Use of Ultrasound-Activated Resorbable Poly-D-L-Lactide Pins (SonicPins) and Foil Panels (Resorb-X) for Horizontal Bone Augmentation of the Maxillary and Mandibular Alveolar Ridges

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Horizontal bone augmentation of the maxillary and mandibular alveolar ridges has been conventionally performed using mini titanium alloy screws. The titanium alloy screws are used to fixate corticocancellous block grafts to the recipient site or for tenting the mucoperiosteum to retain particulate bone grafts. Nonresorbable guided tissue regenerative membranes reinforced with titanium have also been developed to use with particulate bone grafts to augment alveolar ridge defects. This report demonstrates the use of resorbable ultrasound-activated pins and resorbable foil panels developed by KLS Martin for augmenting the alveolar ridges with particulate bone grafts.

Before implant placement, it is important to have sufficient width and height of bone for successful osseointegration. Various surgical bone grafting techniques have been developed to augment the alveolar ridges. Mandibular cortical and corticocancellous block grafts are fixated to the deficient site with nonresorbable mini-screws. Nonresorbable guided tissue regenerative membranes re-enforced with titanium have been used to tent the mucoperiosteum for the underlining particulate bone graft.

The aim of this study was to determine the efficacy of resorbable ultrasound-activated pins (SonicPin) and foil panels (Resorb-X) developed by KLS Martin to support particulate bone grafts in horizontal augmentation of the maxillary and mandibular alveolar ridge.

Surgical Technique

All patients who needed at least 3 mm of horizontal bone augmentation were selected. To determine the handling characteristics in placing the SonicPins, multiple sites were chosen in the maxilla and mandible.

A 1.6-mm diameter adjustable drill was used to prepare the sites for pin placement. The depth of penetration was at least through the outer bony cortex. SonicPins used for tenting were 7 mm in length and 2.1 mm in diameter and placed approximately 2 to 3 mm into bone (Fig 1). Shortening the pins was accomplished by resonication. SonicPins used to fixate the resorbable foil panels were 5 mm in length and 1.6 mm in diameter.

The Resorb-X foil panels were 0.1 mm in profile and heated in a sterile water bath at 60° C to 70° C for approximately 30 seconds before adapting to the alveolar ridge. The foils were cut to the desired shape before placing the particulate bone (Fig 2). After fixating the base of the foil panels with SonicPins (Fig 3), the final shape of the foil was adapted over the particulate bone graft and the adjacent native bone by reheating the foil with heated sterile water on a cotton Q-Tip (Fig 4). The foil was perforated with the sonotrode to allow vascularization of the graft (Fig 5).

A full-thickness mucoperiosteal flap was performed at all sites. Before placing the particulate bone, the recipient site was trephinated to enhance the porosity of the cortex for osteogenic cells. Puros allograft (RTI; Biologics, Alachua, FL) was used for particulate bone (Fig 6) and was overlaid
Biodegradable materials have been used for various surgical procedures of the maxillofacial region. Resorbable poly-L-lactide plates and screws have been used to treat mandibular condylar process fractures with reliable stability. Eppley\(^2\) used copolymer plates and screws composed of 82% polylactic and 18% polyglycolic acid (LactoSorb; Biomet, Jacksonville, FL) for reduction of fractures in pediatric patients. However, resorbable screws have shown some problems, particularly with poor mechanical stability, difficulty in handling properties, and can be time-consuming to place. The tapping of threads can take a long time and can make it difficult to handle especially in areas of limited access.

KLS Martin has developed a bioresorbable pin composed of 50% poly-D-lactide and poly-L-lactide.\(^3\) The pin is pushed into a funnel-shaped pilot hole with sonic frequency vibration. At this time, the edges of the pin rub on the bone causing friction to bring the polymer to a liquid state. The pilot hole is smaller than the pin, causing the polymer to flow into the intertrabecular spaces of the bone. When the sonic frequency is stopped, these liquefied portions become hard again in seconds. This is illustrated in Figure 1. When welding the resorbable SonicPins to the bone, the pins were extremely easy to handle and it took very little time to place.
them (Fig 7). Even in the posterior maxilla, where access is limited, the pins were not difficult to place (Fig 8). The sonic pins were very secure, did not fracture or break, and did not have to be replaced with a larger diameter pin. It was also easy to shorten the pins by resonication.

Rasse et al4 examined tissue response to the poly-D-L-lactide pins after 2, 6, and 12 months. They found that there was no evidence of any foreign body reaction or granulation tissue. After 12 months, there was no evidence of polymer and the pin sites were completely transformed into lamellar bone. Pilling et al3 showed that there was no infiltration of polymorphonuclear granulocytes, lymphocytes, or plasma cells indicating the 2 stages of inflammation. At the bone–polymer interface, there was no evidence of foreign body reaction or interposition of fibrous tissue at the interface. There was no bony necrosis indicating the absence of thermally induced damage to the tissue.

Resorbable meshes have been used in various procedures for containment of particulate bone grafts. Louis et al5 showed how a resorbable mesh (Macroplastique, Santa Barbara, CA) made of 70% L-lactide and 30% Co-D-L-lactide is used for continuity defects of the mandible and for atrophic mandibular fractures. Although the mesh provides containment for the particulate bone graft, it needs to be supported by some form of rigid fixation.

The Resorb-X foil panels used in this study did not need any additional support. Although it was extremely thin, the foil provided its own rigidity and support after cooling. Once the foil is heated, it can be adapted to the bone surface and shaped to the desired position. Once cooled, the material turns rigid again and reliably retains its shape. The foils used in
this study were 0.1 mm thick, which provided excellent support for the particulate bone graft and to tent the mucoperiosteum. The base of the mesh was secured with two 1.6-mm SonicPins. The foil was re-heated with sterile cotton Q-Tips to fold the panel over the graft and alveolar ridge. The foils did not need to be secured with additional pins.

Tissue response to the SonicPins and Resorb-X foil panel was unremarkable. There was no evidence of prolonged inflammation, swelling, or discomfort at any of the operative sites. The poly-D-L-lactide complex polymer absorbs water in the surrounding tissue, which initiates the degradation process, continuously breaking down the long polymer chains into shorter structures.\(^3\) The D-lactides and L-lactides are transformed into carbon dioxide and water.\(^6\)

Upon entering the grafted sites, there was sufficient bone width to place the implants (Figs 9-12). When comparing preoperative with postoperative computed tomographic scans, there was an approximately 3 mm increase in bone width (Figs 11, 13-16). Comparing the guided tissue membrane with the Resorb-X foil panel, there was no clinical difference in the nature of the new bone grafts. The bone grafts also seemed to be similar in density.

In conclusion, there are many advantages to using the resorbable SonicPins and Resorb-X foil panels for augmenting alveolar ridge defects—a second surgical procedure is not necessary to harvest bone, and the handling and placing the pins and foil is easy and...
provides excellent support for the underlining muco-periosteum for particulate bone grafting. The Resorb-X foil panels are unique in their ability to be shaped to the desired width of bone necessary for adequate augmentation.

Further studies are being undertaken to determine the quality of bone with the Resorb-X foil panels compared with conventional resorbable guided bone regenerative membranes.
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References