CHAPTER 14

CLINICAL USES OF ABSORBABLE SCREWS IN FOOT AND ANKLE SURGERY

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Absorbable screws have been used in human trials since 1987 in Helsinki, Finland where they were developed. Both polyglycolic acid (PGA) and poly-L-lactide (PLLA) screws are now available for clinical use in the United States in a range of sizes that are applicable to the podiatric or orthopedic surgeon. The authors' experience with the PLLA screws began in July 1994 in forefoot surgical procedures with minimal complications.[1] Since that time, the authors have followed those early cases, and successfully expanded the use of the screws for a variety of reconstructive foot and ankle procedures.[2]

The PGA screw loses its mechanical resistance in vivo between 30 and 60 days, and the PLLA screw between 3 and 12 months. The biodegradation time (or time to complete absorption) is 5 to 10 months for PGA, and 15 to 36 months for PLLA. The initial resistance to shear and flexion forces of the screws is 20 to 30 times that of cancellous bone. Their modulus of elasticity is comparable to cortical bone, and roughly 2 to 3 times that of cancellous bone.[3]

Both Lavery et al. and Higgins et al. performed experimental base wedge osteotomy studies. They reported no statistically significant differences in the structural characteristics (ultimate load, ultimate displacement, structural stiffness) between 3.5 mm and 4.0 mm PLLA screws and their metallic counterparts.[4,5]

In a study on sheep olecranon, Manninen et al. demonstrated that osteotomies fixated with PLLA, gained strength up to the 12th postoperative week, while those with metallic fixation weakened.[6] Suuronen et al. noted this same phenomenon in a similar study on sheep mandibles.[7] Recently, Viljanen et al. found higher bone mineral density in fractures fixated with absorbable screws versus those with metallic screws using quantitative computed tomography studies in combination with plain radiographs and magnetic resonance imaging.[8] These studies may lend credence to the theory that mechanical weakening of fixated bone can be avoided or reduced by using absorbable fixation rather than metallic screws.

Soft tissue complications associated with these implants are also an area of frequent interest. Foreign body reactions to the PGA material has been exhaustively studied and discussed.[1,9-12] The currently reported incidence is approximately 4%. In studies dealing specifically with PLLA, Bucholz et al. observed one inflammatory reaction in 83 patients, with an average follow-up of 37 months after medial malleolar fracture repair.[13] A 0.4% incidence of sinus tract formation was reported in 1993 by Rokkenen et al. in a follow-up of 264 study operations with the PLLA material.[14]

The indications for the use of absorbable screws is sure to expand in the next several years. Presently, long term follow-up (longer than 10 months) is lacking, with the exception of proximal first metatarsal procedures.

Insertion of the screws follows standard metallic screw sequences although the absorbable screws have their own dedicated tap, countersink and screwdriver.[1] Prominent screw heads or threads may be easily reduced with a power saw or loop cautery unit. The authors have noted minimal complications. During two cases, screws delaminated (splintered) along their shafts during insertion, and were determined to be defective. The manufacturing process has since been modified, and no further complications have been experienced. Further benefits and limitations of these screws will be determined by more extensive use and future research (Figs. 1-4).

Figure 1A. Preoperative radiograph of hallux valgus deformity.

Figure 1B. 10 month postoperative radiograph of a closing base wedge osteotomy fixated with two 3.5 mm PLLA screws.

Figure 2A. Preoperative radiograph of transverse plain deformity at the Lisfranc articulation. Note the arthritic changes at the first metatarsal-medial cuneiform and second metatarsal-intermediate cuneiform joints.

Figure 2B. Intraoperative radiograph of Lisfranc arthrodesis. Temporary fixation and intraoperative radiographs are very important when using absorbable screws because they are not radiopaque.

Figure 2C. Postoperative radiograph of a Lisfranc arthrodesis utilizing four 3.5 PLLA screws and two staples.

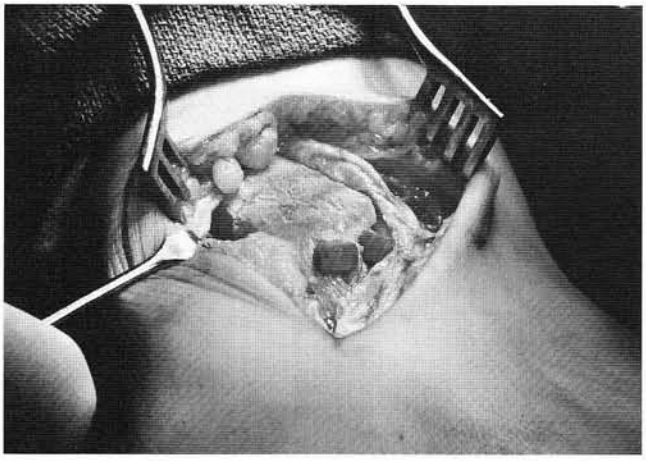

Figure 3B. Two 4.5 mm PGA screws fixating the medial malleolar osteotomy.

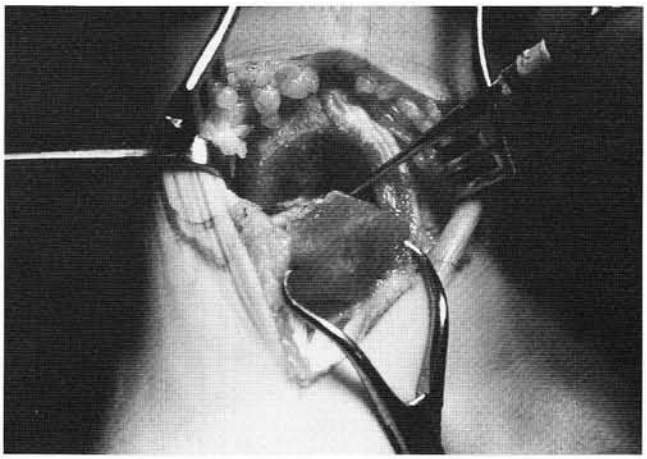

Figure 3A. Intraoperative view of an inverted Chevron medial malleolar osteotomy.

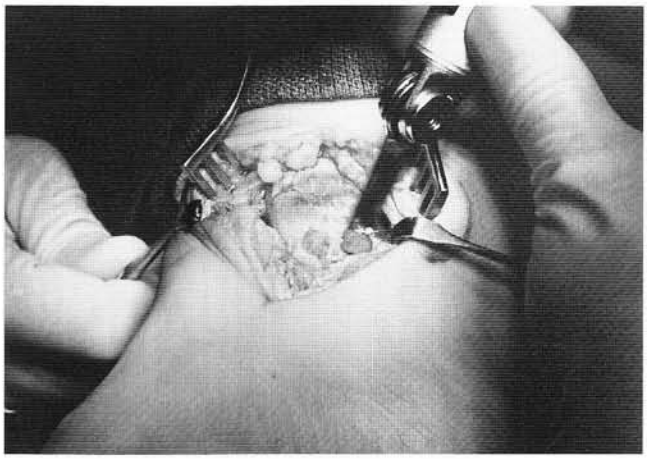

Figure 3C. Prominent screw heads are reduced with an oscillating saw.

Figure 3D. Immediate postoperative radiograph of fixation with PGA screws.

Figure 4A. Preoperative lateral radiograph of severe degenerative joint disease of the ankle.

Figure 4B. Anterio-posterior radiograph.

Figure 4C. Four month postoperative lateral radiograph of an ankle arthrodesis with three 4.5 mm PLLA screws and two staples.

Figure 4D. Four month postoperative anterio-posterior radiograph.

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