# Meta-analysis of repair and reconstruction in the treatment of lateral ankle ligament injury

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**Keywords:** Repair and reconstruction; Ankle joint; Ligament injury; Meta analysis

**Abstract:** Objective: Ankle joint injury is usually not a simple fracture, but often complicated with peripheral tissue injury, and the incidence of triangular ligament injury is extremely high. Treatment of triangular ligament injury includes surgical treatment and conservative treatment. This meta-analysis is Meta evaluate the efficacy of repair and reconstruction treatment. So as to provide reference for clinical treatment of triangular ligament injury complicated with ankle fracture. Methods: The databases such as Pubmed, EM base, Cochrane library, CNKI and Wanfang were searched by computer to screen the literatures that fit this study. With "ankle joint", "lateral ligament", "repair" and "reconstruction" as key words, postoperative AOFAS score, postoperative visual simulation score, operation time, postoperative complications, medial ankle joint space (MDS) and talus inclination were selected as indicators to evaluate the postoperative clinical efficacy of patients. Results: M eta analysis showed that the functional stability of ankle joint treated by surgery was significantly better than that treated by non-surgery. The combination of thread anchor and open reduction and internal fixation can effectively improve the excellent and good rate of treatment; Conclusion: Repeated sprain and pain can be effectively relieved after operation, and anatomical repair and reconstruction can effectively treat lateral ligament injury of ankle joint.

## 1. Introduction

The injury of lateral ligament of ankle joint is the most common sports injury. Nearly 85% of sprains involve the lateral ligament complex of ankle joint, of which about 65% involve the anterior talofibular ligament alone, and about 20% involve both the anterior talofibular ligament and calcaneal ligament [1]. However, the injury of posterior talofibular ligament is very rare and often occurs only in severe fracture and dislocation. Usually, I-degree and II-degree ligament injuries can be recovered by conservative treatment, and if III-degree injuries are ineffective by conservative treatment, surgery is needed [2]. At present, there are many surgical methods reported in the literature [3], which are mainly divided into anatomical repair, anatomical reconstruction and non-anatomical reconstruction. The long-term clinical follow-up results show that the non-anatomical reconstruction is not effective [4], and it is easy to have limited ankle joint movement, degenerative changes of hind feet and recurrent instability after operation, which has been avoided as much as possible.

A large number of randomized controlled trials show that surgical or non-surgical treatment (plaster splint fixation or functional treatment) can achieve better results in acute lateral collateral ligament injury of ankle joint. A systematic evaluation result in literature [5] shows that the effect of surgical treatment is better than that of non-surgical treatment, but it does not evaluate the occurrence of complications after treatment and whether it is in line with economic benefits. The purpose of this study is to compare the efficacy and complications of repair and reconstruction in the treatment of acute lateral collateral ligament injury of ankle joint through Meta-analysis, so as to provide an effective basis for the choice of treatment methods for acute lateral collateral ligament injury of ankle joint.

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## 2. Materials and methods

### 2.1. Inclusion and exclusion criteria

Inclusion criteria: (1) patients with ankle fracture and triangular ligament injury; (2) All ankle fractures were treated by operation. (3) Patients with triangular ligament injury were divided into two groups in the same literature: one group underwent surgical repair; The other group received conservative treatment.

Measurement indexes: 1. AOSAF score after operation: 2. Medial space (MDS) after operation; 3. Postoperative talus inclination: 4. The number of postoperative complications; 5. Visual analogue scale (VAS) after operation; 6. Operation time.

Exclusion criteria: 1. ankle fracture combined with fractures of other parts of the ipsilateral lower limbs, such as tibia and fibula shaft fracture, tibial plateau fracture, talus fracture, tarsal fracture, etc.; 2. The vital signs of the subjects are unstable or combined with risk factors affecting fracture and ligament healing; 3. Non-clinical controlled trials; 4. Non-Chinese and English documents; 5. Repeated publication of literature.

### 2.2. Document retrieval

With "ankle joint", "lateral ligament", "repair" and "reconstruction" as key words, through searching Pubmed, EM base, Cochrane library, CNKI and Wanfang databases, we screened the literature materials that fit this study.

### 2.3. Standard of literature retrieval and literature quality evaluation

Two independent researchers searched Chinese and English databases by computer according to Chinese and English search terms. And import the retrieved documents into Endnote software, and use the software to intelligently delete duplicate documents. Read the title of literature and delete irrelevant literature. Read literature abstracts and delete irrelevant literature. Download and read the full text of the remaining literatures, select the literatures that meet the requirements, and finally bring them into the study. Next, the two staff members who participated in the research exchanged the documents that met the requirements finally selected by themselves for further verification. If there is any dispute in the verification process, it will be resolved through in-depth study or discussion or submitted to the third party for blind evaluation. Finally, the author's name, publication time and other basic information of all eligible documents are transcribed.

### 2.4. Statistical analysis

Meta-analysis was conducted on the extracted data by using the statistical software Review Manager5.3 version 5.3 recommended by Cochrane Collaboration Network. The relative risk (RR) and 95% confidence interval (CI) were used in the analysis of classified variable data, while the mean difference (MD) and 95%CI were used in the analysis of continuous variable data. Heterogeneity test adopts $I^2$ statistic test, and Q value is used to estimate heterogeneity. If P>0.10 and $I^2$ <50%, it is considered to have small heterogeneity, and the fixed effect model is adopted; If P≤0.10, $I^2$ ≥50%, it is considered to have great heterogeneity, and the random effect model is adopted.

## 3. Result

### 3.1. Retrieval results

Chinese and English databases were searched by computer, and 1056 documents were retrieved. Using Endnote software, 720 duplicate literatures were excluded, and 336 literatures remained. After reading the topic, 285 irrelevant documents were deleted, and the remaining 51 were deleted. After reading the literature abstracts, 23 unrelated literatures were deleted, and the remaining 28 literatures. Download the full text of 28 literatures, read them carefully, and exclude 5 literatures.

Finally, 23 literatures were included in Meta-analysis, including 333 in the experimental group and 327 in the control group.

### 3.2. Quality evaluation included in the study

The methodological quality of each article that met the inclusion criteria was evaluated according to Jadad et al. [6] and the four main quality standards for RCTs in Cochrane System Appraiser's Manual, version 4.2.6. Of the 23 included studies, 7 had fully hidden randomization schemes, 4 had evaluator-blinded methods, and 12 reported follow-up. Five studies used the random number table, eight studies randomly selected envelopes, and three randomized studies did not describe the random allocation method. All 23 studies compared baseline prior to study entry with consistent baseline across groups. Evaluation of the legal quality in this study: 7 points for three studies, 6 points for four studies, 5 points for one study, 4 points for three studies, 3 points for one study, and 2 points for one study. Only 2 articles were of low quality and 11 articles were of high quality.

### 3.3. Excellent rate of Baird-Jackson ankle joint related score

Two RCTs reported the excellent and good rates of Baird-Jackson ankle-related scores [7–8]. The results of the meta-analysis showed that there was homogeneity among the articles (P=0.06, $I^2$ =0%). By using the fixed-effect model analysis, the difference between the two groups was significant [RR=1.37, 95%CI(1.07, 1.40), P=0.005]. Compared with the control group, the combination of suture anchor and open reduction internal fixation could effectively improve the excellent and good treatment rate, as shown in Fig. 1.

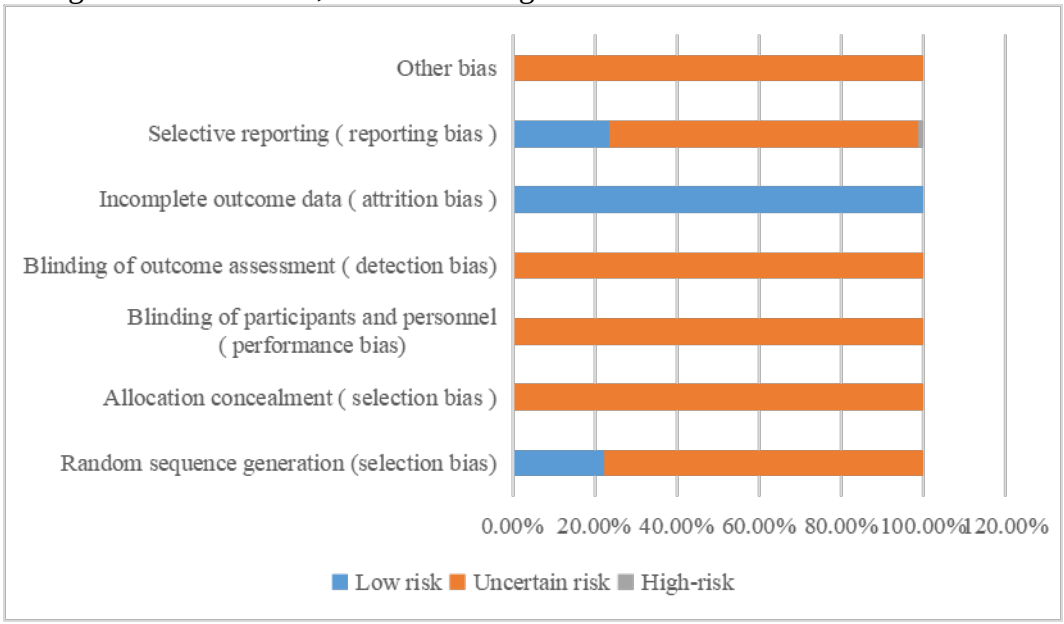


Figure 1 Comparison of excellent and good rates of ankle joint related scores between the two groups

### 3.4. Stability of joint function

Three studies [9-11] reported 810 cases of ankle functional stability after treatment, including 327 cases of surgical treatment and 483 cases of non-surgical treatment; There was heterogeneity in all study questions ($I^2$ = 75%, P = 0.001). Therefore, using the random effect model analysis, the difference between the two treatment methods was statistically significant [OR = 0.74, 95% CI (0.42, 0.89), P < 0.05], suggesting that the functional stability of ankle joint in the surgical treatment group was significantly better than that in the non-surgical treatment group.

### 3.5. Postoperative talus inclination

Two groups were compared in talus inclination after operation. Comparison of talus inclination

after operation of two groups in treatment methods was reported in three articles. The results of the meta-analysis heterogeneity Meta showed ($p<0.1$, $I^2$ =86%), $I^2$ =86%>50% indicated that the analysis had severe heterogeneity. Random effect model (RE) was used for analysis. There was a significant difference between the two groups ($MD = -2.69$, 95% CI = − 3.14,-1.07, $P < 0.01$). It indicated that the postoperative talus inclination could be significantly reduced in the surgical repair group.

### 3.6. Publishing bias analysis

According to Cochrane's manual, if funnel chart is used for publication bias evaluation, the number of studies included in meta-analysis of this index should not be less than 10 literatures. Otherwise, because the number of studies included in this index is too small, the inspection ability of funnel graph will be reduced, so that it is impossible to judge the authenticity of asymmetry. In this study, the observation indexes of each study did not reach 10 literatures, so the published bias funnel chart analysis was not carried out.

## 4. Discussion

The triangular ligament is located inside the ankle joint, close to the rotation center of the hind foot, and plays an irreplaceable role in maintaining the stability of the ankle joint. With the anatomical structure of distal tibia and fibula, it can be seen that the lateral bony structure of ankle joint is stronger than the medial one, which requires a stronger triangular ligament to maintain the stability of joint. The incidence of ankle fracture is very high, mainly in active young adults and osteoporotic elderly people [12]. Although the ankle joint is small in size, it has heavy load, complex structure and many articular surfaces.

Anatomical reconstruction mainly uses autologous ligament, allogeneic ligament or artificial ligament to reconstruct the physiological starting point and ending point of ligament complex and ligament, which can restore the ankle joint mobility to the greatest extent, and has better clinical effect, especially for patients with higher requirements for ankle joint stability, such as young adults, athletes and patients who fail to perform anatomical repair. Based on the reconstruction of lateral related ligaments with autologous ligaments, a part of tendon tissue or ligament function may be sacrificed, and recurrent instability may occur. Allogeneic ligaments or artificial ligament complexes may produce rejection, slow proprioception recovery, and relatively high transplantation costs. Clinically, conservative treatment, anatomical repair and reconstruction can be used to treat the injury of lateral collateral ligament of knee joint. Therefore, clinicians should select the optimal treatment method according to the severity of the injury, including the selection of graft [13], establishment of bone tunnel [14], and application of anchor. All these should be comprehensively evaluated in combination with the clinical situation.

The results of this systematic evaluation showed that there was no difference in the recovery of ankle motion level between surgical and non-surgical treatment of acute lateral accessory ligament injury of the ankle. Therefore, surgical treatment has no obvious advantage for the recovery of ankle joint activity level. Regardless of the treatment option, the majority of patients with acute lateral collateral ligament injury of the ankle obtain satisfactory recovery of ankle mobility. At present, non-surgical treatment is still the preferred treatment for most acute injuries of the lateral collateral ligament of the ankle.

At present, there is a Meta-analysis comparing the efficacy of repaired or not-repaired trigonal ligament in the treatment of ankle fractures combined with trigonal ligament. However, this study focuses on whether or not the trigonal ligament is repaired, and does not specifically compare the surgical methods for repairing trigonal ligament. Therefore, there is no systematic evaluation on the treatment of ankle fracture combined with trigonal ligament injury with suture anchors combined with open reduction internal fixation compared with simple open reduction internal fixation in China and abroad. Therefore, the authors consider it necessary to conduct a meta-analysis based on randomized controlled trials in order to compare the clinical efficacy of two specific surgical

approaches of suture anchor combined with open reduction internal fixation for the treatment of ankle fracture combined with trigonal ligament injury.

There are still shortcomings in the meta-analysis of the efficacy of repair and reconstruction in the treatment of lateral ligament injury of the ankle compared with conservative treatment: 1. A total of 660 patients were included in the 23 articles in this experiment, with a small sample size. 2. There is severe heterogeneity in talus inclination, width of medial space of ankle, operation time and visual simulation score comparison. The cause of heterogeneity may be related to the degree of injury mechanism and medical staff's proficiency. Meta-analysis is to collect relevant published articles, but it cannot guarantee the authenticity and reliability of these articles, which will affect the results.

## 5. Conclusions

In summary, our patient's repeated sprains, pains and other uncomfortable symptoms are effectively relieved after surgical treatment. Both anatomical repair and anatomical reconstruction can effectively treat the injury of lateral ligament of ankle. Surgical repair of the ruptured trigonal ligament can reduce or delay the incidence of complications such as joint stiffness, hyperplasia, and traumatic arthritis in patients after surgery. It can accelerate and promote the recovery of postoperative ankle function. Conventional surgery is recommended for the treatment of trigonal ligament injury.

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