical appointment 6 months later, the adhesive bridge was again removed (Figs 7 and 8), and a full-thickness flap was prepared to access the augmented bone (Fig 9). The osteosynthesis screws were removed, and two implant beds were prepared with a diameter of 2.75 mm, followed by the insertion of two 3.25-mm wide and 11.5-mm long parallel walled implants (Osseotite Certain 2, Biomet 3i). The implants were provided with cover screws (Figs 10 and 11). An autologous connective tissue graft was harvested from the tuberosity on the right side and placed above the implants. The flap was closed in a microsurgical manner according to the procedure previously described, and a postoperative radiograph was taken (Fig 27).

**Fig 9** The augmented bone after 6 months.

**Figs 10 and 11** Two 3.25 x 11.5-mm parallel walled implants were placed.
After a closed healing time of 4 months (Figs 12 and 13), the implants were uncovered in a tunneling procedure, and an autograft from the left tuberosity was inserted into the created pouch. Before the healing abutments were connected (MicroMini 6 mm, Biomet 3i), they were adjusted manually in the dental laboratory to allow proper fit into the small gap.

The adhesive bridge was cemented again, and vertical double-crossed sutures (Seralene 6-0 DS-15, American Dental Systems) were placed (Fig 14). The medication prescribed was identical to that for the first procedure, and the site was healing well at the time of suture removal 1 week later (Fig 15).
A month later, the implant impression was taken and the healing abutments were reconnected (Figs 16 to 18, and 29). After another 2 weeks, long-term provisional restorations were inserted on individually fabricated zirconia abutments (Figs 19 and 20) using provisional cement (TempBond, Kerr) to allow the peri-implant tissues to develop.

Fig 16  Implant impression was taken 1 month after soft tissue augmentation.

Figs 17 and 18  The manually adjusted healing abutments were reconnected after the implant impression.

Figs 19 and 20  Individually fabricated zirconia abutments were placed 2 weeks after impression, and restored with long-term provisional restorations.
Four months later, the final full-ceramic crowns (Creation CC, Creation Willi Geller International) were placed, and another 2 weeks later, and then another 3 months later, the laboratory technician performed esthetic refinements (Figs 21, 22, and 30). Figure 32 shows the scheme of the order of interventions.

The patient was satisfied regarding the function and esthetics of the final result, and returned for a follow-up appointment 7 months after crown insertion (Figs 23 and 24), and then 8 months later (Figs 25, 26, and 31). She was advised to come back for yearly follow-ups in addition to dental hygiene visits at her referring dentist.
CASE REPORT

Discussion

The treatment outcome of the presented patient case was a success in terms of esthetics, which were very pleasing. Looking back at the original situation (a class III defect before treatment), the actual result could not have been expected with certainty. A good precondition for reconstruction was the high bone level of the neighboring teeth, which was visible in the initial radiograph. One reason for the success of this case might be that the applied cortical bone plate method seems to offer a high reconstructive potential for vertical defects. Although scientific investigations show that the GBR technique, the distraction technique, and the sandwich technique can lead to complete defect reconstruction in both horizontal and vertical dimensions, clinical experience shows that, especially between two implants or two pontics, complete success cannot be definitely predicted with these treatment techniques. Despite the positive clinical results experienced when the cortical bone plate method is applied, it is currently not clear from a scientific point of view how successful it can be when applied to class III defects on a regular basis.

A question of special interest in this context is the long-term prognosis and volume stability of the augmented tissue in the vertical dimension. In esthetically irrelevant areas, resorption processes can be tolerated to some extent, but in the anterior zone, exposed implant components lead to relevant difficulties. Another important aspect is the technique sensitivity of all techniques, and the patient morbidity involved. Considering these factors, none of the above-mentioned available augmentation techniques can be said to be superior to any other for the routine treatment of vertical defects. The authors are of the opinion that Khoury’s cortical bone plate method is the method of first choice because the combination of cortical bone and bone particles appears to imitate...
conditions that are most similar to the natural structure of alveolar bone, which is composed of cortical and cancellous bone.\textsuperscript{23} This, however, has not yet been sufficiently proven scientifically.
Before choosing the prolonged and risky reconstructive surgical approach, a prosthetic solution should always be considered and discussed with the patient to evaluate which is best and which the patient prefers. An alternative solution to the described approach could be a FPD, combined with soft tissue augmentation of the pontic area. This is a feasible option, especially in the anterior mandible, and adhesive bridges work well over the long term. The use of pink ceramics in unexposed areas can be preferable to a soft tissue build-up; the precondition is that the area is not visible when the patient smiles, and that adequate oral hygiene measures are still possible.

As an alternative to the chosen approach, a one-time abutment solution is worth considering. It has been reported that repeated abutment changes during prosthetic treatment for implant impressions and for the delivery of the final abutments might have a negative influence on the stability of the peri-implant bone and the surrounding soft tissues. Therefore, connecting the final abutment as early as possible in the course of treatment and leaving the epithelial seal untouched may be advantageous because it allows for a reduction of clinical procedures. The benefits of digital fabrication give additional value to this approach. On the other hand, placing the final abutment at the time of surgery may be a disadvantage because it is not possible to predict the amount of soft tissue shrinkage. In the presented case, for example, the surgeon expected more soft tissue shrinkage, and multiple soft tissue augmentations were done, which made the soft tissue contour even more unpredictable. Without individualized abutments, there would have been less control over the position of the crown margins, which could have resulted in less access for the removal of excess cement.

Another point of discussion regarding the course of reconstruction is the choice of the soft tissue graft to be applied. Soft tissue grafts can be harvested from different areas in the oral cavity: the anterior and posterior lateral palate, and the maxillary tuberosity. These grafts vary as regards their geometric shape and their histologic composition. A graft from the tuberosity is more voluminous and appears to contain more dense tissue, characteristics which might affect its healing dynamics and long-term stability. In contrast, a graft from the anterior lateral palate appears to be looser, and contains more fatty and glandular tissue,
due to which it might be less prone to necrosis when exposed in the event of flap dehiscence. Although these issues must be evaluated in scientific studies, a surgeon may already take them into consideration when choosing the harvesting site for soft tissue augmentation.21

Conclusion

A general recommendation for the best treatment modality cannot be given, but in very difficult cases such as the one presented here, the treatment option decision also depends on the surgical skills and experience of the clinician. While demanding surgical treatment paths can lead to functionally successful and esthetically pleasing results, prosthetic solutions with less surgical involvement may be a feasible alternative. The potential, as well as the stability, of the cortical bone plate method for alveolar ridge construction has to be evaluated scientifically in long-term observations, as do the characteristics of the different soft tissue grafts.

References

13. Simion M, Jovanovic SA, Tinti C, Benfenati SP. Long-term evaluation of osseointegrated implants inserted at the time or after vertical ridge augmentation. A retrospective study on 123