



# A systematic review and meta-analysis of functional outcomes and complications following external fixation or open reduction internal fixation for distal intra-articular tibial fractures: an update

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Received: 23 August 2018 / Accepted: 3 January 2019 / Published online: 9 February 2019  
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## Abstract

**Purpose** To conduct a systematic review and meta-analysis comparing physical function and complications following DIATF surgery with external fixation (EF) or open reduction internal fixation (ORIF).

**Method** A search was conducted using PubMed, Embase, Cochrane CENTRAL, Open Grey and Orthopaedic Proceedings. Studies with a level of evidence of I–III on patients ( $\geq 18$  years) with DIATFs operated on with either EF or ORIF were included. A total of 3814 studies were identified. The Cochrane Risk of Bias Tool for randomised controlled trials and the ROBINS-I tool for nonrandomised studies were used to assess risk of bias.

**Results** Nine studies with 478 patients, 271 ORIF and 197 EF met the inclusion criteria. The mean follow-up ranged from 12 to 38 months. The meta-analysis showed a higher incidence of superficial wound infections (RR = 2.94, 95% CI 1.62–5.34,  $p = 0.0004$ ) and malunions (RR = 2.62, 95% CI 1.27–5.43,  $p = 0.009$ ) in the EF group compared to the ORIF group. Also worse physical function was associated with the EF group. However, the overall evidence was low.

**Conclusion** This systematic review is the first to report on physical function following DIATF surgery. In general, decreased physical function was reported. The meta-analysis showed lower incidence of superficial wound infection and malunion rates in the ORIF group. Heterogeneity was low. In conclusion, this review reports lower complication rates following ORIF for DIATF. The overall evidence was limited, and therefore, the authors cannot recommend ORIF to be superior to EF treatment for DIATF. More multi-centre studies with larger sample sizes are needed to assess long-term physical function and complications following DIATF surgery.

**Level of evidence** Level 1.

**Keywords** Distal intra-articular tibia fractures · ORIF · EF · Physical function · Complications

## Introduction

Physical function and quality of life (QoL) following operative treatment of distal intra-articular tibial fractures (DIATF) are unsatisfactory. Despite the introduction of two-stage procedures in 1999 demonstrating lower complication rates [1–5], patients still suffer from decreased physical function and thereby reduced quality of life (QoL), which may lead to either unemployment or change in job [6–10]. Levis et al. [11] reported decreased physical function and reduced working ability in 39% of patients who were in full-time employment prior to injury. Van den Berg et al. [8] showed that 75% of patients experience a notable decrease in physical function and general health status markedly affecting QoL at one year, with more than 75% still suffering from daily pain. Romero et al. [10] showed poor functional

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outcome 5 years after operative treatment of DIATF. They reported a negative correlation between fracture reduction and physical function, and worse reduction quality was seen in the external fixation group. Other authors have suggested that external fixation (EF) causes more mal- and nonunions compared with two-stage open reduction internal fixation (ORIF) because of the indirect reduction methods used [7, 12, 13]. However, a systematic review and meta-analysis from 2015 showed no statistical differences in mal-, nonunion or infection following DIATF treated with either EF or ORIF [14].

To date, no systematic review has reported on physical function after DIATF treatment. Hence, the aim of this study was to conduct a systematic review evaluating physical function and complications following DIATF surgery with ORIF or EF.

## Methods

### Protocol and registration

This systematic review was planned, conducted and reported according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) Statement [15]. The study protocol, prior to data extraction and data analysis, was registered at the PROSPERO International Prospective Register of Systematic Reviews number: CRD42016036252).

### Eligibility criteria

#### Types of studies

Studies with an LoE of I–III according to the Oxford Centre for Evidence-Based Medicine (CEBM) [16], reporting on DIATF AO 43 B1-3 and C1-3 or Rüedi-Algöever I, II and III [17]. Open fractures were classified by the Gustilo classification [18].

#### Types of participants

Participants  $\geq 18$  years of age with DIATFs operated on with either EF or ORIF.

#### Types of intervention

**EF** External fixation includes ring fixation and hinge frame with or without additional screw fixation.

**ORIF** Temporary external fixation followed by internal fixation with plates.

### Types of outcome measures

**Physical function** Physical function scores validated in patients with foot and ankle disorders were included [19].

**Mal- and nonunion** Malunion was defined as  $> 5^\circ$  of angulation in the coronal plane,  $> 10^\circ$  in the sagittal plane or  $> 2$  mm of articular step-off as seen on post-operative radiographs. Nonunion was defined as a fracture that had not healed radiographically within 6 months of injury.

**Infection** Deep wound infection was defined as positive bacterial organisms obtained from operative debridement or fracture site.

Superficial infection was defined as red and warm skin with associated pain with curative effect of oral antibiotics. Pin site infection was also considered as superficial infection and defined as symptoms located around a pin with curative effect by either antibiotics, removal of the pin or debridement.

### Information sources

The search was applied to the PubMed/Medline (1 January 2000–31 October 2018), Embase (1 January 2000–31 October 2018) and Cochrane CENTRAL databases (1 January 2000–31 October 2018). One ongoing study was identified through the WHO database for ongoing clinical trials [20]. Information on grey literature was searched in Open Grey [21] using the terms ‘distal intra-articular tibia fracture’ or Pilon fracture’. Four studies were identified, including one narrative review of DIATF [22]. Three studies did not report on operating techniques [23–25]. The digital archive of *Orthopaedic Proceedings* was screened for abstracts from conference proceedings from the period from 1 January 2000 to 31 October 2018. Titles and abstracts were searched using the terms ‘distal intra-articular tibial fracture’ and ‘pilon fracture’. A total of 153 abstracts were identified, and none of the abstracts met the inclusion criteria for the current study.

### Search terms

(Distal tibial fractures OR distal tibial fracture OR distal tibia fracture OR distal tibia fractures OR plafond fracture OR plafond fractures OR pilon fracture OR pilon fractures) AND (fracture fixation OR fracture fixations OR skeletal fixation OR skeletal fixations OR ORIF OR plate OR plates OR internal fixation OR external fixation OR extern fixation OR Ilizarov OR ring fixator).

## Study selection and data collection process

Management of the search results was carried out in Covidence ([www.covidence.org](http://www.covidence.org), Veritas Health Innovation). Duplicate studies were identified and removed. The titles and abstracts of all retrieved studies were reviewed. The two reviewers independently reviewed each article and determined its eligibility. All of the eligible studies ( $n=28$ ) were read and 19 studies were excluded (Fig. 1). Data extraction from the remaining nine studies was performed using a data extraction sheet based on type of study, type of participants, type of intervention and outcomes. The corresponding authors were contacted if data were missing.

The data were extracted (JLE) and double-checked (PIA). Disagreement between the two reviewers was

resolved by discussion. If no agreement could be reached, a third reviewer (BV) was contacted.

## Data items

The following information was extracted from each trial: (1) the characteristics of the trial participants (age, fracture classification, number of open fractures and length of follow-up); (2) intervention (EF or two-stage ORIF); and (3) outcome measures (type of function score, superficial or deep infection, mal- and nonunion).

## Risk of bias tool

The Cochrane Risk of Bias Tool was used to evaluate bias in RCT studies [26]. The Cochrane ROBINS-1 tool was used to evaluate nonrandomised cohort studies [27].

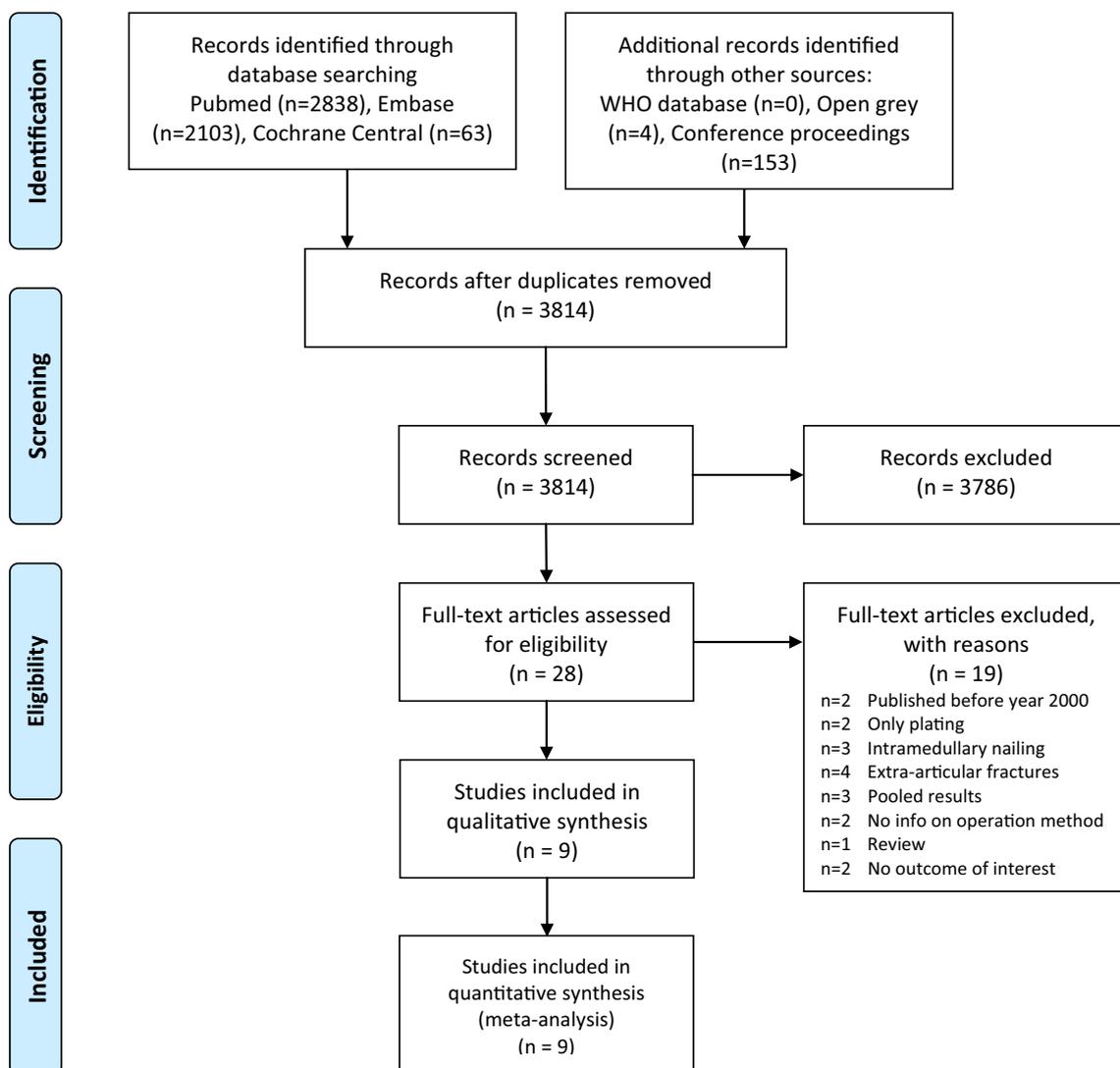


Fig. 1 Flow diagram of article inclusion

## Summary measures

The outcome measures reported across studies were meta-analysed using forest plots (statistical software: RevMan

5.3). The intervention effect was expressed as a risk ratio (RR). Statistical significance was defined as  $p \leq 0.05$ .

The pooled data were assessed for heterogeneity using Chi-squared and I-squared tests. Heterogeneity was defined as ‘absent’ (0–25%); ‘low’ (26–50%), ‘moderate’ (51–75%)

**Table 1** Characteristics of the studies included in this review

Study	LoE	Group	Mean age (SD)	n	AO 43/Rüedi (n)	Open fractures, n (%)
Wang et al. [42]	I	ORIF	40 (-)*	27	B3:3 C1:9 C2:10 C3:15 B3:2	0
		EF	37 (-)	29	C1:7 C2:13 C3:7	0
Richards et al. [43]	II	ORIF	47 (13)	27	C2:5 C3:21	8 (30%)
		EF	41 (13)	18	C2:1 C3:16	5 (28%)
Guo et al. [44]	II	ORIF	41 (-)	52	III: 52	15 (29%)
		EF	40 (-)	26	III:26	9 (34%)
Koulouvaris et al. [45]	III	ORIF	48 (12)	13	B:8 C:5	8 (61%)
		EF	42 (25)	42	B: 11 C: 31	16 (38%)
Davidovich et al. [46]	III	ORIF	39 (-)	26	C1:3 C2:4	5 (20%)
		EF	43 (-)	21	C3:19 C1:2 C2:6 C3:13	4 (20%)
Danoff et al. [47]	III	ORIF	43 (-)	18	B:2 C1:0	C3:23
		EF	43 (-)	10	10 C3:23	10 (100%)
Bacon et al. [48]	III	ORIF	39	25	C1:3 C2:7 C3:15	3 (12%)
		EF	32	25	C1: 1 C2: 3 C3: 9	3 (12%)
Harris et al. [7]	III	ORIF	40	63	B1: 5 B1: 5 B3:2 C1:14 C1:14 C1:14 B2:1	16 (25%)
		EF	57	16	B3:0 B3:0 C2:0 C2:0	5 (31%)
Xiao et al. [49]	III	ORIF	43	20	I:8 II:6	–
		EF		22	III:6 I:9	

ORIF open reduction internal fixation, EF external fixation, LoE level of evidence

–: Information not available

or ‘high’ (76–100%). Fixed-effect meta-analysis was performed when the I-square was less than 50% [28].

## Results

### Study selection

The search retrieved a total of 5161 citations. After adjusting for duplicates, 3814 studies remained, of which 3786 had to be excluded. The remaining 28 studies all met the inclusion criteria, and the full text of each was examined in detail. Following the examination, an additional 19 studies were excluded [2, 5, 6, 8, 9, 25, 29–41]. A total of nine studies were subsequently analysed (Fig. 1).

### Study characteristics

The nine studies selected for the review comprised one randomised controlled trial (RCT), Wang et al. [42], two prospective cohort studies, Richards et al. and Guo et al. [43, 44], and six retrospective cohort studies: Davidovich et al., Danoff et al., Bacon et al., Harris et al., Koulovaris et al. and Xiao et al. [7, 45–49] (Table 1).

All studies on DIATF used EF and ORIF. The total study sample was 468 patients, 271 (57%) were operated on using ORIF and 197 (43%) underwent EF. The mean age of the patients across the studies was between 39 and 44. All 468 fractures were high-energy fractures due to motorcycle accident, vehicle accidents or falling from heights. They were all intra-articular fractures AO43B and C or Rüedi-Algöever

type I, II and III and could also be classified as pilon fractures [50].

Six studies [7, 43–46, 48, 49] reported both open and closed fractures. Wang et al. [42] reported only closed fractures, whereas Danoff et al. [47] reported only open fractures. Xiao et al. [49] did not report fracture type. The follow-up period varied across the studies from 12 months [43] to 38 months [47].

### Results of individual studies

#### Physical function

Physical function was assessed in six studies [7, 42–44, 46, 47] (Table 2). Both Harris et al. [7] and Richards et al. [43] reported worse functional score (FFI:  $p < 0.05$ , MFA:  $p < 0.05$ , IAS:  $p = 0.002$ , SF-36:  $p = 0.03$ ) in the EF group compared to the ORIF group. No difference between EF and ORIF was seen across the remaining four studies. The evaluation made use of eight different function scores, making a meta-analysis impossible to perform.

#### Complications

A total of 134 complications (468 fractures) were reported with 82 of 197 (42%) fractures in the EF group and 52 of 271 (19%) fractures in the ORIF group leading to complications (Table 3). The meta-analysis showed that the ORIF procedure significantly reduces the incidence of complications (Fig. 2: RR = 2.11; 95% CI 1.59–2.80;  $p < 0.0001$ ). Low heterogeneity was found in this comparison ( $Chi^2 = 13.91$  ( $p = 0.08$ );  $I^2: 42%$ ). We adjusted the

**Table 2** Physical function scores by study

Study	Function score (SD)	ORIF (SD)	EF (SD)	<i>p</i> value
Wang et al. [42]	Mazur score	86 (9.8)	85 (11)	
Richards et al. [43]	Iowa ankle score	11 (8)	23 (12)	0.002**
	SF-36 physical	49	25	0.03**
Guo et al. [44]	Mazur score	79 (11)	81 (11)	
Davidovich et al. [46]	SMFA*	34*(19)	26*(15)	
	AOFAS	72 (21)	77 (14)	
	AAOS	77 (12)	72 (13)	
Danoff et al. [47]	SMFA	17 (11)	22 (13)	
	AAOS	77 (12)	72 (13)	
Harris et al. [7]	FFI	0.23	0.40	<0.05**
	MFA	21	34	<0.05**

SMFA short musculoskeletal function assessment questionnaire, AOFAS American Orthopaedic Foot and Ankle Score, AAOS American Academy of Orthopaedic Surgeons Score, SF-36 Short Form Health Survey-36—physical function, FFI Foot Function Index, MFA Musculoskeletal Function Assessment Score, SD standard deviation

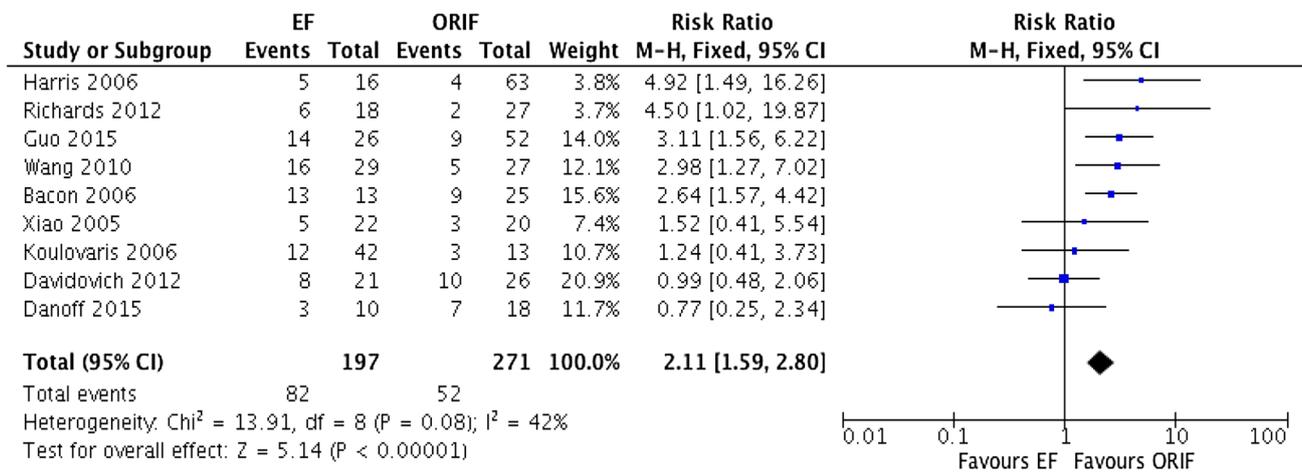
\*SMFA, physical function index

\*\**p* value <0.05: significant for lower physical function score in the EF group compared to the ORIF group

**Table 3** Complications by study

Study	Deep infection, n (%)		Superficial infection, n (%)		Malunion, n (%)		Nonunion, n (%)	
	ORIF	EF	ORIF	EF	ORIF	EF	ORIF	EF
Wang et al. [42]	–	–	3/11	12(41)	1 (4)	3 (10)	1 (4)	1 (3)
Richards et al. [43]	1 (4)	2 (11)	–	–	–	–	1 (4)	4 (22)
Guo et al. [44]	3 (6)	4 (15)	3 (6)	5 (19)	3 (6)	5 (19)	0 (0)	0 (0)
Davidovich et al. [46]	6 (23)	6 (28)	–	–	3 (11)	2 (9)	1 (4)	0 (0)
Danoff et al. [47]	3 (17)	1 (10)	3 (17)	1 (10)	0 (0)	0 (0)	1 (6)	1 (10)
Koulouvaris et al. [45]	1 (7)	0 (0)	1 (7)	6 (14)	1 (7)	6 (14)	–	–
Bacon et al. [48]	0 (0)	1 (7)	3 (12)	4 (31)	2 (8)	3 (23)	4 (16)	4 (7)
Harris et al. [7]	0 (0)	1 (6)	0 (0)	2 (12)	3 (5)	1 (6)	1 (1)	1 (6)
Xiao et al. [49]	0 (0)	0 (0)	0 (0)	2 (9)	–	–	3 (15)	3 (14)

– Information not available



**Fig. 2** Comparison of total number of complications between the EF and ORIF groups

meta-analysis by excluding three studies, which reported either closed or open fractures [42, 47, 49]. This adjusted meta-analysis confirmed ORIF significantly reduces the complication rate compared to EF (RR = 2.24; 95% CI 1.62–3.10;  $p < 0.0001$ .  $Chi^2 = 9.67$  ( $p = 0.09$ );  $I^2: 48\%$ ) (Table 4).

**Infection**

Eight studies reported deep wound infections in 15 fractures in the EF group ( $n = 168$ ) (9%) and 14 fractures in the ORIF group ( $n = 238$ ) (6%) (Table 3). The meta-analyses showed no significant difference in deep wound infection between the two groups (Fig. 3: RR = 1.40; 95% CI 0.77–2.52;  $p = 0.27$ ) and no significant heterogeneity ( $Chi^2 = 7.41$  ( $p = 0.28$ );  $I^2: 19\%$ ). Adjusting for open and closed fractures did not change the results (RR = 1.54; 95% CI 0.83–2.86,  $p = 0.17$ ). Heterogeneity was not significant ( $Chi^2 = 6.78$  ( $p = 0.24$ );  $I^2: 26\%$ ) (Table 4).

Seven studies reported superficial wound infections (Table 3). In the EF group, 32 fractures ( $n = 158$ ), or 20%, developed superficial infections, while in the ORIF group, 13 fractures ( $n = 218$ ), or 6%, did. The meta-analysis revealed a lower incidence of superficial wound infections in the ORIF group (Fig. 4: RR = 2.94; 95% CI 1.62–5.34;  $p < .0004$ ) and no significant heterogeneity ( $Chi^2 = 4.14$  ( $p = 0.66$ );  $I^2: 0\%$ ). Adjusting for open and closed fractures did not change the results (RR = 3.21; 95% CI 1.46–7.17;  $p < .004$ ), with no significant heterogeneity ( $Chi^2 = 1.74$  ( $p = 0.63$ );  $I^2: 0\%$ ) (Table 4).

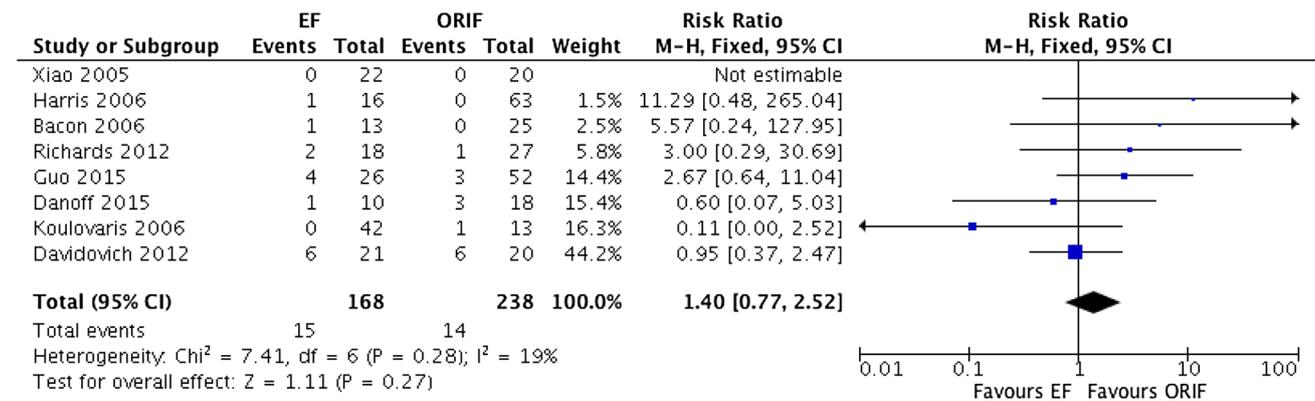
**Mal- and nonunion**

Seven studies reported malunions. The number of malunions was 21 in the EF group ( $n = 157$ ) (13%) and 11 in the ORIF group ( $n = 224$ ) (5%) (Table 3). The meta-analysis of malunions showed significantly lower incidence of malunion in the two-stage ORIF group (Fig. 5: RR = 2.62; 95% CI

**Table 4** Relative risk (95% confidence) from the meta-analysis with nine studies and the adjusted meta-analysis with six studies (open/closed fractures)

	Meta-analysis			Adjusted meta-analysis		
	Relative risk	I <sup>2</sup> (%)	p value	Relative risk	I <sup>2</sup> (%)	p value
Total complications	2.11 (1.59–2.80)	42	0.0001	2.24 (1.62–3.10)	48	0.0001
Deep infection	1.40 (0.77–2.52)	19	0.27	1.54 (0.83–2.86)	26	0.17
Superficial infection	2.94 (1.62–5.34)	0	0.0004	3.21 (1.46–7.17)	0	0.004
Malunion	2.62 (1.27–5.43)	0	0.009	2.46 (1.11–5.47)	0	0.03
Nonunion	1.70 (0.85–3.39)	0	0.13	2.31 (0.95–5.59)	0	0.06

I<sup>2</sup> heterogeneity was defined as ‘absent’ (0–25%); ‘low’ (26–50%); ‘moderate’ (51–75%); or ‘high’ (76–100%). Fixed-effect meta-analysis was performed when the I-square was less than 50% (34). Statistical significance was defined as  $p \leq 0.05$



**Fig. 3** Comparison of deep infection rates between the EF and ORIF groups

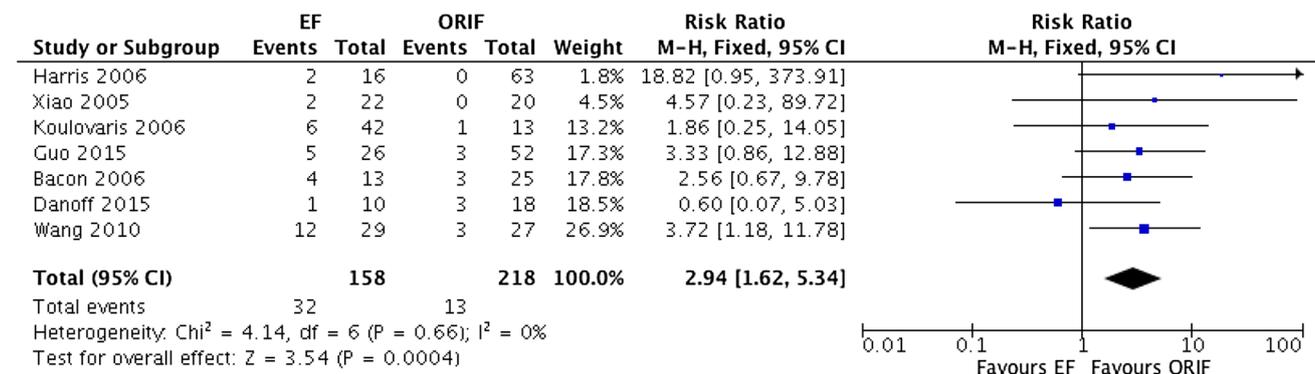
1.27–5.43;  $p = .009$ . Table 4: adjusted analysis: RR = 2.46; 95% CI 1.11–5.47;  $p = 0.03$ , with no significant heterogeneity ( $Chi^2 = 0.82$  ( $p = 0.99$ );  $I^2 = 0\%$ ;  $Chi^2 = 0.62$  ( $p = 0.96$ );  $I^2 = 0\%$ ).

Eight studies reported on nonunion. The number of nonunions was 14 in the EF group ( $n = 155$ ) (9%) and 13 in the ORIF group ( $n = 258$ ) (5%). No significant difference in the incidence of nonunion was seen between the two groups and no significant heterogeneity (Fig. 6: RR = 1.70; 95% CI

0.85–3.39;  $p = .13$ ,  $Chi^2 = 3.44$  ( $p = 0.75$ );  $I^2 = 0\%$ . Table 4: adjusted analysis: RR = 2.31; 95% CI 0.95–5.59;  $p = .06$ ,  $Chi^2 = 2.18$  ( $p = 0.54$ );  $I^2 = 0\%$ ).

**Risk of bias**

The studies were predominately level II and III evidence cohort studies with moderate risk of bias across most domains (Table 5). The RCT study had low bias across



**Fig. 4** Comparison of superficial wound infection rates between the EF and ORIF groups

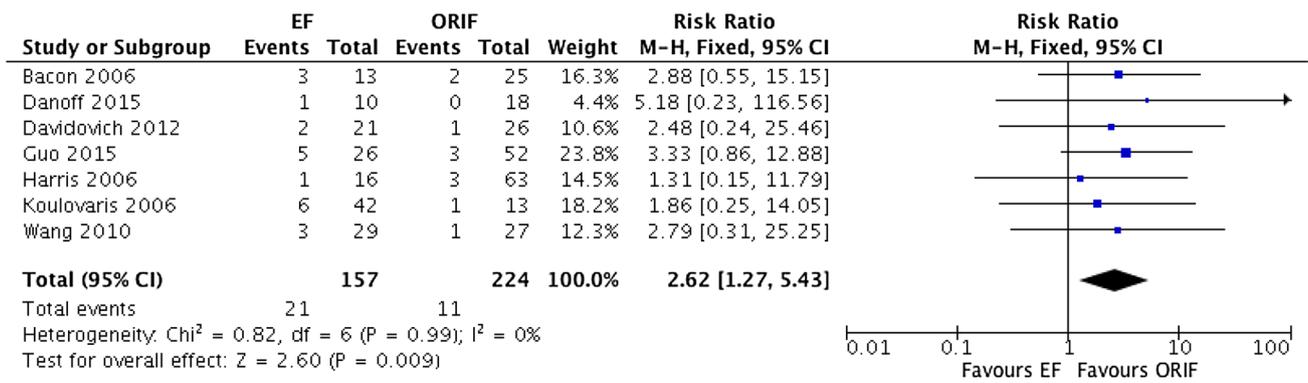


Fig. 5 Comparison of malunion rates between the EF and ORIF groups

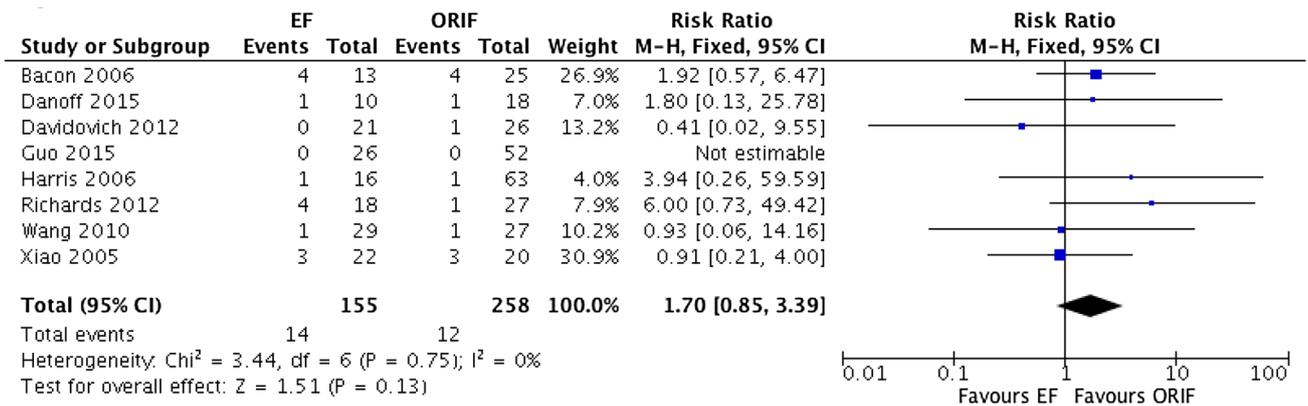


Fig. 6 Comparison of nonunion rates between the EF and ORIF groups

most domains. The cohort studies had limited control of confounding factors, small sample sizes, and six of the studies used retrospective data [7, 45–49].

## Discussion

### Physical function

In this present study, physical function meta-analyses were not performed due to the variety of physical function scores used. However, Richards et al. [43] and Harris et al. [7] found significantly lower physical function scores in the EF group compared to the ORIF group ( $p = 0.03–0.002$ ). EF treatment was more frequently applied in AO 43 C3 fractures. Other studies have shown that EF treatment is frequently applied to 43 C fractures and therefore mistakenly associated with worse functional outcome than ORIF [7, 10].

The remaining four studies [42, 44, 46–48] reported decreased physical function independent of treatment but found a correlation between the level of physical activity

(function score) and fracture severity. The authors of a comparative study evaluating load bearing using dynamic pedography concluded that clinical outcomes and restricted motion (affected ankle) correlated with fracture severity in the AO classification [29]. Another study concluded that 75% of patients with DIATF experienced noteworthy loss of ankle function and suffered from daily pain [8].

### Complications

Before the millennium, deep wound infections were common (50%) and frequently resulted in amputation [10, 12, 51, 52] Sirkin et al. and Borrelli were the first to introduce two-stage protocols [2, 53]. The use of temporary EF to treat the soft tissue before employing the final fixation method drastically reduced the infection rate. Today, deep tissue infections are as low as 3.4% [2]. The low deep tissue infection rate is consistent with the results of this study. The meta-analysis did not show significant differences in deep wound infection between the two groups (Fig. 4). The seven studies reporting on deep tissue infection also reported on both open and

**Table 5** Bias judgment by study (Cochrane Risk of Bias Judgement for RCT Studies)

RoB	Random sequence	Allocation	Performance	Outcome assessment	Attrition	Reporting	Bias judgement	
Wang et al. [42]	Low	Low	Low	Moderate	Low	Unclear	Low	
ROBINS-I	Confounders	Selection of participants	Classification of interventions	Departures from intended interventions	Missing data	Measurement of outcomes	Reported results	Bias judgement
Richards et al. [43]	Moderate	Low	Moderate	Low	Moderate	Moderate	Moderate	Moderate
Guo et al. [44]	Moderate	Low	Serious	Moderate	Moderate	Moderate	Moderate	Moderate
Davidovich et al. [46]	Moderate	Low	Moderate	Low	Moderate	Moderate	Moderate	Moderate
Danoff et al. [47]	Serious	Serious	Moderate	Moderate	Serious	Moderate	Moderate	Serious
Harris et al. [45]	Moderate	Moderate	Low	Moderate	Serious	Moderate	Moderate	Moderate
Koulouvaris et al. [45]	Moderate	Serious	Low	Moderate	Moderate	Moderate	Moderate	Moderate
Harris et al. [7] and Bacon et al. [48]	Serious	Serious	Moderate	Serious	Serious	Moderate	Moderate	Moderate
Xiao et al. [49]	Moderate	Moderate	Moderate	Serious	Moderate	Moderate	Serious	Moderate

closed fractures. It was not possible to perform sub-analysis for open fractures but each individual study reported that higher incidence of deep infections was associated with open fractures.

The ORIF group had significantly lower incidence of superficial infection. Within the studies, only Wang et al. reported higher superficial infection rate in the EF group (41%), solely due to pin site infection, without having an impact on the final outcome [42]. A high incidence of pin site infection has been associated with EF because of the lengthy treatment period of 4–6 months. In most cases, antibiotics and pin removal are adequate to defeat the infection [53].

Regarding malunion, the meta-analysis revealed a significantly lower incidence of malunion in the ORIF group, but no significant difference in nonunion was seen. Other studies have hypothesised that the incidence of malunion might be lower in the ORIF group because of the direct fracture reduction [54, 55]. The studies included in this review reported an increased use of EF for metaphyseal stabilisation as the Gustilo classification and fracture severity increased and therefore might be skewing the results of this study.

The overall complication rate was significantly lower in the ORIF group also when adjusting for studies reported on isolated open or closed DIATF. Therefore, this review indicates that DIATF operated on with ORIF has a lower incidence of complications compared to EF. Two recently published systematic reviews with

meta-analyses comparing DIATF operated on with either EF or ORIF did not report any differences in fracture healing, complications or arthritis of the ankle joint. The study population for these reviews were more heterogeneous; hence, they reported on both extra-articular and intra-articular distal tibial fractures, and one-stage ORIF procedures were seen as the same operative procedure and studies with either closed fractures, open fractures or both were pooled and analysed together [14, 56].

This study faced a number of limitations. First, the number of studies reviewed was 9, with a preponderance of observational studies and only one RCT. Six studies reported on both open and closed DIATF, whereas three studies reported on either open or closed fractures [42, 47, 49]. Furthermore, the sample sizes of the included studies were small, which might have affected the results.

### Overall evidence

This systematic review and meta-analysis reported on physical function and complications after EF or ORIF surgery. Observational studies dominated. Overall, the evidence was not sufficiently strong to determine which operative method is preferable. In addition, the studies all had small sample sizes and evaluated physical function using different scores. Thus, they provided low evidence to allow for definitive conclusions to be drawn.

## Conclusion

This systematic review is the first to report on physical function following DIATF surgery. In general, decreased physical function was reported. The meta-analysis showed lower incidence of superficial wound infection and malunion rates in the ORIF group. Heterogeneity was low.

In conclusion, this review reports lower complication rates following ORIF for DIATF. The overall evidence was limited, and therefore the authors cannot recommend ORIF to be superior to EF treatment for DIATF. More multi-centre studies with larger sample sizes are needed to assess long-term physical function and complications following DIATF surgery.

**Funding** This study was funded by Syddansk Universitet.

## Compliance with ethical standards

**Conflict of interest** The authors have no conflicts of Interest.

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