Continuous Loop Double Cortical Button Technique for Distal Tibiofibular Syndesmosis Stabilization: A Technical Note and Case Series

Theodore S. Wolfson, MD and Steven Struhl, MD

Abstract: Injury to the distal tibiofibular syndesmosis is common and failure to correct instability may lead to inferior outcomes. Recently, suture-button devices have garnered increasing attention for dynamic syndesmotic fixation. However, current constructs and techniques have been consistently associated with complications such as lateral knot irritation and wound breakdown. In addition, knot slippage, loosening, and osteolysis have been described leading to recurrent syndesmotic diastasis. To address these shortcomings, a continuous loop double cortical button technique has been developed for dynamic syndesmotic stabilization. The continuous loop double cortical button technique has been utilized for coracoclavicular ligament stabilization for both acromioclavicular joint dislocation and distal clavicle fractures with excellent clinical outcomes. This procedure has been adapted for fixation of the distal tibiofibular syndesmosis. The technique utilizes 2 cortical buttons linked by a continuous loop of ultra-high molecular weight polyethylene suture for dynamic knotless syndesmotic fixation. The continuous loop double cortical button technique was performed on 4 consecutive cases of distal tibiofibular syndesmosis diastasis. Accurate, stable fixation was achieved in all cases without loosening or diastasis. At the final follow-up, no evidence of button-related osteolysis or migration was observed. One patient with prominent lateral hardware developed a wound infection requiring reoperation for hardware removal and debridement. Otherwise, no complications related to syndesmotic hardware were observed. The continuous loop double cortical button technique is a reproducible and reliable procedure for fixation of the distal tibiofibular syndesmosis. The construct allows for accurate restoration of the dynamic syndesmotic complex without compromising stability. Knot-related complications are minimized. As with all systems, limiting lateral hardware prominence appears to reduce the risk of wound-related complications.

Level of Evidence: Diagnostic Level IV—case series. See Instructions for Authors for a complete description of levels of evidence.

Key Words: syndesmosis, cortical button, suture button, ankle, technique

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HISTORICAL PERSPECTIVE

Injury to the distal tibiofibular syndesmosis is common and can occur in isolation or in the presence of a concomitant ankle fracture. Isolated syndesmotic injury, often referred to an as high ankle sprain, comprises 7% to 15% of all ankle sprains,[1,2] but only rarely results in complete diastasis. In contrast, complete syndesmotic disruption has been estimated to accompany 10% of all ankle fractures[3] and 20% of those requiring operative fixation.[4] Failure to address syndesmotic instability can lead to altered joint contact forces,[5–7] followed by early degenerative changes and ultimately inferior clinical outcomes.[4,8] Anatomic reduction and fixation of the syndesmosis is critical to prevent instability and associated sequelae.[9–11]

Although a variety of syndesmotic fixation techniques and constructs have been described, screw fixation has historically been considered the gold standard due to its reproducible and reliable results.[12] Recently this has been called into question as rigid screw fixation has several drawbacks. Syndesmotic malreduction occurs in up to 52% of cases.[13] Screw loosening and breakage is common.[14–16] Late syndesmosis diastasis after screw breakage or removal has been described.[17,18] As a result, several authors have recommended prolonged immobilization which may have additional morbidity.[18] Even in the absence of malreduction, syndesmotic screw fixation interferes with physiological ankle motion.[19] Syndesmotic screw fixation is also associated with increased rates of tibiofibular synostosis which may further impair motion.[20] Intact screw fixation has been associated with inferior functional outcomes.[21] As a result, a second operation for routine screw removal may be required, with nontrivial complication rates.[22,23]

In light of these shortcomings, suture-based fixation has gained increasing popularity.[24] The use of a flexible fixation construct, in theory, more closely restores the dynamic native anatomy from time 0. The syndesmotic reduction is more accurate,[9] and malreduction is better tolerated.[25] Fixation strength is equivalent to screw fixation,[26–28] but the syndesmotic reduction is more reliably maintained with suture fixation.[9] As a result, routine reoperation and implant removal are avoided. Ankle motion is not restricted and prolonged immobilization is unnecessary.[29] The most extensively studied, commercially available construct consists of 2 cortical buttons connected by ultra-high molecular weight polyethylene (UHMWPE) suture (TightRope; Arthrex Inc., Naples, FL) tied over the lateral button. Recent outcome studies demonstrate excellent functional scores with low rates of failure and reoperation.[9,29–40] In addition, a recent analysis demonstrated that syndesmosis fixation with a suture-button device is more cost-effective than syndesmotic screws without routine removal.[41]

However, despite these promising results, current suture-button techniques are not without risk. Loosening and recurrent syndesmotic diastasis may occur.[42] Variable knot tension may result in inaccurate syndesmosis reduction.[43] Osteolysis and implant subsidence can accompany aseptic loosening.[9,31,32,38,39,44] Lateral knot irritation and wound complications have been described, often requiring reoperation.[9,39,45,46] In 1 series, an overall complication rate of 44% was reported, with 22% of cases requiring reoperation.[39]

To address these concerns, a novel suture-based cortical button technique is introduced. The continuous loop, double cortical button technique, previously applied to coracoclavicular

From the New York University Langone Orthopedic Hospital, New York, NY.

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Address correspondence and reprint requests to Theodore S. Wolfson, MD, New York University Langone Orthopedic Hospital, 301 East 17th Street, New York, NY 10010. E-mail: theodore.wolfson@nyumc.org.

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ligament reconstruction is adapted to ankle syndesmosis repair. This technique offers the advantages of flexible suture-based fixation, with the added benefit of a knotless system to avoid variable suture tension, knot-slippage or irritation, and construct loosening. The continuous loop double cortical button technique has been previously validated biomechanically, radiographically, and clinically in the treatment of both acromioclavicular (AC) dislocation and unstable distal clavicle fracture. The following technique describes the application of this construct to syndesmosis repair.

INDICATIONS AND CONTRAINDICATIONS

Indications for syndesmotic fixation with the continuous loop double cortical button include all complete distal tibia syndesmotic injuries resulting in instability and diastasis. This includes purely ligamentous injuries as well as fibular fractures with syndesmotic instability. Syndesmotic stabilization with the continuous loop double cortical button can be performed either alone or in conjunction with open reduction and internal fixation of ankle fractures. Contraindications to this technique include active infection, advanced arthropathy of the ankle, and inadequate medial cortical bone stock to support button fixation.

PREOPERATIVE PLANNING

Standard preoperative planning for syndesmotic injuries in performed. If there is clinical suspicion, physical examination should include provocative testing such as the squeeze test or the external rotation test. Routine radiographs should include 3 views of the ankle [anteroposterior (AP), mortise, and lateral], as well as 2 views of the tibia and fibula (AP and lateral). Manual or gravity-assisted external rotation stress radiographs of the ankle are performed to confirm syndesmotic instability. Radiographic parameters may be applied to assess for indications of syndesmotic instability including increased tibiofibular clear space, decreased tibiofibular overlap, and increased medial clear space. Contralateral radiographs are often useful for equivocal cases. Special attention is paid to the evaluation of ankle malleolar fractures which may accompany the syndesmotic injury. Computed tomography (CT) examination is useful to further delineate subtle or comminuted periarticular fractures and assist with operative planning.

TECHNIQUE

The patient is positioned supine on the operating room table with an appropriate bump under the hip to stabilize the ankle in neutral rotation. If a concomitant ankle fracture is present, open reduction and internal fixation of the fracture is performed using a standard plate and screw osteosynthesis. In the absence of an associated ankle fracture, a small, ~3 cm longitudinal incision is made along the anterior border of the distal fibula at the level of the distal tibiofibular syndesmosis. The syndesmotic complex is identified and debrided of any hematoma or fibrous tissue that may impede reduction. Reduction of the syndesmosis is performed with the ankle in neutral dorsiflexion under direct visualization using a large pointed reduction clamp and confirmed on fluoroscopic AP, mortise, and lateral views (Video 1, Supplemental Digital Content 1, http://links.lww.com/TFAS/A59).

Under direct fluoroscopic imaging, a 2.4 mm quadricortical hole is drilled parallel and ~1 to 2 cm superior to the tibial plafond and directed ~30 degrees oblique from posterior to anterior. If a plate is used for an associated distal fibular fracture one of the holes can be purposely left free for the continuous loop construct. Once an adequate position is confirmed, a cannulated 4.5 mm reamer is used to overdrill the quadricortical tunnel. Again, if a plate is present, the bone tunnel may be oriented through one of the free holes. However, as the plate hole is not large enough to accommodate the 4.5

FIGURE 1. Illustration of the continuous loop cortical button device (*white*) prepared with 2 ultra-high molecular weight polyethylene sutures—one threaded through to peripheral holes of the cortical button, one passed through the continuous loop (*blue-white striped*).

reamer, it must be drilled from medial to lateral. The total tunnel length is measured with a depth gage and the appropriate continuous loop size is selected accordingly. The closed-loop double cortical button system (Endobutton CL; Smith and Nephew, London, UK) is available in a fixed 5 mm increments. If the measured tunnel length is not within 1 mm of available size, the next larger closed-loop length is chosen. The selected continuous loop and cortical button device are then prepared with sutures as shown in Figure 1. A small, 1 cm vertical incision is then made directly over the medial tibial cortex overlying the bone tunnel. A Beath pin is passed through the tunnel from medial to lateral. All 4 limbs of the suture are placed in the eyelet of the Beath pin which is pulled out the lateral side to shuttle the sutures. With the ankle held reduced, firm tension is pulled on the loop stitch to reduce the medial button and firmly lock it to the medial cortex (Fig. 2). This leaves the remaining suture with 2 pairs of tails exiting the lateral tunnel. A free cortical button (Endobutton; Smith and Nephew) is held with a needle holder and slid under the protruding loop so that it sits centered under the loop. It is critical that the button is held on its side, rather than flush against the cortex to permit suture passage through the button. The suture tails exiting the fibula are passed through the cortical buttonholes on either side of the loop (Fig. 3). The cortical button is then turned flush to the cortex and the sutures are tied over the button and loop to secure them (Fig. 4). When the required loop length exceeds the measured tunnel length, either a larger button (Xtendobutton; Smith and Nephew) can be substituted or a single washer can be placed under the standard cortical button on either or both sides of the ankle to facilitate accurate reduction. Fluoroscopy is used to confirm implant position and a final external rotation stress test is performed to verify stable syndesmotic reduction.

If additional rotational stability is desired, a suture-based cerclage can be placed above the initial construct. A second 2.4 mm bicortical hole is drilled through the fibula parallel to and an additional 1 cm above the first hole. A 4.5 mm bioabsorbable double-loaded suture anchor (Healicoil PK Suture Anchor; Smith and Nephew) is then placed into the lateral tibia at the level of the tunnel and 1 limb of each suture is passed through the fibula. These sutures are tensioned and tied with care not to overreduce or overconstrain the syndesmosis.

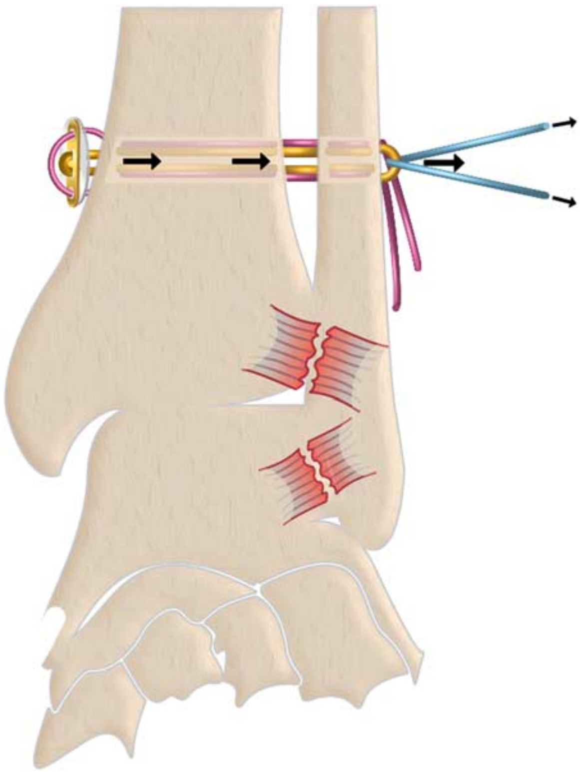

FIGURE 2. Illustration of the prepared continuous loop device passed from medial to lateral through the bone tunnel. The cortical button is seated flush on the medial distal tibia cortex by gradually tensioning the loop suture (*blue*).

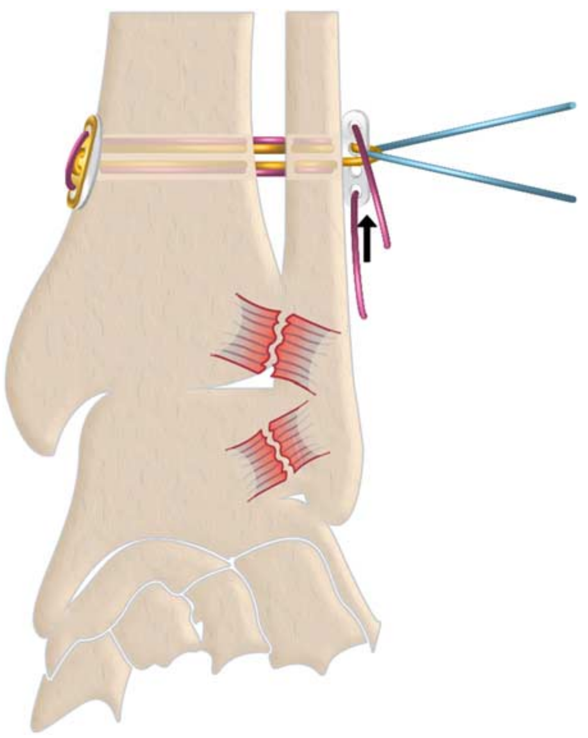

FIGURE 3. A second cortical button is passed under the continuous loop and positioned on its side against the lateral distal fibula cortex to permit passage of the traversing suture (*red*).

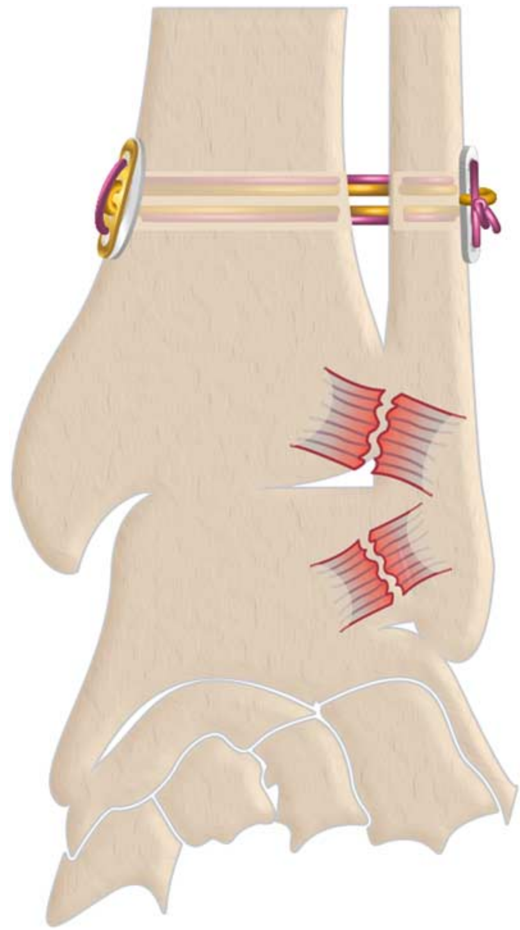

FIGURE 4. The loop suture (*blue*) is removed. With the syndesmosis reduced and stabilized, the traversing suture (*red*) is tied over the lateral cortical button to secure it in place and complete the fixation.

RESULTS

To date, the senior author (S.S.) has performed 4 consecutive cases for distal tibiofibular syndesmotic diastasis using the continuous loop double cortical button technique. These cases, including technical aspects, are described in detail.

Case 1

The patient is a 48-year-old male construction worker who twisted his right ankle while playing touch football ~10 days before presentation and sustained a spiral fracture of the fibular shaft with associated syndesmotic rupture (Figs. 5A, B). The patient was taken to the operating room the following week. Open reduction and plate osteosynthesis of the proximal fibular shaft fracture was first performed with a one third tubular plate. Open reduction and fixation of the syndesmosis was then performed with the continuous loop double cortical button technique. A 60 mm continuous closed-loop device (Endobutton CL; Smith and Nephew) with 2 standard cortical buttons (Endobutton; Smith and Nephew) was utilized. A supplemental 4.5 mm bioabsorbable double-loaded suture anchor (Healicoil PK Suture Anchor; Smith and Nephew) was placed in the lateral distal tibia above the initial fixation construct for additional rotational stability. The patient was advanced to weight-bearing as tolerated at 4 weeks. Fracture consolidation

FIGURE 5. Fluoroscopic images from case #1, including preoperative images demonstrating the syndesmotic diastasis (A) and fibular shaft fracture (B), and postoperative images after continuous loop double cortical button fixation of the syndesmosis (C) and plating of the fibular shaft (D).

and union were achieved by 3 months (Fig. 5D) and the patient returned to work. Clinical and radiographic follow-up until 20 months postoperatively demonstrated maintained reduction without evidence of loosening, osteolysis, or hardware-associated complication (Fig. 5C). Early asymptomatic ossification of the syndesmosis was incidentally noted at the final follow-up.

Case 2

The patient is a 30-year-old male who injured his left ankle after a slip and fall 4 days before presentation and sustained a Maisonneuve spiral fracture of the proximal fibula with associated deltoid ligament rupture and syndesmotic instability (Figs. 6A, B). The patient was taken to the operating room the following day and open reduction and internal fixation of the syndesmosis was performed with the continuous loop double cortical button technique. The channel length was measured to 48 mm and a 50 mm continuous closed-loop device (Endobutton CL; Smith and Nephew) was used with 1 standard cortical button (Endobutton; Smith and Nephew) medially and 1 large cortical button (Xtendobutton; Smith and Nephew) laterally. Supplemental suture anchor fixation superior to the continuous loop construct was again utilized. The patient was advanced to partial weight-bearing at 4 weeks and weight-bearing as tolerated at 6 weeks. He was followed clinically and radiographically until 5 months postoperatively at which point he had full resolution of his symptoms. The syndesmotic reduction was maintained without complication (Figs. 6C, D).

Case 3

The patient is a 28-year-old male who sustained a right ankle fracture during an assault 2 days before the presentation. Radiographs demonstrated a distal fibula fracture with associated deltoid and syndesmotic ligament instability (Figs. 7A, B). He was taken to the operating room the following day and open reduction and internal fixation of the distal fibula fracture were performed. Following fracture fixation, stress examination under fluoroscopy revealed persistent syndesmotic instability and the syndesmosis was reduced and fixed using the continuous looped double cortical button technique. The bone tunnel was angled through a hole in the plate and measured to 53 mm. A 55 mm continuous closed-loop device (Endobutton CL; Smith and Nephew) was selected with 2 standard cortical buttons (Endobutton; Smith and Nephew) and a washer placed medially. The

FIGURE 6. Fluoroscopic images from case #2, including preoperative images demonstrating deltoid and syndesmotic instability (A) and proximal fibular fracture (B), and postoperative anteroposterior (C) and lateral (D) images after continuous loop double cortical button fixation of the syndesmosis with reduced mortise.

patient was advanced to partial weight-bearing at 3 weeks and weight-bearing as tolerated at 5 weeks. Radiographic union was achieved without hardware complications. The patient was followed until 3 months postoperatively with well-maintained reduction and uneventful healing (Figs. 7C, D).

Case 4

The patient is a 45-year-old female smoker who sustained a left bimalleolar ankle fracture after a syncopal fall 4 days before the presentation. She was taken to the operating room the following day. The distal fibula fracture was first reduced and stabilized with a lag screw and neutralization plate. Open reduction and internal fixation of the medial malleolus was then performed with 2 partially threaded cannulated screws. The syndesmosis remained unstable after fracture fixation and was reduced under direct visualization. Syndesmotic stabilization with the continuous loop double cortical button technique was then performed. The channel was drilled through a hole in the plate and measured to be 47 mm. A 50 mm continuous loop device (Endobutton CL; Smith and Nephew) was chosen with 2 standard cortical buttons (Endobutton; Smith and Nephew) and 2 washers placed laterally to achieve the desired loop length (Figs. 8A, B).

The patient's initial postoperative course was uneventful. She was advanced to weight-bearing as tolerated by 6 weeks. At 10 weeks postoperatively, prominence of the lateral hardware was noted with wound erythema, punctate breakdown, and scant serous drainage. Radiographs demonstrated fracture union with maintained syndesmotic reduction and hardware in an unchanged position. Antibiotics were administered without resolution of wound breakdown and drainage. The patient was taken back to the operating room 3 months following the initial procedure for irrigation and debridement of her wound followed by removal of the hardware, including the continuous loop double cortical button construct. The syndesmosis was healed and stable at the time of hardware removal and remained intact without diastasis until the final follow-up (Figs. 8C, D). The incision healed without further complication or sequelae.

COMPLICATIONS

Syndesmotic malreduction is more common than initially thought, occurring in up to 52% of cases.[13] The risk of malreduction is minimized by direct visualization and utilization of a more forgiving suture-based fixation construct.

FIGURE 7. Fluoroscopic images from case #3, including preoperative images demonstrating distal fibula fracture on anteroposterior (A) and lateral (B) views, and postoperative mortise view of the ankle (C) and anteroposterior view of the distal fibula (D) demonstrating lag screw and neutralization plate fixation of the distal fibula and continuous loop double cortical button fixation of the syndesmosis with a supplemental washer under the medial button.

However, malreduction may still occur with knot tensioning and is mitigated by the continuous loop design.

Late syndesmotic diastasis may also occur. Knot-slippage may contribute to delayed syndesmotic instability and is prevented by the continuous loop double cortical button construct. The continuous loop of UHMWPE suture linking 2 cortical buttons provides robust biomechanical properties with minimal fatigue under cyclical loading and high load-to-failure strength.[47,48]

Wound complications remain common after fixation of ankle fractures and syndesmotic injuries. The continuous loop double cortical button technique minimizes hardware and knot prominence to limit soft tissue irritation and wound complications. However, wound-related issues remain a potential complication and should be managed aggressively with wound care, antibiotics if the infection is suspected, and low threshold for formal irrigation and debridement.

POSTOPERATIVE MANAGEMENT

Postoperatively, patients are temporarily immobilized in a splint. For isolated syndesmotic injuries, patients are initially restricted to non–weight-bearing on the operative extremity and advanced to partial weight-bearing in a walking boot at 2 weeks, followed by weight-bearing as tolerated in a walking boot at 4 weeks. For syndesmotic injuries with an associated fibular fracture, patients are initially restricted to non–weight-bearing on the operative extremity for 2 to 4 weeks depending on the fracture pattern and choice of fixation before they are advanced to partial weight-bearing or weight-bearing as tolerated.

POSSIBLE CONCERNS, FUTURE OF THE TECHNIQUE

The continuous loop double endobutton technique was originally described by Struhl for coracoclavicular ligament reconstruction to treat complete AC joint dislocation.[49] The technique utilizes a continuous loop of UHMWPE suture bridging 2 cortical buttons, thereby eliminating the complications associated with suture knot fixation, including knot prominence, slippage, or breakage. This fixation construct has been validated in multiple biomechanical studies.[47,48] Furthermore, the technique has been demonstrated to have excellent long term clinical outcomes for both AC joint

FIGURE 8. Radiographic images from case #4, including postoperative anteroposterior (A) and lateral (B) images after lag screw and neutralization plate fixation of the distal fibula, cannulated screw fixation of the medial malleolus, and continuous loop double cortical button stabilization of the syndesmosis. The continuous loop construct is positioned through a hole in the distal fibula plate with 2 additional washers placed laterally for accurate syndesmotic reduction. Anteroposterior (C) and lateral (D) radiographs after removal of lateral hardware and debridement demonstrate maintained mortise with stable syndesmosis.

dislocation as well as unstable distal clavicle fractures.[50,51] Given the prior success and biomechanical advantages in treating injuries of the AC joint, the continuous loop double endobutton technique has been adapted for dynamic stabilization of the distal tibiofibular syndesmosis.

Numerous techniques for fixation of the distal tibiofibular syndesmosis have been described using a variety of constructs including Kirschner wires, bioabsorbable implants, and metallic plates and screws.[52–55] Historically, metallic screw fixation has been considered the standard for syndesmotic stabilization. It offers a simple, reproducible technique for static syndesmotic stabilization with reliable results. However, rigid syndesmotic screw fixation fails to replicate the dynamic function of the native syndesmotic ligaments. This, in turn, may lead to malreduction and overconstrained of the syndesmosis,[13] thereby leading to altered joint mechanics and predisposing to early degenerative changes.[5–8] Furthermore, rigid screw stabilization often and predictably leads to screw breakage, which may result in late syndesmotic diastasis, hardware complications, and inferior clinical results.[14–16] These potential risks may warrant extended weight-bearing restriction and prolong recovery.[18] Last, a second operation for screw removal is required, thus subjecting the patient to additional risk and cost.[22,23,41]

In light of these shortcomings, the dynamic suture-button construct was developed as an anatomic solution for distal tibiofibular syndesmotic stabilization. In recent biomechanical studies, suture-button constructs and screw fixation restored comparable stability to the disrupted syndesmosis. However, the suture-button devices allowed translational and rotational motion closer to the native anatomy of the syndesmosis.[28,56–58] Naqvi et al[9] reiterated these findings in vivo—in a cohort study of 46 patients treated with either suture-button versus screw fixation of the syndesmosis, postoperative CT scans at a mean follow-up of 2.5 years demonstrated a more accurate syndesmotic reduction in the suture-button group. Clinically, not only does suture-button fixation obviate the need for prolonged weight-bearing restriction and planned removal, but it has been associated with superior functional outcomes relative to classic metallic screw fixation. In a recent randomized controlled trial by Andersen and colleagues comparing a suture-button construct to a single quadricortical screw for syndesmotic fixation in 97 patients, median functional outcome scores at 2 years were significantly higher for the suture-button group. In addition, radiographic and symptomatic recurrent syndesmotic diastasis was substantially lower in the suture-button group.[59] These findings were echoed by earlier randomized controlled trials comparing suture-button and screw fixation.[29,34]

However, currently available suture-button constructs are not without issues. Most studies investigating the outcomes of dynamic suture-button stabilization of the distal tibiofibular syndesmosis utilize a commercially available system consisting of 2 cortical buttons linked by UHMWPE suture (TightRope; Arthrex).[9,29–34,36–40,42,45,46,59–61] The system calls for the drilling of 1 or 2 quadricortical holes from lateral to medial along the anatomic course of the syndesmotic ligaments followed by the passage of an oblong cortical button to rest on the medial cortex of the tibia. The lateral button is then reduced to the lateral cortex of the distal fibula, and the suture limbs are tensioned and tied over the lateral button, completing the repair. Although there is a slight variation in technique between studies, all systems call for manual suture tensioning and knot tying. Early on, several authors noted issues with lateral suture knot prominence causing discomfort, skin irritation and breakdown, and infection.[9,31,32,36–40,46,59] Discomfort and wound issues led to frequent late reoperation and implant removal, estimated in a systematic review to be 10.5% at a mean of 7.8 months.[62] This high incidence of knot-related complications led several authors to recommend technique modifications including recessing or burying the prominent knot.[39,45,63,64]

In addition to knot-prominence, suture slippage at the knot interface has also been described, resulting in late syndesmosis diastasis and necessitating reoperation.[42] Although there are limited reports of suture slippage related to suture-based constructs for syndesmotic stabilization, knot security has been extensively studied for other applications, particularly tendon repair and ligament reconstruction. Abbi et al[65] found that although UHMWPE suture has superior absolute load-to-failure strength than traditional braided polyester suture, it is prone to early knot-slippage during cyclical loading. Barber et al[66] echoed these findings, demonstrating high rates of "loop failure" secondary to knot-slippage with UHMWPE suture subjected to cyclic loading, regardless of knot configuration. Both authors attributed the high rate of slippage to surface frictional properties of the UHMWPE suture material.

These knot-related limitations and complications have prompted authors to adopt knotless suture-button systems. Recently, a novel knotless adjustable loop suture-button device (ZipTight; Zimmer Biomet, Warsaw, IN) has been used for syndesmotic fixation with good functional results and low rates of hardware irritation and removal.[67,68] However, both studies found concerning rates of late diastasis. Kocadal et al[68] found a significant increase in total syndesmotic and distal tibiofibular volumes measured on postoperative CT scan in patients undergoing knotless suture-button fixation relative to the contralateral ankle. Similarly, Peterson and colleagues evaluated the clinical and radiographic results of syndesmotic stabilization with either 1 or 2 knotless adjustable loop suture-button constructs in 56 patients at a mean of 13.4 months and demonstrated an increase in both the tibiofibular clear space and tibiofibular overlap at final follow-up. The authors also found a mean elongation of 1.1 mm between cortical buttons, which they attributed to gradual suture creep.[67]

Again, there is a paucity of literature on biomechanical properties of adjustable loop constructs specifically for syndesmotic stabilization. The only recent cadaveric study comparing common knot (TightRope) and knotless (ZipTight) suture-button devices to standard screw fixation for syndesmotic fixation demonstrated similar gradual diastasis between both suture-button devices during cyclical and continuous loading. In 1 specimen (10%), the knotless adjustable loop system failed from device loosening.[27] Despite the lack of literature related to syndesmotic stabilization, the risk of suture loosening and loop lengthening with adjustable loop devices has been described in several related biomechanical studies for anterior cruciate ligament reconstruction.[69–76] These findings are particularly concerning in the context of the distal tibiofibular syndesmosis, where every millimeter of diastasis dramatically alters tibiotalar contact forces.[5–7]

In light of the deficiencies of prior systems, the ideal construct for syndesmotic stabilization should have several key features. It should be technically facile to deploy. It should permit anatomic reduction and restore the dynamic physiological motion of the syndesmosis. Knotless fixation should prevent knot-related complications including variable tensioning and knot-prominence and loosening. Last, suture material should be of sufficient strength and stiffness to ensure stable fixation without creep. The continuous loop double endobutton technique described in this technical note fulfills these criteria. It has been shown to have excellent biomechanical strength on cyclical testing and clinically validated for stabilization of the AC joint for both AC joint dislocation and distal clavicle fracture.[47–51] Suture slippage and prominence are eliminated and reoperation for fixation related failure or complication is avoided.

One of the potential limitations of the continuous loop double cortical button system is the accuracy of reduction using a fixed loop size. The continuous suture loop is only available in 5 mm increments, however, the loop length can be effectively adjusted to within 1 mm of the desired size with the use of washers or a supplemental cortical button (Xtendobutton; Smith & Nephew). This modification, as described, permits stable and accurate syndesmotic reduction to within 1 mm. Although, knot tying is employed to secure the lateral cortical button it is not subjected to the same physiological loads as the continuous loop. Consequently, loop security is not a concern and the suture caliber, material, and a number of knots can be minimized to prevent prominence.

Although the continuous loop device prevents lateral knot prominence, hardware prominence remains possible. In the final case of the series, 2 washers and a standard cortical button were combined over a distal fibular plate to maintain the desired loop length for syndesmotic reduction. Only a single cortical button was utilized on the medial cortex of the distal tibia. The prominence of the lateral hardware can be appreciated on the initial postoperative radiographs and was clinically palpable. The patient developed a deep infection with punctate wound breakdown over the lateral hardware necessitating hardware removal. Although the syndesmosis was healed and stable after hardware removal, the patient was subjected to reoperation and prolonged recovery. Even though knot prominence is minimized, lateral hardware prominence may occur and is potentially compounded by the presence of a distal fibula plate. If loop length is to be adjusted with a washer or larger button, these should be distributed evenly between the medial and lateral cortices. In the presence of a distal fibular plate, additional implants may be placed on the medial side to minimize lateral hardware prominence. Using multiple washers on a single side should be avoided.

In our small case series, all patients obtained stable syndesmotic stabilization without subsequent diastasis. Reoperation was required in 1 case that developed a wound complication.

Further studies are warranted to further validate this novel technique and construct for distal tibiofibular syndesmosis stabilization. Biomechanical studies should focus on evaluating the reduction and stabilization of the syndesmosis with this construct relative to the intact state and other common constructs. The effect of drill hole size, trajectory, and number may also be of utility. High-quality clinical studies with clinical and radiographic follow-up are ongoing to compare the continuous loop double cortical button construct to other available systems.

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