Treatment Concepts for Extraction Sockets

Scientific Studies
Clinical Cases
Summary

The healing of extraction sockets and the resorption processes that take place after tooth extraction have been investigated thoroughly in recent years. The most recent scientific studies have shown that:

- after tooth extraction the bundle bone resorbs, and hence part of the buccal lamina,
- immediate implant placement cannot prevent resorption of bundle bone,
- Geistlich Bio-Oss® and Geistlich Bio-Oss® Collagen can compensate for buccal bone loss and preserve the contour of the alveolar ridge.

Different treatment concepts

Many different treatment options are available for the extraction socket. When an individual patient risk profile has been compiled, the most suitable type of treatment for management of the extraction socket can usually be inferred by coherently evaluating the various aesthetic risk parameters. Importantly, the scheduling of treatment must be compatible with the type of treatment selected. This brochure provides several examples for the treatment of extraction sockets matching various common clinical presentations.

Long-term successful outcome with Geistlich Bio-Oss®

The use of a biofunctional material such as Geistlich Bio-Oss® is crucial to the long-term successful outcome of extraction socket treatment. After tooth extraction, the slowly resorbing bone matrix Geistlich Bio-Oss® and Geistlich Bio-Oss® Collagen preserve volume over time and thus make a major contribution towards the success of treatment when they are used:

- for Ridge Preservation, i.e. with intact buccal bone wall, or
- in combination with Geistlich Bio-Gide® when a buccal bone defect is present, or
- at a later point in time within the scope of guided bone regeneration (GBR).

Driving new discoveries

Research in recent years has provided plenty of new information about the mechanisms underlying resorption processes in the extraction socket and highlighted the most appropriate case management, but some issues are still unresolved. Geistlich Biomaterials has initiated further research investigations to support the discovery process and deliver competent replies to the open questions. In addition, Round Table Meetings on the topic of extraction sockets are conducted by Geistlich Biomaterials in several countries worldwide with the aim to facilitate the establishment of the most effective treatment concepts.

The concepts presented in this brochure have been developed in collaboration with leading implant dentists and we would like to take this opportunity to express our sincere gratitude for the productive collaboration and the valuable exchange of experiences.

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Introduction

Although the first publications describing the healing processes that take place after tooth extraction date back to the 1960s\(^1\), the healing of extraction sockets and the resorption processes after tooth extraction are still today active areas of investigation. Researchers are constantly providing us with new information about how management of the extraction socket with various treatment concepts simplifies implantation and leads to a predictable positive outcome. Ridge Preservation techniques using biomaterials have shown to be effective and are outlined below.

Treatment of extraction sockets

Irrespective of the time of treatment and the individual situation in each patient, the products from Geistlich Biomaterials can make a major contribution towards the success of treatment. Regenerative measures to preserve the ridge in extraction sockets are the following:

Ridge Preservation with intact socket

Regenerative measures for extraction sockets without bone wall defects; Geistlich Biomaterials recommends the use of Geistlich Bio-Oss® Collagen.

Ridge Preservation with deficient socket

Regenerative measures for extraction sockets with bone wall defects; Geistlich Biomaterials recommends the use of Geistlich Bio-Oss® Collagen in combination with Geistlich Bio-Gide® (Geistlich Combi-Kit Collagen).

Animal-experimental and clinical studies have allowed investigators to decipher the basic biological processes taking place in fresh extraction sockets. Already in 1960 Amler described in a publication the different phases of wound healing in extraction sockets. However, only recent animal studies have demonstrated in detail the processes that take place after tooth extraction and proposed solutions to prevent tissue loss.

### Biological processes of alveolar healing

Alveolar healing in a dog model (Fig. 1a):
1. Stabilisation of blood coagulum
2. Formation of provisional matrix (after 7 days)
3. Woven bone (after 14–30 days)
4. Lamellar bone (after 30–180 days)
5. Resorption of lamellar bone and replacement by bone marrow (after 60–180 days)

### Bundle bone plays a key role

The main reason for the changes of the alveolar dimensions after tooth extraction is the loss of the bundle bone; a tooth-related structure that is lost when the tooth is extracted. The buccal bone wall of the socket is very thin and consists largely of the bundle bone. Accordingly, the loss of the bundle bone inevitably results in a reduction of the vertical and horizontal dimensions of the alveolar ridge.

### Bundle bone will be lost in any case

Irrespective of the procedure, the bundle bone – and hence a large part of the buccal lamina – will always resorb after tooth extraction (Fig. 1). It does not matter whether the socket remains untreated (Fig. 1a), immediate implant placement is performed (Fig. 1b) or augmentative measures are taken (Fig. 1c). On the buccal side of the extraction socket 2.2 mm vertical bone resorption were measured. In such cases, Geistlich Bio-Oss® Collagen is able to compensate for the resorbed hard tissue structures in the buccal aspect of the socket.

### Possible precautions to prevent tissue loss

**Bone:** Even though prevention of bundle bone resorption was not possible in an animal model, filling of Geistlich Bio-Oss® Collagen led to regeneration in the socket which mostly compensated for the horizontal and vertical bone loss (Fig. 1c). The hard and soft-tissue volume was thus preserved in the coro-
Contour changes in extraction socket (animal model)

a) spontaneous healing

Starting situation
0 weeks

Situation after
12 weeks

b) immediate implant placement

Starting situation
0 weeks

Situation after
12 weeks

c) augmentation with Geistlich Bio-Oss® Collagen

Starting situation
0 weeks

Situation after
12 weeks

Fig. 1: Contour changes in extraction sockets up to 12 weeks after tooth extraction (dog model); a) spontaneous healing, b) immediate implant placement, and c) augmentation with Geistlich Bio-Oss® Collagen. CEJ=cemento-enamel junction; aJE=apical cells of junctional epithelium; LB=lingual bone; BB=buccal bone; PM=provisional matrix; C=blood clot; WB=woven bone; BM=bone marrow; M=mucosa.
nal part of the socket up to the time of the check-up (6 months). The soft tissue: Geistlich Bio-Oss® Collagen was able, in an animal model, to support the soft tissue above the bone. Furthermore, in clinical cases it was shown that Ridge Preservation can preserve soft-tissue volume, leading to an improved treatment outcome.

**Main loss coronal**

In their studies, Araujo et al. divided the extraction sockets into an apical portion, a middle portion and a coronal portion. For the authors’ analysis it is the coronal third, which is crucial. If the extraction socket is filled with Geistlich Bio-Oss® Collagen, one can expect to preserve coronal bone volume. On the other hand, the volume of the coronal portion decreased by about 30% if no Geistlich Bio-Oss® Collagen was used (Fig. 2 and 3). Geistlich Bio-Oss® Collagen was thus able to substitute for coronal bone structure.

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Clinical data

The majority of research findings presented so far is based on preclinical data. It may be assumed that the basic biological processes taking place in the extraction socket of human beings and animals are comparable. However, the time intervals of the animal model cannot be applied to humans, but more and more clinical studies on the processes that take place after tooth extraction are published and the amount of clinical data confirming the preclinical findings is growing.

Human histological analysis with Geistlich Bio-Oss®

In a histomorphometric analysis, Heberer et al. provides further information about the healing processes in intact human sockets. In principle, the biological processes taking place in the patient’s socket are comparable to those described by Cardaropoli et al. The hard tissue in the socket passes through various stages of maturity, and histological micrographs demonstrate that after 12 weeks the tissue is on its way to becoming bone. Figures 4–6 show histologies representing a range of phases, from provisional matrix to mature lamellar bone. According to Heberer et al., however, it is not possible in a heterogeneous patient population to determine with absolute reliability what bone quality is to be expected at what time. The variability in humans is greater than in dogs.

Volume loss

Clinical investigations have also demonstrated that the alveolar volume loss after tooth extraction is severe: it was observed that approximately 50% of the buccal ridge width and 2–4 mm of the alveolar ridge height are lost within the first year after extraction. Two-thirds of resorption takes place within the first three months.

Hard and soft-tissue recession

Implant placement, especially in the aesthetic area, is very demanding because if no additional measures are taken after tooth extraction, the socket will not refill with bone to the original level of the alveolar crest. Buccal hard and soft-tissue resorption is observed in most cases. In patients with a thin periodontal biotype – and especially with prominent roots – major horizontal and vertical volume loss of the alveolar ridge must be expected. Thereby, the horizontal bone loss is larger than the vertical.

A thin buccal bone wall often leads to recessions around implants, and treating such recessions is very challenging. When extraction sockets are left to heal without Ridge Preservation, collapse of soft tissues will occur when the underlying bony support is lost. Furthermore, a shift of the mucogingival line and loss of the papilla over the defect have been observed.

Ridge Preservation

Clinical data indicate that Ridge Preservation can prevent volume loss and lead to an optimised hard and soft-tissue situation independently from the chosen time for implantation. Also, when the treatment goal is to place a bridge, Ridge Preservation can improve the aesthetic outcome by preserving the alveolar ridge volume and contour. Furthermore a Ridge Preservation procedure may increase the possibility of inserting implant without the need for a sinus augmentation procedure.
Immediate implantation: fill the gap

It has been proposed that immediate implant placement should be preserved to supercede hard and soft tissues. However, changes in the level of hard and soft tissues have been reported.\(^1\,2\,3\,4\) It was observed that the horizontal resorption of the buccal bone dimension amounted to about 56%.\(^4\)

Therefore, when immediate implant placement is performed it may be beneficial to fill the gap between the implant and the buccal bone wall with a slowly resorbing bone substitute, such as Geistlich Bio-Oss\(^5\), or autogenous bone to reduce resorption as supported by clinical\(^6\,7\,8\) and preclinical\(^9\,10\) data. This is especially important since about 90% of the buccal bone walls in the aesthetic region were shown to be thinner than 1 mm.\(^2\,11\)

In these cases augmentation is necessary, which will come to fill completing the gap independently from the thickness of the bony wall.\(^12\) Without filling the gap, healing of the defect can be expected to be adequate only in sockets with thicker bone walls.

When a buccal bone defect is present, immediate implant placement may not be successful. In molar implants which had horizontal defect dimensions of 4 mm, only 17% bone-to-implant contact was observed.\(^11\)

Flap or flapless?

The question, whether to prepare a flap or not, remains open. Preclinical data have demonstrated that resorption might be reduced when no flap is opened.\(^13\) However, clinical investigations thus far could not confirm this, and no differences were observed in regard to the amount of bone resorption.\(^14\)

When immediate implant placement is performed it may be beneficial to fill the gap with Geistlich Bio-Oss\(^5\).
The appropriate type of treatment for the management of extraction sockets is derived from a coherent evaluation of the aesthetic risk factors (see section 6: The patient’s individual aesthetic risk profile). In addition to the time of implantation, the attending dentist needs to make a decision regarding regenerative measures directly after tooth extraction. Various procedures are recommended, such as Ridge Preservation for intact and deficient sockets in addition to the soft-tissue punch technique.

**5 Extraction socket treatment options**

What is the patient’s individual aesthetic risk profile and how does it influence the treatment concept?

Should I place an implant?

- yes
- no

When should I place an implant? What are the consequences for my further treatment steps?

- immediately*
- early* (4–8 weeks)
- delayed* (10–12 weeks)/ late* (>16 weeks)

Fill the gap

Socket sealing or spontaneous healing

Ridge Preservation and socket sealing

Ridge Preservation

Ridge Preservation

GBR when implant is placed

6 Benefits of regenerative measures for treatment outcome

Numerous reports from practice and laboratory findings indicate that the use of a slowly resorbing, biofunctional bone substitute material can have a positive influence both on the soft-tissue situation and on the hard tissue structure of intact sockets.

Practice-relevant advantages of Ridge Preservation:

> In aesthetically challenging regions, an optimum outcome in terms of pink and white aesthetics can be achieved.
> Alveolar ridge dimensions are preserved also under conventional construction (bridge).\(^1\)
> The therapeutic time window for subsequent implantation is extended.
> The extent of any future invasive surgery can be reduced.

7 The patient’s individual aesthetic risk profile

The table below lists various diagnostic parameters which can be used for patient evaluation before treatment. This catalogue of criteria is used to compile the patient’s individual risk profile, which can point to opportunities for achieving an aesthetically positive therapeutic outcome. In order to present the initial situation of the case studies below in a simple, comparable manner, each patient situation is first evaluated on the basis of this risk profile.

The patient’s risk profile

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Fig. 5: Evaluation of aesthetic risk factors with extraction sockets; based on Buser D, Belser U, Wismeijer D, ITI Treatment Guide, Implant Therapy in the Esthetic Zone, Single-Tooth Replacements, 2007.

3 Shakibaie-M B: Socket and Ridge Preservation from the three-dimensional perspective – a clinical study. ZZI 2009;4:369-377
Conclusions on the treatment of extraction sockets

Several points emerged from the round table meetings on which an international consensus already exists. The majority of the experts came to the following conclusions in several countries, independently of one another:

> In the event of buccal bone defects and especially in the anterior region, besides a volume filling material (e.g. Geistlich Bio-Oss® or Geistlich Bio-Oss® Collagen), a membrane should also be used (e.g. Geistlich Bio-Gide®) for Ridge Preservation.
> Ridge Preservation should be performed under a non-implant restoration (bridge) to maintain the volume of tissues.
> In the case of immediate implantation, the gap between the implant and buccal wall should be treated with volume-stable filler (e.g. Geistlich Bio-Oss®).
> If Ridge Preservation is performed, there should be at least a four-month wait before implantation.
> A dentist inexperienced in implantology is recommended to perform Ridge Preservation immediately after dental extraction and to choose a later time for implantation.

Open questions – the topic of extraction sockets remains exciting

Besides many enriching discussions, numerous problems solved and the consensus achieved, there remain some open questions.

Sophisticated surgical techniques that are only partly reliable in everyone’s hands, reproducible results and problems in determining the patients’ individual biotype – these are the difficulties frequently cited.

Likewise, different therapeutic procedures exist for “early implantation” (i.e. ITI type 2, 4–8 weeks after extraction). One solution could be Ridge Preservation directly after extraction (sometimes in conjunction with a soft-tissue punch), followed by an additional small augmentation at the time of implantation after 4–8 weeks. Another is characterised by early implantation with concomitant GBR, albeit without Ridge Preservation. In any case, according to the ITI 2010, DGI 2010 and Osteology 2011 consensus, for each implantation into an extraction socket, the need for regenerative therapy should be considered. Bone augmentation is explicitly recommended to optimise the functional and aesthetic results. Since there is, however, insufficient evidence clearly defining the advantages or disadvantages of immediate, immediate-delayed, or delayed implantation, which technique to choose remains a matter of experience and depends on the practitioner’s concept.

Further round table meetings planned

Extraction sockets remain a topic in focus. Since the Geistlich Biomaterials round table meetings have been considered a great success, further national and international round table meetings on the topic of extraction sockets will be conducted.

Cases

Immediate implant placement with Ridge Preservation
Dr. Tiziano Testori (Milan, Italy)

Objectives
- Minimise surgical trauma with “gentle” (atraumatic) teeth extractions
- Immediate implant placement to reduce treatment time for patients
- Maintenance of mucosa and periodontal architecture with minimal flap elevation
- Maintenance of buccal and palatal bone volume after tooth extraction
- Over correct defects anticipating physiological resorption to obtain long-term best aesthetic results
- Use of low resorption rate biomaterials to obtain long-term best aesthetic results

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Material selection
- Geistlich Bio-Oss® spongiosa small granules (0.25 – 1 mm)
- Geistlich Bio-Gide® membrane, 25 x 25 mm

Conclusion
“Immediate post extraction implants represent a valid approach for optimising surgical procedures, timing and management of the aesthetic issues after tooth extraction in anterior area. It is important to pay attention during diagnostic phase to carefully evaluate the patient risk profile. In this way, nothing will be left behind causing unfavorable results. Implants were thought to preserve bony buccal plates from resorption. However, recent studies and our clinical experience underline that buccal bone resorption takes place despite placement of an implant immediately after tooth removal, mainly because of vascular supply changes: a permanent loss of periodontal ligament vessels and, if flap elevated, a temporary periosteal vascular supply loss. These changes affect the thin buccal bundle bone mostly. Bone augmentation procedures are often required at the time of implantation since the goal is to preserve the buccal plate and reduce bone resorption over time. Long-term results depend on biomaterial resorption rate: many studies showed that Geistlich Bio-Oss® has a low substitution rate during years and that’s why Geistlich Bio Oss® represents our choice when clinical goal is hard and soft-tissue stability over years. Furthermore, an aesthetic score is needed to evaluate the outcome.”
Case documentation

1. A hopeless first upper premolar.

2. Tooth socket after the atraumatic extraction.

3a. Implant direction pin parallel to the root of the adjacent premolar.

3b. Buccal angulation to avoid apical fenestration and to achieve a correct emergence profile of the future crown.

4. Implant positioned with a 2 mm healing abutment.


6. Geistlich Bio-Gide® membrane is placed over the healing abutment and left exposed to avoid any secondary mucosal approximation.

7. Healing of the peri-implant soft tissue after 3 months.

8. Temporary prosthesis 4 months after implant placement, vestibular view.

9. Temporary prosthesis 4 months after implant placement, occlusal view.

10. Definitive prosthesis 2 months after provisional, vestibular view.

11. Definitive prosthesis 2 months after provisional, occlusal view.

12. X-ray 6 months after final prosthesis restored with the platform switching concept.
Ridge Preservation for early implant placement
PD Dr. Ronald E. Jung (Zurich, Switzerland)

Objectives
› Optimum soft-tissue situation 6 weeks after extraction
› The buccal and crestal contours of the soft tissue should be supported and preserved after extraction

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Material selection
› At the first step of alveolar management: soft-tissue punch from the palate with Geistlich Bio-Oss® Collagen, 100 mg
› At the second step of alveolar management: Geistlich Bio-Oss® spongiosa small granules (0.25–1 mm) and Geistlich Bio-Gide® membrane, 25 x 25 mm

Conclusion
“In the case of early implant placement, the implant is placed a few weeks after extraction. During that period the soft tissue undergoes spontaneous healing. The thickness of the mucosa forming at the centre of the socket varies according to healing time. However, the biological processes which lead to bone resorption and partial or complete loss of the bone lamina commence directly after tooth extraction. This, in turn, has a negative influence on hard and soft-tissue contours. Although in my opinion it is not usually possible to prevent bone loss after extraction with Geistlich Bio-Oss® Collagen and soft-tissue grafts, Geistlich Bio-Oss® Collagen supports the graft and buccal soft tissue so it counteracts loss of soft-tissue contour above the resorbing bone lamina. The graft for its part closes and protects the fresh extraction wound and creates an optimum thickness and structure of soft tissue available for ensuing implant placement.”
Case documentation


2. De-epithelialization of the wound margin using a coarse diamond drill.

3. Application of an amount of Geistlich Bio-Oss® Collagen that corresponds to the tooth root.

4. Independent of whether the buccal bone wall is present or not, Geistlich Bio-Oss® Collagen is applied with light stuffing motions until it reaches the height of the rim of the palatine bone.

5. The graft is removed using a scalpel or a sharp tissue elevator. Bleeding is stopped using compression with sterile gauze, and the wound is covered with a tissue adhesive.

6. Using 6–8 single button sutures, the graft over the Geistlich Bio-Oss® Collagen is carefully fixed to the marginal gingiva of the extracted tooth. Follow-up treatment: antibiotics for 4 days.

7. During suture removal after 7–10 days, one sees an integrated graft, partially covered with fibrin.

8. Clinical situation after 6 weeks. The graft is, biologically and color-wise, very well integrated and shows a mature mucosa in the area where the implant will later be inserted.


10. Thanks to the good mucosa quality and the maintained contour, a relief incision is made in the periosteum, and a tension-free wound closure is achieved.

11. After the implant healing phase (3 months), a minimally invasive abutment connection of implant 21 is made.

12. Prosthetic construction with 2 full ceramic crowns after 7 months of loading.
Ridge Preservation for early implant placement

Dr. Adrián Guerrero / Dr. Julia Guerrero (Málaga, Spain)

Objectives

> To reduce treatment time
> To avoid complex augmentation procedures in cases with severe resorption of the buccal bone crest
> To achieve an optimal soft-tissue healing before implant placement
> To create a favourable situation for early implant placement in the prosthetically position
> To increase buccal contour and reduce or avoid soft-tissue grafting
> To achieve optimal clinical results

The patient’s risk profile

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Material selection

> At the first step of alveolar management: Geistlich Bio-Oss® Collagen, 100 mg; Geistlich Bio-Gide® membrane, 25 x 25 mm
> At the second step of alveolar management: Geistlich Bio-Oss® spongiosa small granules (0.25-1 mm) & Geistlich Bio-Gide® membrane, 30 x 40 mm

Conclusion

“We apply this treatment concept to aesthetically demanding cases with compromised bony walls with the aim of avoiding complex procedures. In this case the buccal bone wall was completely resorbed due to the infection process. This fact introduces a high risk for immediate implant installation. The use of this slow-resorbable bone substitute embedded into a collagen matrix provides some soft-tissue support on the buccal aspect of the extraction socket and it may serve, at least, to promote a mature provisional matrix for early bone formation at 6 weeks after its application. Thus, implant placement could be performed at an early stage and in the ideal position. The buccal aspect of the implant was surrounded by previously grafted Geistlich Bio-Oss® Collagen, that has been in place for 6 weeks. In addition, as soft-tissue healing is completed at this stage, further augmentation procedures can be applied and primary intention healing can be obtained by tension-free soft-tissue flaps. This simple 2-step procedure may reduce treatment time and morbidity in these complex cases.”
1 Tooth 21 cannot be preserved due to recurrent endodontic problems. A re-endodontic treatment and an unsuccessful apicectomy were previously performed.

2 Atraumatic extraction of tooth 21. A severe resorption of the buccal bone wall was confirmed. The probe measures an 8 mm distance between the gingival margin and the most coronal aspect of the actual buccal bone crest.

3 Application of Geistlich Bio-Oss® Collagen, moistened with saline solution. All granulation tissue was carefully debrided before the application of the biomaterial.

4 Application of Geistlich Bio-Gide® on top of the Geistlich Bio-Oss® Collagen. The membrane is fixed with an internal matrix cross suture and left open for healing.

5 Healing and clinical situation 6 weeks after tooth extraction.

6 Reopening after 6 weeks and early implant placement. Geistlich Bio-Oss® Collagen is visible, but well integrated in native bone. Geistlich Bio-Oss® Collagen is left in place. The coronal aspect of the implant is exposed and further GBR is needed.

7 Application of Geistlich Bio-Oss® granules.

8 Application of Geistlich Bio-Gide® membrane. The implant was installed following a one-stage procedure, exposing a healing abutment to the oral cavity.

9 Healing, at suture removal, 10 days after implant placement.

10 Occlusal view on soft-tissue healing 4 weeks after implant placement.

11 1 year follow-up on the definitive restoration.

12 Radiological view before and 1 year after implantation.
Ridge Preservation for delayed implant placement
Dr. Karl-Ludwig Ackermann (Filderstadt, Germany)

Objectives
- Three-dimensional structure preservation
- Alveolar over-epithelialisation
- Predictability of final outcome

The patient’s risk profile

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Material selection
- > Geistlich Bio-Oss® Collagen, 100 mg
- > Palatal connective tissue graft

Conclusion
“3-D preservation of the alveolar hard and soft tissue is the focus of attention in the Ridge Preservation technique. The cause of losing the tooth or teeth and the quantity of bone and soft-tissue structure remaining intact are of no consequence. Based on an introduced “substitute” the hard and soft tissue can regenerate in the healing phase. Consequently, the tissue collapse defect, which always occurs otherwise, is avoided and the basis of all further treatment is improved. With regard to the treatment decision in favour of Ridge Preservation, it does not matter whether further treatment will be solely prosthetic, augmentative or implant dentistry, or a combination.”
Case documentation

1 A close-up shows the different heights of the marginal gingiva, the marginal discoloration and substantial train of scars in the vestibule.

2 After gentle extraction the large-volume socket is impressive. The labial bone lamina is missing.

3 Application of Geistlich Bio-Oss® Collagen is very easy on account of its material properties. Intra-alveolar bleeding is stopped by the Geistlich Bio-Oss® Collagen. The 3-D structure soaks up intra-alveolar blood like a sponge and ensures haemostasis.

4 Four months after alveolar filling with Geistlich Bio-Oss® Collagen volume preservation is clearly evident. On the crestal side an intact mucoperiosteal cover has formed above Geistlich Bio-Oss® Collagen on account of secondary epithelialisation.

5 Structural preservation is also in evidence from the labial side. Papillary height and the shape of the marginal gingiva labially and palatally are the same as those of the corresponding structures on the adjacent teeth.

6 The mineralised portion (55.9%) of the biopsy appears below the yellow line and is alveolar bone. Newly formed bone (36.3% in bright red) with integrated Geistlich Bio-Oss® (19.6% in green) is seen in the upper part of the image.

7 The soft-tissue flap is a combination of mucosal and mucoperiosteal flaps. The perforating muscle fibres are systematically excised and the periosteum is exposed separately.

8 After curettage of the alveolar segment and partial removal of the Geistlich Bio-Oss® Collagen, which has now fulfilled its placeholder function, the labial and crestal bone is built up by the bone block.

9 After a few weeks, the three-dimensional large-volume augmentation can also be seen at the soft-tissue level. Changes in the height of the papillae are barely visible but in the region of the marginal gingiva they are distinct.

10 The connective tissue graft from the palate should, whenever possible, take the form of a so-called “soft-tissue sandwich” from labial between the periosteum and the mucosa. Implants usually settle in transgingivally without any stress.

11 The gingiva can be conditioned accordingly with temporary prosthetic solution. The labial soft tissue can be fully contoured and the papillae can be shaped in the interproximal regions by means of skilful “tissue pushing”.

12 4 years follow up. Stable hard and soft-tissue conditions.
Ridge Preservation for delayed implant placement
Dr. Ham Byung-Do (Seoul, Korea)

Objectives
› Reconstruct alveolar bone for the lower left second molar
› Augment severely reduced vertical bone loss from chronic periodontitis at the time of tooth extraction
› Investigate the clinical and histological result by using both Geistlich Bio-Oss® Collagen and Geistlich Bio-Gide® after tooth extraction

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Material selection
› Geistlich Combi-Kit Collagen (Geistlich Bio-Oss® Collagen, 100 mg + Geistlich Bio-Gide® membrane, 16 x 22 mm)
› Implantium® 4.8w x 10 mm, Dentium, Korea

Conclusion
“Most of clinicians have met an unsolved question whether extraction socket heals spontaneously in a certain period of time regardless of the socket environment, or not. In a situation of severe loss of alveolar bone, augmentation procedure may be necessary to make sure of delayed implant placement. In this particular case, the initial defect was completely filled with newly-formed hard tissue after 6 months and the primary stability of the implant was good. Histomorphometric analysis revealed 45% of the hard tissue area including bone substitutes material and 28% of the soft tissue area. The restorative procedures were uneventful with the screw-retained type of PFM restoration.”
Case documentation

1 Radiological status prior to extraction.

2 Starting situation.

3 Status following atraumatic extraction of tooth 17.

4 A flap is raised.

5 Filling of the extraction socket up to the level of the crestal bone level using Geistlich Bio-Oss® Collagen.

6 Insertion of the Geistlich Bio-Gide® membrane over the defect.

7 Closure of the extraction socket with a mattress suture. Open healing.

8 Situation 6 months post-op.

9 Newly formed hard tissue. Geistlich Bio-Oss® Collagen is not obvious.

10 One stage protocol with healing abutment.

11 Provisional prosthesis.

12 Radiological view after implantation.
Ridge Preservation for late implant placement
Dr. Dietmar Weng (Starnberg, Germany)

Objectives
> Healing of alveolar bone
> Preservation of the alveolar ridge in its original form
> Healed and closed soft tissue cover at the time of implant placement
> Avoidance of connective tissue invasion due to dehiscence
> Implant placement in prosthetically correct position without any additional augmentation

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Material selection
> Geistlich Bio-Oss® spongiosa small granules (0.25–1 mm)
> Geistlich Bio-Gide® membrane, 25 x 25 mm
> Gelastypt resorbable gelatine sponge, Aventis Pharma, Frankfurt

Conclusion
“The concept presented for the management of extraction sockets which is not suitable for immediate implant placement propagates filling with Geistlich Bio-Oss® and covering the dehiscence defect with Geistlich Bio-Gide®, whereby the collagen membrane is introduced between the periosteum and the bone in a low-risk, atraumatic intervention.
After several months of healing the alveolar ridge has resumed its original width and thus permits implantation without any lateral augmentation. The use of slow-resorbable bone substitute material ensures that the original volume of the alveolar bone is preserved in the long-term. Performing augmentation and implant placement at different times and separating them physically reduces the wound healing risk, facilitates soft-tissue management and simplifies surgical requirements. Owing to the slow resorption of Geistlich Bio-Oss® the time window for further treatment steps is extended.”
Case documentation

1. Starting situation shows tooth 16 before extraction.
2. Situation after atraumatic extraction of tooth 16. On the buccal side the tooth was already exhibiting a recession of hard and soft tissue.
3. On the buccal side Geistlich Bio-Gide® was placed between the periosteum and the bone surface after exposure without cutting. No incisions were made.
4. The socket was filled with Geistlich Bio-Oss®, which restores the original contour of the alveolar ridge.
5. On the palatal side, the free end of the Geistlich Bio-Gide® membrane was pushed between the periosteum and the bone surface.
6. A gelatine sponge has been positioned over the Geistlich Bio-Gide® membrane and fixed in place with cross suture.
7. A second gelatine sponge has been placed on the first cross suture and held in place with a second cross suture.
8. Situation of the socket from figures 2 to 7 after ten days. After disintegration of the covering layers isolated particles of Geistlich Bio-Oss® are visible.
9. Situation of the socket from figures 2 to 7 after three weeks. After disintegration of the covering layers, again, some isolated particles of Geistlich Bio-Oss® are visible.
10. Situation 13 months after Ridge Preservation.
11. A flap is raised during implant placement: The buccal contour is completely intact.
12. Implant insertion in the region of 16. After Ridge Preservation it was possible to perform implant placement without any complicated augmentation, despite the original recession defect.
Ridge Preservation and soft-tissue grafting with delayed implant placement
Prof. Dr. Martin Lorenzoni / Dr. Marlene Stopper (Graz, Austria)

Objectives
› Reduction of crestal bone loss
› Improved soft-tissue coverage
› Reduced scarring after extraction
› Augmentation of facial contours
› Preservation of healthy periimplant tissue
› Preservation of the papillae architecture

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Material selection
› Geistlich Bio-Oss® Collagen, 100 mg
› Geistlich Bio-Oss® spongiosa small granules (0.25–1 mm)
› Geistlich Bio-Gide® membrane, 25 x 25 mm

Conclusion
“Ridge Preservation with Geistlich Bio-Oss® is a viable treatment concept to prevent crestal hard and soft-tissue loss of extraction sites with remaining buccal bone plate. To avoid a soft-tissue collapse into the socket and undesired scarring, a free gingival graft harvested from the tuberosity, is applied to seal the socket. The maintenance of hard and soft-tissue contours facilitates implant placement. Additionally, a subepithelial connective tissue graft at reentry increases the facial tissue volume and stability and provides improved aesthetic outcome.”
**Case documentation**

1. External root resorption (trauma) tooth 11.
2. Radiographic view.
4. Adaption and fixation of subepithelial connective tissue graft (palate).
5. Socket sealing with free gingival graft (punch) secured with non-resorbable sutures 6.0.
7. Implant placement 4 months post-op, including GBR with Geistlich Bio-Oss® and Geistlich Bio-Gide®.
8. Soft-tissue graft (subepithelial connective tissue) 8 weeks post reentry.
10. Soft-tissue healing 3 weeks post-op.
11. Clinical appearance 3 months after all-ceramic crown incorporation (labwork by MT Rudi Hrdina).
12. Radiographic view of osseointegrated implant with customized zirconia abutment.
Ridge Preservation for bridge restoration
Dr. Pedro Peña (Madrid, Spain)

Objectives
- Maintenance of hard- and soft tissue
- Preservation of the papillae architecture
- Patients comfort with immediate extraction/immediate loading
- Shorter treatment time

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<td>☐️ None</td>
<td>☐️ Chronic</td>
<td>☐️ Acute</td>
</tr>
<tr>
<td>Bone height at adjacent tooth</td>
<td>☐️ ≤ 5 mm from contact point</td>
<td>☐️ 5.5–6.5 mm from contact point</td>
<td>♦️ ≥ 7 mm from contact point</td>
</tr>
<tr>
<td>Restorative status of adjacent tooth</td>
<td>☦️ Intact</td>
<td></td>
<td>☐️ Restored</td>
</tr>
<tr>
<td>Width of tooth gap</td>
<td>☐️ 1 tooth (≥ 7 mm)</td>
<td>☐️ 1 tooth (≤ 7 mm)</td>
<td>☐️ 2 teeth or more</td>
</tr>
<tr>
<td>Soft-tissue anatomy</td>
<td>☦️ Intact</td>
<td></td>
<td>♦️ Defective</td>
</tr>
<tr>
<td>Bone anatomy of the alveolar ridge</td>
<td>☦️ No defect</td>
<td>☦️ Horizontal defect</td>
<td>☐️ Vertical defect</td>
</tr>
</tbody>
</table>

Material selection
- > REPLANT, 4.3 x 13 mm ImplantDirect. California
- > Straight Sthetic abutments, ImplantDirect California USA
- > Geistlich Bio-Oss® spongiosa small granules (0.25–1 mm)

Conclusion
“Patients who suffer from a severe degree of bone loss in the vertical dimension show an increased risk of dehiscence and a collapse of the soft tissue into the socket. A combination of immediate implant placement, flapless surgery and the use of Geistlich Bio-Oss® enable a provisional prosthesis to be employed. Additionally, the gingival architecture and entire tissue volume are maintained, facilitating the final aesthetic restoration.”
Case documentation

1. Pre-op orthopantomograph of the clinical case. Severe horizontal bone loss and mobilization of teeth in region 12, 11, 21, 22.


3. It is more challenging to achieve an aesthetically satisfying result if the teeth show a triangular shape.

4. Frontal view of the orientation guide devices. An x-ray from this surgical step is recommended.

5. Occlusal view of the orientation guide devices. It is crucial to check the distance between the pins and the teeth.

6. Transgingival positioning of the implants. The transfer device shown in the picture is a helpful tool when a casting has to be taken.

7. Provisional bridge made of acryl, which is mounted onto the abutments.

8. Mounting of the abutments and augmentation of the sockets 11 and 21 and the gaps in region 12 and 22 with Geistlich Bio-Oss® granules.


10. Clinical situation right after application of the provisional prosthetics.

11. Frontal view of the well healed tissue 5 months post-op. After 6-8 months the finals casts will be taken and the case is finished.

12. Orthopantomograph, 5 months post-op.
Product range

Geistlich Bio-Oss®
Small granules (0.25 – 1 mm)
Quantities: 0.25 g, 0.5 g, 2.0 g (1 g = 2.05 cm³)
The small Geistlich Bio-Oss® particles allow close contact with the surrounding bone wall. They are recommended for smaller 1–2 socket defects and for contouring autogenous block grafts.

Geistlich Bio-Oss®
Large granules (1–2 mm)
Quantities: 0.5 g, 2.0 g (1 g = 3.13 cm³)
The large Geistlich Bio-Oss® granules have more space between the particles than the small granules. Particularly in large defects, this enables improved regeneration over large distances and provides enough space for the ingrowing bone.

Geistlich Bio-Oss Pen®
Small granules (0.25 – 1 mm)
Quantities: 0.25 g ≈ 0.5 cc, 0.5 g ≈ 1.0 cc
Large granules (1–2 mm)
Quantities: 0.5 g ≈ 1.5 cc
Geistlich Bio-Oss® granules are available in an applicator. It allows the bone substitute material to be applied faster and more precisely to the surgical site. The Geistlich Bio-Oss Pen® is available containing both the small granules and the large granules.

Geistlich Bio-Oss® Collagen
Geistlich Bio-Oss® (small granules) + 10% collagen (porcine)
Sizes: 100 mg (0.2–0.3 cm³), 250 mg (0.4–0.5 cm³), 500 mg (0.9–1.1 cm³)
Geistlich Bio-Oss® Collagen is indicated for use in periodontal defects and extraction sockets. Through the addition of collagens, Geistlich Bio-Oss® Collagen can be tailored to the morphology of the defect and is particularly easy to apply.

* Product availability may vary from country to country
Geistlich Bio-Gide®
Resorbable bilayer membrane
Sizes: 25 × 25 mm, 30 × 40 mm
Geistlich Bio-Gide® consists of porcine collagen and has a bilayer structure – a rough side that faces the regenerated bone tissue and a smooth side that faces the soft tissue. Geistlich Bio-Gide® is easy to handle: it can be positioned easily, adheres well to the defect, and is resistant to tension and tearing.

Geistlich Bio-Gide® Perio
Resorbable bilayer membrane
Size: 16 × 22 mm with cutting pattern
Geistlich Bio-Gide® Perio has the same biological properties as Geistlich Bio-Gide® but has a smoothened upper surface. This slows the absorption of moisture. Particularly in periodontal indications, this offers the practitioner a longer time window to enable exact positioning of the membrane, especially in the interdental space.

Perio-System Combi-Pack
Geistlich Bio-Oss® Collagen 100 mg + Geistlich Bio-Gide® Perio 16 × 22 mm
When used in combination, the system has optimised properties for periodontal regeneration.

Geistlich Combi-Kit Collagen
Geistlich Bio-Oss® Collagen 100 mg + Geistlich Bio-Gide® 16 × 22 mm
When used in combination, the system has optimised properties for ridge preservation and minor augmentations according to the GBR principle.