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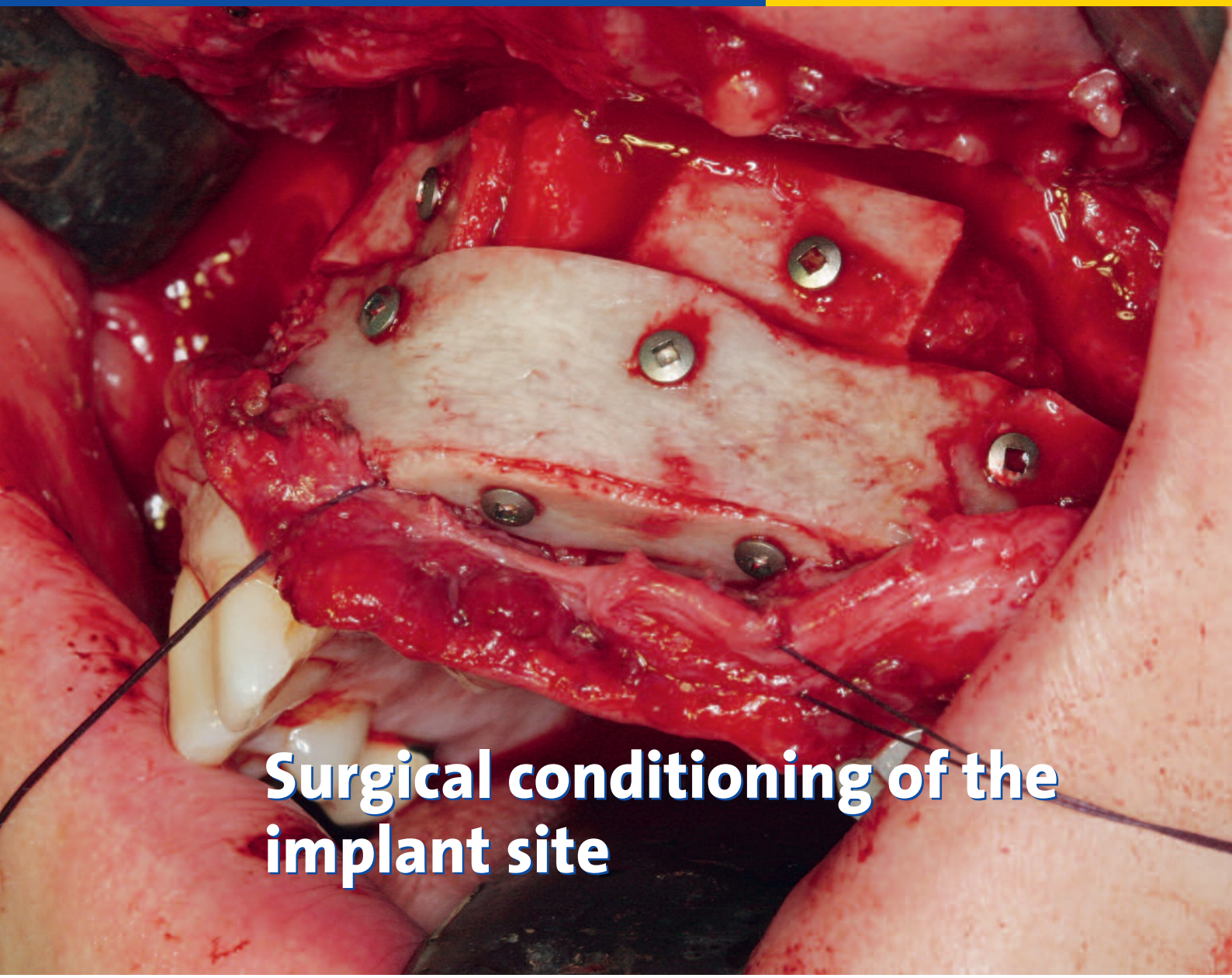

# Surgical conditioning of the implant site

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Bone and soft-tissue management in oral implantology

# Surgical conditioning of the implant site

**The long-term success of dental implants depends on a precise fit and stable position of the restoration, facilitating natural oral hygiene, but also, to a significant extent, on the surgical conditioning of the implant site. Good health of the peri-implant site presupposes sufficient bony coverage of 1 to 1.5 mm of the implant surface. A hygiene-friendly shape of the peri-implant soft tissue in conjunction with optimum soft-tissue thickness (approximately 2 to 3 mm) and a zone of keratinized mucosa (at least 2 mm) will seal the implant from exposure to the oral cavity thanks to close soft-tissue apposition.**

For implants in the aesthetic zone following the loss of tooth-bearing portions of the ridge, positioning them analogously to natural teeth – as is desirable – often requires not only horizontal but also vertical bone augmentation. The implant site can be surgically conditioned by bone or soft-tissue augmentation already at the time of tooth extraction, as a measure preparing for or accompanying implant placement or in the context of the prosthetic restoration or rehabilitation.

## Measures at the time of tooth extraction/explantation

At the time of tooth extraction, a conservative surgical approach that exerts no compressive load on the facial lamella may help preserve bone substance. If the facial lamella is successfully preserved, the alveolar process can extensively regenerate through subsequent reorganization of the extraction socket. In the event of component failure – such as implant fracture or irreversible destruction of the implant thread – the implant must be removed very gently as per the manufacturer's instructions or using standardized trephine drills (Figs. 1 and 2).

Over the past 20 years, with the use of bone substitutes, different approaches to filling extraction sockets with xenogeneic, autogenous or autologous material have been proposed. However, conditioning the future implant site with a non-resorbable material is a risky procedure. As the extraction renders the socket prone to infection, partial or incomplete regeneration and connective-tissue coverage of the bone substitute may be the result. Rather than actively conditioning the implant site, this procedure jeopardizes osseointegration, since the implants are not inserted into regenerated bone but into a conglomerate of bone substitute and connective tissue.

One risk factor for increased bone loss after tooth extraction is the post-extraction syndrome (alveolar osteitis, dry socket), which appears in up to 25 per cent of cases and will require lengthy post-treatment in addition to causing the loss of the tooth-bearing area of the alveolar ridge.

It is therefore recommended to use a resorbable material for defect augmentation, i.e. a material that is prone to extensive remodelling, so that a maximum number of trabeculae contact the implant surface after preparing the implant bed, achieving a high level of bone-to-implant contact. In addition to stable granular bone substitutes, the

*Fig. 1 Implant fracture after crestal bone loss. The geometry and the position of the external and internal threads were unfavourable.*

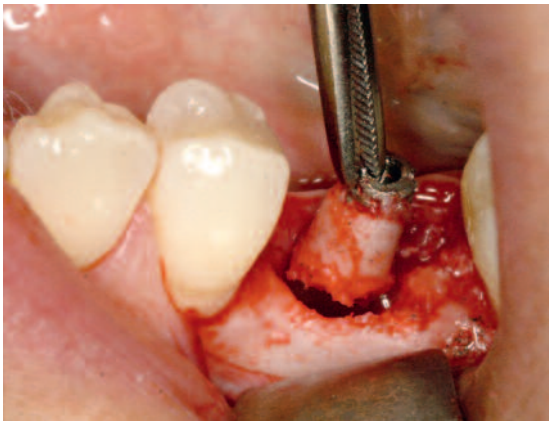

*Fig. 2 Gentle explantation using a trephine bore without damaging the facial lamella.*

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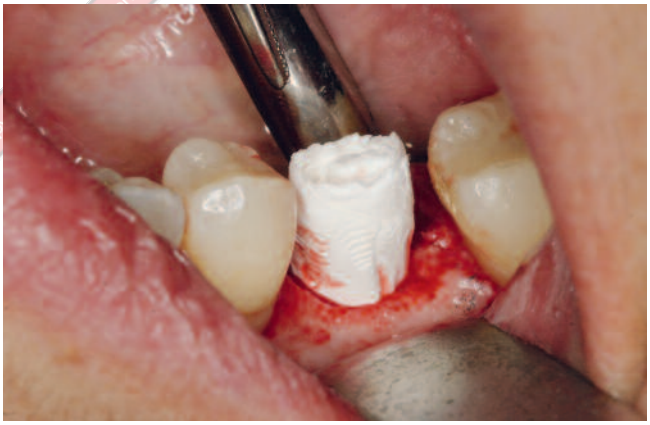

*Fig. 3 Augmenting the explantation defect with a collagen cone to stabilize the coagulum.*

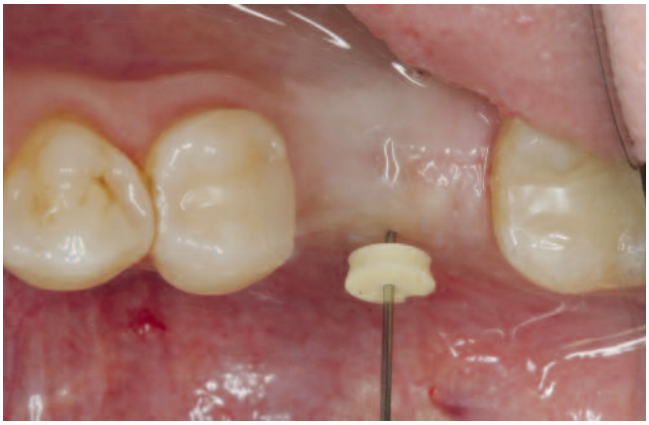

*Fig. 4 Determining the bone supply before implant insertion by measuring the mucosal thickness on preservation of the facial lamella.*

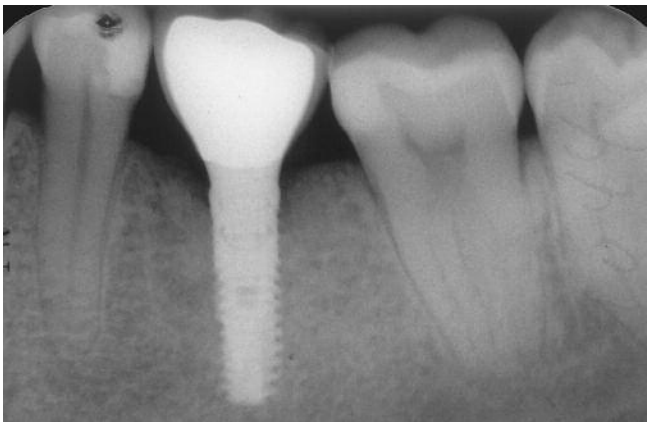

*Fig. 5 Radiological control one year after restoration of the newly inserted implant.*

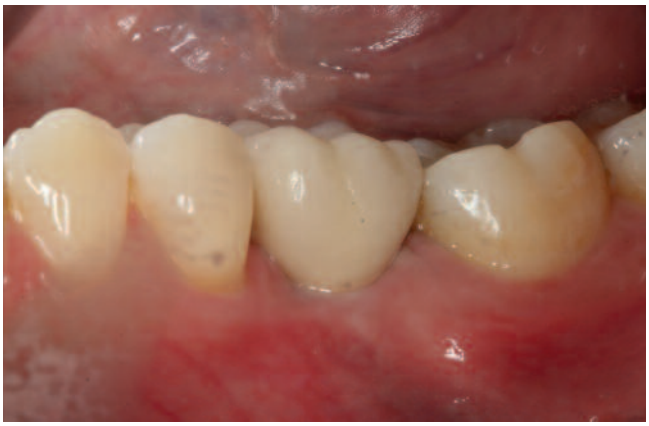

*Fig. 6 Single crown with stable peri-implant soft tissue thanks to complete bony coverage of the implant.*

use of wound-healing materials and hemostyptics has become established for this purpose. Specifically, the use of equine collagen sponges yields a stable coagulum and creates an internal guiding structure for the regeneration of the bone defect. Stable extraction sockets preserve the thin vestibular lamella and maintain the volume of the alveolar process (Figs. 3 to 6).

One promising approach to maximizing defect regeneration is antimicrobial photodynamic therapy (aPDT), which can significantly reduce the bacterial colonization responsible for the post-extraction syndrome. Another way to regenerate the socket is to place a connective-tissue or mucosal graft from the palate above the socket and suture it into place. In this way, saliva-proof closure and optimum bone regeneration can be achieved.

## Preoperative augmentation

Depending on the defect situation and the extent of atrophy, effective implant treatment requires reconstructing the alveolar process by vertical or horizontal augmentation or both in combination. And depending on the size of the defect, bone can be harvested externally or intraorally to obtain adequately sized graft material to three-dimensionally restore the ridge in its original configuration (Figs. 7 to 10).

Preimplantological approaches to preserving or restoring the alveolar ridge facilitate three-dimensional apposition of the bone graft, especially in the case of a vestibular incision. The cortical structures must be placed below the periosteum, and the cancellous bone must be built up with particulate cortical bone or compressed cancellous bone. A combination of incision, soft-tissue conditioning and bone-grafting techniques achieves a stable volume of the autologous bone graft without the use of a membrane – the autogenous cortical bone protects the graft from

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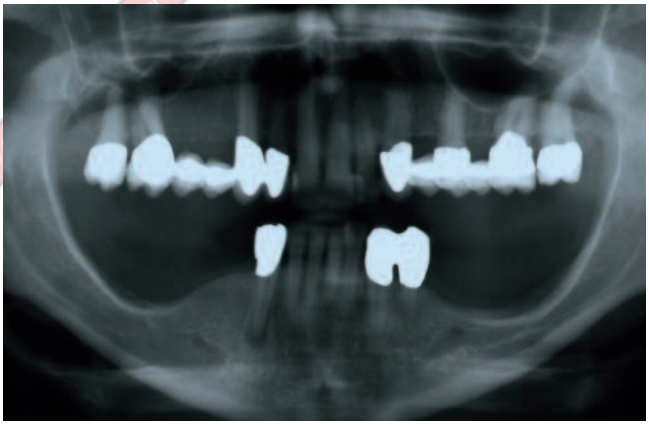

*Fig. 7 Hopeless 43 and 34 and extremely atrophic posterior mandible.*

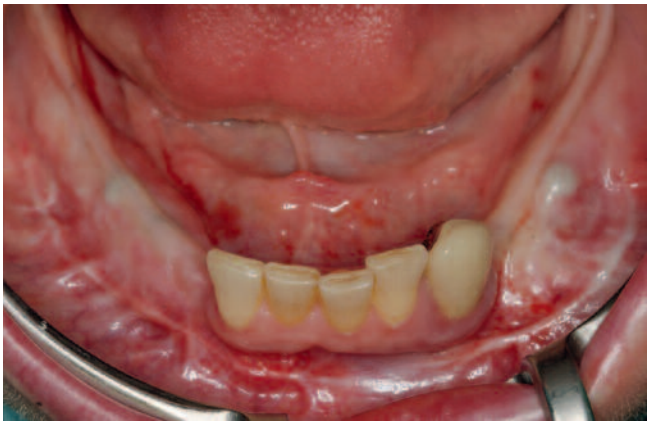

*Fig. 8 Situation after tooth extraction and ridge reconstruction using a free iliac-crest graft.*

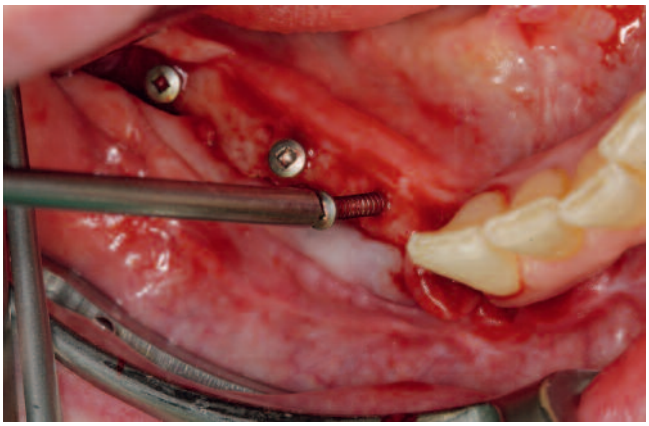

*Fig. 9 At the time of removal of the osteosynthesis screws, only minor vertical resorption of the bone graft is seen.*

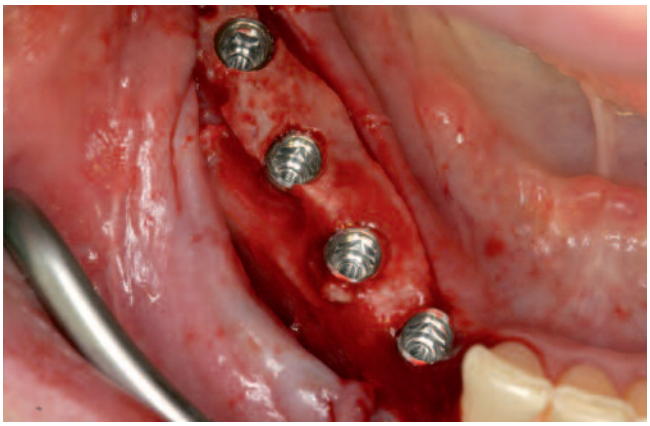

*Fig. 10 Prosthetically guided implant placement. Incomplete defect regeneration on the vestibular aspect of the implant.*

resorption, while cancellous and particulate cortical bone are successfully revascularized.

Especially if bone is harvested from the retromolar region, bone chips can be produced from cortical bone in a bone mill, bone crusher or bone mill forceps. Scraping by piezosurgery or with hand instruments may also yield sufficient quantities of bone chips.

## Peri-implant augmentation

In the posterior maxilla with a caudalized sinus floor or as necessitated by the desired implant position, peri-implant application of bone substitutes or bone grafts may be required. A large number of different bone substitutes is available, although it should be noted that not all bone substitutes can be combined with all membranes. Cross-linked collagen membranes such as Bio-Gide have proven successful in conjunction with non-resorbable bovine bone substitutes. Applying these slowly degrading membranes in combination with a porous, rapidly resorbable bone substitute can result in fibrous regeneration with low-stability soft tissue in the presence of peri-implantitis. Peri-implant augmentation can be performed not only with xenogeneic bone substitutes but also with autologous bone obtained from the prepared implant bed or otherwise harvested intraorally, e.g. from the zygomatic alveolar crest or the retromolar area by means of piezosurgery or bone scrapers. Bone chips should only be placed below the well-prepared intact periosteum (Figs. 11 to 14).

If the bone bed is built up to a volume that is greater than the original volume, periosteal separation does not always allow full mobilization to completely cover the

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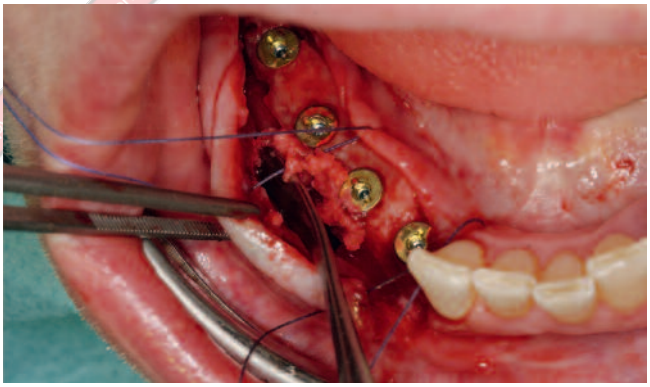

*Fig. 11 Regional augmentation of the defect with bone chips obtained from the bone cavity.*

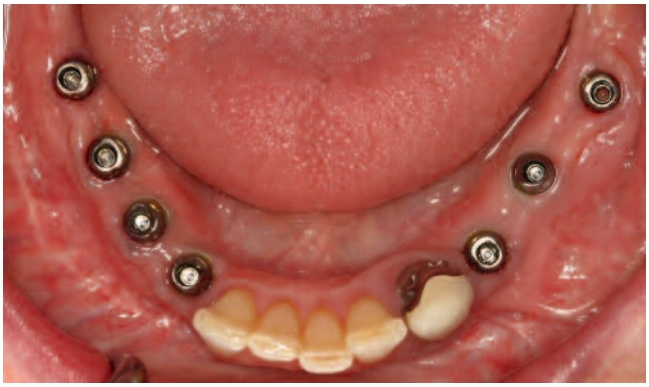

*Fig. 12 An apically repositioned flap has been reflected during re-entry with stable lingual and vestibular mucosa.*

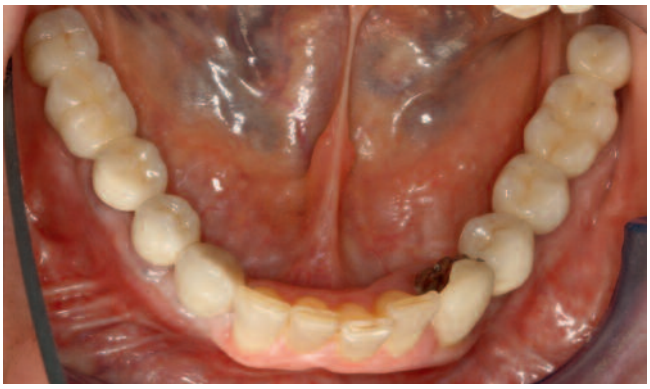

*Fig. 13 Superstructure with metal-ceramic bridges and splinted crowns.*

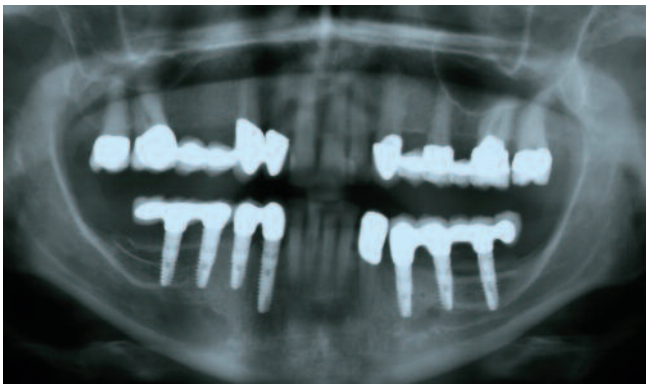

*Fig. 14 Radiological control to check the implant position and the stability of the bone graft.*

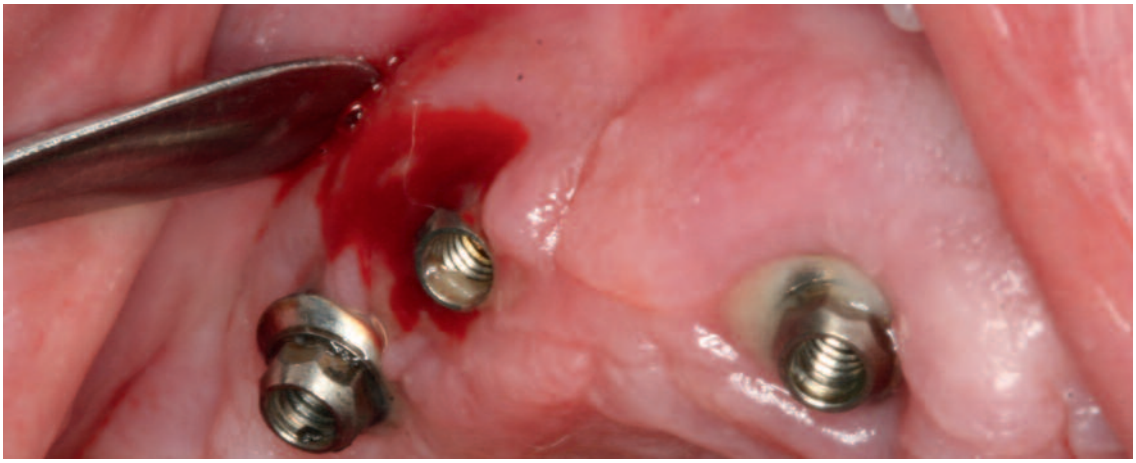

*Fig. 15 Massive bleeding on probing and pus secretion in advanced peri-implantitis.*

grafted area. To achieve a tension-free wound closure, it may therefore be advisable to prepare a connective-tissue graft, which in the maxilla could be a pedicled graft. In this way, the graft is safely covered, while the dimensions of the peri-implant soft tissue are optimized.

## Augmentation after implant placement

The chances of optimizing the hard tissue of the implant bed are better before or during implant placement than after osseointegration. Since the transgingival eruption profile of the implant will usually have been established at this point, complete coverage with bone substitute can no longer be assured. A physiological bone substitute or autologous bone should therefore be used particularly in peri-implantitis (Figs. 15 to 19).

Once the implants have healed, however, the soft tissue can be op-

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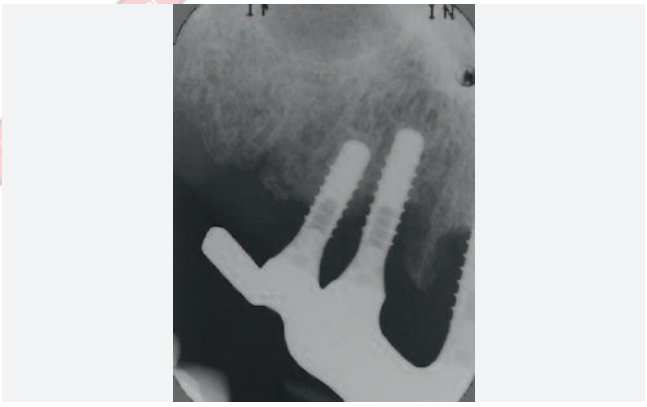

*Fig. 16 Peri-implant bone defects up to half the length of the implant.*

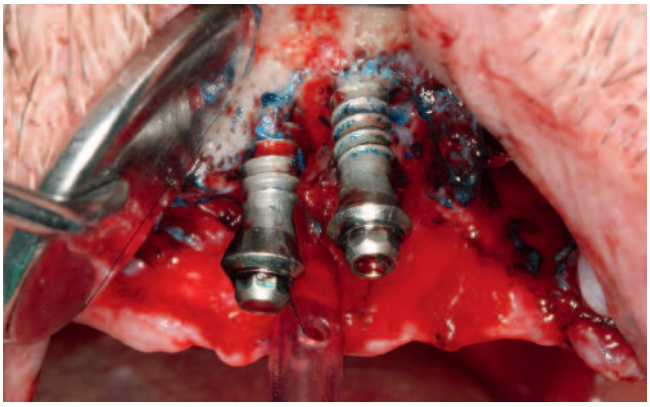

*Fig. 17 Peri-implantitis surgery with removal of granulation tissue and photodynamic therapy for local germ count reduction.*

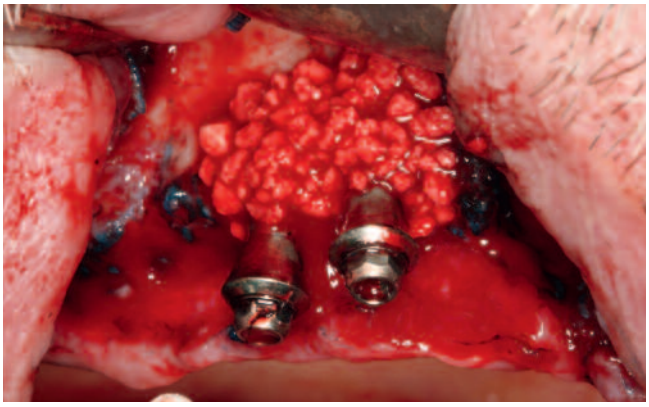

*Fig. 18 Augmenting the defect with a synthetic resorbable bone substitute.*

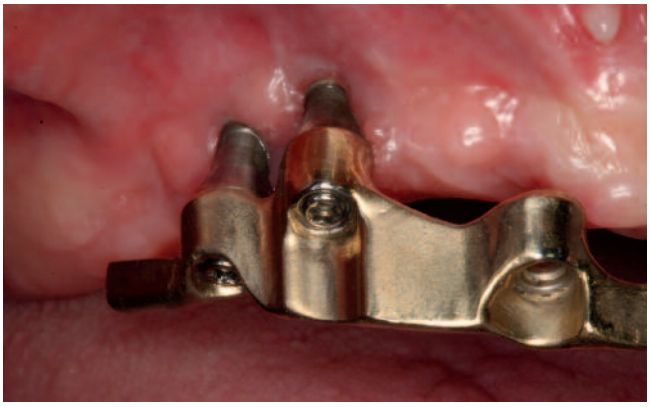

*Fig. 19 The implant at site 11 has been removed, peri-implantitis has been successfully treated at sites 13 and 14.*

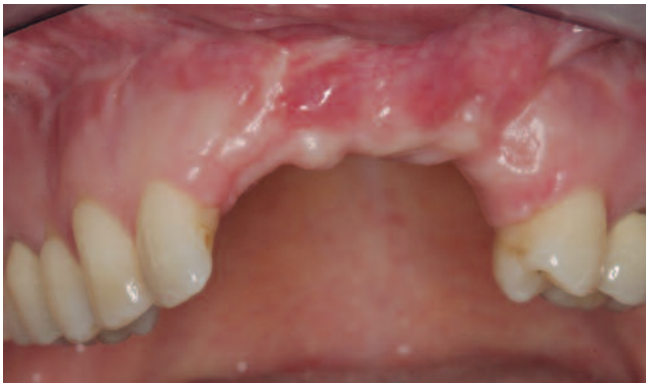

*Fig. 20 Extensive defect in the anterior region after a traffic accident.*

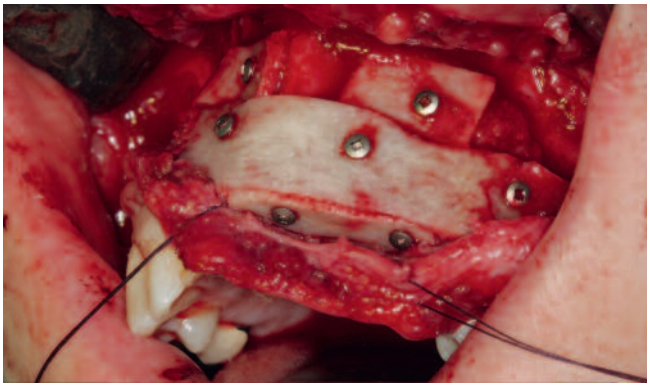

*Fig. 21 Three-dimensional reconstruction with a vestibular incision and a free iliac-crest graft.*

timized in various ways to ensure long-term stability and to improve the aesthetic result. To avoid »pumping« effects with aspiration of the bacteria into the peri-implant sulcus, a zone of keratinized mucosa of at least 2 mm in width should be present around the implant. This is best achieved by a vestibuloplasty (Figs. 20 to 28). If the dark titanium body is visible through thin mucosa, this can be remedied by a free connective-tissue graft.

## Summary

Currently available options for hard- and soft-tissue management allow us to improve the results at all stages of the implant surgery and restorative treatment, even in the presence of a compromised baseline situation or later complications. Depending on the extent of the hard- or soft-tissue defect, simple or more comprehensive techniques may yield the desired results.

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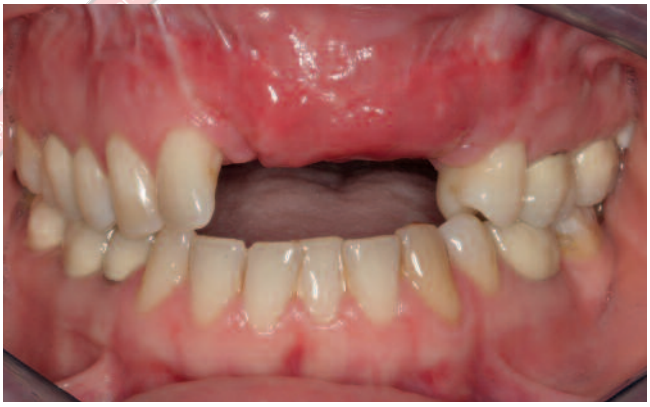

Fig. 22 Traumatic loss of the fixed mucosa after ridge reconstruction.

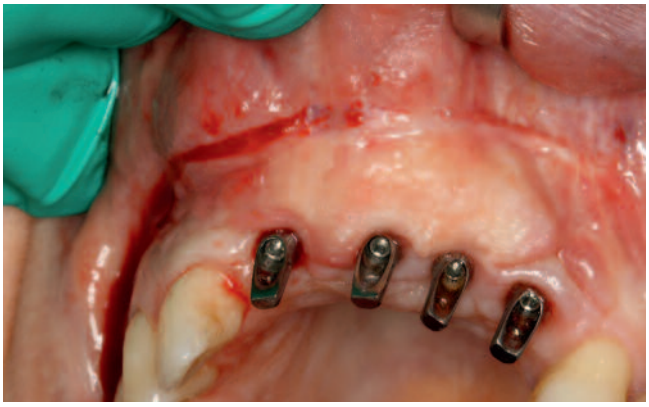

Fig. 23 Re-entry and delivery of a provisional superstructure to prepare for the vestibuloplasty.

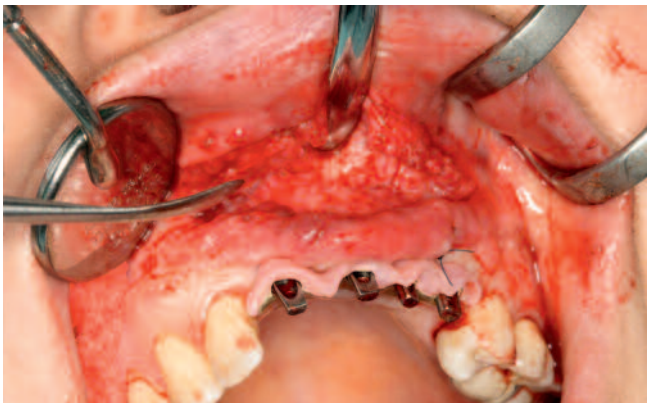

Fig. 24 Preparing the mucosal flap for excising the connective tissue in the ridge reconstruction area.

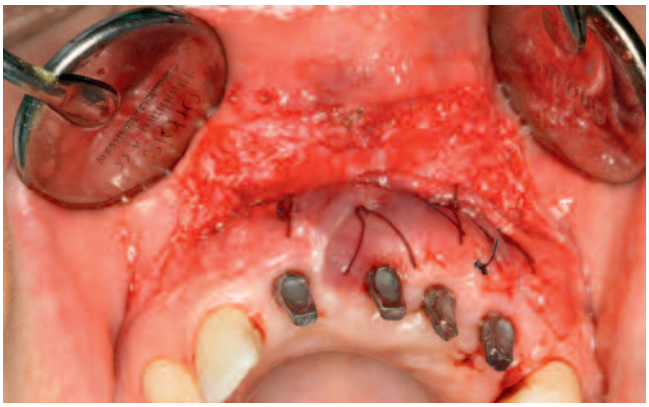

Fig. 25 Open granulation of the vestibular wound.

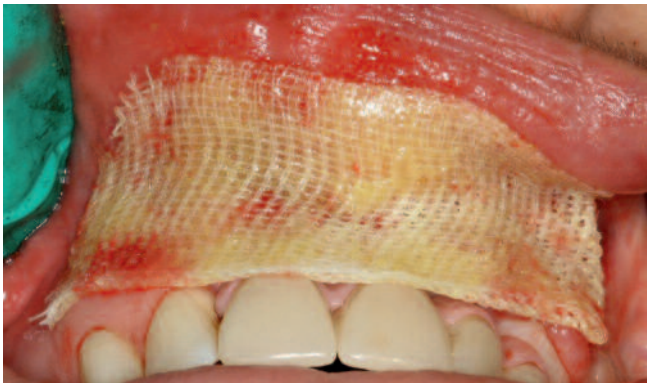

Fig. 26 Fixating the mucosa to the periosteum of the augmented area.

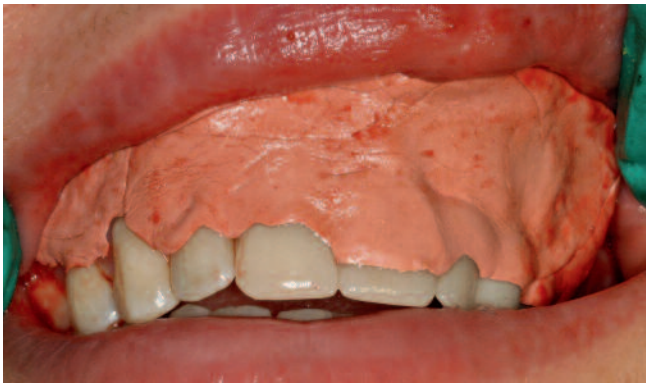

Fig. 27 Covering the wound with iodoform gauze after delivery of the provisional restoration. The iodoform strip has been secured with a periodontal dressing.

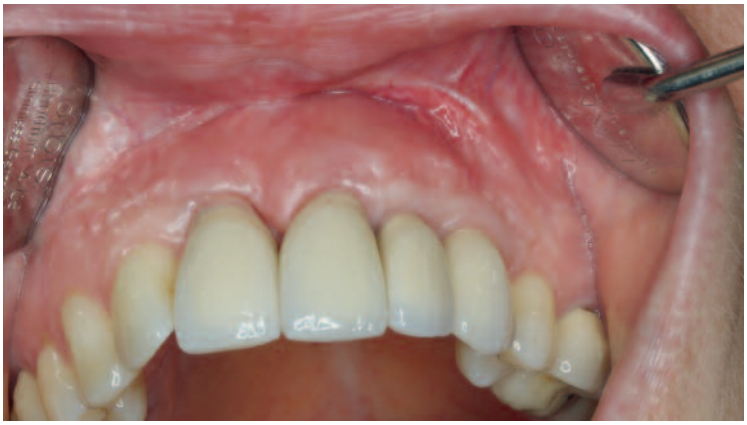

Fig. 28 Definitive restoration, 11 to 23. The mucosa is attached all the way to the sulcus.

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