Use of the collagen products Remotis® Fleece and Cone in dental surgery and implantology

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The beginning of every regeneration is marked by the formation of a blood clot which stabilizes the wound site and makes possible the ingrowth of blood vessels in addition to the formation of granulation tissue.

Besides the use of collagens as membrane and soft tissue replacement materials, for many years industry has been offering diverse collagen matrices which are used to support soft and hard tissue healing through blood clot stabilization. It seems obvious here that macro- and microstructural aspects, porosity (Fig. 1), pH value, biocompatibility and immunological tissue origin considerably affect the physico-chemical characteristics of these collagen fleeces that are mostly used as hemostats. The resorption stability which is essential for the membrane technology of the collagen is rather less relevant when using collagen fleeces – on the contrary the prime focus is on absorbing blood components at a stable volume and biochemical support to blood coagulation in conjunction with an inflammation-free reduction and support of the blood vessel invasion (Fig. 2).

Collagen and blood coagulation

The beginning of every regeneration is marked by the formation of a blood clot which stabilizes the wound site and makes possible the ingrowth of blood vessels in addition to the formation of granulation tissue. As the basis for uneventful wound healing the primary and secondary hemostasis rely on activating different regulatory systems; these can be divided into the thrombocytic and plasmatic coagulation system. In the thrombocytic system blood platelet contact with different activators produces a change in the cytosolic calcium concentration (Nesbitt et al. 2003). The consequent conformational change causes a release of additional mediators which not only activate other thrombocytes, but also the plasmatic ex- and intrinsic system with the final common pathway of the conversion of fibrinogen into fibrin, thus activating the secondary hemostasis.

If you consider the different receptors on the thrombocyte membrane, a high density of collagen receptors can be detected in addition to fibrin, ADP and a number of other regulatory units (Farndale et al. 2003). Being the most important inductor of primary hemostasis, they are activated when thrombocytes come into contact with collagenic (non-endothelial) surfaces. This mechanism assumes key significance precisely in the healing of traumatic or also surgical wounds.

Collagens in patients with blood coagulation disorders

Patients on anti-coagulation therapy exhibit significantly higher mortality after dental surgery resulting from thrombo-embolisms and cardiovascular events due to changing
their medication than from uncontrollable postoperative hemorrhages (Wahl 2000). Furthermore, in precisely the dental-surgical context there are indications that it is possible to adequately stem bleeding even in patients receiving anti-coagulation solely by using local hemostats (Blinder et al. 1999; Federici et al. 2000). In some cases this casts doubt on the necessity of completely changing the anti-coagulation mandated by internal medicine (Devani et al. 1998). If gelatine-based products tend to support a wound situation by mechanical means, apart from the purely physical aspect of physical wound closure collagenic matrices can also support blood clotting physiologically by activating collagen receptors. For instance, a clear deposition of thrombocytes was detected on the surface of collagen matrices in an in-vitro study examining thromboocyte behavior on native and cross-linked collagen sponges using confocal laser scan microscopy (Rothamel et al. 2006). In a current clinical study on Remotis Fleece and Cone at a German maxillofacial-surgical hospital 200 patients receiving anticoagulation therapy who had to undergo up to seven tooth extractions as in-patients were treated with native Remotis collagens for their extraction wounds. Thus far 4.2% secondary bleeding has been shown in 192 – including partially multi-morbid – patients. This is a very positive result taking into account the partly strong anti-coagulation and the necessity of switching to high dosage administration of low- and high-molecular heparin.

Collagen and extraction wound healing

After tooth extraction systematic dimensional losses of jaw bone are seen chiefly on the buccal side of the alveolar process during wound healing. This is attributed to the theory of the “bundle bone”, actually a thin bone lamella with only less pronounced resorption stability, forming part of the periodontium of the removed tooth (Araujo et al. 2005).

Various techniques have become established in the last few years to prevent bundle bone resorption; these are generally termed «socket preservation»). Unlike filling the extraction socket with bone substitutes, inserting collagen sponges constitutes a very natural approach, which is meant to support hard- and soft-tissue regeneration by stabilizing the blood clot. As is familiar from the field of collagen membranes, attention here should be paid to ensuring that the collagen used is highly biocompatible and native. Although cross-linked collagens are more slowly resorbed, they can support wound healing complications and bone resorption by their heightened inflammatory breakdown (Rothamel et al. 2004; Rothamel et al. 2005; Becker et al. 2009). As was observed in an animal study on the role of periodontal ligament fibroblasts in osseous regeneration, a significantly higher mineralized proportion was detected after filling the sockets with collagen compared to untreated control sockets. This confirms the positive impact on wound healing after tooth extraction by using native, flaked collagen (Cardaropoli et al. 2005). A separate series of cases involving a consecutive series of 120 extraction patients which examined the open healing of collagen fleeces in extraction sockets noted a systematic epithelial creeping on the blood clot volume-stabilized by the collagen and consequent acceleration of soft tissue healing (Fig. 2–6). Complications meaning fleece losses and pain resulted solely when sockets were infected, whereby it has to be taken into account that in such cases even classical socket preservation with bone substitutes is considered to be contraindicated.

Collagens and volumizing bone defects

Minor bone defects during surgery for cysts, during bone transplant removals and in resective surgery in the area of the root apex usually exhibit a formative morphology which depending upon size do not necessarily require treatment
with filling material (Dehen et al. 1989). However, if a size of 5 mm, meaning a critical size defect, is exceeded, due to the physiological contraction of the blood clot the clotted blood can lose contact with the surrounding bone walls, which encourages incomplete defect regeneration and the appearance of wound healing complications due to the emerging gaps (Micheletti et al. 1992). Owing to the defect’s formative property, introducing bone graft substitutes does not seem absolutely necessary and also seems very costly – in this case an option is to use native collagens to support defect regeneration by stabilizing the blood clot (Fig. 7–13).

**Collagens for perforation coverage of the Schneiderian membrane**

Although sinus floor elevation is considered to be a predictable vertical augmentation option for the maxilla, even this surgery can be associated with intraoperative complications which may jeopardize both further execution and subsequent uneventful wound healing.

Although the general opinion still held a few years ago that if the Schneiderian membrane was perforated the site should be scaled and a second attempt planned three months later, it is an established procedure for smaller perforations that do not detract from stability to continue surgery after coverage with collagen. In a current prospective study, too, no negative effect on implant survival rate could be determined from the emergence of intraoperative perforations below 5 mm in diameter as long as they were covered by an overlaid collagen membrane (Becker et al. 2008).

The fact that no soft tissue invasion is to be expected by the Schneiderian membrane into the defect region, but the healing of the membrane defect, in particular, is meant to be supported and displacement of the bone substitutes in the sinus is meant to be prevented, casts doubt upon the necessity of the inserted collagen’s long-term barrier function.

A fleece, rehydrated as the case may be, and compressed to membrane thickness can lend sufficient stability here and support secondary soft tissue healing of the sinus membrane by natural means if perforations are minor (Fig. 14–24).

**Literature available on request**