

# The WasherLoc and Bone Dowel: A Rigid, Slippage-Resistant Tibial Fixation Device for a Soft Tissue Anterior Cruciate Ligament Graft

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**Summary:** The WasherLoc is a tibial fixation device for soft tissue anterior cruciate ligament (ACL) reconstruction that combines superior fixation properties (945 N strength, 507 N/mm stiffness, and high resistance to slippage) with a simple surgical technique. The WasherLoc is a washer with 13 short spikes that penetrate the soft tissue ACL graft in multiple locations and 4 long peripheral spikes that contain the graft beneath the washer. A cancellous screw is used to compress the WasherLoc against the soft tissue ACL graft and posterolateral wall of the tibial tunnel. The WasherLoc does not cause hardware symptoms because it is recessed in a counterbore drilled at the distal end of the tibial tunnel. A bone dowel harvested from the tibial tunnel is used as a joint-line fixation device in a series with the WasherLoc to improve fixation stiffness (58 N/mm) and increase the fit, which is known to enhance tendon graft-to-bone healing in the tibia. The bone dowel, which is driven to the level of the joint line anterior to the WasherLoc and soft tissue graft, prevents tunnel enlargement. **Key Words:** WasherLoc—Anterior cruciate ligament reconstruction—Tibial fixation device—Soft tissue graft—Superior fixation properties—Reliable surgical technique.

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This review article describes the design rationale and fixation performance of the WasherLoc and bone dowel, clinical, and biomechanical performance of the WasherLoc (Arthrotek, Inc., Warsaw, IN) and bone dowel (Fig. 1). The surgical steps for the insertion of this combination of tibial fixation devices are discussed.

## Rationale for the Use of the WasherLoc and Bone Dowel Tibial Fixation

The WasherLoc addresses the mechanical fixation and soft tissue graft-to-bone healing issues that are especially problematic in the tibia.<sup>3,8,26</sup> The cancellous bone in the tibia is softer than the femur, which impairs the grip of fixation devices that primarily purchase cancellous bone

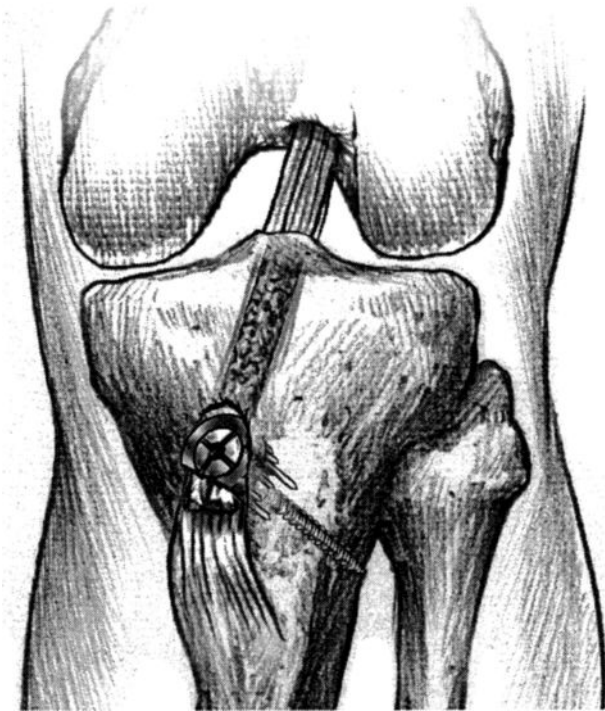
such as the interference screw.<sup>6</sup> The marrow-dominated metaphysis of the tibia slows soft tissue graft-to-bone healing.<sup>8</sup> Tibial fixation methods that improve the mechanical fixation and rate of healing of a soft tissue anterior cruciate ligament (ACL) graft should enable patients to be mobilized early and restore better stability to the knee.<sup>21</sup>

Fixation techniques that promote tendons to heal faster in a tunnel are especially important for those surgeons who are used to the fast tunnel healing of a bone plug (ie, bone–patellar tendon–bone graft) and are considering the use of the slow-healing soft tissue ACL graft. The fixation of a soft tissue ACL graft needs to be stronger, stiffer, and slip less than a bone plug graft because the tunnel healing of a soft tissue ACL graft requires 6 weeks to equal a bone plug graft.<sup>25</sup> Studies have shown that soft tissue ACL graft-to-bone tunnel healing is promoted by 1) lengthening the tunnel,<sup>9</sup> 2) tightening the fit in the tunnel,<sup>9</sup> 3) providing circumferential contact between the graft and tunnel (ie, no interference screw),<sup>23</sup> and 4) inserting a biologically active substance in the tunnel<sup>4,18</sup> (Fig. 2). The use of the WasherLoc at the distal end of the

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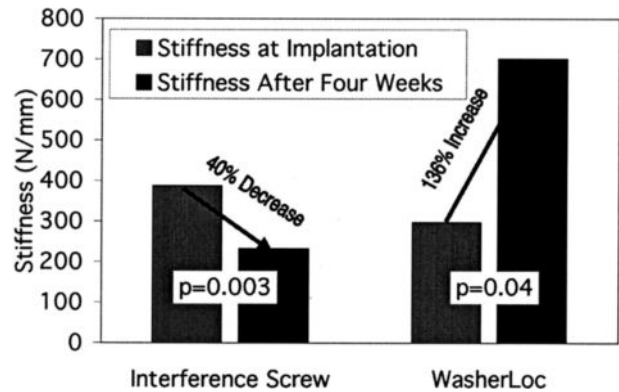
**FIG. 1.** The WasherLoc is recessed in a counterbore at the distal end of the tibial tunnel, which prevents hardware irritation and the subsequent need for removal. The WasherLoc is a modified washer with 13 short spikes that penetrate the soft tissue anterior cruciate ligament (ACL) graft in multiple locations and 4 long peripheral spikes that contain the graft beneath the washer. A cancellous screw is used to compress the WasherLoc against the soft tissue ACL graft and posterolateral of the tibial tunnel. The bone dowel is compacted into the tibial tunnel anterior to the soft tissue ACL graft and WasherLoc.

tibial tunnel and the compaction of a bone dowel anterior to the soft tissue ACL graft fulfills these 4 conditions for promoting soft tissue graft-to-bone healing.<sup>13</sup>

#### Fixation Properties of the WasherLoc and Bone Dowel

The ultimate strength of the WasherLoc (945 N) is greater than the Intrafix fastener (Mitek, Inc), RCI screw (Smith and Nephew), Delta Tapered Screw (Arthrex, Inc.), double staples, single soft tissue washer, and bicortical interference screw (Arthrex, Inc).<sup>5,19</sup> The WasherLoc derives the superior ultimate strength because it purchases cortical bone, which is 30 times stronger than the cancellous bone purchased by the interference screw and Intrafix.<sup>2,5</sup>

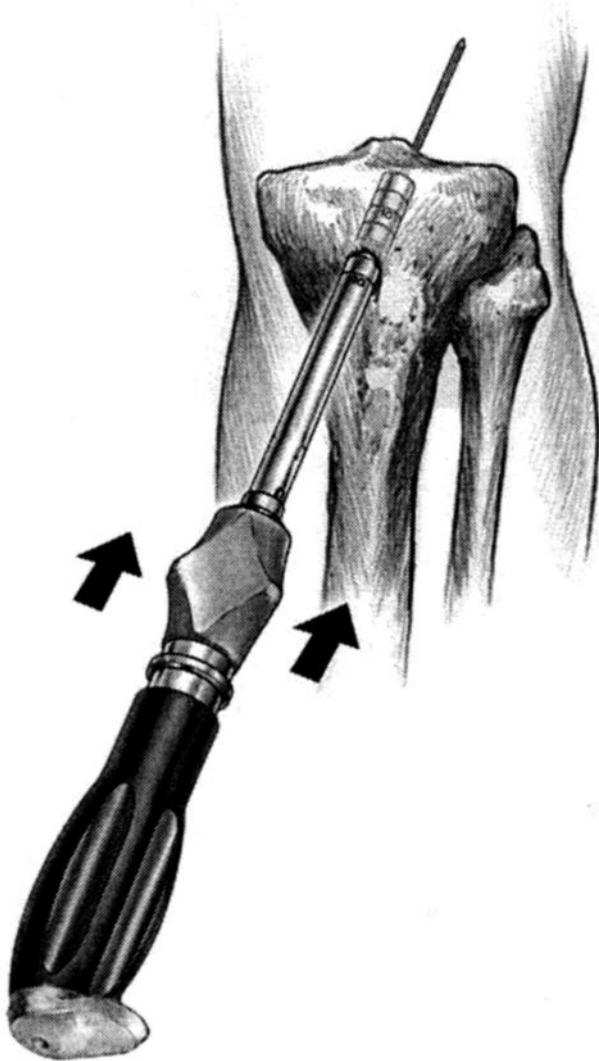
The stiffness provided by the WasherLoc and bone dowel is greater or at least similar to the stiffness provided by joint line fixation with a wide variety of metal and bioabsorbable interference screws, although the graft length is greater with the WasherLoc.<sup>16,17,19,23,24</sup> One reason



**FIG. 2.** A graph showing that healing of a soft tissue anterior cruciate ligament graft is stiffer at 5 weeks with distal fixation with a WasherLoc than with interference screw fixation. The interference screw blocks tendon-tunnel healing because it prevents the tendon from contacting the tunnel wall.<sup>23</sup>

that the stiffness of the graft construct is high with a distal device is that the distal device purchases cortical bone, which is stiffer and stronger than the cancellous bone purchased by an interference screw. Another reason that the stiffness is high with a distal device is that the stiffness of the graft construct is determined more by the fixation stiffness than by the stiffness (ie, length) of the graft, which is analogous to the strength of the graft construct being determined more by the fixation strength than by the strength of the graft.<sup>19,24</sup> When the stiffness of the bone dowel of 58 N/mm is added to the stiffness of the WasherLoc of 507 N/mm, the combined stiffness of the 2 fixation methods when used in series is 565 N/mm.<sup>13</sup> The use of fixation devices with high fixation stiffness is the best method for matching the stiffness of the graft construct to that of the intact ACL.<sup>7,15,19,24</sup> The use of a device with high fixation stiffness benefits the knee by lowering the initial tension needed to restore stability<sup>15</sup> and protects the knee against a recurrent instability from the obligatory loss in graft tension after fixation from moving the knee.<sup>10</sup> Therefore, the surgeon interested in a stiff graft construct can use a WasherLoc in series with a bone dowel instead of joint line fixation with an interference screw.<sup>13</sup>

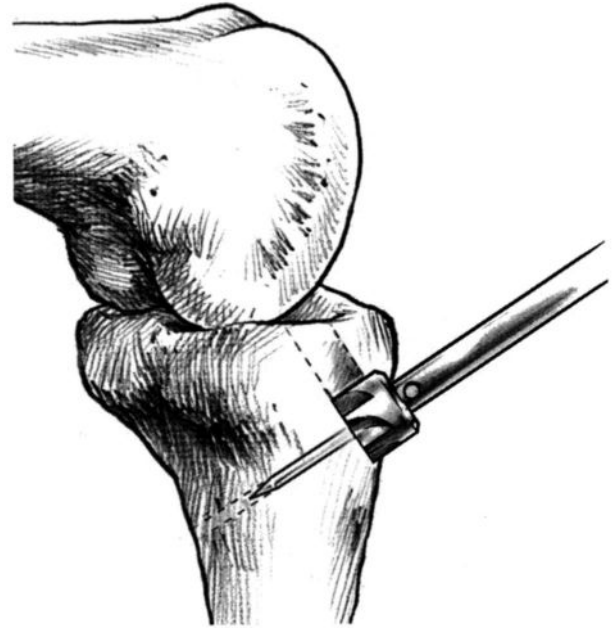
Slippage or lengthening at the site of fixation under cyclic load is less with the WasherLoc than with the Intrafix fastener (Mitek, Inc), RCI screw (Smith and Nephew), Delta Tapered Screw (Arthrex, Inc), double staples, single soft tissue washer, and bicortical interference screw (Arthrex, Inc).<sup>5,19,22</sup> Slippage of a soft tissue ACL graft fixed with a WasherLoc was less than 1 mm when subjected to a loading protocol that was designed to simulate the magnitude of loading (170 N) and num-



**FIG. 3.** The illustration shows the impaction of the dowel harvester over the K-wire to the level of the subchondral bone. The typical length of the bone dowel is 20 to 30 mm.

ber of load cycles (225,000) that an ACL graft might experience during the early healing period before biologic incorporation of the graft in the bone tunnels.<sup>22</sup> Graft tension and stability is better maintained with the use of fixation devices that resist slippage or lengthening at the site of fixation.<sup>10</sup>

Adding the bone dowel in series with the WasherLoc limits tunnel expansion at 4 months and 2 years to no more than the cross-sectional area of the reamer used to drill the tunnel. With this fixation technique and correct tunnel placement, the majority of patients regain sufficient function and confidence in their knee to return to preinjury activity level 4 months after reconstruction (Arthrotek, Inc.).<sup>1,11,12</sup>



**FIG. 4.** The counterbore is reamed aiming toward the fibula and perpendicular to the posterolateral wall of the tibial tunnel. Reaming is stopped when the counterbore is flush with the posterolateral wall of the tibial tunnel.

## SURGICAL TECHNIQUE

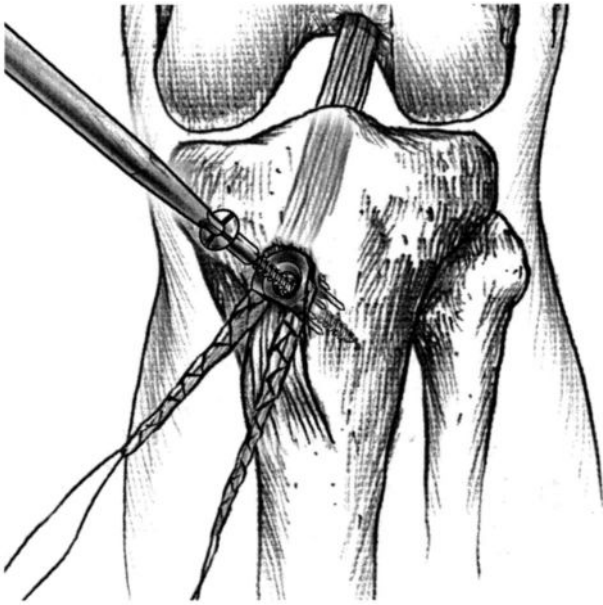
The surgical technique for fixing a soft tissue ACL graft to the tibia with the WasherLoc and compacting a bone dowel into the tibial tunnel can be viewed in streaming video at this web address: [http://www.drstevehowell.com/WasherLoc\\_video.cfm](http://www.drstevehowell.com/WasherLoc_video.cfm).

### Harvest the Bone Dowel From the Tibial Tunnel

Position the K-wire for the tibial tunnel with a drill guide (Howell Tibial Guide; Arthrotek, Inc.) using the technique described in this issue.<sup>20</sup> Remove the cortex at the distal end of the tibial tunnel with a reamer. Insert the cannulated plunger over the K-wire. Impact the harvesting tube over the cannulated plunger and K-wire to the subchondral bone (Fig. 3). Rotate the harvesting tube clockwise and counterclockwise to break the tip of the bone dowel from the subchondral bone. Remove the harvesting tube from the tunnel. Finish reaming the tibial tunnel through the subchondral bone.

### Drill the Counterbore

Insert the counterbore guide into the tibial tunnel and orient the vertical sleeve toward the fibula. Impact the awl through the vertical sleeve to create a pilot hole. Insert the tip of the counterbore in the pilot hole. Maintain the cutting surface of the counterbore parallel to the posterolateral wall



**FIG. 5.** The illustration shows the strands of the soft tissue graft gripped by the WasherLoc and the insertion of the cancellous screw. The WasherLoc and screw should be aimed toward the fibula so that the compression screw exits the lateral and not the posterior tibial cortex.

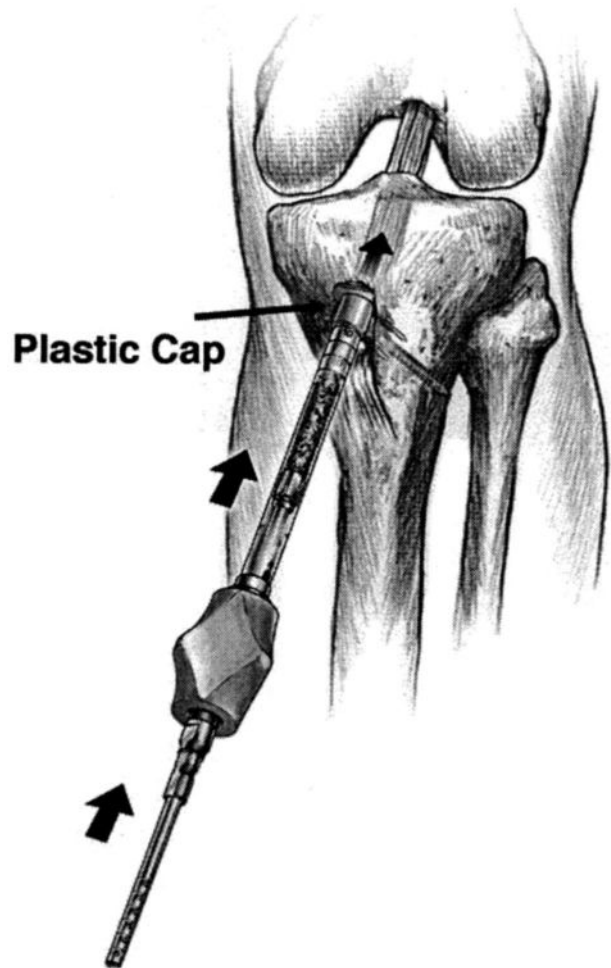
of the tibial tunnel and aim toward the fibula. Ream until the counterbore is flush with the posterolateral wall of the tibial tunnel (Fig. 4).

#### Insert the WasherLoc

Thread the WasherLoc on the drill sleeve and thread the awl in the drill sleeve. Tension the sutures attached to the strands of the soft tissue ACL graft exiting the tibial tunnel. Place one strand from each tendon on opposite sides of the tip of the awl and between the four long spikes of the WasherLoc. Orient the WasherLoc parallel to the posterolateral wall of the tibial tunnel and aim toward the fibula. Drive the spikes of the WasherLoc into cortical bone with a mallet. Remove the awl and drill a 3.2-mm hole through the lateral tibial cortex. Remove the drill sleeve, measure the length of the hole, and insert a 6.5 mm in diameter self-tapping cancellous screw through the WasherLoc to tighten and compress the graft (Fig. 5).

#### Insert the Bone Dowel

Create a cone-shaped space anterior to the graft and WasherLoc to receive the bone dowel by driving the dilator 25 mm into the tibial tunnel to the level of the joint line. Place the protective plastic cap over the sharp tip of the harvester. Center the tip of the harvester over the dilated opening (Fig. 6). Strike the plunger on the



**FIG. 6.** The bone dowel is compacted into the tibial tunnel anterior to the WasherLoc and soft tissue anterior cruciate ligament (ACL) graft. The plastic cap is placed over the tip of the sharp bone dowel harvester to protect the ACL graft.

harvester to compact the bone dowel into the dilated space.

#### CONCLUSION

The WasherLoc is a tibial fixation device for soft tissue ACL reconstruction that is simple and reliable for both the high volume and occasional ACL surgeon and surgical team. The WasherLoc in combination with the bone dowel provides superior fixation properties (945 N strength, 565 N/mm stiffness, and high resistance to slippage) and allows circumferential healing of the tendon graft to the tunnel wall, which allows aggressive rehabilitation without a brace and return to sport at 4 months.<sup>1,11,14</sup>

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