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REVIEW ARTICLE

Dynamic Fixation versus Static Fixation in Treatment Effectiveness and Safety for Distal Tibiofibular Syndesmosis Injuries: A Systematic Review and Meta-Analysis

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To compare the effectiveness and safety of dynamic fixation (DF) and static fixation (SF) in distal tibiofibular syndesmosis injuries (DTSI) by a system review and meta-analysis. PubMed, Cochrane, and EMBASE were systematically searched by computer to select clinical randomized controlled trials (RCT) and cohort trials comparing DF and SF in treating patients with DTSI. RCT and cohort trials comparing DF and SF for patients with DTSI were included. Inclusion criteria: (i) prospective or retrospective study of patients with DTSI; (ii) patients were diagnosed as having DTSI by imageology and only received DF treatment or SF treatment; (iii) the study compared DF and SF in DTSI; and (iv) one or more of the following outcomes were reported: ankle joint functional score, surgical complications, malreduction of syndesmosis, and second operations. Exclusion criteria: (i) non-human studies; (ii) DTSI patients accompanied with other complications or other joints injuries; and (iii) full text unavailable. RevMan V5.3 software was used to perform the statistical analysis. Outcomes analyzed by Revman software showed that there were no statistically significant differences between DF and SF in the American Orthopaedic Foot and Ankle Society (AOFAS) ankle–hindfoot score (*MD*, 1.90; 95% *CI*, –0.23 to 4.03; $P = 0.08$; $I^2 = 0\%$), Olerud–Molander (OM) score (*MD*, 1.92; 95% *CI*, –7.96 to 11.81; $P = 0.70$; $I^2 = 55\%$), incidence of syndesmotic malreduction (*RR*, 0.19; 95% *CI*, 0.03 to 1.09; $P = 0.06$; $I^2 = 0\%$), and overall postoperative complication rate (*RR*, 0.30; 95% *CI*, 0.09 to 0.99; $P = 0.05$, $I^2 = 75\%$) and the rate of second procedure was significantly lower with DF (*RR*, 0.17; 95% *CI*, 0.07 to 0.43; $P = 0.0002$, $I^2 = 54\%$). Compared to SF, DF has an advantage, with a low rate of second procedures to treat DTSI.

Key words: Ankle joint; Dynamic fixation; Meta-analysis; Static fixation; Tibiofibular syndesmosis

Introduction

The distal tibiofibular syndesmosis complex is critical for maintaining the congruency of the ankle mortise. The complex consists of four ligaments: the anterior–inferior tibiofibular ligament, the posterior–inferior tibiofibular ligament, the inferior transverse tibiofibular ligament, the and interosseous ligament[1]. Distal tibiofibular syndesmosis injuries (DTSI) of sufficient severity can disrupt the normal stability of the ankle joint. Up to 50% of ankle sprains occur during sports activities, causing damage to the distal tibiofibular syndesmosis in approximately 1% to 18% of cases[2–4]. DTSI arise when an external rotation force applied to the foot leads to eversion of the talus within the ankle mortise, which is thought to occur in 80% of Weber type C fractures[5,6]. DTSI also occur in patients with Weber type B fractures. In one study, DTSI were identified in 17% of supination–external rotation type IV injuries[7]. Such injuries can also occur in the absence of fractures. DTSI can disrupt the normal stability of the ankle joint, leading to alterations in weight transmission between the tibia and the fibula and subsequent traumatic arthritis.

Operative stabilization is performed to treat unstable DTSI. Static fixation (SF) with one or more cortical screws is the standard method for fixation. However, some significant

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Received 8 December 2018; accepted 28 July 2019

issues should be considered. Screw loosening, breakage, discomfort, the need for a second operation for screw removal, and the risk of late diastasis after early removal are potential drawbacks of screw fixation[8–13]. An alternative method, dynamic fixation (DF) using an implanted suture-button device (TightRope; Arthrex, Naples, Florida), offers potential advantages over the syndesmosis screw: less risk of hardware pain and recurrent syndesmotic diastasis, quicker recovery to mobility, maintenance of physiologic movement while retaining reduction, earlier rehabilitation, and no need for implant removal[14–16]. However, functional outcomes, rates of syndesmotic malreduction, and complication rates are still uncertain for the two techniques. The optimal surgical protocol is still a subject of dispute in the published literature[17,18].

The aim of our study was to evaluate DF and SF for the treatment of DTSI, comparing the clinical outcomes, incidence of syndesmotic malreduction, postoperative complications, and rate of second procedures for the two fixation methods. To the best of our knowledge, this study is the first comprehensive meta-analysis of DF versus SF for DTSI treatment.

Materials and Methods

Protocol and Registration

Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA)[19] was used in the meta-analysis and the study had been registered in the International Prospective Register of Systematic Reviews (the registration number is CRD42018109934).

Search Strategy

Cochrane, PubMed, and Embase were searched systematically for clinical randomized controlled trials (RCT) and cohort trials comparing the effectiveness of DF and SF in treating DTSI which were published between database initiations and November 2018, with no language restriction. MeSH terms such as ankle joint, tissue fixation, orthopedic fixation devices and bone screws, and relevant free terms were searched in the databases. The detailed searching strategy is presented in Table 1.

Inclusion and Exclusion Criteria

Studies meeting the following criteria were included: (i) prospective or retrospective study of patients with DTSI; (ii) patients were diagnosed as DTSI by imageology and only received DF treatment or SF treatment; (iii) the study compared DF and SF in DTSI; and (iv) one or more of the following outcomes were reported: ankle joint functional score, surgical complications, malreduction of syndesmosis, and second operations.

Studies meeting any of the following criteria were excluded: (i) non-human studies; (ii) DTSI patients accompanied with other complications or other joints injuries; and (iii) full text unavailable.

Study Selection

To select studies, two authors (XF and PZ) independently screened the titles and abstracts of the identified studies to decide if the studies met the inclusion criteria and then full texts of the eligible studies were searched for further study. Then we reviewed reference lists of selected articles for other potentially relevant citations.

Two authors (XF and PZ) independently extracted data of the included studies, and the third reviewer (ZT H) resolved disagreements between the two authors.

The following data from included studies were collected by the authors: authors, study type, setting, interventions, patients' age, follow-up time, American Orthopaedic Foot and Ankle Society (AOFAS) ankle–hindfoot score, Olerud–Molander

TABLE 1 Detailed searching strategy in PubMed

Procedure	Search strategy	Number of articles
#1	Search "Ankle Joint"[Mesh]	14 675
#2	Search (((((Joint, Ankle) OR Ankle Syndesmosis) OR Talocrural Joint) OR Tibiofibular Ankle Syndesmosis) OR Distal Tibiofibular Joint) OR Inferior Tibiofibular Joint) OR Tibiofibular Syndesmosis	29 147
#3	Search ("Ankle Joint"[Mesh]) OR ((((((Joint, Ankle) OR Ankle Syndesmosis) OR Talocrural Joint) OR Tibiofibular Ankle Syndesmosis) OR Distal Tibiofibular Joint) OR Inferior Tibiofibular Joint) OR Tibiofibular Syndesmosis)	29 147
#4	Search "Tissue Fixation"[Mesh]	6383
#5	Search (((Fixation, Tissue) OR TightRope) OR endobutton) OR suture button	26 248
#6	Search ("Tissue Fixation"[Mesh]) OR ((((Fixation, Tissue) OR TightRope) OR endobutton) OR suture button)	26 248
#7	Search "Orthopedic Fixation Devices"[Mesh]	73 425
#8	Search (Device, Orthopedic Fixation) OR Fixation Device, Orthopedic	73 986
#9	Search ("Orthopedic Fixation Devices"[Mesh]) OR ((Device, Orthopedic Fixation) OR Fixation Device, Orthopedic)	73 986
#10	Search "Bone Screws"[Mesh]	22 839
#11	Search (Screw, Bone) OR Screw	42 703
#12	Search ("Bone Screws"[Mesh]) OR ((Screw, Bone) OR Screw)	42 703
#13	Search ((((("Ankle Joint"[Mesh]) OR ((((((Joint, Ankle) OR Ankle Syndesmosis) OR Talocrural Joint) OR Tibiofibular Ankle Syndesmosis) OR Distal Tibiofibular Joint) OR Inferior Tibiofibular Joint) OR Tibiofibular Syndesmosis))) AND (("Tissue Fixation"[Mesh]) OR ((((Fixation, Tissue) OR TightRope) OR endobutton) OR suture button))) AND (("Orthopedic Fixation Devices"[Mesh]) OR ((Device, Orthopedic Fixation) OR Fixation Device, Orthopedic))) AND (("Bone Screws"[Mesh]) OR ((Screw, Bone) OR Screw))	147

(OM) score, number of syndesmotic malreductions, overall complications, and second procedures.

Literature Quality and Risk Bias Assessment

Two authors (XF and PZ) independently assessed the quality and risk bias of the cohort trials by Newcastle–Ottawa Quality Assessment Scale[20] in terms of selection of study group, comparability of groups, and outcomes and assessed the quality and risk bias of RCT using the Cochrane Risk of Bias Tool[21]. The third reviewer (ZT H) resolved disagreements about the literature quality and analysis.

Outcome Indicators

In the study, the primary outcome indicators included the AOFAS ankle–hindfoot score, the OM score, and syndesmotic malreduction. The second outcome indicators included incidence of overall postoperative complications and rate of second procedure.

American Orthopaedic Foot and Ankle Society Ankle–Hindfoot Score

The AOFAS ankle–hindfoot score is a scale established by the American Orthopaedic Foot and Ankle Society to evaluate the pain and locomotion of ankle–hindfoot. In the scale of AOFAS ankle–hindfoot score, evaluation criterions include pain, locomotion, and maximum walking distance.

Olerud–Molander Score

The OM score is a scoring system proposed by Olerud and Mallander in 1984 to evaluate the efficacy of ankle fracture patients. The score is completely self-rated by patients, including pain, stiffness, swelling, stairs, running, jumping, squatting, and walking to evaluate the function of ankle.

Syndesmotic Malreduction

The reduction of the distal tibiofibular joint was assessed by measuring the width of the syndesmosis from both ankles in the anterior (AW) and posterior (PW) borders in axial CT scans approximately 1 cm proximal from the tibial plafond. The mean width of the syndesmosis was calculated as ([AW injured ankle – AW normal side] + [PW injured ankle – PW normal ankle])/2. Malreduction was defined as >2 mm side-to-side difference. The number of patients with syndesmotic malreduction was recorded and the incidence of malreduction of syndesmosis was calculated. Syndesmotic malreduction was used to evaluate the effect of operations on distal tibiofibular joint injury in clinic.

Incidence of Overall Postoperative Complication

Incidence of overall postoperative complication was used to evaluate the safety of the operations on distal tibiofibular joint injury in clinic. Incidence of overall postoperative complication was calculated as the events of complications/overall events.

Rate of Second Procedure

A second procedure is described as a reoperation to remove screws over months postoperatively due to local irritation. Rate of second procedure was calculated as the cases of reoperation/overall cases in the study.

Statistical Analysis

RevMan 5.3 software (Cochrane Collaboration, London, UK) was used to analyze the data. For dichotomous outcomes such as incidence of syndesmotic malreduction, overall postoperative complication rate and rate of second procedure, risk ratio (*RR*) with 95% confidence interval (*CI*) was calculated. For continuous outcomes such as AOFAS ankle–hindfoot score and OM score, mean difference (MD) and odd ratio (*OR*) with 95% *CI* were calculated. Statistical heterogeneity was evaluated using the χ^2-test and I^2-index, and values of $I^2 > 75\%$ and $P < 0.1$ indicated that the statistic heterogeneity and the random effects model were used[22].

Results

Literature Selection

Initially, 129 articles were searched from databases and other sources. After removing duplicate entries, 74 articles remained. After reading the title and abstract, 44 articles were excluded. Meanwhile, 19 reviews and 1 article without full text were also excluded. Finally, 10 studies[23–32] including 7 cohort trials[23–26,29–31] 31 and 3 RCT[27,28,32], comprising a total of 420 patients, were included in the meta-analysis. A flow diagram of the study screening procedure and the result is shown in Fig. 1.

Characteristics of Eligible Studies

All 10 studies included in this meta-analysis were published from 2006 to 2016 (Table 2); 7 of the studies were retrospective or prospective cohort studies and 3 were prospective RCT. Among the studies, 1[27] was a multicenter study, and 9[23–26,28–32] were single-center studies; 7 studies[25–28,30–32] compared the clinical effect of TightRope and Syndesmotic screws on DTSI. Two studies[23,29] compared the clinical effect of suture buttons and Syndesmotic screws on DTSI and only 1 study[24] compared the clinical effect of single-level elastic fixation and single cortical score on DTSI. In terms of outcome indicators, 8 studies[24,26–32] reported overall postoperative complications rate; 5 studies[24,25,27,29,30] reported AOFAS score; and 2 studies[27,28] reported OM score and postoperative incidence of syndesmotic malreduction (Table 2).

Risk of Bias

The risk of bias of the 10 included studies was low because the quality of the included studies is high. Among the 7 cohort studies, the quality of 6 studies[23–25,29–31] was very high with high scores and only 1 study's[26] score was of general quality with a score of six. Therefore, 6 studies received nine stars and 1 study received six stars (Table 3). Among the 3 RCT studies, 1 study[32] did not report the random sequence generation and allocation concealment with an unclear risk on selection bias; 2 studies[28,32] did not detail blinding of outcome assessment with an unclear risk on detection bias and no study stated the blinding of participants and personnel with a high risk on performance bias (Fig. 2).

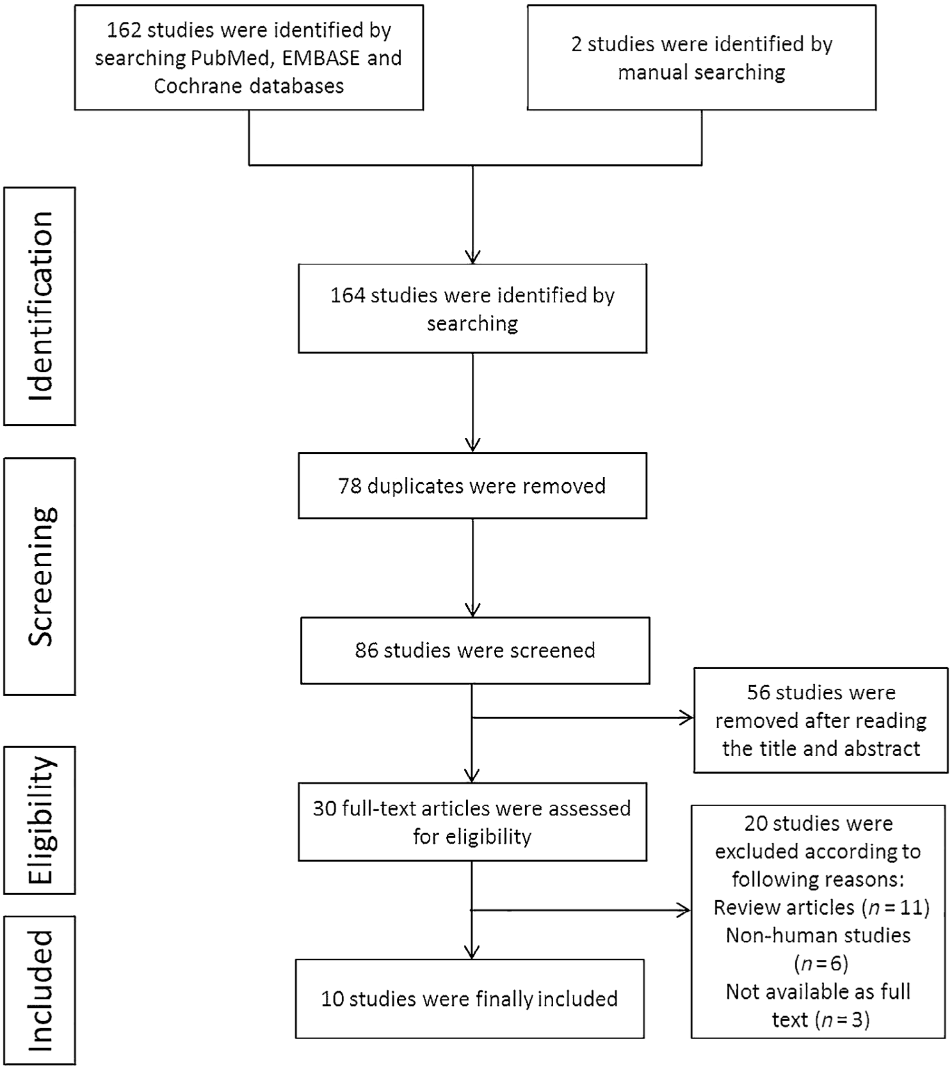

Fig. 1 Study selection process.

Results of Meta-Analysis

American Orthopaedic Foot and Ankle Society Score

Five studies[24,25,27,29,30] contributed data for analysis of the AOFAS score. The analysis revealed no significant difference between the DF group and the SF group (*MD*, 1.90; 95% *CI*, −0.23 to 4.03; $P = 0.08$; $I^2 = 0\%$) (Fig. 3).

Olerud–Molander Score

Two studies[27,29] provided OM scores, which also did not significantly differ between the two groups (*MD*, 1.92; 95% *CI*, −7.96 to 11.81; $P = 0.70$; $I^2 = 55\%$) (Fig. 4).

Incidence of Malreduction of Syndesmosis

Two studies[25,28] which involved a total of 86 patients reported the number of patients with malreduction of syndesmosis after surgical fixation. The meta-analysis showed no statistically significant difference in syndesmotic malreduction between the DF and SF groups (*RR*, 0.19; 95% *CI*, 0.03 to 1.09; $P = 0.06$; $I^2 = 0\%$) (Fig. 5).

Postoperative Complications

Eight studies[24,26–32] reported rates of complications after surgical operations. Complications included wound infections, wound dehiscence, deep infections, local implant irritation, hardware failures (screw loosening or breakage), syndesmosis ossification, nerve injury, subluxation, and reflex sympathetic dystrophy. The meta-analysis revealed no statistically significant difference in the incidence of overall complications between the two groups. The incidence was 17 of 164 patients (10.4%) in the DF group and 76 of 178 patients (42.7%) in the SF group (*RR*, 0.30; 95% *CI*, 0.09 to 0.99; $P = 0.05$; $I^2 = 75\%$) (Fig. 6).

Second Procedure

The number of patients requiring a second procedure was reported in 8 studies[23,24,26–29,31,32]. For DF, there were

TABLE 2 Characteristics of included studies

Study	Study type	Setting	Intervention		Mean age (years)		Follow-up (months)		Outcomes
			DF	SF	DF	SF	DF	SF	
Maempel *et al.*	Retrospective cohort study	Single center	*N* = 12 TightRope	*N* = 23 Syndesmotic screw	41.5	41	14.6	NR	Complications Second procedures
Thornes *et al.*	Prospective cohort study	Single center	*N* = 16 Suture button	*N* = 16 Syndesmotic screw	32	31	12	12	Time not weight-bearing Time to return to work Patient's overall satisfaction Second procedures
Cottom *et al.*	Prospective cohort study	Single center	*N* = 25 TightRope	*N* = 25 Syndesmotic screw	34.68	36.68	10.78	8.2	SF-12 score Time to full weight-bearing Radiographic outcomes Complications, second procedures
Naqvi *et al.*	Retrospective cohort study	Single center	*N* = 23 TightRope	*N* = 23 Syndesmotic screw	41.65	39.82	30.3	29	AOFAS score, FADI score Time to full weight-bearing Radiographic outcomes Malreduction
Kortekangas *et al.*	Prospective randomized controlled trial	Single center	*N* = 21 TightRope	*N* = 19 Syndesmotic screw	46	43.5	36	39	OM score, Rand-36 score FAO score VAS for pain and function Complications, malreduction Second procedure
Laflamme *et al.*	Prospective randomized controlled trial	Multicenter	*N* = 33 TightRope	*N* = 32 Syndesmotic screw	40.1	39.3	12	12	OM score, AOFAS score VAS for pain, ROM Ankle circumference Time to full weight-bearing Radiographic outcomes Complications, second procedures
Kim *et al.*	Retrospective cohort study	Single center	*N* = 20 TightRope	*N* = 24 Syndesmotic screw	51.3	40.5	13.4	14.6	Radiographic outcomes AOFAS score, VAS for pain Complications
Kocadal *et al.*	Retrospective cohort study	Single center	*N* = 26 Suture button	*N* = 26 Syndesmotic screw	43.3	44.8	16.7*		Radiographic outcomes AOFAS score Complications, second procedure
Seyhan *et al.*	Retrospective cohort study	Single center	*N* = 15 Single-level elastic fixation	*N* = 17 Single cortical screw	43.3	44.8	14.6*		ROM, AOFAS score Complications, second procedure
Coetzee *et al.*	Prospective randomized controlled trial	Single center	*N* = 12 TightRope	*N* = 12 Syndesmotic screw	35	38	27	27	ROM, AOFAS score Complications, second procedure

* Only the mean follow up for the two groups was reported. AOFAS, American Orthopaedic Foot and Ankle Society; DF, dynamic fixation; FADI, Foot and Ankle Disability Index; FAO, Foot and Ankle Outcome; NR, not reported; OM, Olerud–Molander; ROM, range of motion; SF, static fixation; SF-12, Short Form-12 Health Survey; VAS, Visual Analogue Scale. The modified AOFAS score is a score system with a maximum of 63 points. The Rand-36 score refers to the Rand 36-Item Health Survey

TABLE 3 Newcastle–Ottawa Quality Assessment Scale results for included cohort studies

Study	Selection of study group	Comparability of groups	Outcome	Total score
Maempel *et al.*	***	*	**	6
Thornes *et al.*	****	**	***	9
Cottom *et al.*	****	**	***	9
Naqvi *et al.*	****	**	***	9
Kim *et al.*	****	**	***	9
Kocadal *et al.*	****	**	***	9
Seyhan *et al.*	****	**	***	9

12 cases needing a second procedure because of routine removal of implants (1 case), implant removal for superficial infection (3 cases), implant removal for local implant irritation (7 cases), revision to syndesmotic screw for deep infection (1 case). In contrast, for SF, there were 94 cases needing a second procedure because of routine removal of implants (75 cases), revision to a hindfoot nail for subluxation (1 case), revision to a hindfoot nail for deep infection (1 case), implant removal for deep infection (1 case), implant removal for local implant irritation (14 cases), revision for technically insufficient fixation (1 case), and implant removal for prominence of the screw head (1 case). The meta-analysis showed that the risk of a second procedure was significantly greater in the SF group than that in the DF group (*RR*, 0.17; 95% *CI*, 0.07 to 0.43; $P = 0.0002$, $I^2 = 54\%$) (Fig. 7).

Publication Bias

Funnel plot analysis of 8 studies reporting second procedure rate is showed in Fig. 8 because the risk of a second procedure was significantly greater in the SF group than that in the DF group and among the included studies, 8 studies reporting second procedure rate. As you can see from Fig. 8, only 1 study lies to the right of the funnel plot, revealing that there is no evidence of publication bias in this meta-analysis.

Discussion

Syndesmotic screws and suture-button devices are accepted surgical fixation options for syndesmotic injuries. Until recently, syndesmotic injuries were treated with static (screw) fixation, which has been considered the gold-standard treatment. Although this fixation method stabilizes the joint, it eliminates normal motion between the tibia and fibula[33,34]. DF with a suture-button device has gained increasing interest and popularity over the past decade. Although DF is not as rigid as syndesmotic screw fixation, it may facilitate motion of the distal tibiofibular joint[35].

Debate concerning the superior surgical treatment for syndesmotic injuries is ongoing. However, evidence is insufficient to conclude which is superior. Therefore, we performed the meta-analysis of clinical comparative studies to determine whether DF or SF is superior in terms of functional scores, incidence of syndesmotic malreduction, and rates of postoperative complications and second procedures.

The results of our meta-analysis revealed no significant difference between the DF and SF groups in postoperative functional scores (AOFAS and OM scores). Some previous studies[24,25,28–30,32] reported no difference between DF and SF in functional scores, whereas other studies[23,27] showed that patients treated with DF had better postoperative functional scores than those treated with SF. Further studies are required to confirm our results concerning the clinical outcomes of these procedures because of the limited number of studies contributing to the analysis.

Malreduction of syndesmosis is the most important independent predictor of long-term functional outcome[36]. We analyzed the incidence of syndesmotic malreduction after DF and SF and found no significant difference between

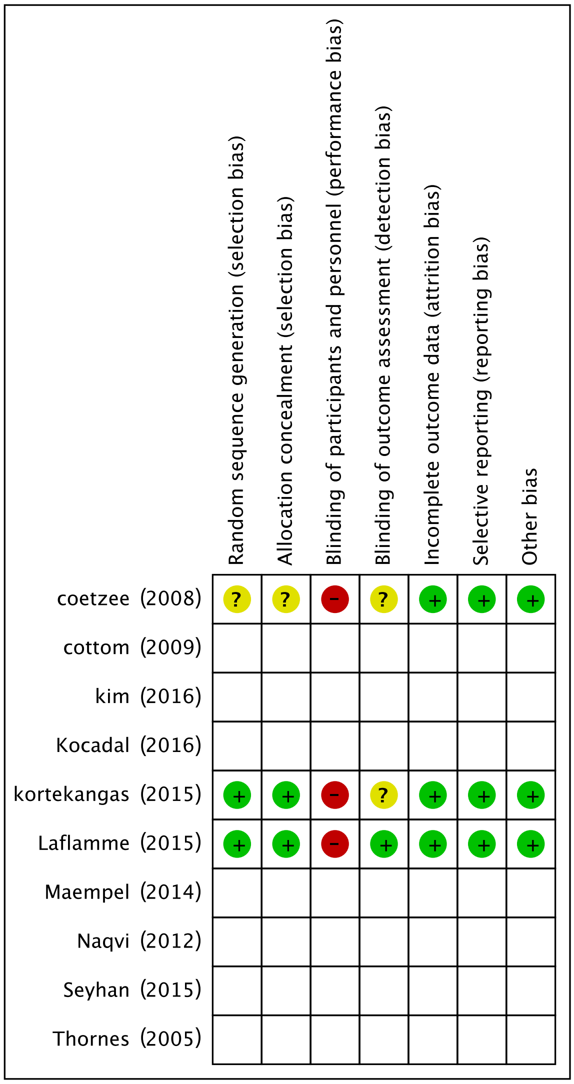

Fig. 2 Risk of bias summary for included randomized controlled trials (RCT).

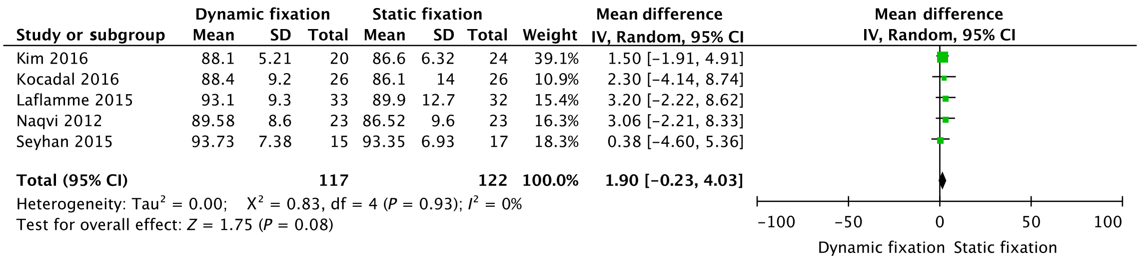

Fig. 3 Comparison of postoperative American Orthopaedic Foot and Ankle Society (AOFAS) score in DF group and SF group. DF, dynamic fixation; SF, static fixation.

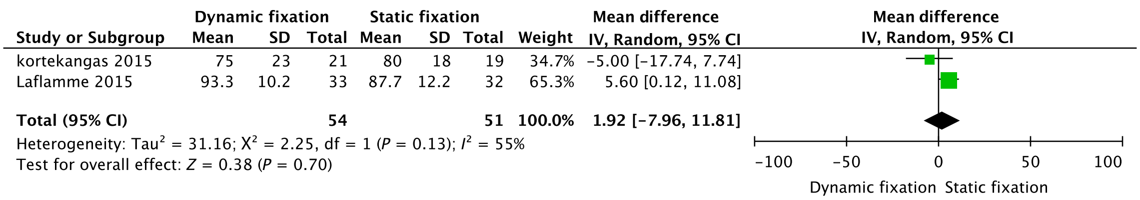

Fig. 4 Comparison of postoperative Olerud–Molander (OM) score in DF group and SF group. DF, dynamic fixation; SF, static fixation.

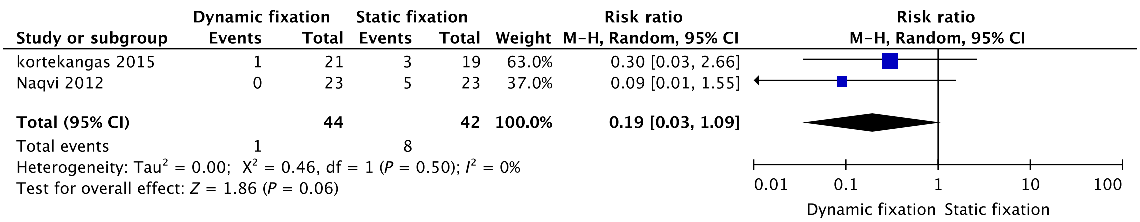

Fig. 5 Comparison of postoperative incidence of syndesmotic malreduction in DF group and SF group. DF, dynamic fixation; SF, static fixation.

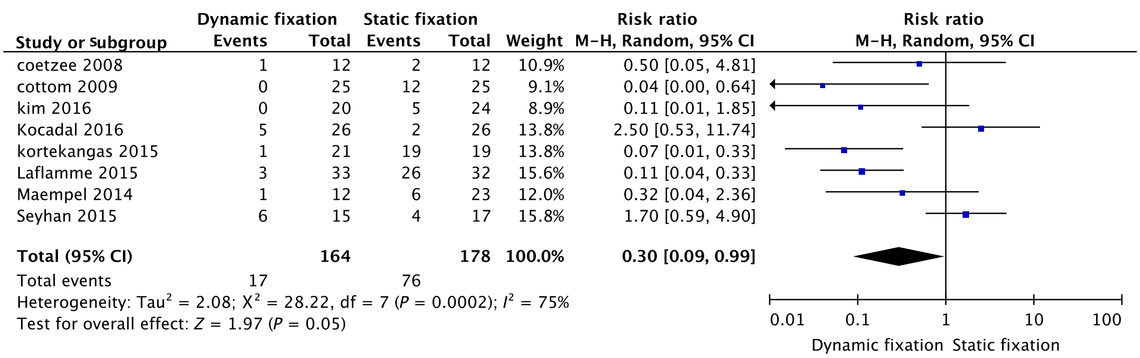

Fig. 6 Comparison of overall postoperative complication rates in DF group and SF group. DF dynamic fixation; SF static fixation.

the two groups. However, in the DF group, 1 in 44 patients experienced a syndesmotic malreduction, as compared with almost 1 in 5 patients in the SF group. We also found no significant difference in overall postoperative complications between the two groups. However, nearly 1 in 10 patients in the DF group and nearly 1 in 2 patients in the SF group experienced a complication. It is possible that these differences were not statistically significant because the studies included were of limited quantity, possibly because of the small number of patients or differences in the inclusion criteria with regard to fracture type.

Our meta-analysis demonstrated that the rate of second procedures was statistically lower in the DF group than in the SF group. The routine removal was the most common reason for a second procedure in the SF group. Typically, syndesmotic screws are removed in the 7th to 12th weeks

	Dynamic fixation		Static fixation			Risk ratio
Study or subgroup	Events	Total	Events	Total	Weight	M–H, Random, 95% CI
coetzee 2008	1	12	1	12	8.3%	1.00 [0.07, 14.21]
cottom 2009	0	25	17	25	7.9%	0.03 [0.00, 0.45]
Kocadal 2016	1	26	10	26	11.9%	0.10 [0.01, 0.73]
kortekangas 2015	1	21	3	19	10.7%	0.30 [0.03, 2.66]
Laflamme 2015	2	33	12	32	16.4%	0.16 [0.04, 0.67]
Maempel 2014	1	12	22	23	12.7%	0.09 [0.01, 0.57]
Seyhan 2015	6	15	17	17	24.2%	0.42 [0.23, 0.76]
Thornes 2005	0	16	12	16	7.9%	0.04 [0.00, 0.62]
Total (95% CI)		**160**		**170**	**100.0%**	**0.17 [0.07, 0.43]**
Total events	12		94			

Heterogeneity: Tau^2 = 0.82; χ^2 = 15.10, df = 7 (P = 0.03); I^2 = 54%
Test for overall effect: Z = 3.75 (P = 0.0002)

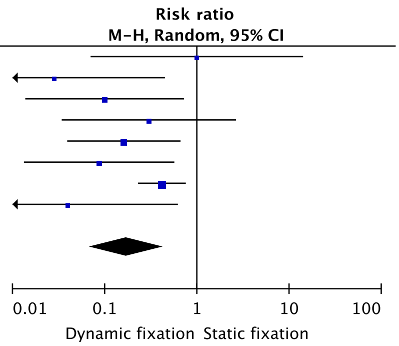

Fig. 7 Comparison of second procedure rates in DF group and SF group. DF, dynamic fixation; SF, static fixation.

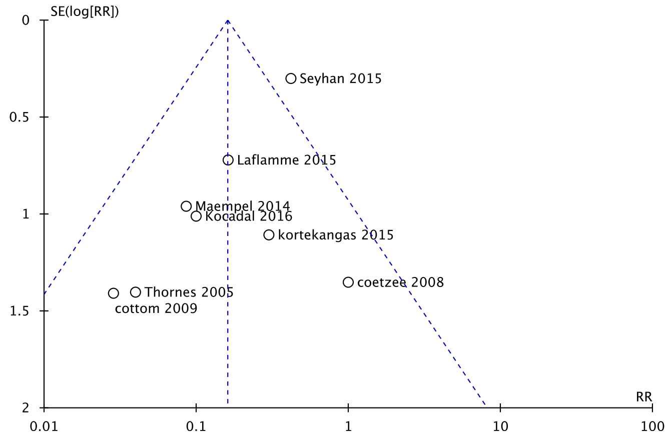

Fig. 8 Funnel plot with 95% confidence limit.

after the first operation to avert implant failures such as screw breakage or loosening. Removal of suture-button devices is generally not necessary or recommended after successful surgical procedures[37]. The lower rate of second procedures in the DF group could indicate the superiority of DF in this regard.

A limited number of the included studies contributed to the analysis of functional scores because the studies used various score scales. Fewer than 6 studies provided data on AOFAS and OM scores. Therefore, the meta-analytic results of these functional scores have low reliability. Of the 10 included studies, 3 were prospective RCT. However, 7 studies were prospective or retrospective cohort studies, which lack randomization. This uneven allocation leads to selection bias. Further RCT are necessary to strengthen the conclusions.

Few of the included studies provided hospitalization cost analyses of the operative interventions. Therefore, little is known about the cost-effectiveness and economic value of these surgical treatments.

The meta-analysis revealed that DF and SF could achieve similar functional outcomes, resulting in similar rates of syndesmotic malreduction and overall postoperative complications. The incidence of second procedures was significantly higher with SF than with DF.

However, there are some limitations of the present study. The number of comparative trials, especially RCT, included in our meta-analysis was small because of the general scarcity of clinical cohort studies of this subject. However, we believe that there is little evidence to support publication bias. We performed a thorough search to identify all available studies. Whether unpublished studies have been conducted is unknown. One limitation of this meta-analysis was the small total number of participants, which could explain why we found no statistically significant differences in functional outcome, incidence of syndesmotic malreduction, and rate of postoperative complications. Besides, the heterogeneity of the postoperative complications is relatively high, and, for instance, different study type, surgery technology, surgeons, medical apparatus, and degree of impairment in patients may cause heterogeneity in the study. Meanwhile, better-quality evidence and a larger sample size are required before a recommendation can be made. Further comparative studies, especially RCT, are required before we can establish which internal fixation method is more effective for surgical treatment of DTSI.

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