Original Article

Evaluation of Syndesmosis Reduction after Removal Syndesmosis Screw in Ankle Fracture with Syndesmosis Injury

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Abstract

Background: Ankle fracture–dislocation with a syndesmotic injury has been treated with syndesmotic screw fixation. There are little evidences about the safety and efficacy of syndesmotic screw removal on the syndesmotic malreduction. This study aimed to evaluate the effects of syndesmotic screw removal of distal attachment of the fibula and tibia bones on the syndesmotic reduction and also impact of syndesmotic screw removal on the final functional score of ankle joint. **Materials and Methods:** Patients who underwent syndesmotic screw fixation for diagnosed syndesmosis injury during internal fixation surgery for ankle fractures from April 2017 to March 2018 were assessed for enrollment in our study. During open reduction and internal fixation for ankle fracture, existence of syndesmosis injury was evaluated using the Cotton test and external rotation stress test. Appropriate rehabilitation including short leg cast and nonweight bearing have been accomplished for a duration 12 weeks before removing of syndesmotic screws. At 12 weeks, screws were removed. After 1-month weight bearing, bilateral axial computed tomography (CT) scan and single-leg weight-bearing X-ray for injured ankle were obtained. **Results:** Of all 60 participants, 42 cases (70%) were male and 18 cases (30%) were female. Postoperative ankle radiographies were normal except one case with increased medial clear space. It was interesting findings that from total 60 cases, 18 patients (30%) had evidence of syndesmosis malreduction on postoperative initial CT scan, and after removing of syndesmotic screws (12 weeks) and a period of weight bearing and rehabilitation (4 weeks), there is evidence of appropriate reduction in 13 cases (of 18 patients [72.2%]) on final CT scans. **Conclusion:** Syndesmotic screw removal and weight bearing may be advantageous to achieve final anatomic reduction of the syndesmosis. Syndesmotic screw removal at appropriate time could not improve foot functional outcomes; however, more studies with the larger sample size are required to confirm the results of the study.

Keywords: *Ankle fracture, syndesmosis injury, syndesmotic screw, syndesmotic screw removal*

Introduction

Ankle fracture is among the most prevalent of the joint and bone fractures in worldwide, with an occurrence of 174 patients per 100,000 individuals per annum.[1] This fracture can induce serious complications and morbidities in short, moderate, and long terms.[1]

Syndesmosis injury is a severe unfavorable event with ankle fracture or rotational ankle injury that occurs following a disruption in the distal ends of the fibula and tibia bones.[2] Incidences of syndesmosis injury are up to 15% and 0.5% of cases with fractures and sprains of ankle, respectively.[2]

It cannot be denied importance of early diagnosis and treatment of syndesmosis injury after ankle fractures because of occurrence of negative clinical outcomes such as early ankle arthrosis, painful ankle, instability of tibiofibular, and limited activity if not detected properly. [3-5]

Several studies reported that syndesmosis screw fixation could reduce significantly tibiofibular syndesmosis and improve functional and clinical outcomes clearly.[3-5] There are little evidence about the safety and efficacy of syndesmotic screw removal on the syndesmotic malreduction.[6]

This study was designed to characterize the role of syndesmotic screw removal of distal attachment of fibula and tibia bones on the syndesmotic reduction with clinical examinations and computed tomography (CT) scans and also evaluates the impact of syndesmotic screw removal on the final functional score of ankle joint.

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Materials and Methods

Patients selection

This analytical descriptive study was approved at the Review Board of Shahid Beheshti University of Medical Sciences, Tehran, Iran. After taking the informed consent from participants who underwent syndesmotic screw fixation for diagnosed syndesmosis injury during internal fixation surgery for ankle fractures from April 2017 to March 2018 were assessed for enrollment in our study. Two hundred and twenty-nine patients, who required surgical fixation for recent ankle dislocations and fractures, were enrolled in this study protocol. Of them, 82 cases suffered from syndesmosis injury were candidate for embedding of syndesmotic screw. Totally, 22 cases were withdrawn according to exclusion criteria during the study period and the study was done on 60 cases.

Exclusion criteria

Patients with incomplete medical records were removed. Moreover, cases with immaturity of the skeletal system, history of severe trauma of lower extremity, history of any prior ankle fracture, comorbidities such as uncontrolled diabetes mellitus or hypertension, history of myocardial infarction or heart failure, history of recent severe local or systemic infection, and also pregnancy were delisted.

Study protocol and statistical analysis

During open reduction and internal fixation for ankle fracture, existence of syndesmosis injury was evaluated by using the Cotton test and external rotation stress test. A 3.5-mm tricortical stainless steel syndesmotic screw was fixed if there was a considerable syndesmosis injury. For evaluating of primary reduction, axial CT scan was performed for each patient postoperatively. Appropriate rehabilitation including short leg cast and nonweight bearing have been accomplished for a duration 12 weeks before removing of syndesmotic screws. At 12 weeks, screws were removed. After 1-month weight bearing, the patients were evaluated by Karlsson and Peterson scoring system for ankle function and bilateral axial CT scan and single-leg weight-bearing X-ray for injured ankle [Figures 1 and 2].

Important items of general questionnaire including demographic characteristics, type of fracture, comorbidities, reduction of ankle dislocation technique, time of removal of syndesmotic screws, reports of initial and final CT scans, and also items of foot and ankle outcomes questionnaire such as severity of pain, activities of daily living, amusement and sports, and ankle- and foot-related quality of life were evaluated and completed for each patient during the study period.

All of radiographies including X-ray and CT scans were reviewed by a certain team of physician consist of two attending orthopedic surgeons and one senior resident of orthopedic and also one board-certifies radiologist independently. Data were analyzed by SPSS (v. 24. IBM Inc., IL, USA) and MedCalc software (MedCalc Software bvba, Ostend, Belgium). P <0.05 was considered statistically significant.

Results

Of all participants, 42 cases (70%) were male and 18 cases (30%) were female. Distribution of participants by age and type of ankle fracture are presented in Tables 1 and 2, respectively. There is not any significant difference among demographic characteristics.

The mechanism of ankle fracture was supination-external rotation in 32 cases (53.3%), pronation-external rotation in

	Degree	Score
Pain	None	20
	During exercise	15
	Walking on uneven surface	10
	Walking on even surface	5
	Constant	0
Swelling	None	10
	After exercise	5
	Constant	0
Instability	None	25
	1-2 / year (during exercise)	20
	1-2 / month (during exercise)	15
	Walking on uneven ground	10
	Walking on uneven ground	5
	Constant (severe) using ankle support	0
Stiffness	None	5
	Moderate (morning, after exercise)	2
	Marked (constant, severe)	0
Stair climbing	No problems	10
	Impaired (instability)	5
	Impossible	0
Running	No problems	10
	Impaired	5
	Impossible	0
Work activities	Same as pre-injury	15
	Same work, less sports, normal leisure activities	10
	Lighter work, no sports, normal leisure activities	5
	Severe impaired work capacity, decreased leisure activities	0
Support	None	5
	Ankle support during exercise	2
	Ankle support during daily activities	0

- Karlsson J, Peterson L: Evaluation of ankle joint function: the use of a scoring scale. The Foot 1991, 1:15-19.

Figure 1: The Karlsson and Peterson scoring system for ankle function

Table 1: Distribution of patients by age

Classification of age (years)	Number of patients (%)
18-<20	3 (5)
20-30	16 (26.6)
30-40	14 (23.3)
40-50	14 (23.3)
50-60	11 (18.3)
60-70	2 (3.3)

Table 2: Distribution of patients by type of fracture

Classification of type of fracture	Number of patients (%)
Bimalleolar fracture	28 (46.6)
Isolated medial malleolus fracture	4 (6.6)
Isolated lateral malleolus fracture	15 (25)
Trimalleolar fracture	10 (16.6)
Maisonneuve	3 (5)

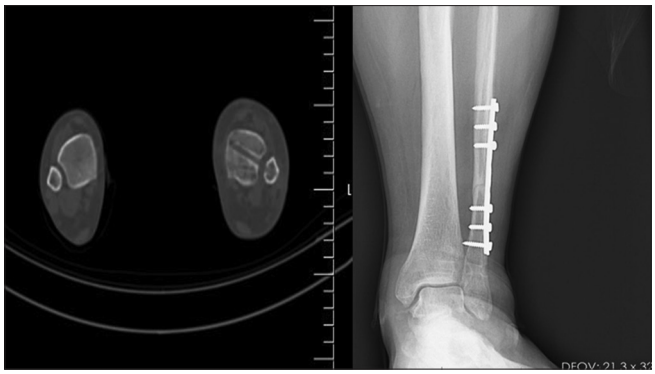

Figure 2: Computed tomography scan and single-leg weight-bearing X-ray for injured ankle at 12th weeks

19 cases (31.6%), supination-adduction in 3 cases (5%), and pronation-abduction in 6 cases (10%), respectively.

Fluoroscopy during syndesmotic screw fixation and postoperative CT scan and X-ray of ankle joint were obtained for evaluating of reduction status. Postoperative ankle radiographies were normal except one case with increased medial clear space [Figure 3].

From a total 60 cases, 18 patients (30%) had evidence of syndesmosis malreduction on postoperative initial CT scan, and after removing of syndesmotic screws (12 weeks) and a period of weight bearing and rehabilitation (4 weeks), there is evidence of appropriate reduction in 13 cases (of 18 patients [72.2%]) on final CT scans.

There is not any significant improvement of foot- and ankle-functional score at final evaluation by foot and ankle outcomes questionnaire ($P > 0.05$).

Discussion

Ankle fracture, as one of the most common lower limb fractures, occurs with an incidence of 187 cases per 100,000 populations in both genders at all ages, especially between the age of 40 and 45 years. Open reduction and internal fixation are accepted surgical treatment for displaced fracture of the ankle.[7] Infection, painful retained hardware, failure to heal, early and late arthritis, and arthrosis are possible complications of this therapeutic approach.[8] Syndesmosis injury is severe unfavorable event with ankle fracture or rotational ankle injury that occurs following a disruption in the distal ends of fibula and tibia bones.[3-5,9] Severe ankle injuries, including dislocations and fractures, are the most and prevalent causes for referral to emergency departments in worldwide, while syndesmosis injury is rare but highly debilitating and commonly misdiagnosed.[8,9]

This study investigated the role of syndesmotic screw removal of distal attachment of fibula and tibia bones on the syndesmotic reduction with clinical examinations and CT scans and also evaluates the impact of syndesmotic screw removal on final functional score of ankle joint.

Figure 3: Case of increased medial clear space

An interesting study by Weening *et al*. reported that there are considerable therapeutic controversies in the treatment of syndesmosis injury. They reported that approximately 15% of syndesmotic screws fixation is not necessary at all. They reported that several technical aspects of operative procedure such as selection of screw size, number of fixed screws, and removal of them are highly variable among the orthopedics.[10]

According to our results, 18 patients had evidence of syndesmosis malreduction on postoperative initial CT scan, and after removing of syndesmotic screws (12 weeks) and a period of weight bearing and rehabilitation (4 weeks), there is evidence of appropriate reduction in 13 cases (of 18 patients [72.2%]) on final CT scans. We can indicate that the rate of malreduction is not depended to operative techniques. Song *et al*. carried out a study on evaluating of syndesmosis screw removal on the reduction of the distal tibiofibular joint.[6] Their findings indicated that there is not any significant difference in the rate of malreduction according to different surgical techniques including screw size and number.[6] They concluded that despite a high rate of malreduction (36%) after inserting of syndesmosis screws, 89% of the malreduced syndesmoses spontaneously were reduced after removing of screws.[6] Their study is in a similar line with our findings.

In a comprehensive systematic review by American surgical team, it was reported that 15% to 23% of surgically managed ankle dislocations and fractures have related syndesmotic injury that needs to reduction and fixation. Syndesmotic screws removal is recommendable in cases of patient complaints relevant to the other fixed perimalleolar hardware or syndesmosis malreduction at least 8 weeks after surgery. Orthopedic surgeons should not remove loose or broken screws routinely unless causing symptoms.[11]

A study conducted by Schepers shows similar or better clinical findings when screws are preserved.[12] Removal of screws, when intact after 4–6 months, might be justified if the positioning screw gives rise to physical complaints.[12] When one or two syndesmotic screws have been implanted tricortically, the need for removing of hardware is 10%.[12] It is valuable finding about syndesmotic screw removal that locked screw removal can improve foot functional

outcomes both objectively and subjectively.[13] The removing of the transsyndesmotic implant seems to assist betterment in the quality and speed of rehabilitation.[13]

An important report by Jeong *et al*. indicated that the rate of malreduction is relatively high after fixing syndesmotic screws. However, the malreduced syndesmosis was spontaneously reduced in 71% of cases after removing of screws.[14] They suggest that it is beneficial to remove the syndesmotic screws a certain period of time after fixation to achieve appropriate reduction of the syndesmosis.[14] Tucker *et al*. and Kaftandziev *et al*. evaluated functional and clinical outcomes in patients with retained or removed transsyndesmotic screws between 8 and 12 weeks postinjury.[15,16] Tucker *et al*. concluded that retained syndesmotic screw fixation does not substantially impair functional capacity, and it leads to higher functional scores in each of the Olerud-Molander Ankle Score (OMAS) domains and less pain, with additional cost-effectiveness. Schepers *et al*. in 2014 demonstrated no difference in merican Orthopaedic Foot and Ankle Society (AOFAS), OMAS, or Visual Analog Scale scores in patients whose syndesmotic screws were removed prior to 8 weeks (at a minimum of 6 weeks) versus after 8 weeks postinjury[17]. The authors followed Arbeitsgemeinschaft fur Osteosynthesefragen guidelines for routine removal of syndesmotic screws at 6–8 weeks during their study. However, their results support the finding that routine removal of syndesmotic hardware may not be beneficial to patients.

We obtained fluoroscopy during syndesmotic screw fixation and postoperative CT scan and X-ray of ankle joint for evaluating of reduction status. Postoperative ankle radiographies were normal except one case with increased medial clear space. From a total 60 cases, 18 patients (30%) had evidence of syndesmosis malreduction on postoperative initial CT scan, and after removing of syndesmotic screws (12 weeks) and a period of weight bearing and rehabilitation (4 weeks), there is evidence of appropriate reduction in 13 cases (of 18 patients [72.2%]) on final CT scans.

Conclusion

It can be a hypothesis that there is no difference between insertion of syndesmotic screws or no insertion in the patients without unstable ankle, and it seems better to remove syndesmotic screws in patients with malreduction of the ankle. Syndesmotic screw removal and weight bearing may be advantageous to achieve final anatomic reduction of the syndesmosis. Syndesmotic screw removal at appropriate time could not improve foot functional outcomes. However, more studies with the larger sample size are required to confirm these opinions.

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Conflicts of interest

There are no conflicts of interest.

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