Today guided tissue regeneration (GTR) and guided bone regeneration (GBR) are standard procedures in surgical practice. The first attempts at osseous regeneration of a bone defect, excluding influences from connective tissue, by using cellulose acetate filters were taking place at the end of the 1950s (Hurley et al. 1959).

Indications for Guided Tissue Regeneration

Today membranes are used in the following areas:

- Dental implantology—with pre-implantological preparation of the alveolar crest and all forms of implantation.
- Periodontology—to replace lost periodontal structures and for periimplantitis treatment.

Membranes are intended to prevent the proliferation of connective tissue cells into a bony defect, create and maintain an artificial antrum in which the bony regeneration can take place, be biocompatible and cell occlusive, and provide some protection against infections. Clinical manageability needs to be ensured with their use.

Classification of Membranes

Today a range of membranes is available for which a classification into resorbable and non-resorbable membranes appears logical. There are two biologically degradable product classes:

- 1. Synthetic polymers such as polyacrylates (Guidor®, Epi-Guide®) or polyglycolides (Vicryl®) and their chemical modifications (Gore Resolut®, Artisorb®), and
- 2. Xenogenous collagen (Bio-Gide®, BioMend™, bovine origin).

The materials in the first class are dissolved into small fragments by hydrolysis and undergo phagocytosis. Collagen are resorbed by collagenases and proteases (Schlegel 1996, Heinzel et al. 1998). For the non-resorbable membranes, comprehensive clinical and experimental reports with e-PTFE expanded polytetrafluoroethylene (GoreTex®) and PUR aliphatic polyurethane (bone-up®) are available (Buser et al. 1994).

Barriers from calcium sulfate (Capert®) or titanium in net, lattice or wire form (Friso® Bone Shield, Tiomes) have their uses (Paulus 1996, Einsteigerhandbuch 2000). Today two types are favored: the resorbable collagen membranes and the non-resorbable e-PTFE membranes (Watzek 1999). The advantage of resorbable membranes is the low degree of stress on patients due to the absence of an exposure operation, which allows protection of soft and hard tissue structures. It is important to note that not only resorbable materials but also biocompatible during the implantation phase, but also waste products from decomposing membranes. Moreover, re-osseification of the defect region at the time of disintegration of the membrane should have occurred. A period of three months is thought to be ideal for this (Schlegel 1996).

Membranes & Bone Replacement Materials

Membranes are often used in combination with bone transplants as spacers or fillers. Different antrum fillers are used:

- autologous bone,
- bone mineral structures (calcium phosphate ceramics (Cerasorb® and xenogenic materials (Bio-Oss®,
- homologue bone products (FDBA freeze-dried bone allograft) or
- collagens (in liquid, paste, sponge or membrane form).

When selecting, consideration needs to be given to what extent the bone regeneration is positively influenced by the spacer (Schlegel 1996).

Complications with the application of membranes are, for example, membrane expositions caused by debuccence (depend- ing on the author, this is between 4% and 80%). With non-resorbable membranes removal is necessary due to the therapy resistant bacteria colonization of the surfaces and the resulting osteolytic. The TeuflGen® membrane is an exception as it can remain in situ for three to four weeks in case of accidental exposure.

Clinical studies with resorbable materials have shown that after their exposition and with daily cleansing with 3% H2O2 and 0.12% CHX, removal is only necessary after eight weeks post implantation (Urbani et al. 1995). Different authors reported a failure rate of between 5% and 60% with resorbable membranes (Buser et al. 1994, Becker et al. 1995). There is a risk to patients with the use of materials of bovine origin due to possible allergic reactions and infectious diseases (for example CJD). This is not the case with synthetically produced materials as these are pure.

For the future, it can be assumed that the development of existing and new membranes, particularly in combination with bone formation inducing and accelerating materials (for example BMP, PRP), will progress further. Furthermore, the techniques for replacing lost bone structures will be further optimized due to their wide use.

Clinical Case Examples

Following is documentation of the use of different augmentation systems and membranes using case examples. As some operations were performed abroad, materials that aren’t yet approved in Germany were used.

Case 1: front tooth trauma, upper jaw

The 41-year-old female patient lost her incisors (11, 21, 22) in an accident approximately 25 years ago. When she came to the practice she had had implants two years ago that had to be removed three months later. After explantation, no measures were taken to rehabilitate the lost bone. The missing teeth have since been replaced by a provisional bridge (Fig. 1).

The extent of the jaw bone loss through atrophy and as a consequence of the lack of augmentation can be clearly seen on the palatal view (Fig. 2). The pillar teeth had root treatments and were provisioned with pins (Fig. 3). After checking the retention worthiness and doing an appropriate root canal treatment of the remaining teeth, an augmentation to create an alveolar crest in which implants can be inserted later was planned. The procedure had to be performed in two phases in this instance as the primary stability with an immediate implantation could not be guaranteed.

The missing bone parts were replaced with Cerasorb® after surgical exposure involving a slightly palatinally positioned pararesternal incision (Fig. 4).

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From our own clinical experience and human-histological investigation we know that β-tricalcium phosphate is completely resorbed after six to twelve months and simultaneously transformed into newly formed bone.

The alloplastic bone replacement material used with a particle size of 500–1,000 µm was mixed with patient blood before the procedure (Fig. 5). The augmentation was affixed with a liquid Atrisorb® membrane and a Frialt II Synchro implant Ø 4.5 mm; 15 mm was immediately fitted (Fig. 12).

The peri-implantational region and the infection-free bone defect at 21 were filled with Cerabon® (500–1,000 µm) (Fig. 15). A resorbable Epi-Guide® membrane was used for fixation and as a barrier (Fig. 14). After closure with a single button suture (Fig. 15), the patient received a temporary arrangement with a Maryland bridge (Fig. 16), which was rebuilt from the extracted tooth 11. The necessary dental medicine procedures were carried out parallel to the operation.

Post operative medication treatment with Amoxicillin, Ibuprofen, and Chlorhexamed ensured an infection-free healing process. Figure 17 shows an irrigation-free state six days post-op with temporary arrangement of tooth 11 as explained above. The patient was able to receive the final application ten months later (Figs. 18, 19).

Case 3: toothless lower jaw

The third patient case describes an implant application in a toothless lower jaw. Figure 20 shows the atrophied, conventionally untenable lower jaw of a 65-year-old female patient who introduced herself to the practice in 1995. After extensive planning, four Frialt II implants had to be inserted to fixate a total prosthesis. Figure 21 shows the exposed alveolar crest.

The implants were inserted (Fig. 22) and a resorbable Ethicon® membrane was used to cover the implants and the bone material Ospruvit. The membrane was affixed值守ally with a Frios® nail and crestally with the screws of the implants (Figs. 25–27).

A continuous suture ensured tight wound closure (Fig. 28). The patient received Amoxicillin, Ibuprofen, and Chlorhexamed post op. Figure 29 shows the situation six months later, before integration of the implant-based full prosthesis in the lower jaw. Until then the patient was provided with a soft padded prosthesis.

Case 4: toothless, atrophied upper jaw

The original X-ray of the fourth patient case shows a toothless, severely atrophied upper alveolar crest on both sides (Fig. 26). It was so thin in places that spontaneous nose bleeding ensued after pressure from a prosthesis was applied. The 55-year-old female patient requested a palate-free upper jaw prosthetic solution, which was only feasible with Frialt II implant based tooth replacement.

To create an adequate implant base, a bone block was taken from the intraoral lower jaw region in the first operation and the defects were filled and closed with Cerasorb® (Figs. 28–31). A sinus lift on both sides was performed in the posterior upper jaw while Cerabon® was used as bone replacement material.

In the anterior upper jaw region, the bone blocks were fixated with osseosynthesis screws (Mondial), and this allowed a sufficient bone height as well as alveolar crest to be achieved. The TefGen membrane (Figs. 32–34) was used to fixate and close the surgical area. The patient received Ibuprofen, Amoxicillin and Chlorhexamed post op. The membrane was removed six weeks later with a local anesthetic.

Figure 35 shows the latter in situ, Figure 36 after removal, and Figure 37 four weeks later. The existing prosthesis was padded repeatedly and adapted to the altered biting conditions. Ten months after the first procedure the patient had eight Frialt II Synchro implants inserted. Again Cerabon® was used for the elevation of the sinus and floor of the nose with a simultaneous bone spreading technique (to improve primary stability).

Two weeks later the patient received her soft padded upper jaw prosthesis back. One year later the patient is wearing a magnet based, palate free upper jaw prosthesis with complete satisfaction.

Literature
12. The list of materials used and patient facturers can be requested from the editorial office.