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What is the Effective Technique for Syndesmotic Stabilization Tight Rope or Screw?

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Abstract

Background: Complex syndesmotic ankle injuries (SAI) require restoration of normal biomechanics aiming to minimize expected complications.

Aim: The purpose of this study was to compare tightrope (Arthrex) technique in syndesmotic injury versus 3.5 mm tricortical trans-syndesmotic screw in terms of accuracy and syndesmosis reduction.

Methods: prospective clinical for twenty-two patients presented by SAI randomly allocated into two groups. Group A was fixed using tightrope technique, while group B fixed using 3.5 mm trans-syndesmotic cortical screw. All patients underwent clinical examination, radiological investigations, functional evaluation using American Orthopedic Foot and Ankle Society (AOFAS); preoperative, 6th, 12th and 17th months as follow up. SPSS was used for statistical analysis.

Results: The mean participants' age was (39.4±3.7) years and mean follow up was (15.7±3.4) months. The study showed that AOFAS scores were better in Tightrope group (P value < 0.018); with faster weight bearing (4.9 weeks), which required 6 weeks in tricortical trans-syndesmotic screw group. Along follow up period, tightrope group was shown higher range of motion (ROM) than group B (P value < 0.042). Moreover, tightrope group not required secondary implant removal. Conclusion: Tightrope technique provides alternate safe, efficient SAI fixation and advantageous early weight bearing, plus long-term stability that radiologically confirmed as well shown higher AOFAS scores.

Keywords: Tightrope; Screw fixation; Syndesmosis; AOFAS scores; Ankle stability

Abbreviations: SAI: Syndesmotic Ankle Injuries; AOFAS: American Orthopedic Foot and Ankle Society; ROM: Range of Motion

Introduction

SAI may occur in 10 up to 15% in patients presented with ankle fractures commonly associated with pronated, external rotated ankle injuries, [1] or Weber C fractures, and around 20% of ankle fractures require surgical stabilization [2]. Most misdiagnosed SAI complicated by chronic ankle pain, rapid degeneration, functional disabilities, instability and latent diastasis [3,4]. Evidence gap still prove a specific and standard care for SAI; fixation technique, screws size and numbers of cortices and weight bearing progression. On the other hand, drawbacks of SAI fixation presented some complications including limited ankle mobility, delayed weight bearing, risk of screw breakage and necessity of its removal [5,6], which may complicate by wound infection, screw breakage or syndesmotic diastasis [7].

Numerous studied confirmed that tightrope SAI fixation is a minimal invasive technique, which allows micro syndesmosis motion throughout reduction with least pain, and longer stability that permits early patients mobility, weight bearing and faster return to work. Furthermore, it was advised for osteoporosis (snowshoe, hold on cortical bone), while screw fixation may lead to cut out due to low screw breakage risk or need for its removal [8,9]. Otherwise, loose tightrope may lead to later syndesmosis diastasis [10]. Recently, tightrope technique was highly recommended for SAI, as well for isolated syndesmosis separations. The purpose of the current study was to compare tightrope procedure (Arthrex, Naples, FL, USA) versus 3.5 mm tricortical trans-syndesmotic screw in terms of accuracy and adequate syndesmosis reduction.

Patients and Methods

Twenty-two patients were management in this prospective study from February 2016 to July 2017. The eligible patients mean ages was (39.4±3.7), were included if have SAI that are sustained distal tibiofibular (tibiofibular clear space "TFCS" >6 mm on A/P or mortise radiographs or tibiofibular overlap "TFOL" <6 mm on A/P radiographs or <1mm on mortise radiographs, or medial clear space "MCS" >5mm on A/P radiographs) [11], syndesmotic diastasis with or without ankle fractures less than 4 weeks. Patients were excluded if they had polytrauma or open fracture, open growth plates, uncontrolled diabetes mellitus and neuropathic arthropathy.

Each patient had signed a written informed consent then all patients were randomized allocated into two groups. Every patient

underwent complete clinical examination and preoperative, 6th, 12th and 17th months follow up specific radiological investigations; functional evaluation using American Orthopedic Foot and Ankle Society (AOFAS), total 100 points divided into nine items grouped into three categories; (pain: 40 points, functional abilities: 50 points, alignment) [12].

Tightrope Structure

Tightrope implant (Arthrex, Naples, FL, USA) consists of two-button construct (titanium or stainless steel), and two No.5 braided fibre suturing wire, when tensioned provide ankle mortise stability, where previous clinical trials reported its equivalent strength that improve clinical outcomes [13].

Surgical Procedures

Both tightrope and screw SAI fixation techniques were almost similar procedures, where tightrope used one device, but may augment by another one in highly unstable distal tibiofibular joint or screw technique used one tricortical screw. Open reduction and internal fixation of ankle fractures, almost syndesmotic diastasis reduced spontaneously. While, remaining diastasis were reduced primary by reduction clamp placed across ankle and compressed SAI then reduction maintained by the tightrope or screw which were inserted directly, through fibula or fibular plate`s hole, in case of fibular fracture.

In tightrope fixation all fractures were stabilized prior to tightrope insertion. Once a plate fixed to distal fibula, one or more cortices screw holes (2-5 cm above tibial plat fond using 3.7 mm drill bit) used for tightrope. A guide wire using cannulated drill bite was recommended to confirm accurate drill positioning prior by fluoroscopy, guided suturing along drill holes to intact medial skin, where button seated direct on medial cortex that confirmed by C-arm. Flipping was done by transmitting medial pressure from the needle to fibre wire suture laterally then toggling the two pairs, which ensured endobutton flat seating preventing later losing. With reduction clamp in place, both ends of fibre wire tensioned on lateral side providing compression on buttons aiming to maintain syndesmosis reduction (Figure 1). In screw fixation; with ankle in neutral position used a 3.5 mm cortise screw was inserted into previously drilled 2.5 fibular hole 30° from posterior to anterior up to lateral tibial cortex, just inferior to inferior tibiofibular joint, parallel to tibial plafond (Figure 2).

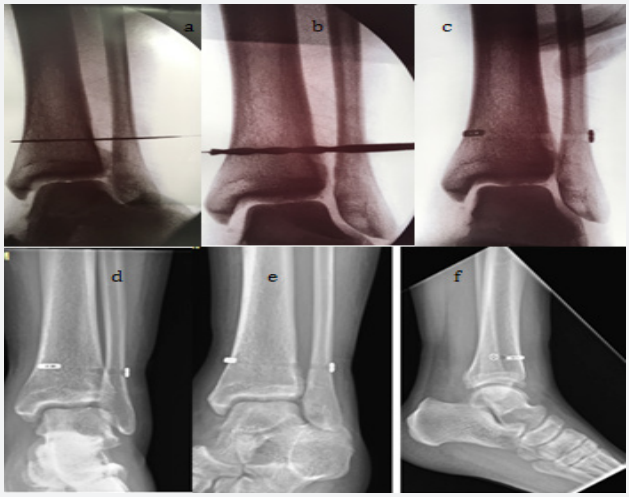

Figure 1: Surgical technique for tightrope;
a & b: guide wire using cannulated 3.7 drill bite.
c: suture button seated in medial cortices and fibre wire on lateral malleolus.
d, e & f: post-operative follows up of reduced syndesmosis by tightrope.

Figure 2:
A. Bi malleolus Potts Fracture with Weber C,
B. post-operative screw fixation.

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Results

Twenty-two patients with syndesmotic disruption were management with tightrope or screw, the mean age was (39.4±3.7) years. There were 17 patients sustained ankle fractures; 9 patients presented Weber C fracture and 8 patients Weber B fracture, plus 5 patients have been diagnosed isolated syndesmosis diastasis (Table 1).

Table 1: Demographics characteristics of study population.

	Age	Gender	Side of Injury	Fracture Pattern	Associated Injury
	Mean± SD				Mean± SD
Tightrope Group A	41.6±2.1	4M:7F	8Lt:3Rt	5B:4C; 2 Isolated	6Lat. M; 3Tri M.
Screw Group B	38.3±1.7	6M:5F	6Lt:5Rt	4B:4C; 3 Isolated	4Lat M;3 Bi M;1 Delt R
Total	39.4±3.7				

SD: Standard deviation; Lat M: Lateral Malleolus; Tri M: Trimalleolus; Bi M: Bimalleolus; Delt R: Deltoid Repair

Figure 3: Syndesmotic disrupture with dislocation at distal tibuofibular joint, post-operative reduced by two tightropes through hole of fibular plate.

Figure 4: A: Medial malleolus fracture with type C Weber, B: Post-operative fixation ORIF by fibular plate and screw for medial malleolus, tightrope for syndesmotic disrupture.

Table 2: Comparative outcomes between Tightrope and screw groups.

	Pre-Op Period	Time Wt.-B	AOFAS				Complications
			Pre-	6th	12th	17th	
Tightrope Group A	3.64	4.93±2.7	16	92.82	92.4	94.36	Skin Irritation, Superficial infection
Screw Group B	5.18	8.21±2.3	16	81.55	85.91	87.1	Broken, Prominent Screw, Dehisned Skin
P-Value	4.27	6.36±1.7 16 3.8 2.05				1.3	
Sig.	0.13^{NS}	0.042^{**}	0.7^{NS}	0.06^{*}	0.041^{**}	0.042^{**}	

*: (P-value≤0.05). **: (P-value≤0.01).

Per-Op: Pre-Operative; TWt-B: Time to Weight Bearing; AOFAS: American Orthopedic Foot and Ankle Society; NS: Non-significant

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In tightrope group A, 6 patients presented by fracture lateral malleolus associated with syndesmosis diastases were spontaneously reduced post fracture fixation then tightrope inserted through fibular plate hole. Other 2 patients presented isolated syndesmosis disruption, and single tightrope was done. One case presented with complete torn syndesmotic diastasis with dislocation at distal tibiofibular joint so added another tight rope to restore ankle stability and augmented by small lateral plate without screws (Figure 3), two patients presented trimalleolar fracture and underwent medial malleolar screws and one tightrope done. Uneventful complications reported, unless one case had lateral side superficial infection and another one had a small stitch irritation on medial side (Table 2). There are two cases had been evaluated at 6th and 12th months follow up period but lost after that (Figure 4).

In screw group B, 3 patients presented isolated syndesmosis diastases managed by one screw tricortical insertion. Another 4 patients underwent standard fibula plate plus syndesmosis screw fixation. As well, 3 patients presented bimalleolar Potts fractures and medial malleolar fixation plus tricortical syndesmosis screw were done. Only one patient underwent deltoid repair (MCS > 5mm). Furthermore, complicated cases at follow up period were reported as, one patient underwent a large fragment removal due to prominent screw head, another one broken screw accidentally discovered throughout routine implant removal and that patient presented by intermittent lateral ankle pain (Table 2). Other patient was presented with dehisned wound and superficial infection after removed of screw.

The mean follow up average was (15.7±3.4) months, and AOFAS were significantly higher in tightrope group versus screw group (91:80; 93:83 and 94:86) by 6th, 12th and 17th months follow up, respectively (P value < 0.018). Average time delayed non-weight bearing 4.9 weeks (range .3.5-6W) versus 6Weeks (range4-12W) in screw group (P value < 0.042), and routine screw removal after 8-12 weeks (Table 2). Finally, the study results shown that tightrope group had significantly better ROM (P value < 0.054) than screw group (P value < 0.018), (Table 3).

Table 3: Comparative ROM between Tightrope and screw groups.

	Normal		Syndesmosis				P-Value	Sig.
		Pre-	Pre-	6th	12th	17th		
Tightrope Group A	DF	11	3	6	10	12	0.041	0.042**
	PF	55	10	45	55	55	0.036	
Screw Group B	DF	10	6	10	10	9	0.042	
	PF	56	12	41	44	48	0.032	

NS: Non-significant. **: (P-value≤0.01). DF: Dorsi flexion. PL: Planter flexion. Per: Pre-Operative.

Discussion

Tightrope stabilization of a syndesmotic injury has been shown as an alternative that has significant outcomes and is more physiological than standard screw techniques [14]. The dynamic flexible fixation of tight rope permits micro-movement of the distal tibiofibular joint, which provides better outcomes in terms of mobility, accelerated ligament healing, earlier return to full weight-bearing and returns of physical abilities, as well unnecessary implant removal [15].

The present study has been shown that tightrope technique provides long standing and accurate syndesmosis reduction, better mobility, plus faster functional abilities, with significantly higher in AOFAS scores, range of motion and full-time weight bearing when compared the screw group along the latest follow up period. Furthermore, the study reported minor complications about (18%) one case skin irritation at medial ankle side, and another case had superficial infection at lateral malleolus when compared with screw technique about (27%), broken screw, prominent head of screw and diastasis after removal of screw, especially within second intervention, while routine implant removal.

The present result coincide with, Thomes et al. [16] reported that tightrope technique permitted earlier weight bearing, and stated its safe, efficient and simple nature versus screw technique, which required second removal surgery. In terms of functional abilities, it was reported higher AOFAS in patients underwent tightrope fixation than screw technique [17,18]. Plus, tightrope fixation patients were permitted earlier weight bearing (4.1 weeks) with no need for further surgical interventions as reported by Naqvi et al. [19] in advance no loading failure or residual diastasis were reported even with accelerated full weight bearing [20-22].

Cottom et al. [23] also reported that it was accelerated early weight bearing in the tightrope group with no complication such as implant failure or removal was noted. Degroot et al. [18] demonstrated that shorter average time to full weight-bearing of 5.7 weeks using tightrope, with no complication of implant failure or residual displacement at a follow-up of 2years. On the other hand, in this study usage of second tight rope was occurring in highly unstable distal tibiofibular joint with improper fixation by single device. This agree with Naqvi et al. [19] usage of extra tightrope implant to gain accurate syndesmosis reduction was advised in 26% of population study and 75% as confirmed by DeGroot et al. [18] to prevent later enlarged tibial hole or implant subsidence or in case of oseolysis. This study was undertaken routine removal of syndesmotic screws range from 8-12 Weeks, however, did not occur routinely at tight rope group. Moreover, Schepers et al. [24] recommended no significant differences when elective screw removal or not, additionally routine screw removal procedure as second intervention, commonly associated with complication more than 20% with both recurrent diastases or

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wound infection risks [25], In contrary, tightrope implant removal was not required, even in case that will be minor invasive with no definite evidence reported, yet [26].

In same context with previous studies, screws placement level determines the protection period prior allowing patient to weight bearing that directly affects mobility in term of ROM [27]. Cottom et al. [23] demonstrated that tightrope technique has a valid, safe and least cost with low irritation, infection risks. They also recommended; performing of two suture buttons could also be more useful for in Weber C or comminuted fibular fractures. Furthermore, Klitzman et al. [28] confirmed tightrope permits more flexibility than screw technique through using suture button fixation, which was accelerated the physiological healing of syndesmosis. Moreover, Rigby and Cottom ensured that less invasive nature of tightrope technique provides advantageous ankle stability for rediastasis [29] than screw fixation, where the later had routine second intervention for implant removal by 8-12 weeks.

Storey et al. [30] determined potential the disadvantages of tightrope such as skin irritation by fibre wire, rediastasis loosening due to osteolytic reaction, are the most common complications. They has been recommended to remove the implant just in case of osteolysis [30]. The current study had some limitation those should be addressed in future clinical trials, which are small sample size with absence of control group, plus potential bias concerning clinical picture and radiological evaluation. Although satisfactory outcome were reported in all nine-patient treated by Tightrope stabilization of the distal tibiofibular joint does not appear to be a major problem this study has shown that. Finally, Tightrope and screw fixation of the injured syndesmosis provided effective reduction of the syndesmosis, each with its advantages and disadvantages [31].

Conclusion

The dynamic stabilization or flexible fixation was done by tightrope provides an alternate to static fixation done by syndesmotic screw features a lot of advantages besides its complications. It permits remarkable earlier return to work with longer efficient syndesmosis reduction and better stability, as well preventable risks and correctable complications. In screw fixation group achieve rigid fixation with lack of mobility at syndesmosis to achieve ligament healing, however hardware removed had done routinely at a later date with minor complications attributable such as broken, prominent screw and superficial infection.

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Conflict of Interest

No conflict of interest.

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