Aftercare following syndesmotic screw placement; a systematic review

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Abstract

Introduction For ankle fractures in general there have been several studies on immobilization (*e.g.*, cast or boot) versus early motion following surgical treatment. However, no studies have been performed to determine the best aftercare strategy for surgically treated patients with ankle fractures with concomitant acute distal tibiofibular syndesmotic injuries. The aim of the current review was to compare the functional outcome of ankle fractures with syndesmotic injury treated with cast or boot versus early motion.

Material and methods Systematic review using the electronic databases from January 1, 2000 to September 1, 2012 of 'the Cochrane Library', 'Pubmed Medline', 'EMbase', and 'Google Scholar'. Studies included where those in which ankle fractures with acute distal tibiofibular syndesmotic injuries were treated with one or more syndesmotic screws, with a mean follow-up of at least twelve months and at least 25 patients included. Functional outcome as measured with the American Orthopaedic Foot Ankle Society Hindfoot score, Olerud-Molander Ankle Score and Short Musculoskeletal Function Assessment were compared.

Results A total of nine studies were identified with 531 patients. The number of included patients ranged from 28 to 93. Mean follow-up was between 12 and 101 months. Three studies used an early motion protocol (195 patients), and six studies (336 patients) immobilized for at least six weeks. For the AOFAS the mean scores for immobilization were 86 to 91 points and for early motion 84 to 89. For the OMAS the scores for immobilization were 47 to 90 and for early motion 46 to 82 points. The SMFA scores for immobilization were 11 and for early motion they ranged between 12 and 27 points.

Conclusion No apparent differences could be detected in the literature considering functional outcome between immobilization versus an early motion protocol in ankle fractures with acute distal tibiofibular syndesmotic injuries treated with a syndesmotic screw. There is however a lack of level one and two studies on this subject.

Introduction

Throughout the last years various aspects of the treatment of patients with acute syndesmotic injury have been investigated and more evidence is becoming available on the best treatment strategy. For ankle fractures in general there have been several studies on immobilization (*i.e.*, cast or boot) versus early motion following surgical treatment. However, considering the aftercare of surgically treated ankle fractures with concomitant acute distal tibiofibular syndesmotic injuries there have been no studies to determine the best strategy.

In case of a ruptured distal tibiofibular syndesmotic-complex the anatomy is frequently restored and supported using a syndesmotic screw [1]. One millimeter of lateral displacement of the talus gives a significant decrease in tibiotalar area of contact, which might lead to early joint degeneration [2-4]. Because of the trapezoid shape of the talus, the fibula and tibia move in relation to each other at the level of the syndesmosis. In a recent study, during each dorsal to plantar flexion 2mm lateral, 1.5mm ventral, and 0.5mm cranial movement was seen and simultaneously, four degrees of exorotation of the fibula could be observed [5]. These movements might lead to secondary displacement or recurrent syndesmotic diastasis, therefore temporarily immobilization of the ankle joint during several weeks is frequently advised. The duration that this support is needed, or in other words the time the ligaments need to heal, is estimated between 6 to 12 weeks [6-7]. On the other hand, in the joint the cartilage layer is fed via diffusion, and the pressure created by weight bearing (and to some extent by motion) works as a pumping mechanism to exchange nutrients and waste-products. Joint immobilization impairs the articular cartilage layer, and the effects last for a long period of time, even after restarting unprotected weightbearing [8-10].

There is currently no clear evidence that either immobilization or early motion following the treatment of ankle fractures with syndesmotic injuries improves the functional outcome. The aim of the current literature review was therefore to compare the functional outcome of ankle fractures with syndesmotic injuries treated with immobilization or early motion exercise.

Material and Method

A systematic review was performed using a literature search to identify studies in which ankle fractures with acute distal tibiofibular syndesmotic injury were treated with a syndesmotic screw. The electronic databases from January 1, 2000 up to September 1, 2012 of 'the Cochrane Library', 'Pubmed Medline', 'EMbase', and 'Google Scholar' were explored using the combination of the following search-terms and Boolean operators: syndesmo* OR tibiofibular AND ankle OR distal fibula AND screw.

In addition, the reference lists of all identified articles were reviewed to find additional publications. Only full text studies were included. Each manuscript was reviewed by two observers (TS, JPL) and was found eligible when it concerned (1) the treatment of ankle fractures with concomitant acute syndesmotic disruption, (2) use of a rigid syndesmotic fixation (*e.g.*, bolt, metallic or bioabsorbable screw) as a surgical technique, (3) reported aftercare strategy in the manuscript or after contacting the corresponding author, (4) reporting of a commonly used functional outcome score, (5) at least 25 patients included in the study, and (6) mean follow-up of at least twelve months.

The data extracted per included study were the number of patients, the duration of follow-up (months), the type of aftercare (immobilization for at least six weeks versus early motion within two weeks), the type of outcome scoring system, and the mean number of points with standard deviation (SD) if available. Only those scoring systems were analyzed that were used both in one or more immobilized studies and in functional aftercare studies. If an article made a comparison between two subgroups (*e.g.*, metallic versus bioabsorbable, intact/broken/removed screws, or anatomical versus malreduced fibula in the tibial incisura) the individual scores were reported.

Results

Twenty-three studies were excluded because of one or more of the reasons described in the method section [11-33]: 1. No outcome score was used [11-17]; 2. use of an infrequently applied outcome score [18-20], a modified score [21-22], or reporting results only as satisfactory [23], making comparison impossible; 3. No information on aftercare could be obtained [24]; 4. Less than 25 patients were described [16, 20, 25-31], or 5. The mean follow-up was less than 12 months [11, 13, 21, 32], 6. Same study population as in a long-term follow-up study [33].

A total of nine studies that fulfilled the inclusion criteria were identified with 531 patients (Table 1). The number of included patients ranged from 28 to 93. The reported duration of follow-up per study varied between 12 and 101 months. Three studies used an early motion protocol (195 patients), with in two cases a splint for two weeks or less for wound protection. Six studies (336 patients) immobilized for at least six weeks. The scores used in both early motion and immobilization patients were the American Orthopaedic Foot Ankle Society Hindfoot score (AOFAS), the Olerud-Molander Ankle Score (OMAS), and the Short Musculoskeletal Function Assessment questionnaire (SMFA) [34-41].

The mean outcome scores and SD (if available) for the individual studies are presented in Figure 1. For the AOFAS the mean scores for immobilization were 86 to 91 points and for early motion 84 to 89. For the OMAS the scores for immobilization were 47 to 90 and for early motion 46 to 82 points. The SMFA scores for immobilization were 11 and for early motion they ranged between 12 and 27 points. No apparent difference in outcome could be detected for studies using an immobilization versus early motion protocol.

Discussion

The aim of this review study was to determine which aftercare would give the best functional results at follow-up following the fixation of an ankle fracture with acute distal tibiofibular syndesmotic rupture using a syndesmotic screw. Considering the AOFS, OMAS, and the SMFA there was no apparent difference in outcome between immobilization and early motion. The small differences detected were much smaller than the SD's available per score (AOFAS 11.6-13.6; OMAS 4.9-28.5; SMFA 10.6-23.3). This might imply that these small differences were probably not statistically significant nor clinically relevant.

We realize that several biases are present in the current review. A systematic review is as strong as the weakest included study, which means that the current study provides Level-4 evidence. Selection bias might have been introduced upon including some and excluding other studies. We tried to minimize this using a thorough literature search and strict inclusion criteria of studies with sufficient follow-up and number of patients.

Thomas *et al.* performed a meta-analysis including nine randomised studies comparing immobilization and early motion following operative treatment of ankle fractures. [42]. Three studies reported the inclusion of patients treated for syndesmotic instability [43-45]. The other studies excluded syndesmotic injuries or did not report including them. In this meta-analysis [42] only at short-term follow-up an improved range of motion was seen in the early motion group, but no difference in outcome, nor a difference in range of motion after one year could be detected. However, the early motion group showed a four-fold increase in wound complications, which was a statistically significant difference. Most studies included in the current review did not report on post-operative wound complications, making comparison impossible.

Because of the trapezoid shape of the talus, the fibula and tibia move in relation to each other at the level of the syndesmosis with every full range of motion at the ankle joint, which eventually leads (in case of a retained syndesmotic screw) to breakage in 7 to 29 percent of cases [12-13, 18, 21, 33, 36]. In case of early breakage or loosening recurrent syndesmotic diastasis might occur, which is also seen in 6.6 -15.8 percent with premature screw removal between six to eight weeks [19, 46]. This supports the idea of temporary immobilization. Whether or not protected weightbearing leads to early loosening or breakage is not known [47-49]. Other possible benefits from temporary immobilization are the prevention of ankle equinus deformity in patients who are less able to follow exercise protocols. Secondly temporary immobilization might prevent against secondary dislocation in less cooperative patients. How long this immobilization should be is unknown, as a prolonged immobilization (beyond six weeks) in operatively treated patients with ankle fractures can cause less favorable outcome [50].

The treatment of acute syndesmotic injuries knows many different strategies and for most sub-items (*e.g.*, screw diameter, number of cortices, or level of insertion) of the overall treatment no standardization is available. Several studies using questionnaires [1, 51-53] have shown this, and the variety in aftercare protocols for all included studies in the current review supports this.

Probably more important than the way the screw is placed, what type is used, or how the aftercare is performed, is reducing the fibula in an anatomical position in the incisura fibularis of the tibia and avoiding complications [37, 39]. As these factors negatively influences outcome and are influenced by the surgeon.

In conclusion, this review shows there is little difference in function outcome scores between immobilization versus early motion following the treatment of ankle fracture with concomitant syndesmotic injury.

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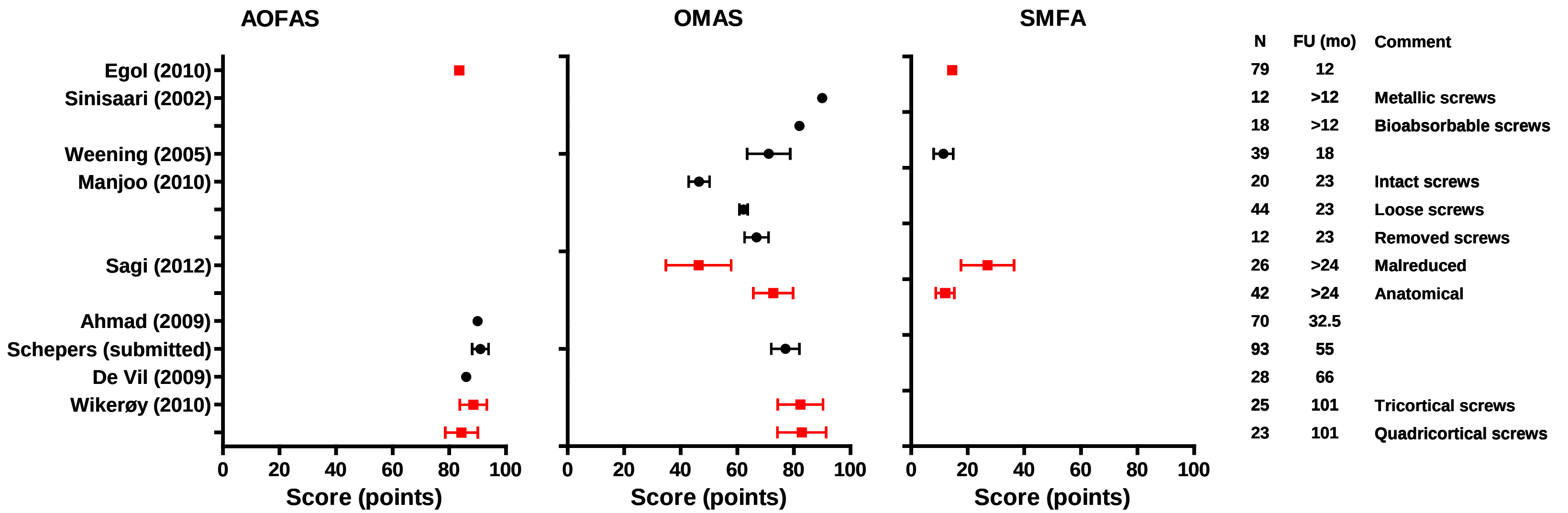
Table 1. **Included studies on syndesmotic injury treatment and their aftercare protocol**

Study (year)	Patients	Screw characteristics[1]	Mean follow-up (months)	Aftercare	Score (max)	Mean score (range/SD)
Sinisaari (2002) [38]	12		> 12	**Immobilization**	OMAS (100)	90 (70-100)
	18	Absorbable		BKC 6w, WB after 4w		82 (25-100)
Weening (2005) [39]	39		18	**Immobilization**	OMAS (100)	74.1±23.4
				NWB cast/boot 6-12w[2]	SMFA (0)	11.4±10.6
Ahmad (2009) [34]	70	Absorbable	32.5	**Immobilization**	AOFAS (100)	90 (44-100)
			(range 12 - 74)	Boot. NWB 6w, PWB 6w		
De Vil (2009) [35]	28	Bolt	66	**Immobilization**	AOFAS (100)	86 (33-100)
			(range 24 - 139)	NWB BKC 6w		
Egol (2010) [41]	79		12	**Early mobilization**	AOFAS (100)	83.5
				NWB 8-10w; cast 1-1.5w, functional brace	SMFA (0)	14.5
Manjoo (2010) [36]	20	Intact	23	**Immobilization**	OMAS (100)	46.5±7.9
	44	Fractured or loose	(range 12-32)	NWB BKC 6w, FWB in boot		62.2±4.9
	12	Removed				66.8±6.7
Wikerøy (2010) [40]	25	Tricortical	101	**Early mobilization**	OMAS (100)	82.3±19.4
			(range 92-107)	PWB 6w, FWB after 8w	AOFAS (100)	88.5±11.6
	23	Quadicortical				82.8±19.9
						84.3±13.3
Sagi (2012) [37]	26	Malreduced	> 24	**Early mobilization**	SMFA (0)	27±23.3
				Splint 2w; NWB 10w, FWB after 12w[2]	OMAS (100)	46.3±28.5
	42	Anatomical				12±10.6
						72.7±22.5
Schepers (submitted)	93		55	**Immobilization**	AOFAS (100)	91±14 (19-100)
			(range 19-102)	Splint 2w; NWB cast 4w, FWB after 6w	OMAS (100)	77±24 (5-100)*

NWB, Non Weight Bearing; PWB, Partial Weight Bearing; FWB, Full Weight Bearing; BKC, Below Knee Cast; AOFAS, American Orthopaedic Foot Ankle Society Hindfoot score; OMAS, Olerud-Molander Ankle Score; SMFA, Short Musculoskeletal Function Assessment

[1] In case of specific screw-characteristics as mentioned in the manuscript; [2] Personal communication

Figure 1. Forest plot for the AOFAS, OMAS, and SMFA score in order of follow-up duration



Data are shown as mean score with 95% confidence interval

Black line, immobilization; Red line, functional aftercare

AOFAS, American Orthopaedic Foot Ankle Society Hindfoot score; OMAS, Olerud-Molander Ankle Score; SMFA, Short Musculoskeletal Function Assessment; N, number of patients; FU, Follow-up