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Comparison of surgical intervention with functional treatment for acute ruptures of lateral ankle ligmant: a meta-analysis

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ABSTRACT

Objective: To compare the effect of surgical intervention on functional treatment. **Methods:** By searching the MEDLINE (1966 to October 2011), EMBASE (1980 to October 2011), the Chinese Biomedical Database Databases (1980 to October 2011), a total of 9 related RCT studies comparing surgical intervention with functional treatment were included in our study. RevMan software was taken to analyze the data. **Results:** These 9 studies involved a total of 1 268 mostly young adults, including 580 patients with surgical treatment and 688 patients with functional treatment. The results showed the stability of ankle activity in surgical treatment group was better than that in functional treatment group, with the *OR* and 95% *CI* of 0.72 (0.52-0.99). No significant difference was found in the recurrence of the surgical and functional group. However, the movement disorder in the surgical treatment suggested increased risk than that in functional group, with the *OR* and 95% *CI* of 2.39 (0.98-5.85). Surgical group found more complication than the function group, such as deep vein thrombosis,deep venous thrombosis, tenderness of scar and sensory loss. **Conclusions:** In conclusion, our finding showed that surgical treatment could gain better efficacy than functional treatment, but may bring more complication. Therefore, further large sample size RCT is warranted.

1. Introduction

Acute ruptures of lateral ankle ligmant, primarily sprains, is one of the most common injuries of the musculoseletal system, and accounted for about 25% of all injuries[1-3]. There are about 23 000 and 5 000 ankle injuries each day in the the United states and United kingdom, respectively, and 600 000 people sustain an ankle injury each day, 120 000 of which are the result of sporting injuries, and of these it is estimated that 43 000 patients present for medical care[4-7]. Each year general practioners in the Netherlands see around 125 000 patients with an ankle sprain, with an incidence of eight per 1 000 patients per year[2]. Among athletes, untimely and inappropriate treatment of the acute ruptures of lateral ankle would induce recurrent sprain, functional instability and other complications.

Management strategies for acute ruptures of lateral ankle ligaments can be divided into cast immobilization, operative treatment and functional treatment. Although this injury is very common, related selection of treatment remains controversial. In previous studies, the operative treatment could gain more efficacy rate for acute rupture of lateral ankle ligaments, but this method may bring more complications such as tenderness of scar, sensory loss, infection or wound necrosis[8-10]. Therefore, we conducted a systematic review of the related literature to explore the effectiveness of operative treatment and functional treatment for acute ruptures of lateral ankle ligmant.

2. Materials and methods

2.1. Criteria for considering studies

The aim of this study was to perform a meta-analysis of the effectiveness of operative treatment and functional treatment for acute ruptures of lateral ankle ligmant. Only

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randomized controlled trial comparing the interventions, operative treatment and functional treatment, for the treatment of acute injuries of lateral ankle ligaments, can be recruited in our study. It included adults with acute injury of the lateral ligment complex of the ankle. Trials excluded children or participants with congenital deformities or degenerative conditions. If studies involved a mixing population of adults and children, the children proportion should not be above 10%. Treatments for the chronic ankle instability or post surgical treatment were excluded. If studies involved treatment on chronic ankle sprains or other ankle injuries such as fractures, the proportions of these diseases should not be above 10%.

Treatment comparing surgical intervention with functional treatment could be included in our study. Functional treatments were defined as strapping, bracing, use of an orthosis, elastic wrapping, a short period of cast immobilization. Surgical treatment can be considered as either ligament repair or reconstruction followed by conservative modalities.

2.2. Searching strategy

We searched the MEDLINE (1966 to October 2011), EMBASE (1980 to October 2011), the Chinese Biomedical Database Databases (1980 to October 2011) and reference lists of articles. We also contacted researchers in this filed.

We used no language or publication status restrictions. The search terms including ´ligment´, ´ankle´, ´sprains or strains or rupture or injury´, ´reatment´, ´functional´ and ´surgical´ and ´randomized controlled trial´. The data of the last search was October 2011.

Two independent authors reviewed the titles, abstracts and keywords of all records retrieved to determine whether the studies were relevant to this review, and where the title and abstract did not provide adequate information, we assessed the full study and contact the authors of the study if additional information was required for further clarification. We also attempted to identify additional studies by searching the reference lists of relevant trials, and scrutinized author names, location, study date, setting, number of participants, and outcome to ensure that each trial would be included only once. Of the 134 articles identified, only 9 related RCT studies comparing surgical intervention with functional treatment were included our study (Table 1).

2.3. Statistical analysis

For dichotomous outcomes, measures of effect would be expressed as odds ratios (*OR*), with 95% confidence intervals (*CI*). Pooled results would be analyzed using either a fixed-effect or random-effects model, depending on the level of heterogeneity. Measures of effect for continuous outcomes scores would be expressed as mean differences with 95% *CI*. We analyzed pooled results using either a fixed-effect or random-effects model, depending on the level of heterogeneity. The heterogeneity was tested with a *Q*-statistics with *P*-values < 0.05, and its possible sources were assessed by subgroup analysis as described below. The Egger´s regression asymmetry test was taken to evaluate publication bias ($P<0.1$ was considered representative of statistically significant publication bias). Subgroup analysis and meta-regressions were performed to investigate possible factors that might relate to varying effects of surgical intervention with functional treatmen-t for acute ruptures of lateral ankle ligmant.

3. Results

Search from January 1966 to October 2011 resulted in the identification of nine studies. The publication dates of the trail span 26 years from 1984 to 2010. The trails were conducted in one of the following 6 countries: one in United Kingdom, two in Germany, two in Finland, two in Denmark, one in Netherlands and two in Australia. The 9 studies involved a total of 1 268 mostly young adults, including 580 with surgical treatment and 688 with function treatment. The median or mean ages of trial populations ranged between 16 to 45 years. Most of the included studies focused on the outcome of ankle activity, subjective instability and recurrence as well as complication.

Figure 1 showed the difference of the long term recovery to preinjury activity level between surgical and functional treatment for acute ruptures of lateral ankle ligmant. Pooled resulted did not indicated a significant difference in the recovery of the ankle activity (*OR*=1.08, 95% *CI*=0.37-3.21), and no significant heterogeneity was found. Six studies reported the ankle stability after treatment in Figure 2.

Table 1
Characteristics of included studies.

Study ID	County	Follow up (months)	Intervention group/ control group	Age (years)	Outcome
Evans 1984[8]	United Kingdom	24	50/50	16-35	Ankle activity, subjective instability, complication
Klein 1988[9]	Germany	24	30/30	16-40	Ankle activity, subjective instability, recurrence, complication
Korkala 1987[11]	Finland	24	50/100	15-50	Ankle activity, subjective instability, recurrence, complication
Moller-Larsen 1988[12]	Denmark	12	55/120	15-47	Ankle activity, recurrence, complication
Petersen 1985[13]	Denmark	12	29/30	15-50	Ankle activity, recurrence, complication
Pijnenburg 2003[14]	Netherlands	72	159/158	18-45	Ankle activity, recurrence, complication
Povacz 1998[15]	Australia	6	73/73	16-39	Ankle activity, subjective instability, recurrence, complication
Sommer 1987[11]	Germany	6	36/27	18-45	Subjective instability, recurrence
Pihlajamaki 2010[10]	Finland	168	25/26	Average 20.4	Subjective instability, recurrence

Majority of the studies reported the surgical treatment could gain more people with ankle function stability than the functional treatment, with the *OR* and 95% *CI* of 0.72 (0.52–0.99). However, significant heterogeneity was found in studies on the ankle function stability ($P<0.05$). After removing Evans 1984 and Moller-lasen 1988, the heterogeneity was greatly reduced, and the *P* value was equal to 0.16. The *OR* (95% *CI*) changed to 0.47 (0.32–0.70).

There was a non-significant difference decreased in the numbers of people with recurrent ankle injury in the functional treatment group compared with the surgical treatment group, and the *OR* (95% *CI*) was 0.66 (0.36–1.22) (Figure 3). No significant heterogeneity was found in studies. After excluding study of Peterson 1985[13], significant *OR* was found (*OR*=0.62, 95% *CI*=0.34–0.98), and the heterogeneity was greatly reduced (*P* value deceased from 0.10 to 0.16). The movement disorder in the surgical treatment suggested increased risk than that in functional group, with the *OR* and 95% *CI*) of 2.39 (0.98–5.85) (Figure 4).

Pooled results for the complication of treatment methods showed the surgical intervention had higher risk of getting complication with *OR* (95% *CI*) of 5.28 (2.19–12.72) (Figure

Study or subgroup	Surgical treatment Events	Total	Functional treatment Events	Tota	Weight	Odds ratio M-H. Random. 95% *CI*
Pihlajamaki 2010	10	15	7	18	34.0%	3.14 (0.75, 13.16)
Petersen 1985	2	29	3	30	24.1%	0.67 (0.10, 4.31)
Korkala 1987	4	34	15	83	41.9%	0.60 (0.19, 1.97)
Total (95% *CI*)		**78**		**131**	**100.0%**	**1.08 (0.37, 3.21)**
Total events	16		25			

Heterogeneity Tau^2= 0.37, Ch^2=3.32, *df*=2 (*P*=0.19); I^2=40%

Test for overall effect: *Z*=0.15 (*P*=0.88)

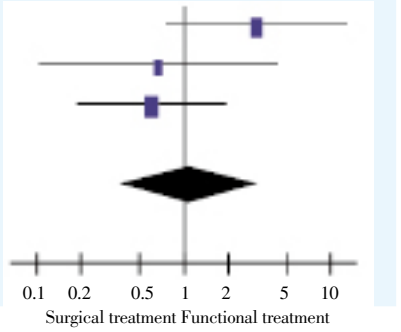

Figure 1. Comparison of recovery to preinjury activity by surgical treatment and functional treatment in acute ruptures of lateral ankle ligmant.

Study or subgroup	Surgical treatment Events	Total	Functional treatment Events	Tota	Weight	Odds ratio M-H. Random. 95% *CI*
Evans 1984	13	50	4	50	3.3%	4.04 (1.22, 13.43)
Klein 1988	10	26	12	29	7.9%	0.89 (0.30, 2.61)
Korkala 1987	3	34	34	83	20.3%	0.14 (0.04, 0.49)
Moller-larsen 1988	14	55	22	120	11.6%	1.52 (0.71, 3.26)
Pijnenburg 2003	31	159	50	158	45.6%	0.52 (0.31, 0.88)
Povacz 1988	7	73	11	73	11.2%	0.60 (0.22, 1.64)
Total (95% *CI*)		**397**		**513**	**100.0%**	**0.72 (0.52, 0.99)**
Total events	78		133			

Heterogeneity Chi^2= 19.85, df^2=5 (*P*=0.001); I^2=75%

Test for overall effect: *Z*=2.03 (*P*=0.04)

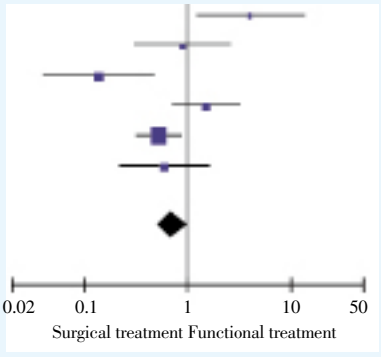

Figure 2. Comparison of ankle function stability by surgical treatment and functional treatment in acute ruptures of lateral ankle ligmant.

Study or subgroup	Surgical treatment Events	Total	Functional treatment Events	Tota	Weight	Odds ratio M-H. Random. 95% *CI*
Evans 1984	0	50	1	50	3.3%	0.33 (0.01, 8.21)
Korkaia 1987	15	75	18	62	25.5%	0.61 (0.28, 1.34)
Petersen 1985	3	29	0	30	3.8%	8.06 (0.40, 163.21)
Pihajamaki 2010	1	24	7	19	6.5%	0.07(0.01, 0.68)
Pijnenburg 2003	35	159	53	158	34.2%	0.56 (0.34, 0.92)
Povacz 1988	20	73	18	73	26.8%	1.15 (0.55, 2.42)
Sommer 1987	0	36	0	27		Not estimable
Total (95% *CI*)		**446**		**419**	**100.0%**	**0.66 (0.36, 1.22)**
Total events	74		97			

Heterogeneity Tau^2=0.22, Chi^2= 9.23, df^2=5 (*P*=0.10); I^2=46%

Test for overall effect: *Z*=1.33 (*P*=0.18)

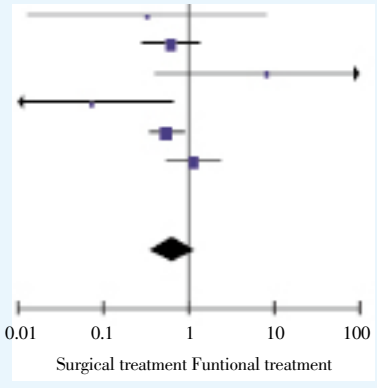

Figure 3. Comparison of recurrent ankle injury by surgical treatment and functional treatment in acute ruptures of lateral ankle ligmant.

Study or subgroup	Surgical treatment Events	Total	Functional treatment Events	Tota	Weight	Odds ratio M-H. Random. 95% *CI*
Evans 1984	3	50	2	50	23.7%	1.53 (0.24, 9.59)
Korkaia 1987	1	34	1	83	10.2%	2.48 (0.15, 40.91)
Povacz 1988	4	73	3	73	33.9%	1.35 (0.29, 6.27)
Specchiulli 2001	10	50	2	50	32.2%	6.00 (1.24, 28.99)
Total (95% *CI*)		**207**		**256**	**100.0%**	**2.39 (0.98, 5.85)**
Total events	18		8			
Heterogeneity Tau^2=0.00, Chi^2= 2.09, df^2=3 (P=0.55); I^2=0%						
Test for overall effect: Z=1.91 (P=0.06)						

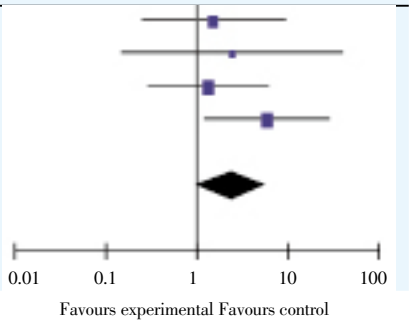

Figure 4. Comparison of movement disorder by surgical treatment and functional treatment in acute ruptures of lateral ankle ligmant.

Study or subgroup	Surgical treatment Events	Total	Functional treatment Events	Tota	Weight	Odds ratio M-H. Random. 95% *CI*
14.1.1 DVT						
Evans 1984	1	50	1	50	9.9%	100 (0.06, 16.44)
Korkaia 1987	3	34	2	83	22.9%	3.92 (0.62, 24.59)
Petersen 1985	0	29	0	30		Not eslimable
Subtotal (95% *CI*)		**113**		**163**	**32.8%**	**2.60 (0.56, 12.07)**
Total events	4		3			
Heterogeneity Tau^2=0.00, Chi^2= 0.64, df^2=1 (P=0.42); I^2=0%						
Test for overall effect: Z=1.22 (P=0.22)						
14.1.2 Tendermess of scar						
Evans 1984	2	50	0	50	8.2%	5.21 (0.24, 111.24)
Klein 1988	5	26	0	30	8.9%	15.60 (0.82, 297.31)
Pihlajamaki 2010	1	25	0	26	7.3%	3.24 (0.13, 83.47)
Subtotal (95% *CI*)		**101**		**106**	**24.5%**	**6.74 (1.14, 39.83)**
Total events	4		3			
Heterogeneity Tau^2=0.00, Chi^2= 0.55, df^2=2 (P=0.76); I^2=0%						
Test for overall effect: Z=2.10 (P=0.04)						
14.1.3 Sensory loss						
Evans 1984	6	50	0	50	9.2%	14.75 (0.81, 269.34)
Povacz 1998	3	25	0	26	8.5%	8.24 (0.40, 168.26)
Zwipp 1986	6	102	0	98	9.3%	13.27 (0.74, 238.79)
Subtotal (95% *CI*)		**177**		**174**	**26.9%**	**11.84 (2.17, 64.45)**
Total events	15		0			
Heterogeneity Tau^2=0.00, Chi^2= 0.08, df^2=2 (P=0.96); I^2=0%						
Test for overall effect: Z=2.86 (P=0.004)						
14.1.4 Wound infection or necrosis						
Kiein 1988	0	26	0	30		Not estimable
Korkala 1987	0	34	0	83		Not estimable
Pihlajamaki 2010	0	25	0	26		Not estimable
Pijnenburg 2003	1	159	0	158	7.5%	3.00 (0.12, 74.20)
Povacz 1998	2	73	0	73	8.3%	5.14 (0.24, 108.94)
Subtotal (95% *CI*)		**317**		**370**	**15.8%**	**3.98 (0.44, 36.34)**
Total events	3		0			
Heterogeneity Tau^2=0.00, Chi^2= 0.06, df^2=1 (P=0.81); I^2=0%						
Test for overall effect: Z=1.22 (P=0.022)						
Total (95% *CI*)		708		813	100.0%	5.28 (2.19, 12.72)
Total events	30		3			
Heterogeneity Tau^2=0.00, Chi^2= 3.27, df^2=9 (P=0.95); I^2=0%						
Test for overall effect: Z=3.71 (P=0.0002)						
Test for subarouo differences: Chi^2=1.83. df=3 (P=0.61). I^2=0%						

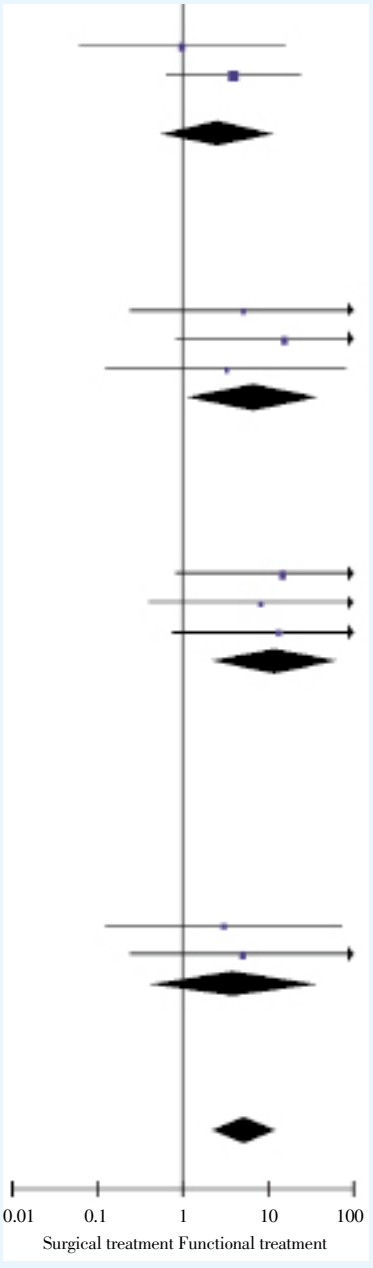

Figure 5. Comparison of complication by surgical treatment and functional treatment in acute ruptures of lateral ankle ligmant.

5), such as deep vein thrombosis,deep venous thrombosis, tenderness of scar, sensory loss and wound infection or necrosis. The surgical treatment had heavy risk of tenderness of scar and sensory loss than the functional treatment [*OR* (95% *CI*)=6.74 (2.25–43.86) and 11.84 (2.17–64.45), respectively]. No heterogeneity was found in these studies.

We did not found a obvious publication bias by funnel plots (Figure 6–8). No evidence of publication bias was found in studies on the recovery to preinjury activity, ankle stability and recurrent ankle injury by Egger test (*P*=0.09, *P*=0.61 and *P*=0.14, respectively).

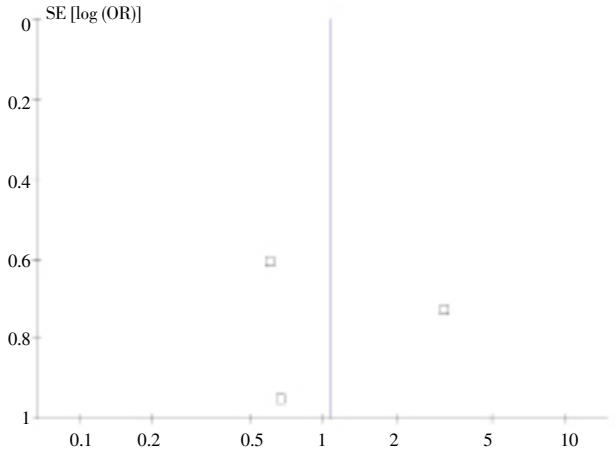

Figure 6. Funnel plot for studies on preinjury activity.

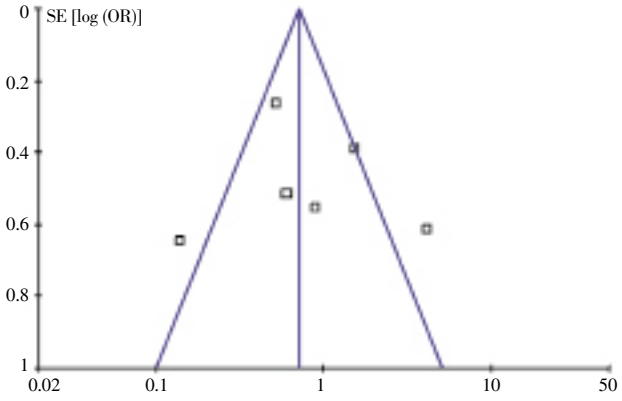

Figure 7. Funnel plot for studies on ankle stability.

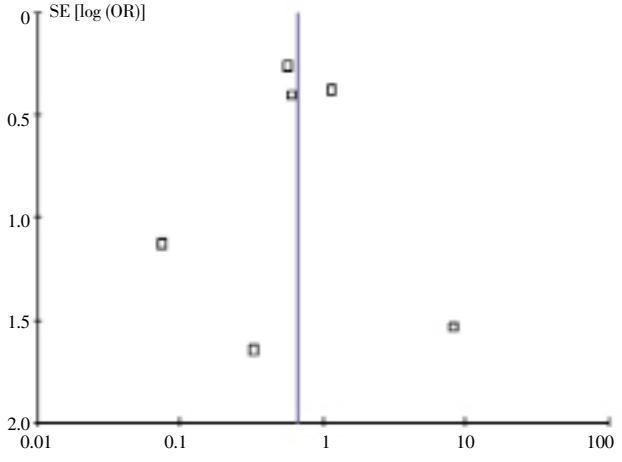

Figure 8. Funnel plot for studies on recurrent ankle injury.

4. Discussion

This systematic review presents a comprehensive examination of all randomized controlled trials comparing surgical treatment with functional treatment for acute ruptures of lateral ankle ligmant. The pooled data from these trials indicate the surgical treatment could gain more benefit in recovery to preinjury activity and ankle function stability than the functional treatment, and the surgical treatment could ovoid more recurrent ankle injury over functional treatment. However, the surgical treatment could bring more risk of complication.

The included studies span 26 years from 1984 to 2010. Most of included studies were in poor quality. Several studies have significant treatment allocation concealment, and they do not include all data of the enrolled patients. This allocation concealment could result in great selection bias, and induce overestimated the treatment efficacy[8,13]. Therefore, we performed subgroup analysis regarding the different outcomes to decrease the bias induced by allocation concealment. The different outcomes, including recovery to preinjury activity and ankle function stability as well as recurrent ankle injury, do not show fundamentally different conclusions, which indicate that the size of the bias do not greatly modify the results of included studies.

We found significantly heterogeneity of pooled resulted in ankle function stability and recurrent ankle injury, which showed there might be other effect on the pooled results. The heterogeneity could result from variations in outcome definition and other variations in study characteristics, such as stage, duration and location of injury. However, most of the included studies do not provide specific characteristics of patients. Therefore, we do not conduct more subgroup analysis regarding the characteristics of patients. For example, the result of Peterson 1985[13] shows a statistically significant difference in the subgroups of treatment efficacy. However, after removing Peterson 1985 study[13], the heterogeneity is greatly reduced, which indicates the outcome of Peterson 1985 could bias the pooled results.

Several studies in this review are conducted in 20 years ago, and reflect previous treatment methods and practice. Even after surgical treatment, the cast immobilization has also been changed[16,17]. However, there is no evidence of how many of the changes from the old studies to the current practices. In our pooled data, surgical treatment could bring more complications due to the invasive treatment.

There are several limitations of our study. Firstly, most of our studies are conducted in 20 years ago, and great selection bias may bias the pooled results. Secondly, the treatment method has been changed during the past 20 years, but no subgroup analysis could be taken due to lack

of evidence of the changes. Thirdly, there is lack of the characteristics of the grade of lateral ligment injuries, which could lead to great heterogeneity of studies. Therefore, further sufficiently powered, high quality and appropriately randomized controlled trials of surgical treatment compared the functional treatment are needed[17].

In conclusion, the pooled results show surgical treatment is superior to functional treatment in recovery to preinjury activity, ankle function stability and recurrent ankle injury. However, the surgical treatment could bring more complication than functional treatment. The low quality of included studies induces heterogeneity in our meta-analysis. Further large sample and high quality studies are needed to explore efficacy of treatment.

Conflict of interest statement

We declare that we have no conflict of interest.

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