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Surgical Treatment of Distal Tibiofibular Syndesmosis Injuries Using Open Reduction Internal Fixation by Plate and Screws: A Case Series and Literature Review

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Abstract: Treatment of distal tibiofibular syndesmosis injuries requires an early and accurate reduction to prevent poor outcomes. Screw fixation technique remains the gold standard for syndesmosis injuries despite the increasing popularity of suture button fixation. We report the cases of three patients with acute distal tibiofibular syndesmosis injuries treated by open reduction and internal fixation using a plate and two screws. The objective of this study was to describe a different syndesmosis fixation technique with a two holes one-third tubular plate and two screws, relate the radiologic findings and analyze the functional outcomes. Clinical and functional outcomes were assessed using the American Orthopaedic Foot and Ankle Society Ankle-Hindfoot scale. Reduction of the syndesmosis was assessed radiographically by measuring the tibiofibular clear space, tibiofibular overlap, and the medial clear space at the final follow-up. Compared to preoperative values, postoperative values were improved with this method. Our findings suggest this new technique as a safe and reliable option to consider for the treatment of acute distal tibiofibular syndesmosis injuries. The main advantage is an optimal positioning of the screws on the lateral fibular cortex in the anteroposterior plan with an ideal space between them.

Keywords: Ankle Injury, Syndesmosis Disruption, Open Reduction, Internal Fixation

1. Introduction

Syndesmosis injuries are commonly encountered clinical conditions, arising in 5% to 10% of all ankle sprains and 23% of all ankle fractures [1]. Syndesmosis consists primarily of the anterior inferior tibiofibular ligament (AITFL), posterior inferior tibiofibular ligament (PITFL), interosseous membrane (IOL), and transverse tibiofibular ligament (TTFL), that plays an important role in the function and stability of an ankle joint [2]. The disruption of the distal tibiofibular ligaments occurs mainly through an external rotation mechanism or hyper dorsiflexion [3]. These injuries can lead to ankle joint failure and poor functional outcomes [4]. Therefore, accurate reduction with restoration of ankle mortise is mandatory [5]. Current guidelines for acute unstable injuries are surgical treatment [6].

We describe an innovative surgical method for syndesmosis injuries adding a two holes one-third tubular plate to the standard screw fixation. We hypothesize that open reduction and internal fixation (ORIF) with this technique provide good clinical and radiologic outcomes with a low rate of complications (infection, loss of fixation, screw breakage).

We report our findings in a long-term follow-up of three patients treated by ORIF. The functional outcomes were analyzed using the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot scale (Table 1) [7].

Table 1. *The questionnaire based on the hind foot score of the American Orthopaedic Foot and Ankle Society.*

	Points
PAIN (40 points)	
None	40
Mild, occasional	30
Moderate, daily	20
Severe, almost always present	0
FUNCTION (50 points)	
Activity limitations, support requirement	
No limitations, no support	10
No limitation of daily activities, limitation of recreational activities, no support	7
Limited daily and recreational activities, cane	4
Severe limitation of daily and recreational activities, walker, crutches, wheelchair, brace	0
Maximum walking distance, blocks	
Greater than 6	5
4-6	4
1-3	2
Less than 1	0
Walking surfaces	
No difficulty on any surface	5
Some difficulty on uneven terrain, stairs, inclines, ladders	3
Severe difficulty on uneven terrain, stairs, inclines, ladders	0
Gait abnormality	
None, slight	8
Obvious	4
Marked	0
Sagittal motion (flexion plus extension)	
Normal or mild restriction (30° or more)	8
Moderate restriction (15°-29°)	4
Severe restriction (less than 150)	0
Hind foot motion (inversion plus eversion)	
Normal or mild restriction (75%-100% normal)	6
Moderate restriction (25%-74% normal)	3
Marked restriction (less than 25% normal)	0
Ankle-hind foot stability (anteroposterior, varus-valgus)	
Stable	8
Definitely unstable	0
ALIGNMENT (10 points)	
Good, plantigrade foot, midfoot well aligned	10
Fair, plantigrade foot, some degree of midfoot malalignment observed, no symptoms	5
Poor, nonplantigrade foot, severe malalignment, symptoms	0
Total =	100

2. Patients and Methods

We report a series of three patients with acute syndesmosis disruption treated by ORIF using a two holes one-third tubular plate and two screws.

All surgical procedures were performed by an experienced trauma surgeon in a trauma center level 2 (Table 2). At follow-up patients were examined by one orthopedic surgeon (K. H). Clinical evaluation was assessed using the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle Hindfoot scale and with the comparison of range of motion (ROM) by reporting the difference of the dorsiflexion and plantar flexion angles of the operated side from the healthy side. Radiographic measurements were based on the anteroposterior (AP) x-ray and the comparison of the following three preoperative and postoperative parameters: the medial clear space (MCS) (normal value $\leq$ 4 mm) [3], the tibiofibular clear space (TFCS) (normal value $\leq$ 6 mm) [3] and the tibiofibular overlap (TFO) (normal value $\geq$ 6 mm) [3].

Table 2. *Baseline characteristics.*

		Patient 1	Patient 2	Patient 3
Age (years)		51	41	50
Mechanism		External rotation + pronation	External rotation + pronation	Unclear mechanism
Follow-up (months)		42	49	11
Postoperative AOFAS score		86	81	82
Difference of dorsiflexion angles		3°	6°	4°
Difference of plantar flexion angles		5°	8°	10°
MCS (mm)	pre-op	6.5	4.4	8.2
	post-op	2.2	3.0	1.8
TFCS (mm)	pre-op	5.7	9.7	9.1
	post-op	4.0	5.5	3.7
TFO (mm)	pre-op	1.1	0.4	1.9
	post-op	3.1	1.8	5.7
Time to return to work (months)		3	4,25	4

Abbreviations: AOFAS, American Orthopedic Foot and Ankle Society; MCS, medial clear space; TFCS, tibiofibular clear space; TFO, the tibiofibular overlap.

2.1. Description of the Surgical Technique

The patient was positioned supine on a radiolucent table with a sandbag under the ipsilateral buttock. A single shot of antibiotic (Cefuroxime: 1.5 g IV) was given 30 minutes before skin incision. The limb was exsanguinated before tourniquet inflation. A 3 cm lateral incision was made first followed by a 1 cm medial incision to introduce the reduction clamp. The fixation was done under fluoroscopy with a two holes stainless steel one-third tubular plate from Biomet® (Zimmer-Biomet, Warsaw, Indiana, United-States) placed 2 cm above the distal tibiotalar joint line. Three cortices were drilled successively by a 2.5 mm and 3.5 mm drill. Two 3.5 mm cortical screws were placed 20 to 30 mm proximal and parallel to the tibiotalar joint line with the foot in maximal dorsiflexion (Figure 2).

Figure 1. *Patient 1 preoperative x-rays.*

2.2. Patients

Patient 1:

The first case was a 51-year-old patient, without a past medical history, who slipped on ice. The mechanism of injury was an external rotation and pronation of the ankle. Immediately, he felt pain with difficulty to bear weight. The radiological assessment revealed an isolated injury of the distal tibiofibular syndesmosis (Figure 1). Radiologic indicators measured on the anteroposterior (AP) x-ray for the diagnosis were: the medial clear space (MCS), the tibiofibular clear space (TFCS) and the tibiofibular overlap (TFO). Preoperative MCS was 6.5 mm, TFCS was 5.7 and TFO was 1.1 mm. The surgical procedure was performed without complications. A posterior leg splint was applied for 6 weeks without weight bearing. Active ankle motion exercises and full weight bearing were allowed at 6 weeks.

Figure 2. *Patient 1 postoperative x-rays.*

Patient 2:

The second case was a 41-year-old patient, without a past medical history, who fell from a ladder at a height of two meters. He twisted his left ankle with a mechanism of external rotation and pronation. On the x-rays, a Maisonneuve fracture was diagnosed with a slightly displaced medial malleolar fracture and a distal tibiofibular syndesmosis injury. The MCS measured was 4.4 mm, the TFCS was 9.7 mm and the TFO was 0.4 mm. The surgeon decided not to fix the medial malleolar fracture which was stable on peroperative fluoroscopy. The surgical procedure was performed without complications. Postoperative immobilization and physiotherapy protocol were the same as patient 1

Patient 3:

The third case was a 50-year-old patient, without a past medical history, who felt on the street. The mechanism was unclear. Immediately, he felt pain with swelling and difficulty to walk. The radiological assessment shows a distal tibiofibular syndesmosis injury with a posterior malleolar fracture. The MCS measured was 8.2 mm, the TFCS was 9.1 mm and the TFO was 1.9 mm. Surgery was planned on the same day of the

trauma. The surgeon decided to stabilize the syndesmosis without fixing the posterior malleolar fracture. The surgical procedure was performed without complications. Postoperative immobilization and physiotherapy protocol were the same as the two previous patients.

Figure 3. *Patient 2 preoperative x-rays.*

Figure 4. *Patient 2 postoperative x-rays.*

Figure 5. *Patient 3 preoperative x-rays.*

Figure 6. *Patient 3 postoperative x-rays.*

3. Results

In our study, the mean age of our patients was 47.3 years and the mean follow-up time was 34 months (Table 2). The mechanism of trauma was external rotation and pronation of the ankle for two patients and unclear for the third one. The mean postoperative AOFAS score was 83 points (range, 81-86). All patients had scores considered as 'good result'. Considering the range of motion, the mean difference of the dorsiflexion angles of the operated side from the healthy side was 4.3° (range, 3-6), and the mean difference for plantar flexion angles was 7.6° (range, 5-10). All radiographic parameters were improved compared to the preoperative values: the mean MCS was decreased from 6.36 mm to 2.33 mm, the mean TFCS decreased from 8.16 mm to 4.4 mm and the mean TFO increased from 1.13 mm to 3.53 mm. The mean time to return to work was 3.75 months. No postoperative complications were noted.

4. Discussion

Early fixation of unstable distal tibiofibular syndesmosis is mandatory [6]. Adequate reduction is needed to restore the normal anatomy of the ankle allowing thus the ligaments to heal [8].

There are different ORIF methods for syndesmotic injury like syndesmosis hooks, bioabsorbable screws and suture-button fixation (Endo Buttons and Tightrope device) which became popular in the last decade [9].

The theoretical advantages of a suture-button device are that it allows physiologic motion at the syndesmosis while maintaining the reduction. It has less risk of hardware pain and there is no need to remove the knot routinely. In addition, this technique may permit earlier return to motion as there is no risk of screw breakage and subsequent recurrent syndesmotic diastasis [10]. Nevertheless, this method has some disadvantages with a higher cost compared to the screws [11]. Some cases of conflict between the soft tissues and the knot have also been reported requiring a revision surgery [12].

Currently, screw fixation remains the "gold standard" for syndesmosis injuries [8, 13, 14]. It has been shown to be an easy and safe technique with good functional outcome [15, 16]. The main advantage of this method is that it can maintain reduction of distal syndesmosis under any weight condition. Furthermore, screw fixation provides a rigid construct in which ligaments healing can take place [17]. The most common complications of this technique are screw loosening or breakage and a higher rate of implant removal [13].

The present study reports a different syndesmosis screw fixation method by adding a tubular plate. The mean patient follow-up in our study was of 34 months.

The technique has shown good clinical results with a mean postoperative AOFAS score of 83 points compared to the study of Stiene et al. in which the average AOFAS score for the screw fixation group was of 86.48 points with an average follow-up of 38.72 months [8].

In comparison with the study of Seylan et al. for the screw

fixation technique, we had better dorsiflexion angles results with a mean difference of 4.3° of the operated side from the healthy side versus 3.65° [18]. However, we had less plantar flexion angles with a mean difference of 7.6 ° versus 8.41° [18].

Our technique improved all postoperative radiologic parameters (MCS, TFCS and TFO) and correlate with the results of other studies for screw fixation [19].

In our study, the patients had a better mean time of return to work of 3.75 months compared to Thrones et al. with a mean time to return to work of 4.6 months [20].

The main advantage of our technique is an optimal positioning of the screws on the lateral fibular cortex in the anteroposterior plan with an ideal space between them. In addition, open surgery allows removing any interposition and permit a direct visual control over the reduction.

However, this method has some disadvantages. The procedure requires a second incision and the use of a clamp for syndesmosis reduction has been reported to cause overtightening that can lead to residual pain, stiffness and ankle osteoarthritis [21, 22].

The current study had certain limitations which are the small sample size and the absence of control group. Further researches with larger numbers of patients are required to validate this technique.

5. Conclusion

Open reduction and internal fixation with a two holes one-third tubular plate and screws for syndesmosis injuries is a safe and reliable technique with low complications rate.

This method allows a better control of the intraoperative reduction and provides effective fixation that restore the syndesmosis stability. This leads to good long-term radiological and functional results which helps prevent secondary osteoarthritis.

Declarations of Interest

All the authors do not have any possible conflicts of interest.

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