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Review Article

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Return to Play Following Arthroscopic *vs.* Open Treatment of Lateral Ankle Instability in Recreational/Athletic

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Abstract

Background: Ankle sprains are very common injuries among athletic populations. Sparse data exists regarding return to play (RTP) following common lateral ligament repairs. Our purpose is to compare RTP timelines and outcomes between open and arthroscopic treatment of lateral ankle instability in athletes.

Methods: In this systematic review, MEDLINE and EMBASE searches were performed to identify available literature through November 2017 describing open and/or arthroscopic treatment of lateral ankle instability in athletes, their outcomes, and a RTP timeline.

Results: A total of ten studies met criteria. 174 athletes were treated with open ankle instability procedures (9 studies) and 19 athletes were treated with arthroscopic procedures (1 study). 167/174 patients with open treatment returned to sport (96% RTP rate, weighted mean RTP timeline of 2.85 months). In comparison, all 19 patients in the arthroscopic group returned to sport (100% RTP rate, weighted mean RTP timeline of 3.794 months).

Conclusion: Very few articles describing outcomes of lateral ligament repair in athletes include return to play metrics. Considering the data available, athletes treated with open ankle ligament repair procedures (nine studies with 167 athletes) returned to play almost 1 month earlier than athletes treated with arthroscopic procedures (1 study with 19 athletes). As timing of return to activities is a valuable metric to compare surgical and rehabilitative techniques, more studies that detail return to sport are needed as part of a description of ankle ligament repairs.

Keywords: Ankle ligaments; Arthroscopy; Return to play; Lateral ankle instability

Introduction

Ankle sprains are very common injuries in the athletic population. At the 2004 olympic summer games in Greece, ankle sprains accounted for 22% of injuries [1]. In Hootman et al. 16-year study of fifteen sports in all three American collegiate divisions, ankle ligament sprains were the most common injury, accounting for approximately 15% of all injuries [2]. Tenforde et al. study of U.S. cross country and track and field high-school athletes suggest that nearly one-third of female and one-quarter of male athletes have a history of an ankle sprain [3]. Lievers et al. studied male collegiate American football injuries from the National Collegiate Athletic Association (NCAA) Injury surveillance system during the 2004-2009 seasons. Lateral ankle sprains were the most common foot and ankle injury, accounting for almost half (45%) of all injuries, as well as the greatest total time loss of all injuries (12,726 days) [4].

Acute ankle sprains have been classified based the amount of ligamentous damage. Grade I entails a stretched anterior talofibular ligament (ATFL) with no laxity on examination. Grade II consists of a complete tear of the ATFL, with or without partial tearing of the calcaneofibular ligament (CFL). Laxity may be present. Grade III involves complete disruption of the ATFL and CFL, with or without posterior talofibular ligament (PTFL) or capsular tearing [5]. While Grade I and II ankle sprains can successfully be treated non-operatively, many grade III injuries require surgical treatment in order to prevent recurrence and facilitate return to full sports participation. Pijnenburg et al. found that when compared to patients treated non-operatively, fewer patients treated surgically reported residual pain, symptoms of giving way, and recurrent sprains (Figure 1) [6].

Techniques used for lateral ligament repair have evolved over time. The most common surgical procedure to repair the lateral ligaments was described by Brostrom et al. as a mid-substance imbrication and suture of the injured ATFL ends [7]. Gould et al. augmented the Brostrom technique with overlap of the nearby lateral talocalcaneal ligament, and by attaching a mobilized lateral portion of the lateral extensor retinaculum to the fibula (in addition to repair of the ATFL and CFL) [8]. Since then, arthroscopic techniques have been introduced to allow repair of the lateral ankle ligaments. Hawkins et al. described an arthroscopic staple technique: the staple tines gather the damaged ATFL and contiguous capsule. The tissue is then fixed to an abraded area on the vertical surface of the talus, anterior to the fibular tip [9]. Maiotti et al. reported the results of arthroscopic thermal capsular shrinkage in 22 soccer players with ankle instability: 86.3% of patients (n=19) had good or excellent functional outcomes at a mean of 42 months [10]. Lui et al. proposed one of the first arthroscopic-assisted lateral ligament reconstructions: An ATFL and CFL reconstruction with a plantaris tendon free-graft via a three-portal

approach [11]. The purported advantage of the less invasive arthroscopic repair is faster recovery and earlier return to sport. However, this purported benefit has not yet been well defined.

The purpose of this review is to compare return to play (RTP) timelines and outcomes between open and arthroscopic treatments of lateral ankle instability in athletes.

Figure 1: Anteroposterior X-ray of the ankle with significant talar tilt secondary to ankle instability.

Methods

Literature search

In this systematic review, a literature search was performed for articles on surgical treatment of lateral ligament ankle sprains. Using the search terms 'ankle ligament surgery' and 'ankle sprain instability repair' in MEDLINE and EMBASE databases, the available literature was obtained up to November 2017. Information obtained included the year of publication, number of athletes, surgical technique, return to play timeline, RTP timeline, RTP performance data, patient reported outcomes measures, and functional outcome measures (Figure 2).

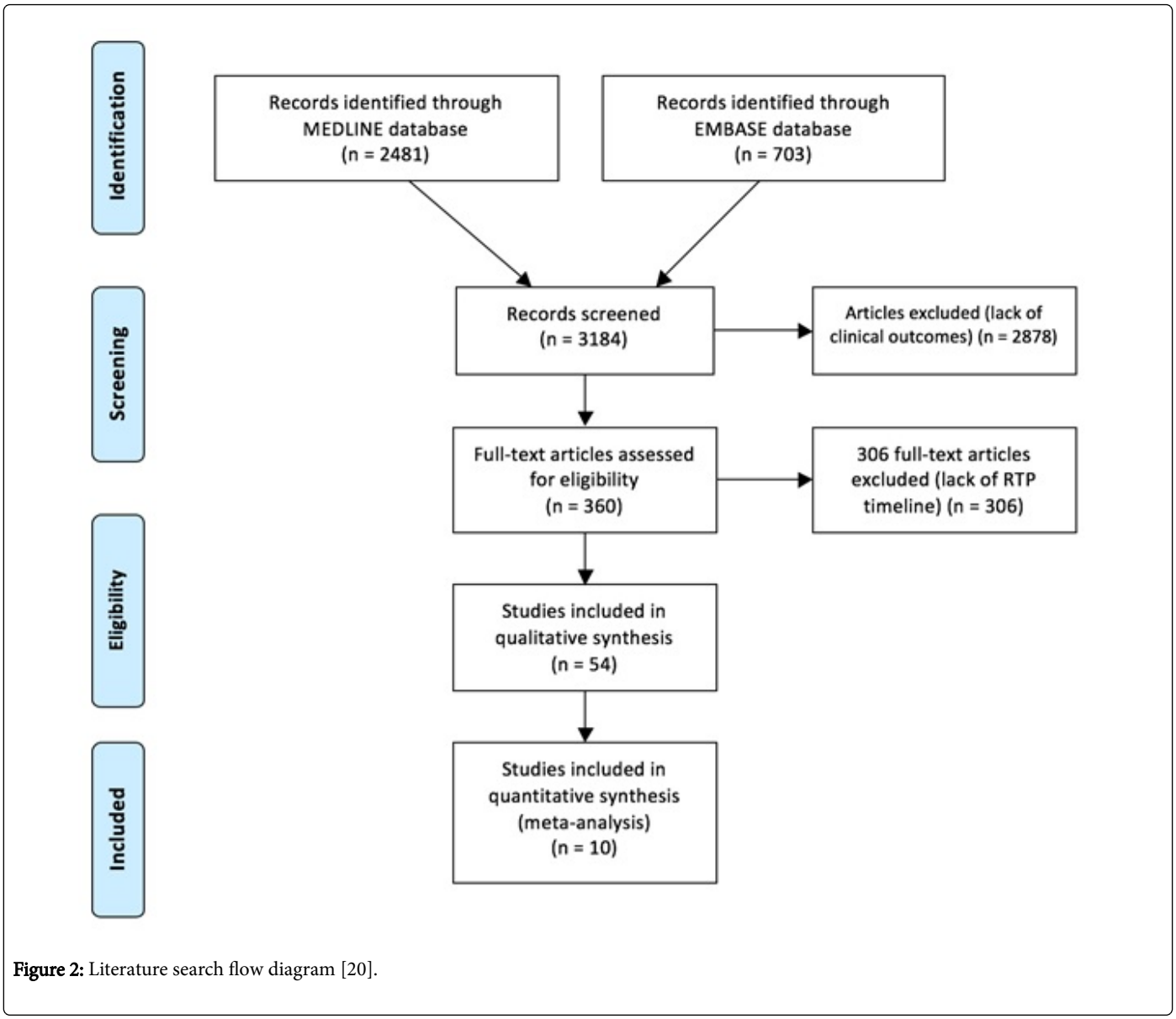

Figure 2: Literature search flow diagram [20].

Study selection

Studies were independently screened by title and abstract. Initial inclusion criteria included: (1) Articles available in the English language, (2) Abstract available, (3) Reported clinical outcomes (Visual Analog Scores, Japanese Society for Surgery of the Foot, Foot and Ankle Ability Measure, etc.). Exclusion criteria included basic science articles, anatomic studies, radiographic studies, and review papers. After passing the initial screening, the remaining manuscripts were completely examined to assess for RTP timeline metrics. To be included in this review, studies needed to contain: (1) Patients who participate in athletic activities, (2) Return to play timelines as an outcome metric or result (i.e. "patients returned to play at 6 months," not "patients were allowed to return to play at 6 months), and (3) Return-to-play timelines reported in means (not medians).

Statistical analysis

Using descriptive statistics from the articles included in this review, a weighted mean and weighted standard deviation for time to return to play were calculated. As some studies reported return to play timelines in weeks while others reported in months, a conversion of 4.3 weeks to 1 month was used. Rate of RTP was described by percentage of all athletes who were able to return to play at all. A percentage was also

calculated for those who returned to sport at pre-injury level, those who returned to sport below the pre-injury level, and those unable to return to sport.

Results

Literature search

The EMBASE database search produced 703 independent results, while the MEDLINE database search produced an additional 2481 results. This generated 3184 total results. Articles that did not report clinical outcomes after surgical management of lateral ankle sprains were excluded, leaving 360 eligible articles. Articles that did not report a return to play timeline were also excluded. The remaining 54 papers discussed a RTP timeline in some capacity. Articles that reported return to play as part of a post-operative protocol (i.e. per protocol, patients are allowed to return to sports at nine weeks), but did not record actual return to play, were excluded, leaving 20 remaining papers. Finally, nine studies reported return to play timelines in means, not medians, and were used for inclusion in this review article. This allowed us to calculate a weighted mean. All nine studies included open procedures, while one of those studies also included arthroscopic procedures (Matsui et al. 19 patients). Further details can be found in Table 1 [12-20].

Author	Year	Procedure	Patients, N (mean age) Activity level/ sport: N	Clinical Outcome (time measured)	Return to play average (range)
Arthroscopic					
Matsui	2016	ATFL repair w/inferior extensor retinaculum reinforcement	19 (28 years)	1. VAS: 12.4 (2 wks) 2. JSSF: 98 (1 year)	3.8 months (2.76–5.06 months)
Open					
Matsui	2016	ATFL repair w/inferior extensor retinaculum reinforcement	18 (24 years)	1. VAS: 19.2 (2 wks) 2. JSSF: 95 (1 year)	3.9 months (2.99–5.06 months)
Giannini	2015	Modified brostrom or anatomic reconstruction with plantaris autograft/ peroneus brevis allograft	31 (25.9 years) Recreational level: 28 Professional: 3	1. AOFAS: 92.2 (5 years)	6 months Return to pre-injury level (n=26) Return to lower-demand sports (n=5)
Ibrahim	2011	Gracilis tendon autograft	14 (25 years) Football: 8 Handball: 3 Basketball: 3	1. AOFAS: 96 (33.5 months) 2. VAS: 6 (33.5 months) 3. Karlssons: 94.7 (33.5 months) 4. Olerud and Molander: 87.5 (33.5 months)	6.8 months (4–11 months)
Morelli	2011	Modified Watson-Jones	14 (22.7 years) Professional: 6	1. Tegner: 5.1 (10.8 years) 2. Good: 1.6 (10.8 years) 3. AOFAS: 92.2 (10.8 years)	6 months (4–8 months) Return to lower-demand sports (n=2) All professionals return to pre-injury level
Jones	2007	Woven polyester tape	4 (42.5 years)	1. Sefton criteria: Grade 1 (24.5 months)	3 months
Coughlin	2004	Direct repair w/gracilis tendon autograft augmentation	28 (31 years) Team sports: 15 Exercise activity: 8 Recreational: 4 No specific sport: 1	1. AOFAS: 98 (23 months) 2. Karlsson score: 95.3 (23 months) 3. VAS: 6 (23 months)	6.5 months
Solakoglu	2003	Colville technique	14 (25 years) Amateur sports: 8 Military: 6	1. Alghren/Larson: 5 (20 months)	6 months

Paterson	2000	Semitendinosis autograft	26	1. ROM (24 months)	2.75 months Return to pre-injury level (n=23) Return to lower-demand sports (n=3)
Hoy	1994	Watson-Jones technique	25	1. Symptoms survey (5 years)	2.29 months 18 returned to sports

Table 1: Summary of articles included in study.

Return to play metrics

Studies were not uniform in their descriptions of a return to play timeline. Although all included studies reported a mean return to play, three studies also reported a range [12,14,15]. One study reported the specific return to play timeline for each individual athlete (Jones) [16]. 174 athletes were treated with open ankle instability procedures, but only 167 were able to return to sport (96% return to play rate for open ankle instability procedures). These athletes returned to sport at a weighted mean of 2.85 months (standard deviation-1.89 months). All 19 patients in the arthroscopic group returned to sport, producing a 100% return to play rate. These athletes returned to sport at a weighted mean of 3.794 months [12].

Three studies specified whether patients returned to sport at the athlete's pre-injury level or below the pre-injury level [13,15,19]. There were a total of 71 patients who returned to play in these three studies (Giannini n=31; Paterson n=26; Morelli n=14), with 10 patients returning to lower demand sports (Giannini n=5; Paterson n=3; Morelli n=2). In Paterson et al. study, two patients cited lack of confidence in the ankle while one patient cited persistent pain. Of the available data, this produces an aggregate of 14% of patients treated with open ankle instability procedure return to sport below the pre-injury level (of the 71 patients from these three studies).

Patient reported outcome measures

Clinical outcome scores were highly variable among identified articles. Thus, we were unable to make a meaningful comparison of patient reported outcome metrics between arthroscopic and open groups among all the studies. However, Matsui et al. did provide a direct comparison between open and arthroscopic treatment. Matsui found no significant differences between open and arthroscopic groups in Visual Analog Scores (VAS) at two weeks after surgery and Japanese Society for Surgery of the Foot (JSSF) scores 1 year after surgery [12]. No other analysis used the JSSF score. For the studies that did use the VAS outcome, these were measured at a different point in time (not at the two weeks as measured by Matsui). Therefore, we are unable to make a direct comparison between this arthroscopic group and open groups from other papers. Interestingly, the Foot and Ankle Ability Measure (FAAM), which is one of few outcome scores validated for ankle instability, was not used in any of the selected articles that describe return to play following lateral ligament repair [21].

Discussion

The most important finding of this study is the relative paucity of articles that describe return to play following lateral ligament repair. When comparing open repair to arthroscopic repair, 167 athletes treated with open ankle instability procedures returned to play almost 1 month earlier than 19 athletes treated with arthroscopic procedures (open: 2.9 months *vs.* arthroscopic: 3.8 months). The variability in the data prevented us from performing a meaningful statistical comparative test.

Considering all athletes in this review, the overall return to play rate was 96% for open ankle instability procedures (167/174) and 100% for arthroscopic repairs (19/19). These rates are similar to other studies in the literature (although not included in this analysis because they did not meet criteria). Nery et al. reported on the outcomes of 38 patients treated with combined open and arthroscopic ("arthroscopic-assisted") anatomic reconstruction of the lateral ligament complex. With an average follow-up of 9.8 years, 96% (29/30) of the active patients were able to return to sport [22]. Our analysis found that only 14% of athletes treated with an open ankle instability procedure returned to sport below the pre-injury level (10/174). Similarly, Nery et al. found that 10% (3/30) returned to sport at a lower level. Our evaluation found that 4% of athletes treated with an open ankle instability procedure do not return to sport at all (7/174). Nery found comparable rates of 3.3% (1/30).

This review of the literature identified nine eligible studies reporting on 167 athletes treated with open procedures, and only one eligible study reporting on 19 athletes treated with arthroscopic procedures. Although open procedures tend to be the gold standard for the treatment of lateral ankle instability, arthroscopy can serve as both a diagnostic and therapeutic tool. The advent of arthroscopy has expanded our knowledge of the magnitude of intra-articular pathology associated with ankle instability [23]. Furthermore, arthroscopy has been used for the surgical treatment of lateral ankle instability, as well. Hawkins first described his arthroscopic technique using a staple for plication of the ATFL [9]. Kashuk et al. described his arthroscopic technique of repairing the lateral ligamentous complex with suture anchors [24]. Maiotti et al. proposed the use of arthroscopic thermal capsular shrinkage to treat ankle instability [10]. Lui et al. detailed a three-portal approach for reconstruction of the ATFL and CFL using a plantaris tendon free graft [11].

We identified substantial variability on the patient reported outcome metrics used. In fact, nine different outcome metrics were used in 9 studies. In addition, the timing of reporting of these measures was highly variable, making it difficult to make a direct

comparison. Although we only had one eligible study reporting on return to play outcomes following arthroscopic management, others have presented the outcomes in the arthroscopic management of this injury. Corte-Real et al. conveyed their results in 28 patients treated with an arthroscopic-assisted technique: with an average follow-up of 24.5 months, the mean AOFAS score was 85.3 and mean satisfaction was 3.8 (out of 5) [25].

Although we had only one eligible study comparing open and arthroscopic outcomes of lateral ankle instability, the comparison of open versus arthroscopic techniques is prevalent in many other foot and ankle pathologies, as well. Yeap et al. compared the outcomes of calcaneal fractures after open reduction internal fixation versus arthroscopic-assisted percutaneous screw fixation. Although Bohler's angle, Gissane's angle, and AOFAS and SF 36 scores were not significantly different, the arthroscopic-assisted group was able to have surgery earlier, go home faster, and return to work earlier [26].

Many of the weakness of this review stem off the fact that there was only one eligible study for the arthroscopic group. As there was only one study for the arthroscopic group, a standard deviation could not be calculated, and consequently, a t-test to compare the two groups could not be estimated. Furthermore, our sample size of ten total studies (nine open and one arthroscopic) does not meet the criteria for the assumption of normally distributed data, which is also needed for a t-test. Additionally, a Wilcoxon-Mann-Whitney test for non-parametric data could not be conducted because the underlying assumptions required for this test were not met. Additionally, the indications for surgery were left to the discretion of the treating provider and oftentimes not reported in the manuscript. Likewise, the nonsurgical interventions were consistently not detailed.

In analyzing the use of clinical outcome measures in our nine studies, no single outcome measurement was used more than 50% of the time. The most often used scores were the AOFAS (n=4), VAS (n=3), and the Karlssons score (n=2). An additional 6 outcomes metrics were reported by the other papers, each used once only by that specific paper [27] (Table 2).

Clinical Outcomes Scores	Frequency
American orthopaedic foot and ankle score	4
Visual analogue scale	3
Karlssons	2
Japanese society for surgery of the foot score	1
Olerud and Molander	1
Tegner	1
Good	1
Sefton	1
Algren/Larson	1

Table 2: Frequency of clinical outcome scores [27].

Level of Evidence

Level III.

Conclusion

Although the outcomes of open procedures in the management of lateral ankle sprains in athletes are well reported in the literature, the techniques and outcomes of arthroscopic treatment in athletes are sparse. We found that athletes treated with open ankle instability procedures (nine studies with 167 athletes) returned to play almost 1 month earlier than athletes treated with arthroscopic procedures (1 study with 19 athletes). However, additional prospective studies are needed to document the outcomes and return to play for athletes treated with arthroscopic ankle instability management. Ideally, these studies would include the following components: 1) consistent and validated patient reported outcome metrics, and 2) consistent description of return to play criteria and timing. This would allow meaningful comparison of surgical techniques as they evolve.

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