Resorbable Collagen Membranes Expansion *In Vitro*

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OBJECTIVE

During guided bone regeneration (GBR), resorbable collagen membranes are placed over the bone graft to protect the augmented area from soft-tissue ingrowth and thus support bone formation. Prior to placement, the membrane is pre-wetted with saline or blood and once hydrated, it expands, potentially influencing the graft stabilization over time. The objective of this study was to compare *in vitro* expansion of two collagen membranes, and to test one of these membranes in a challenging clinical case.

MATERIALS AND METHODS

IN VITRO EXPANSION ASSAY

Two dry non-chemically cross linked collagen membranes with different properties[1], Bio-Gide [BG] (Geistlich Pharma) and creos xenoprotect [CXP] (Nobel Biocare), were immersed in either saline or blood at room temperature. Nine membranes in each group (total of 36) were tested. Their surface area in mm^2 was measured at 5, 15, 30, 60, 120, 180 and 240 min. Surface area expansion of each membrane within the two environments was compared at every time-point using the t-test.

CLINICAL CASE

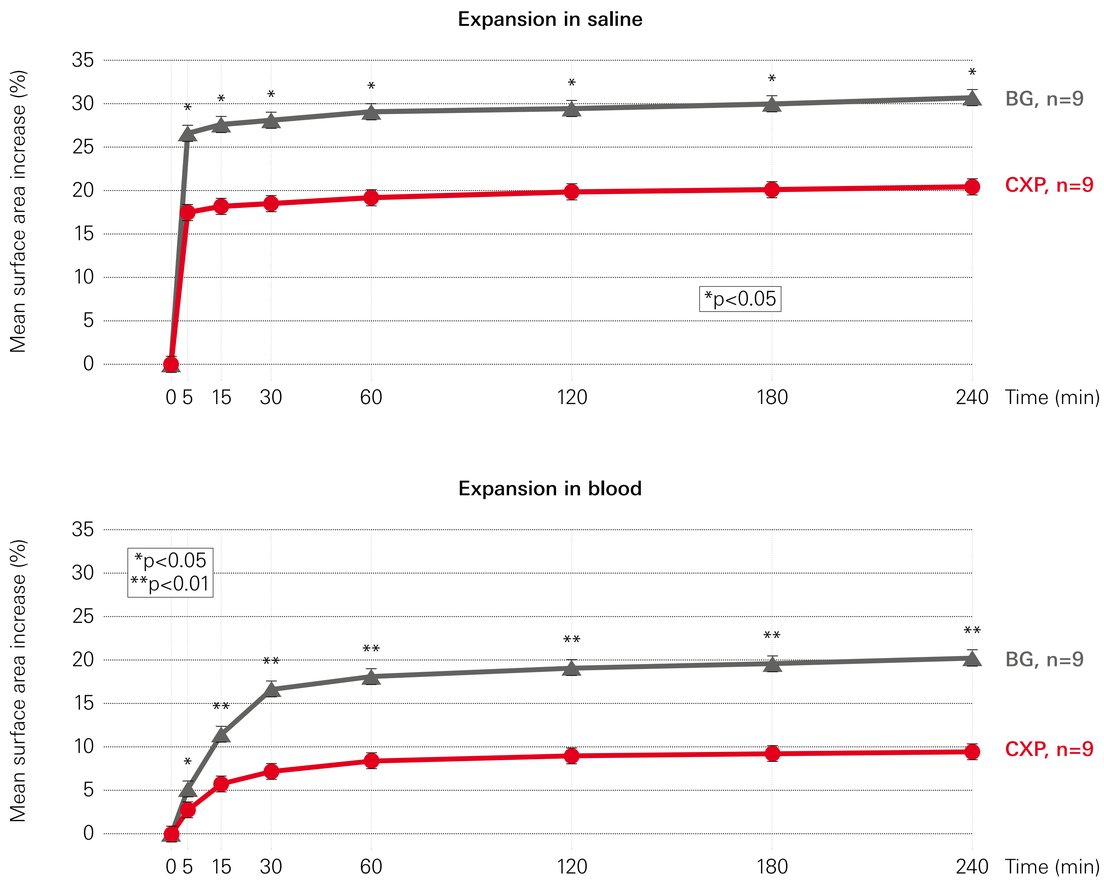
A 57 year old female patient, who was a smoker and had a history of moderate periodontitis that had been treated with a stable result, had missing teeth in positions 22–24 (FDI system). Tooth 22 was extracted 3 months prior to surgery. The patient's alveolar ridge thickness was between 3 mm (position 22) and 4 mm (position 24) with bone quality type 2[2] and the bone quantity Class IV.[3]

RESULTS

IN VITRO EXPANSION ASSAY

– Both methods of hydration led to membrane expansion. The CXP membrane expanded significantly less than the BG membrane in both saline and blood (Figure 1).

Figure 1: Membrane expansion *in vitro*. Membranes were placed in saline or blood and their expansion was measured over 4 hours at indicated time points. The expansion was calculated as the difference in surface area between time point 0 and the given time point, and expressed as percent increase. The graphs illustrate mean expansion over time. For each time point, the two means were compared using the t-test and resulted in the indicated p values. Bars represent standard deviation.



CLINICAL CASE

The patient underwent a combined ridge-split and GBR procedure. A full thickness flap was raised by a midcrestal incision with two vertical releasing incisions on the adjacent teeth on both sides. Piezoelectric alveolar ridge-splitting was performed[4] and two NobelReplace CC PMC implants with a diameter of 4.3 mm and 11.5 mm length (Nobel Biocare AB, Gothenburg, Sweden) were placed in positions 22 and 24 with an insertion torque of 30 Ncm and 35 Ncm, respectively.

A trimmed collagen membrane (CXP) was fixed on the basal area of the buccal side with three cortical titanium pins and subsequently hydrated with sterile saline. Autogenous bone particles were harvested from the surrounding area with a bone scraper and were placed on the implant surface and on the buccal side. The whole area from tooth 21 and an adjacent implant in region 25 was augmented with anorganic bovine bone mineral (ABBM, Bio-Oss, Geistlich, Wolhusen, Switzerland).[5] The graft was immobilized by "tightly" spanning and fixing the CXP membrane with three further titanium pins on the palatal side of the ridge. The mucoperiostal flap was firmly sutured.

The healing was uneventful and showed a broad ridge without wound dehiscence after a 6 month healing period. For the re-entry procedure, a full thickness mucoperiosteal flap was raised to remove the titanium pins and revealed a ridge 6 and 7 mm thick at implant 22 and implant 24, respectively, and a horizontal bone gain of 3 mm at both sites.

GUIDED BONE REGENERATION WITH THE CXP COLLAGEN MEMBRANE

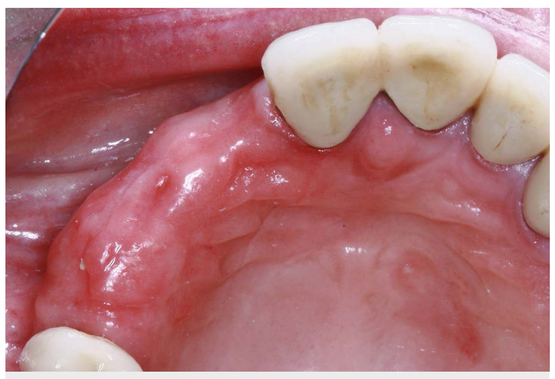


Figure 2: Preoperative view, upper jaw ridge with missing teeth 22–24.

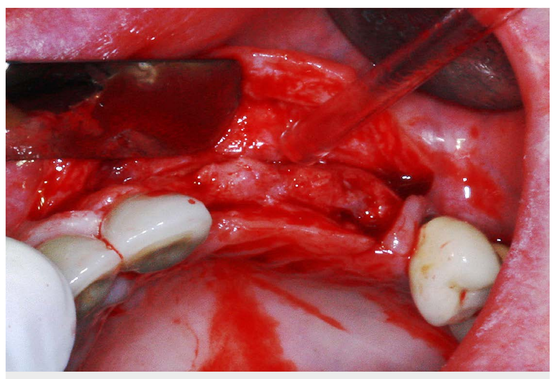


Figure 3: Operative view, upper jaw ridge. The 3–4 mm thick ridge was too thin for implant placement without further augmentation procedure.

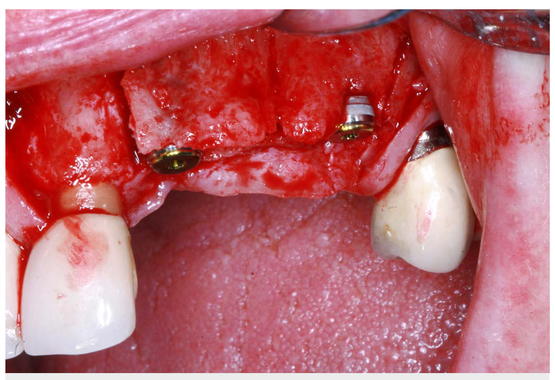


Figure 4: Implant placement. Two NobelReplace CC PMC implants in positions 22 & 24 after ridge split.

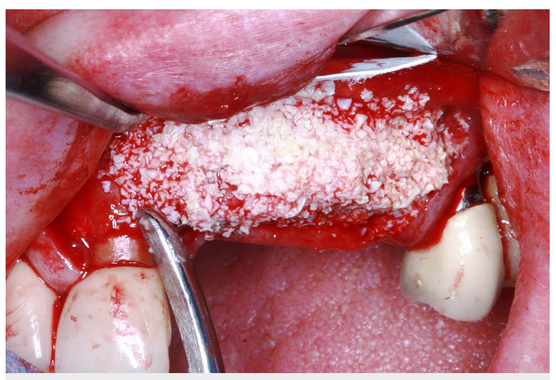


Figure 5: Bone augmentation. Buccally-fixed CXP membrane and autogenous bone particles covered with ABBM.

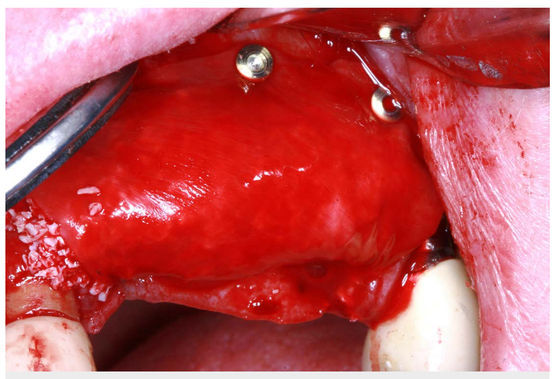


Figure 6: CXP stabilization of the graft. CXP membrane fixed with cortical titanium pins on the buccal and palatal site and "tightly" covering the bone graft to provide safe immobilization.

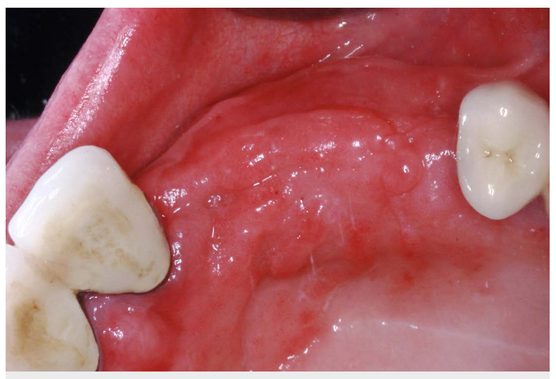


Figure 7: Wound healing. Uneventful wound healing 6 months post-operation.

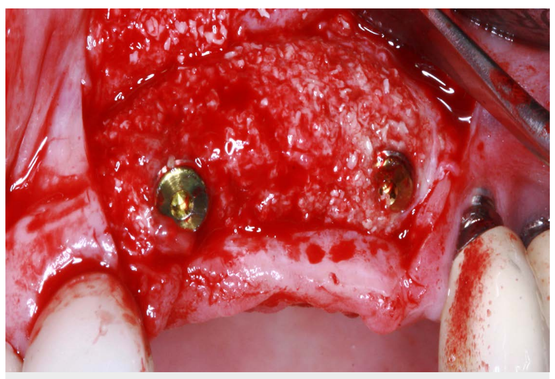


Figure 8: Newly formed vital bone 6 months after GBR. Visible bone gain on top of the implant in region 24.

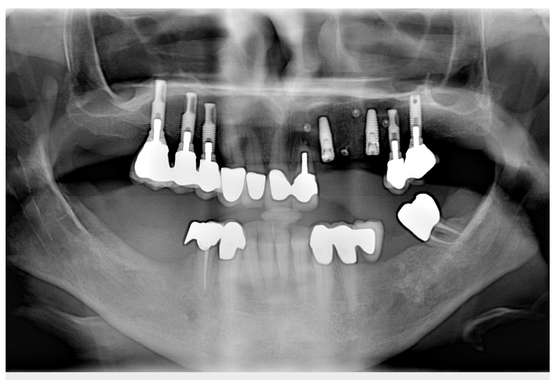


Figure 9: X-ray radiograph 8 weeks post-operation.

CONCLUSIONS

The clinical results achieved with the CXP membrane demonstrated easy fixation, perfect containment of the graft material and excellent wound healing. The significantly lower surface expansion of CXP provides for more accurate trimming of the membrane to the defect dimensions in a dry stage. In addition, the lower surface expansion compared to BG may potentially reduce strain on the primary wound closure. However, the hypothesis of strain reduction requires further investigation.

REFERENCES

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