early childhood anterior tooth trauma

Implant prosthetic restoration with a Xive implant following piezoelectric bone splitting and bone grafting

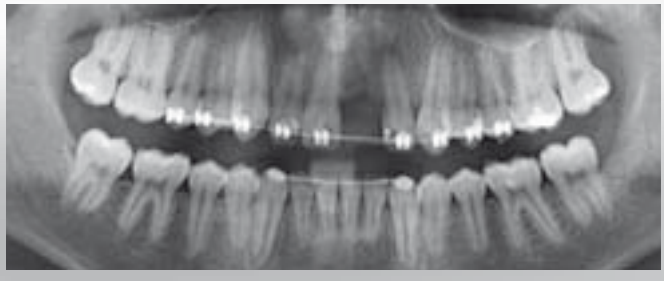
| Fred Bergmann

INTRODUCTION

Being able to replace missing teeth by means of implants opens up new opportunities in patient care and revolutionizes the field of prosthetic rehabilitation. Progress in implant design and in surgical technique has increased the predictability of the treatment results and the survival rates of implants and implant-supported denture. In the maxilla, however, due to the anatomical conditions, implant therapy currently has its limits. Due to its cancellous bone structure, the maxilla does not offer the optimal conditions for the primary and long-term stability of implants. The sinus maxillaris is a further factor, which makes the planning and insertion of implants in the posterior region of the maxilla difficult and requires extensive pre-implantology measures to improve the implant site.

From an esthetic point of view, implant treatment in the maxillary anterior region is a big challenge for engaged dentists in implantology. The smallest error in the positioning of the implant or improper handling of the peri-implant hard and soft tissues can lead to an irreversible cosmetic failure. Single-tooth implants in particular require all of the dentist's skill. In patients with a thin biotype, the visibility of the abutment through the thin gingiva presents a common problem. Postoperative recessions, resulting in parts of the implant becoming visible, are also not uncommon. These recessions generally occur when an implant diameter has been selected too wide or the implant has been positioned too close to the vestibular surface.
Too little soft and hard tissues may eventually lead to the implant restoration not integrating esthetically into the existing dentition. Often, a reconstruction of the interdental papilla is not possible, and the contour of the marginal gingiva cannot be shaped harmoniously. A high smile line does not allow any compromises at all in soft tissue esthetics, since the color and contour of the peri-implant mucosa must correspond to the soft tissues in the region of the neighboring natural teeth. Careful planning while taking all relevant clinical and patient-related parameters into account is therefore very important in order to achieve a predictable and esthetically satisfactory treatment result in the implant restoration of a single tooth.
In a single tooth replacement in the maxilla following traumatic anterior tooth loss, the practitioner faces the problem that there is only reduced amount of hard and soft tissue available. Frequently, portions of the bony alveolar ridge near the tooth have been lost due to trauma or natural resorption processes. The reasonable combination of the grafting technique and implants with an osteoconductive designed surface makes treatment success predictable in terms of implant stability and esthetics. Along with free connective tissue transplants and "Guided-Bone-Regeneration" (GBR) using autogenous or xenogeneic bone materials, piezoelectric supported "bone splitting" or "bone spreading" techniques can also be used for reconstruction.
Piezosurgery has been established as a successful technique in a variety of dental disciplines over the last ten years. Thanks to the adjustable ultrasound working frequency, different tissue types can be treated selectively without the risk of injury. With its narrow 60 to 200 µm width, the frictionless and vibration-free sectioning falls significantly below the incision width produced by using conventional instruments.
Today, bone splitting is considered to be a safe and simple method for the expansion of bone tissue. In a systematic review, success rates of 95 to 100 percent were reported using this technique in combination with a single- or two-stage approach.
The concept is completed by selecting the right implant type: healing and osseous integration are markedly dependent on the chemical composition, the loading, the roughness and the morphology of the surface of the implant. Thanks to its good bone-implant interface characteristics and the associated increased primary stability, the Xive implant system can also be securely and predictably placed into bone where the site is weak, and into areas of low bone density. Long-term results show a high survival rate for the Xive implants that can be traced back to the macro and micro design of the implant system.

1_Along with the nature-healthy dentition, the initial OPG shows the orthodontic brackets and archwires in the maxilla and mandible.
2_In the transverse DVT view, a Xive D 3.8 /L 13 implant has been virtually inserted in the optimal implant position. The buccal lamella falls short of the necessary layer thickness of 1 to 1.5 mm.
3_The route of the nervus nasopalatinus can also be estimated on the axial view of the 3D image.



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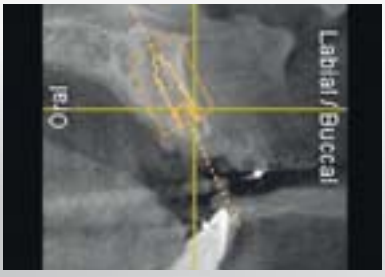

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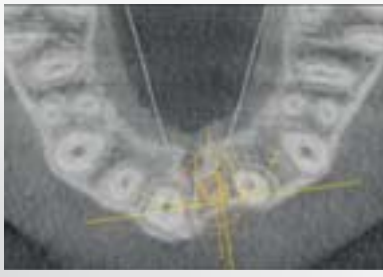

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4_The mucoperiosteal flap is prepared and mobilized. The periosteum is carefully detached from the bone in this process.
5_At the site of the subsequent implant insertion, the marking placed using a round drill is enlarged with a pilot drilling and prepared using the piezotome, with two short vestibular incisions and a long horizontal incision at a 90 degrees angle.
6_The alveolar bone is gradually expanded horizontally.
7_The implant site is prepared with the Xive twist drills.


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CASE STUDY

ANAMNESIS

A 23-year old, healthy patient presented in the practice requesting a replacement for tooth 21. The tooth had already been endodontically restored following an anterior tooth trauma in his childhood. Despite multiple revisions, the apical periodontitis had not healed. The tooth had been extracted and, as a result, there was severe bone resorption. The gap was initially restored with an interim prosthesis. Orthodontic treatment followed some years after the extraction, during which the gap in region 21 also had to be opened due to the implant restoration.
Clinically and radiologically, a caries- and filling-free dentition was evident, with orthodontic brackets and archwires in the maxilla and mandible. There was evidence of severe buccal resorption of the alveolar process in region 21 (Fig. 1).

3D RADIOLOGICAL ANALYSIS

A 3D analysis of the bony structures and the position of the nerve and the vascular bundles was performed for the treatment planning. Three-dimensional assessment plays a central role in the planning of the treatment steps and the predictability of the postoperative result.
The surgical procedure is determined on the basis of the DVT. The central issue is the optimal method of reconstructing the resorbed bone.
Since the horizontal bone volume was adequate, spreading the alveolar ridge by means of bone splitting in combination with implant placement and GBR was the treatment of choice. The anatomy of the patient's alveolar ridge and his bone quality confirmed the resolution to use the Xive implant, as its unique surface promotes the stable attachment of osteogenetic cells and its apically increasing thread depth contributes to a high degree of primary stability. In the DVT transverse view, a Xive implant with a diameter of 3.8 mm and a length of 13 mm has been virtually placed using the software in the optimal implant position. It can be seen that the buccal lamella falls short of the layer thickness of 1 to 1.5 mm, which is necessary for the long-term retention of the implant (Fig. 2). Since this is indispensable for uneventful healing and an esthetic result, the bone splitting must be performed over a depth of 7 to 10 mm. The 3D image shows that the bone volume is adequate for this procedure. In addition to the bone splitting, a final lateral onlay graft had to be performed.
The axial view of the three-dimensional image is well suited to estimating the position of the nervus nasopalatinus (Fig. 3). The position of the nerve is a limiting factor for the implant position in the palatal direction. The risk of a fracture of a buccal bone lamella or of a lesion of the nerve, however, is small where the correct procedure is used.

SURGICAL PROCEDURE

The mucoperiosteal flap is prepared and mobilized for the purposes of a full thickness flap. The periosteum is carefully detached from the bone (Fig. 4). Following the completion of the implant placement, the subsequent suturing should be located approximately over the split bone with the inserted implant. The crista alveolaris at the site of the subsequently planned implant placement is initially marked using a round drill and then enlarged with a pilot hole.

8_Finally, the bone-specific crestal preparation of the cavity is carried out.
9_The Xive S plus D 3.8 /L 13 implant is mechanically inserted at a slow rotational speed.
10_After filling the defect with autogenous bone chips, a stable-volume alloplastic bone grafting material is placed over the bone chips as a "second layer", and a resorbable collagen membrane is fixed to the bone with two Frios membrane tacks.
11_A double-layered wound closure is made using resorbable suture material.

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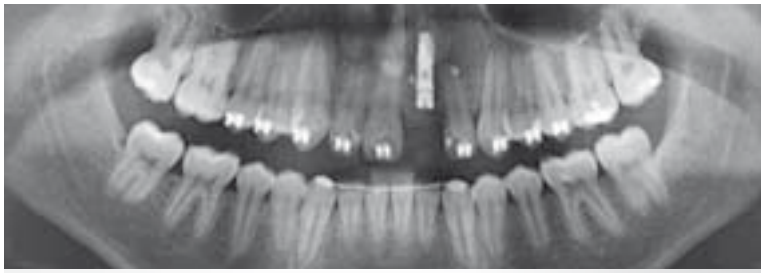
In the next step, two small vestibular incisions and a horizontal incision to a depth of ten millimeters and at an angle of 90 degrees are prepared using the piezotome (Aceton Germany GmbH) (Fig. 5). The two relatively deep (5 to 7 mm) vertical incisions will prevent a fracture of the buccal lamella, improve its mobility and protect the marginal periodontium of the neighboring teeth. The alveolar bone is then gradually expanded horizontally using the appropriate instruments (Fig. 6). In the process, the bone is also condensed horizontally at the same time to improve the primary stability of the implant by compression. Using the twist drill, the bone for the implant site is gradually prepared (Fig. 7). The bone chips can be simultaneously removed via the grooves in the twist drill, to where they can be collected extraorally. The implant site is prepared at low-speed, in order to avoid overheating the tissues. The vestibular bone lamella is stabilized by the apically pediculated flap on the periosteum and fixed. After the final drilling, the actual preparation of the implant site has been completed. The bone-specific crestal preparation of the cavity is then carried out using the crestal twist drill to adjust the preparation individually to the clinical situation (Fig. 8).

In the next step, a Xive S plus implant is mechanically inserted at a slow rotational speed (Fig. 9). In the process, the unique Xive implant thread, on the one hand, grips the bone palatally, while, on the other hand, the labial lamella is not traumatized. The implant is sealed saliva- and bacteria-proof using a color-coded cover screw in preparation for the submerged healing phase.

The gaps in the bone bed are then filled using the autogenous bone chips recovered during the drilling process. To compensate the resorption of the autogenous bone, a stable-volume alloplastic bone replacement material is placed over the bone chips as a "second layer". The raspatory is placed protectively in front of the nervus nasopalatinus, as there is only a thin bone lamella between the nerve and the mucosa. A resorbable collagen membrane is then placed over the augmented area and fixed to the bone with two titanium nails (Frios membrane tacks) (Fig. 10). By this means, the mucoperiosteal flap prevents shifting movements of the membrane. A double-layered wound closure is made in order to prevent dehiscence. First, a resorb-able suture (4.0) is used to attach the periosteum to the periosteum (Fig. 11). Then the mucosa is passively fixed with two over-and-over sutures. It can be seen in the radiological control image that the Xive implant in region 21 is positioned nearer to tooth 22 than to tooth 11 (Fig. 12).

This distal position is typically due to the location of the nervus nasopalatinus and is unavoidable.



12_The radiological control image shows that the Xive implant is positioned nearer to tooth 22 than to tooth 11 in region 21, due to the location of the nervus nasopalatinus.

UNCOVERY AND SOFT TISSUE MANAGEMENT

Three months post implant placement, the vestibular gingiva showed no signs of inflammation (Fig. 13). Measures to improve the soft tissue volume by extension in the esthetic zone are planned. The Xive implant is uncovered (Fig. 14) and the cover screw is replaced by a Friadent gingiva former for this purpose (Fig. 15).

FABRICATING THE TEMPORARY IMPLANT RESTORATION USING CAD/CAM TECHNIQUE IN THE DENTAL LABORATORY

After a brief healing phase of ten days, the patient is recalled to the practice for the actual temporary restoration. A suitable Friadent transfer post with a TransferCap is inserted into the implant for sealed impression making using a polyether (Fig. 16). The cast model of the maxilla subsequently fabricated in plaster is scanned in. An individual abutment is virtually created with the aid of the Friadent ScanBase, which displays the scannable counterpart to the TitaniumBase (Fig. 17). The resulting construction data are transmitted to the milling machine, where the abutment is milled from a lithium disilicate block (Fig. 18). The finished abutment is then cemented to the TitaniumBase. After completion, the precise position for the intra-oral insertion is reproduced on the plaster cast using a transfer key made from Pattern Resin (Fig. 19). In the next step, the fully anatomical provisional crown is designed using the software and is milled from a lithium disilicate block (Fig. 20). After completion, it is polished to a high gloss (Fig. 21).

INSERTION OF THE TEMPORARY CROWN

In the meantime, the mucosa has healed around the gingiva former and exhibits a homogeneous, inflammation-free structure (Fig. 22). Prior to the incorporation of the TitaniumBase abutment into the Xive implant, the screw channel is cleaned with chlorhexidine, dried and the peri-implant mucosa is cleansed. The precise intra-oral position of the abutment is checked using the key. Following this, the optimal position for the temporary crown is also determined by means of the resin

13_Three months post implant placement, the gingiva showed no signs of inflammation.
14_The Xive implant is uncovered.
15_To improve the soft tissue volume in the esthetic zone, the cover screw is replaced by a Friadent gingiva former.
16_Friadent transfer post with suitable TransferCaps in situ prior to impression making.

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transfer key fabricated for this purpose and this is temporarily attached using cement (Fig. 23).
When the mouth is opened, the length of the incisal edge conforms to the functional, esthetic and phonetic requirements (Fig. 24). A well osseointegrated implant can be identified, along with the radiopaque TitaniumBase and superstructure in the final radiographic control (Fig. 25). As the patient was very pleased and as the stable material, lithium disilicate, was used for the temporary restoration, the patient initially did not want a final restoration.

CONCLUSION

The method of implant placement and grafting procedure with bone splitting in the single session procedure presented here describes a realistic alternative to conventional grafting of hard and soft tissues in the esthetic region. The prerequisite is an adequate horizontal and vertical bone volume, in order to make the deep incisions necessary to mobilize the buccal bone lamella. The removal of bone blocks from additional surgical sites can be dispensed with for the patient. The Xive implant, which also guarantees primary stability in weak bone, with its unique, osseointegration-promoting surface and its compressive apical section, also makes the implant insertion in this complicated case predictable, safe and successful. ■

Literature available from the author

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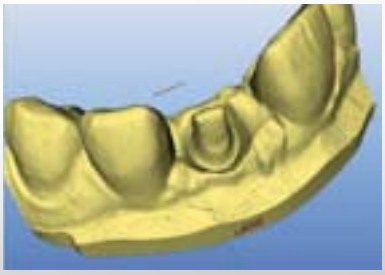
17_Virtually created, individual abutment
18_The abutment is milled from a lithium disilicate block, on the basis of the construction data.
19_The precise position of the TitaniumBase, which is cemented to the customized abutment, is reproduced using a transfer key.
20_The temporary crown is virtually designed using the software and is milled from a lithium disilicate block.
21_The finished, highly polished crown
22_The healed peri-implant soft tissues
23_The crown, inserted with the aid of the transfer key and temporarily attached using cement.
24_When the mouth is opened, the length of the incisal edge conforms to the functional, esthetic and phonetic requirements.
25_The final radiographic control shows a well osseointegrated implant, along with the radiopaque TitaniumBase and superstructure.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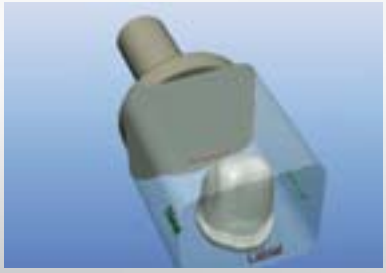
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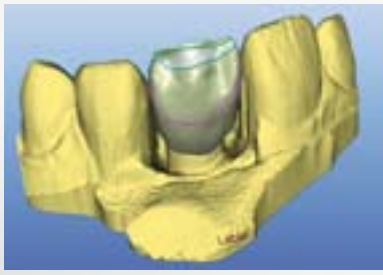
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