Natural preservation of the emergence profile

Authors: Dr Umut Baysal & Dr Arzu Tuna, Germany

Supplying single-tooth gaps with implants in the aesthetic zone is subject to strict evaluation. Objectively verifiable criteria like the "pink and white aesthetic score" were elaborated[1,2] and scientific works focused mostly on the reconstruction of hard- and soft-tissue. However, these concepts are based on the principle of tissue reconstruction after tissue loss. The following case history pursues the approach of preventing resorption processes after tooth extraction.

Introduction

An implant that does not differ from the neighbouring, natural teeth, meets the demands of dentist and patient. Imitating nature is the top priority. The creation of natural, true-to-life surface structures allowing for the distribution of light reflection and absorption is key to perfect aesthetics. Modern ceramic materials facilitate the true-to-life reconstruction of dental hard tissue. If the tissue is not defective and allows for correct positioning of the implant, we can expect an aesthetically satisfying result.

If hard- and soft-tissues show deficits though, adequate augmentation is required. Despite various therapeutic options, the reconstruction of three-dimensional defects still requires great effort and cannot always be achieved completely.[3,4] Many concepts in implantology deal with the principle of tissue reconstruction after tissue loss, even though methods of primary prevention of resorption processes are the actual key to success. Consequently, various methods like "socket preservation" and "ridge preservation" were developed in order to limit the horizontal and vertical changes after tooth extraction. In their overview survey, Darby et al. did not provide any conclusive references that these published techniques improved the potential implant locations.[5] Another technique, the immediate implant, per se is not a ridge-preserving measure, which was proved in animal and clinical studies.[6,7]

The procedure applied in the following is based on the "tissue master concept" by Stefan Neumeyer. Neumeyer was able to show that replanting root segments or highly resected teeth after extraction prevents the alveolar collapse and the subsequent extrusion leads to coronal movement of the alveolar tissue structures.[8] After a period of stabilisation between three and six months, the cavities of the residual alveolar bone were filled entirely with osseous tissue. According to his case analyses, the cause seems to be the periodontal ligament (minimum width: 2 mm), which is able to convert mechanical stimulations into tissue reactions. Complete preservation and vertical gain of alveolar hard- and soft-tissue are predictable and clinically stable in the long term.[9] Additional extrusion may induce the vertical gain of soft- and hard-tissue structures.[9,10]

Fig. 1: Initial condition of tooth 23 on single-tooth radiograph.
Fig. 2: Intraoral initial condition of tooth 23.

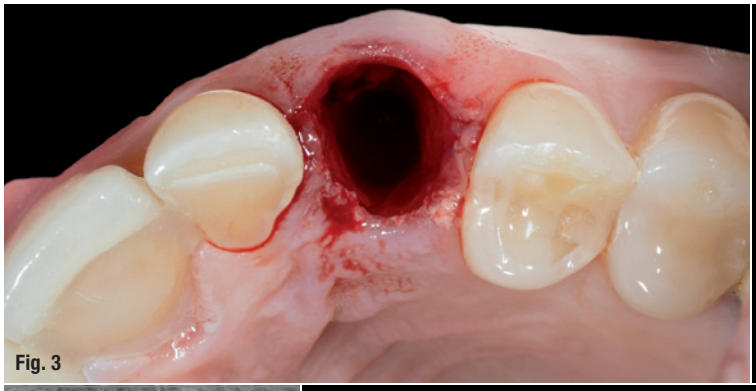
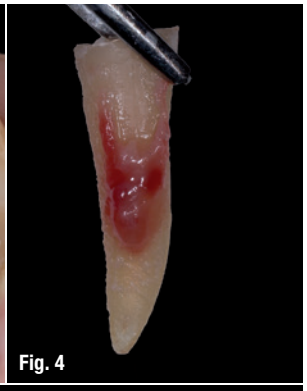


Fig. 3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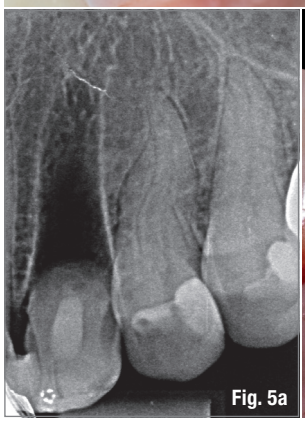
Fig. 5a


Fig. 5b

Fig. 3: Condition after extraction. The inflammatory processes on the buccal side are clearly visible.
Fig. 4: Separated root and inflammatory process in medium third.
Fig. 5a: Single-tooth radiograph after replantation of dental crown.
Fig. 5b: Condition after replantation of dental crown (intraoral). Splinting with SDR® (Dentsply Sirona) to adjacent tooth.

Case history and treatment

A 44-year-old patient visited our practice due to problems with tooth 23 for the first time in January 2016. The patient was healthy at the time of the consultation and suffered neither from acute nor chronic general diseases.

The labial surface in the medium third of the root of tooth 23 was very sensitive to percussion. A dental X-ray scan of region 21–24 did not show any signs of resorptive processes (Fig. 1). The therapeutic goal was to restore the proper function of tooth 23 and to remediate the inflammatory processes. We suggested various therapeutic options and chose the implantological treatment.

Extraction and replantation

Treating the alveolar bone and the surrounding tissue with care during the extraction may positively influence the formation of defects.[11] After cutting all periodontal fibres to be reached from the intrasulcular side using a micro scalpel blade, the tooth was removed from the alveolar bone axially using forceps. Figure 2 shows the situation before and figure 3 right after the extraction. The resorptive processes in the labial area are barely perceptible in figure 3, are confirmed though in figure 4, which shows the separated root and the internal resorption of the labial region. Crown and root were separated 2 mm below the enamel cement junction. If there was no root canal filling available, the dental pulp areas were to be cleaned and filled with composite filler. For replantation, a pre-manufactured palatinal silicone key was used to attach the crown to adjacent tooth 22 by means of acid etching (phosphoric acid, Adhese® Universal, Ivoclar Vivadent) and composite filler (SDR®, Dentsply Sirona). Figures 5a and b show the situation right after replantation and fixing.

Extrusion

After ten days, a loss of approximately 1 mm of marginal gingiva in apical direction became evident (Fig. 6). We intended to recapture that by means of extrusion. The replanted crown was separated in the upper third (Fig. 7) after a healing time of ten days and extruded by 1 mm using rubber bands for 24 hours (Fig. 8). You can see the reactive tissue in the marginal area very nicely. The soft tissue is the first to follow the traction, then the bone. The stabilisation phase until the implantation was 16 weeks.

Implant planning and implant procedure

The aesthetic result depends on the three-dimensional positioning of the implant. After replantation and extrusion, volume loss was prevented and complete ossification of the alveolar extraction site was achieved. Figures 9 and 10 show the radiographical findings right before the implantation. In particular, the volume in orovestibular direction (Fig. 9, centre) prevents that the implant is positioned too far into the


Fig. 6


Fig. 7


Fig. 8

Fig. 6: After ten days already, a loss of marginal gingiva of about 1 mm in apical direction is evident.
Fig. 7: Condition prior to extrusion by means of rubber bands over a period of 24 hours.
Fig. 8: Condition after 24 hours. The reactive tissue in the marginal area is very nicely shown. The soft tissue is the first to follow the traction, then the bone.
Fig. 9: Three-dimensional imaging shows that volume loss is prevented and complete ossification of the extraction alveole could be induced.

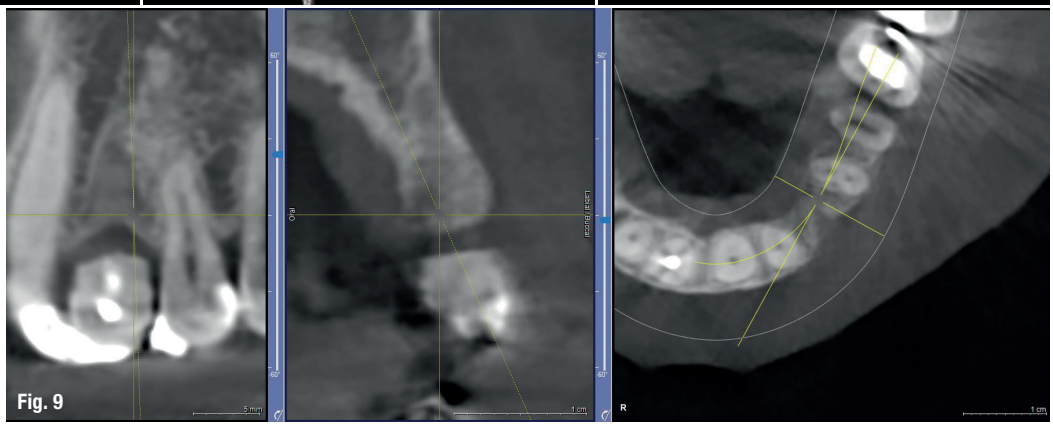
Fig. 9

palatinal direction with sufficient osseous volume of 2 mm on the buccal side. The replanted crown makes it possible to plan the implant position allowing for the prosthetic component in terms of backward planning. A template-guided implantation facilitates the incision-free technique and shorter treatment period, reduced patient morbidity, and better surface texture of the soft tissue. Figure 11 shows the situation after removal of the replanted crown and prior to the implantation. Using a micro scalpel blade, access to the bone was established (Fig. 12). Afterwards, the pilot hole was drilled using the template (MIS Guide, Fig. 13) and the further preparation performed with osteotomes (Fig. 14) after inspection of the buccal bone lamella. Despite the preventive measures, the purely subtractive preparation of the implant bed using drills was not indicated. We used a 3.3/11.5 mm implant in a special triangular design of the crest, which increases the bone deposit in the critical zone additionally (V3, MIS; Figs. 15 and 16).

After the implantation, the crown was replanted. Figures 16a und 17a show the status of the soft tissue right after the implantation. The atraumatic status and the complete preservation of the emergence profile are remarkable. A single-tooth radiograph was prepared to check the implantation (Fig. 17b).

Exposure and dental impressions

The implant was re-exposed three months after the initial implantation. In the meantime, the bonding of the replanted crown had failed once. Because of the slightly undercutting points of the composite, the replanted crown is not lost, but only becomes loose and is retained well by fibres and ligaments. The patient wears a splint at night for protection against aspiration or swallowing. The atraumatic exposure and removal of the replanted crown and the subsequent exposure of the implant using a micro scalpel blade cannot be compared to the typical exposure technique.

Fig. 10: Single-tooth radiograph of region 23 after complete ossification.
Fig. 11: Condition after removal of replanted crown and prior to implantation.
Fig. 12: Access to the bone was established by means of a micro scalpel blade.

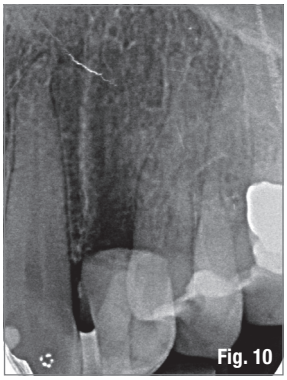
Fig. 10


Fig. 11

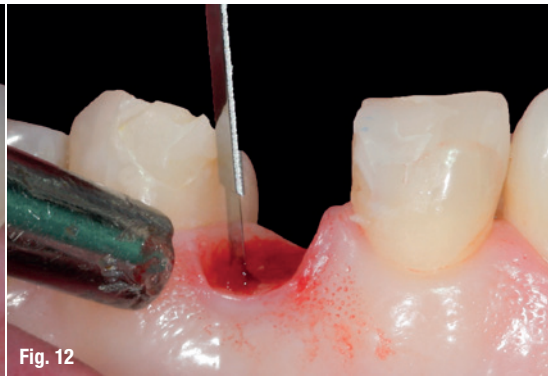
Fig. 12


Fig. 13


Fig. 14


Fig. 15

The dental impressions were taken in an analogue procedure using a closed tray via a transfer cap (Fig. 18). The next step was the manufacture of an individual hybrid abutment (titanium adhesive bonding, zircon abutment) at the laboratory. A digital dental impression would have the advantage that data scanned before the tooth extraction could be matched with the impression after exposure, thus enabling an exact copy of the natural tooth in line with the "biogeneric copy" concept.[10] In the present case, we abstained from the digital workflow because the crown was individually manufactured in laminated ceramics. The dental crown was replanted again after the impression was taken.

In the next session, the definite abutment (Fig. 19) and a synthetic crown were tried on for aesthetic analysis. We removed the composite residues from the adjacent teeth and fixed the abutment tightly using a new screw according to the manufacturer's instructions (Fig. 20). A new silicone impression was made in filament technique. This impression serves to manufacture of the crown with the newly defined contact points to the adjacent teeth. Previously, the laboratory had manufactured an analogue to the abutment of super-hard plaster to ensure the exact preparation of the crown margin. Figure 21 shows the abutment after removal of the composite residues from the adjacent teeth. The synthetic crown was fixed using provisional cement (Telio CS Link, Ivoclar Vivadent). We were thus able to abstain from another replantation of the dental crown. The synthetic crown provides us with diagnostic value with regard to the final appearance of the peri-implant soft tissue and the form of the crown.[12] Additional optimisation by applying and removing provisional masses to form the emergence is not necessary anymore in most cases. This shortens the treatment duration considerably. Figure 22 shows the definite crown right after its placement (Variolink Esthetic DC, Ivoclar Vivadent).

Discussion

Prerequisite for aesthetic prosthesis with long-lasting stable soft tissue is the correct positioning within the three regional comfort zones. If no tissue defects are available, predictable results involving single-tooth implant crowns of the anterior teeth can be achieved.[12] The adjacent teeth contribute to supporting the peri-implant tissue and determine the height of the papilla.

Schropp et al. reported though that the extraction of teeth promotes the resorption of the adjacent tissue.[13] After three months, cervical resorption reaches an extent of 30 per cent and labial resorption an extent of up to 50 per cent. The initial resorption processes after tooth extraction are physiological processes that cannot be prevented from today's point of view. Reference literature describes the implementation of various augmentation strategies to optimise the volume in case of available defects in detail. Horizontal ridge augmentation to widen the alveolar ridge effectively are available and provide for stable results in the long term. The described techniques to augment the alveolar ridge, however, are consider-

Fig. 13: Template-guided pilot hole (MIS Guide).
Fig. 14: After the pilot hole, the implant bed was further prepared, exclusively with osteotomes.
Fig. 15: A 3.3/11.5 mm implant in a special triangular design of the crest, which increases the bone deposit in the critical zone additionally was used (V3, MIS Implants).

Fig. 16: Condition after implantation and prior to replantation of dental crown. The atraumatic status and the complete preservation of the emergence profile are remarkable.
Fig. 17a: Condition right after implantation.
Fig. 17b: Single-tooth radiograph after implantation.


Fig. 16


Fig. 17a

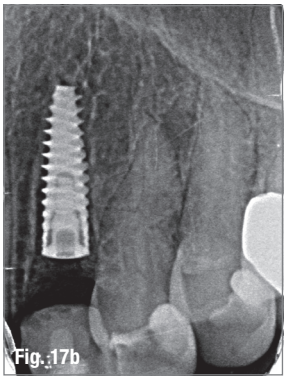
Fig. 17b


Fig. 18


Fig. 19

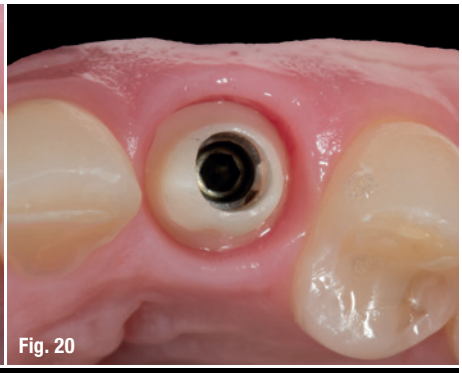
Fig. 20


Fig. 21


Fig. 22

Fig. 18: Condition after exposure and prior to dental impression.
Fig. 19: To try the definite abutment on, the composite residues were removed from the adjacent teeth.
Fig. 20: The abutment was fixed tightly using a new screw according to the manufacturer's instructions. A new silicone impression was made in filament technique. This impression serves to manufacture the crown with the newly defined contact points to the adjacent teeth.
Fig. 21: Buccal view.
Fig. 22: Condition right after placement of crown.

ably less predictable.[14] High biological and technical complication rates had to be expected. Consequently, reliable concepts were required and developed to create optimal initial conditions. Ridge-preserving measures involving different approaches and combinations were developed.

Among others, inserting thick free mucosa grafts into the coronal part of the alveolar extraction site, thickening the soft tissue on the buccal side of the alveolar extraction site using connective tissue grafts, filling the alveolar extraction site using bone or bone replacement material, and the application of the GBR method are described measures.[15] Regarding the filler techniques, Fickl's workgroup was able to show, when comparing the different methods, that none of the examined techniques prevented the resorption of the buccal bone lamella and the formation of tissue defects.[16] Likewise, one cannot achieve the complete compensation of the defect formation by means of closing the alveolar extraction site with a free mucosa graft.[16,17] That is why many new concepts in implantology still engage in the principle of tissue reconstruction after tissue loss.

There is one thing, however, all the described methods, whether mere tissue reconstruction through augmentation or ridge-preserving measures, have in common: The intervention takes place always when tooth was extracted completely. The tissue master concept pursues a whole new approach. Because of the crown replanting, the extraction is incomplete and thus the alveolar fibre structure and periodontal ligament are preserved. The initial resorption processes do not seem to take place and healing processes proceed, preserving the alveolar volume almost completely.[9] Other convincing aspects in this regard are the reduced number of surgical interventions, the abstinence from bone replacement material, the shorter treatment time, and the altogether better patient comfort.

Conclusion

This case report reveals that the intervention implementing ridge-preserving measures before the tooth is fully extracted should be taken into consideration. This biological approach represents the primary prevention of resorption processes and thus facilitates the abstinence from time-consuming and cost-intensive augmentation measures._

contact

Dr Umut Baysal
Dr Arzu Tuna
Große Brinkgasse 29
50672 Cologne, Germany
u.baysal@me.com
www.myveneers.de

Author details Author details Literature

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