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Suture Button Fixation for Syndesmosis Injuries: Review of the Literature

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Abstract

Syndesmosis injuries -also known as high ankle sprains- have an increasing popularity because of an increased awareness of diagnosis. Different from lateral ankle sprains, mechanism of injury mostly involves external rotation, eversion and excessive dorsiflexion. Other mechanisms can also cause sydesmosis injuries. Because of high levels of missed injuries the real prevalence of syndesmosis injuries is underestimated. It is less frequently seen than lateral ankle injuries. For diagnosis, physical and radiological examination is essential.

In radiological examination, associated injuries must be determined if present. Mostly seen associated injury is ankle fracture. Nonoperative treatment provides good results for syndesmosis injuries. Surgical treatment is indicated when syndesmosis injuries include frank diastasis. Arthroscopic view of syndesmotic instability is another indication. Failed conservative treatment may also be an indication. There are a lot of options for surgical fixation. Screws are the most popular among others but there are some complications about them. Alternatively, suture button fixation technique can be used. Suture button fixation is an implant with two metallic buttons surrounded with thick fiberwire sutures. Its stabilization mechanism depends on compression of two buttons to opposite sites by the help of fiberwire. It is designed to resist diastasis but allows small movement to other planes. It is very suitable for fixation of syndesmosis injuries and also to have less complication rates. Purpose of this study is to discuss the syndesmotic injuries and review the suture button fixation technique for the treatment.

Keywords: Syndesmosis injuries; Ankle sprains; Antero inferior tibiofibular ligament; Osteochondral

Introduction

Syndesmosis injuries, also known as high ankle sprains, have an increasing popularity because of an increased awareness of diagnosis [1]. Injury spectrum includes syndesmotic ligament and interosseos membrane injuries and ankle fractures with syndesmotic disruption [2]. Because of high levels of missed injuries the real prevalence of syndesmosis injuries is underestimated [1]. It is less frequently seen than lateral ankle injuries [3]. The incidence differs between 1% to 18% in different studies [4-9].

Anatomy and Mechanics

Syndesmosis composed of tibia and fibula. It is a very stable joint however fibular movement occurs to accommodate talus during gait [10]. Tibia and fibula are connected to each other with four major ligamentous structures. Anteriorly, the antero inferior tibiofibular ligament (AITFL) lies and it provides 35% of overall ankle stability. Second one is the interosseos ligament (IOL). It is the shortest one but the primary attachment between tibia and fibula. It also provides 22% of stability. The third one is the interosseos membrane (IOM) found at the superior aspect of IOL. It prevents posterolateral bowing of fibula and play role in load sharing ability of fibula. The fourth one lies posteriorly and named as posterior inferior tibiofibular ligament (PITFL). It has two portions known as superficial and deep (transverse tibiofibular ligament). Deep portion provides 33% and superficial portion provides 9% of ankle stability. Failure of two of these ligaments leads to mechanical laxity of syndesmosis [2,3,8,10,11]. Syndesmosis widens 1.5 mm physiologically while ankle dorsiflexion [8]. It is showed that failure of total PITFL leads the most syndesmosis widening among other ligaments [10,12].

Mechanisms of Injury

Injuries to these four ligamentous structures lead to separation of syndesmosis. Different from lateral ankle sprains, mechanism of injury mostly involves external rotation, eversion and excessive dorsiflexion [1,3]. Less commonly seen mechanisms are dorsiflexion with axial loading, eversion, inversion, plantar flexion, pronation and internal rotation [4,7,13-17]. In most complete syndesmotic distruptions external rotation causes a Weber B or C fracture with syndesmosis widening [18,19]. When the ankle is in neutral position, excessive external rotation causes injury to only tibiofibular ligaments without damaging other structures. External rotation mechanism mostly seen in American football and skiing [20,21]. Hyperdorsiflexion mechanism is mostly seen in running and jumping like sports [4].

Diagnosis

Diagnosis of syndesmotic injuries are based on careful physical examination [2,22]. Pain and tenderness on the anterior aspect of syndesmosis are the most common findings [22]. In pure ligamentous injuries, squeeze test (Hopkins test) and external rotation under stress test (Kleiger test) may be useful [1,3,9,10,22]. External rotation stress test found more reliable than squeeze test [1]. There are some other tests uncommonly performed like cotton test, cross leg test and stabilization test [9,10].

Radiological examination always starts with antero-posterior (AP), lateral and mortise views of ankle [1,2,22]. Direct radiology usually

used to rule out ankle fractures and detect syndesmotic separation [10]. The criteria for syndesmotic distruption are increased tibiofibular clear space, decreased tibiofibular overlap and increased medial clear space. Tibiofibular clear space should be < 6 mm in both AP and mortise views. Tibiofibular overlap should be > 6 mm in AP and > 1 cm in mortise view. Medial clear space is equal to or less than superior clear space between talar dome and tibial plafond [9,10,22] (Figure 1A and 1B). All injuries out of normal values for these measurements indicate syndesmotic injury. Stress radiographs are also useful for diagnosis [22].

Computed tomography (CT), magnetic resonance imaging (MRI) and arthroscopy are the advanced diagnostic methods for syndesmotic injuries [1,9,10,22]. CT can detect minor separations. MRI is highly sensitive and specific [22]. MRI also shows associated injuries like osteochondral lesions [1]. Bone scintigraphy is also can be used for detection of occult syndesmosis injuries. Arthroscopy allows clear vision to injury site and provides definite diagnosis for syndesmotic disruption [3,8]. Arthroscopy is a good support for accurate diagnosis.

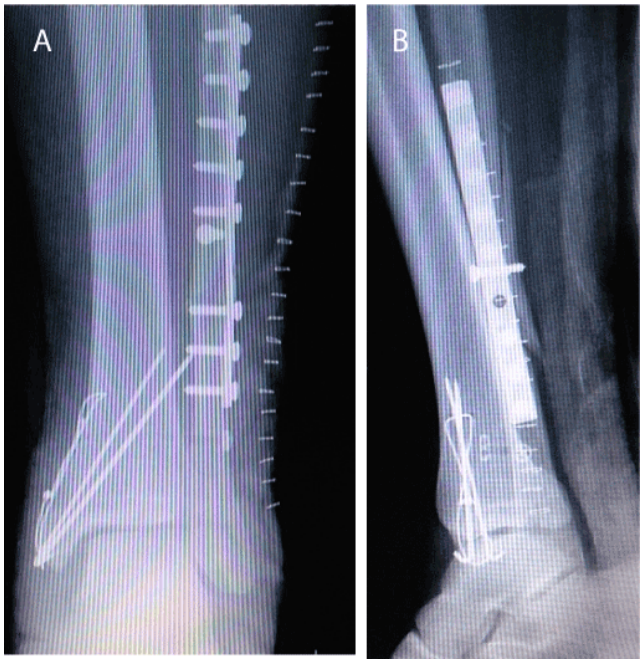

Figure 1: Post-operative anterio-postral; 1B: post-operative lateral.

Treatment

Syndesmotic injuries without fracture and separation can be treated conservatively [3,8,23]. Initial treatment starts with rest, ice, elevation and nonsteroidal anti-inflammatory drugs [3,23]. Immobilization like bracing or casting can be added to treatment according to degree of pain. Recovery time is prolonged in conservative treatment [8]. After one to six weeks rehabilitation can be started to restore function and strength of ankle [9,23]. Non-operative treatment provides good results over 86% of all syndesmosis injuries [23,24].

Surgical treatment is indicated when syndesmosis injuries include frank diastasis. Arthroscopic view of syndesmotic instability is another indication [10]. Failed conservative treatment may also be an indication.

Syndesmosis reduction and transsyndesmotic fixation is performed for standart surgical procedure [10]. Metallic screws are used for fixation implant classically. Besides metallic screws there are some alternatives for fixation which are; bioabsorbable screws, syndesmotic staple, ilizarov ring fixator, kirchner wires, flexible implants (suture buttons), syndesmotic hook, trans-syndesmotic bolt, cerclage wires, ANK nail or ligamentoplasties [25-39].

There is no agreement on number of screws, size of screws, optimal number of cortices, position of screws relative to tibiotalar joint, weight bearing time after surgery [24]. There are some problems reported about conventional screw fixation. These are; screw loosening, screw breakage, stiffness, prolonged non weight bearing for protection of screw, synositosis, second operation for screw removal, late diastasis after screw removal because of insufficient fixation time [40-44].

Because of all these problems, some alternative fixation implants used or newly developed as listed above. The aims of the alternative fixation methods are; stable and flexible fixation, no need for second surgery, early weight bearing and functional recovery and less post-operative complications.

Suture Button Fixation

Suture button fixation is an implant with two metallic buttons surrounded with thick fiber wire sutures. Its stabilization mechanism depends on compression of two buttons to opposite sites by the help of fiber wire. It is designed to resist diastasis but allows small movement to other planes. It can be performed as an open technique in syndesmosis with ankle fractures, also can be performed percutaneously in isolated syndesmosis seperations. The studies about suture button started with cadaver study on 2003 and after this, clinical trials, fixation comparisons and reviews were published.

Thornes et al. in a cadaver study compared external rotation strength of four cortices screw and suture button fixations. There is no significant difference between groups in loading test. Suture button give more consistent performance than screw [31].

Thornes et al. in their study; compared suture button fixation and screw fixation techniques in 16 patients retrospectively. Suture button fixation had better AOFAS scores and they return to work earlier than screw group. It is an easy technique, safe, effective and has high patient satisfaction. It is also found cost effective because there is no need for second surgery for implant removal [32].

Cottom et al. reported 25 cases of syndesmosis separation treated with suture button fixation (Tight-Rope, Arthrex Inc.) technique. They found this technique as a valid, safe and cost effective. They also recommended; performing of two suture buttons may be more useful for in Weber C or communicated Weber B type fibula fractures [45].

Thornes and McCartan published a case review series treated with suture button (Tight-Rope, Arthrex Inc.) at 2006. They found no loss of reduction, no major complications and no patient underwent to second surgery for implant removal. They recommended that joint dislocation, age > 50 and female sex are all associated with poor outcome [46].

Coetzee and Ebeling, in their study; evaluate the indications of suture button. In their prospective serie suture button (Tight-Rope, Arthrex Inc.) group had similar results when compared to screw group

but suture button group had better range of motion measurement, less stiffness and less discomfort [47].

Soin et al. in their biomechanical study; compare loading differences of suture button and screw fixation. They found similar results between groups in cyclic loading. Neither of the groups could not restore the native ankle motion [48].

In another biomechanical study, Klitzman et al. determine more physiologic fibular movement in sagittal plane at suture button fixation than screw fixation. They concluded that filexible fixation like suture button provides more physiologic healing to syndesmosis [49].

Degroot et al. published outcomes of suture button fixation. They recommend that suture button fixation needs more second surgery for implant removal than known before. Osteolysis may occur near the button and subsidence of implant may occur [50].

Teramoto et al. compared different suture button fixation techniques that are single, double and anatomical suture button fixations in cadaver specimens. Finally they said, neither of single or double suture button fixation could not provide multidirectional stability but anatomical fixation directed from posterior cortex of fibula to anterolateral edge of tibia provides dynamic stabilization [51].

Rigby and Cottom published their two year follow-up with suture button fixation (Tight-Rope, Arthrex Inc.). They concluded that this technique provides long term stability of ankle mortise [52].

In two review studies in 2012; Suture button fixation technique found similar to screw fixation but it has more advantages like it is less invasive, easily performed, safe and effective for syndesmosis separations. There is also less need to second surgery for implant removal and earlier return to work [21,53].

Storey et al. determined the complications of suture button syndesmosis. Fiber wire skin irritation, osteolytic reaction, rediastasis are the most seen complications. These complications could be prevented by Laying the fiberwire flat, remove the implant in case of osteolysis and make a mini medial incision for improving the stability of medial button for rediastasis [54].

The author's technique includes percutaneous suture button fixation for isolated syndesmosis injuries. If associated with Weber C fibula fractures the preferred fixation with the suture button is to perform it distal to the plate fixation of fracture mostly (Figure 2A and 2B). If associated with Weber B fibula fracture the suture button usually performed from the screw hole of the plate at the level of 1 cm proximal to syndesmosis [55,56].

Conclusion

Among all these fixation techniques for syndesmosis injuries, suture button fixation has a lot of advantages besides its complications. This technique is less invasive, it may be performed percutaneously for isolated injuries. It needs less second surgery-for implant removal-among all other techniques so it has less morbidity to patient and it is more cost effective. It can be easily performed, technique is easy and practical because it has a sterile application kit. It is a very physiological fixation method because it provides flexible fixation and this also allows to patient early return to work. Besides all these advantages this technique also has high patient satisfaction.

Although suture button fixation has some complications, they are seen less than complications about other techniques and usually about metallic and fiber wire based complications. They are all preventable and correctable. Fiber wire skin irritation, osteoloytic reaction and rediastasis are mostly seen complications.

Among all these studies suture button fixation seems a very good choice for syndesmosis injuries. It may be the first fixation choice for many orthopaedic surgeons.

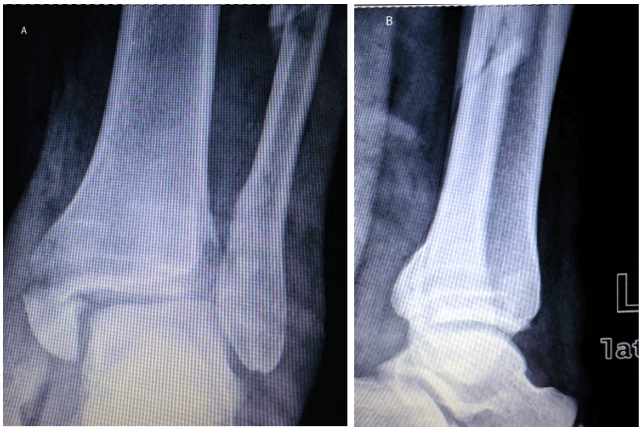

Figure 2: Pre-operative anterio- postral 2B: Post-operative lateral

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