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Return to Play After Isolated Syndesmotic Ligamentous Injury in Athletes: A Systematic Review and Meta-analysis

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Abstract

Background: Syndesmotic ankle sprains are common and challenging injuries for athletes. The management of such injuries is controversial, with a paucity of evidence on treatment protocols with unpredictability regarding the time lost to participate in sports following injury. The present study seeks to review and report the return to play (RTP) time and examine the outcomes and complications of ankle syndesmotic sprains in the athletic population.

Methods: PubMed, Cochrane Library, and Google Scholar were queried in August 2021 for case series, cohorts, and randomized controlled trials that evaluated return to play time after ankle syndesmotic sprains. The primary outcomes were the rate and time to return to play after syndesmotic ankle sprains for both surgical and nonsurgical treatment. Secondary outcomes included short-term complications and recurrence.

Results: Eighteen articles were eligible for meta-analysis with a total of 1133 syndesmotic sprains. The overall RTP was 99% (95% CI 0.96, 1.00), the overall mean RTP was 52.32 days (95% CI 39.01, 65.63). Pooled RTP for surgically treated patients was 70.94 days (95% CI 47.04, 94.85), whereas it was 39.33 days (95% CI 28.78, 49.88) for nonsurgically treated cases. A low incidence of recurrence and complications were reported.

Conclusion: This article reports a high rate of RTP after syndesmotic sprains. Grade of injury and surgical vs conservative management can affect the time to RTP in high-level athletes.

Level of Evidence: Level IV, systematic review and meta-analysis.

Keywords: ankle, athletes, meta-analysis, return to play, syndesmosis

Introduction

Syndesmotic ankle sprains, or high ankle sprains, are a challenging lower extremity injury, especially among high-level athletes. The ligamentous stabilizers of the distal tibiofibular joint are the interosseous membrane, posterior inferior tibiofibular ligament, and the anterior inferior tibiofibular ligament.[30] There are also likely contributions to the stability of the mortise from the deltoid ligament and lateral ligamentous structures of the ankle (talofibular and calcaneofibular ligaments).

Syndesmotic injuries primarily occur during contact sports such as football, rugby, ice hockey, soccer, and lacrosse. The most common mechanism of injury is direct contact to the lateral leg with the foot fixed to the ground. This valgus moment causes an eversion or external rotation force at the ankle joint with the foot placed in dorsiflexion,

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placing excess stress on the ankle's syndesmotic ligaments.[33] High ankle sprains, or syndesmotic injuries, account for around 11% to 17% of total ankle sprains.[6]

Syndesmotic sprains have unpredictable outcomes and can result in residual disability because of decreased performance, absence from competition, adverse psychological effects, and prolonged recovery times.[8] Full recovery and return to play for syndesmotic injuries has been reported to require more than twice the time compared with lateral low ankle sprains.[9]

Current management is directed toward adequate rehabilitation and early return to play without undermining long-term functionality and minimizing reinjury. These objectives are important for in-season athletes, their trainers, and the health care team.[33] More recently, surgical stabilization of high-grade sprains is starting to be advocated for possible earlier return to play, and the benefit of this treatment is still unclear.[2,4,13,14] Accordingly, the ability to predict return to play after syndesmotic injuries would be a useful tool in establishing well-defined treatment plans to ensure full recovery.

The goal of this systematic review and meta-analysis was to provide orthopaedic surgeons with the most updated evidence on high ankle sprains in athletes. Our primary objective was to report updated rate and time to return to play (RTP) after surgical or nonsurgical management of syndesmotic injuries.

Methods

A meta-analysis and systematic review of the literature was performed with adherence to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines.[18] The primary outcome was the rate and time to RTP. Secondary outcomes were complications, as well as recurrent injuries and reoperations after the initial management of an ankle syndesmotic sprain with no associated ankle fracture.

Information Sources and Search Strategy

A systematic electronic search of the literature was conducted using PubMed, Cochrane Library, and Google Scholar. The databases were searched until August 2021. The Boolean search involved the use of the following keywords that involved synonyms of "Ankle" AND "Syndesmosis" AND "Return to play" with duplicate results deleted. To supplement the automatic database search, the references of relevant articles were manually checked. Inclusion criteria were studies published in English on isolated syndesmotic injuries in athletes that reported rate and/or time to RTP. Studies were excluded if they were not available in English or did not report one of the primary objectives. Case reports, reviews, letters to the editor, and studies reporting only lateral ankle sprains or syndesmotic injuries associated with fractures were excluded.

The titles and abstracts of each article were reviewed by 2 reviewers independently. Articles that did not meet the inclusion criteria, or had at least 1 exclusion criterion, were excluded. The authors then reviewed the full texts of the articles meeting the inclusion criteria. Disagreement in the search strategy was resolved by a third author (M.S.).

Data Collection

Data collected for each study included the characteristics of the study (first author's surname, study year, study location, design, and number of patients), the clinical characteristics of the participants (mechanism of injury, grade of the injury, and type of treatment), and clinical outcome after management (RTP time, RTP percentage, return to training, complications, recurrence, and the follow-up period).

Risk of Bias in Individual Studies

To evaluate the risk of bias in the case series included in this study, the Joanna Briggs institute (JBI) critical appraisal tool was used, JBI is a checklist of 10 questions designed to assess the quality of a study and to determine the degree of bias in its design, conduct, and analysis.[20] For the cohort studies, the Newcastle Ottawa Scale for cohort studies was used. The total score of Newcastle Ottawa scale ranges between 0 and 9, and the maximum score that can be achieved for each component is 4, 2, and 3 for selection, comparability, and outcome, respectively.[16] The qualitative analysis of the randomized controlled trials was performed with the revised Cochrane risk-of-bias tool for randomized trials (RoB-2). RoB-2 contains 5 domains that evaluate the randomization process, adherence to treatments, missing outcomes, bias measurement, and reporting bias.[28] Each study was assessed by 2 authors independently, and the final rating of each study was reviewed by the 2 authors and the senior author to arrive at a consensus.

Statistical analysis

Meta XL, version 5.3 (EpiGear International, Queensland, Australia), was used in the data analysis. Three models were created to assess the following outcomes: overall RTP mean time, RTP mean time for surgically treated patients, and RTP mean time for nonsurgically treated patients. The aforementioned models were pooled using mean and SD from the included studies, and the measures of effects were mean and its related 95% CIs. When the included studies reported median and interquartile range instead of mean and SD, the conversion formula by Hozo et al[11] was applied. In addition, the overall rate for RTP was assessed by pooling the rate from the included studies using the random effect model with double arcsine transformation, and the effect size for this model was the rate and its related 95% CIs.

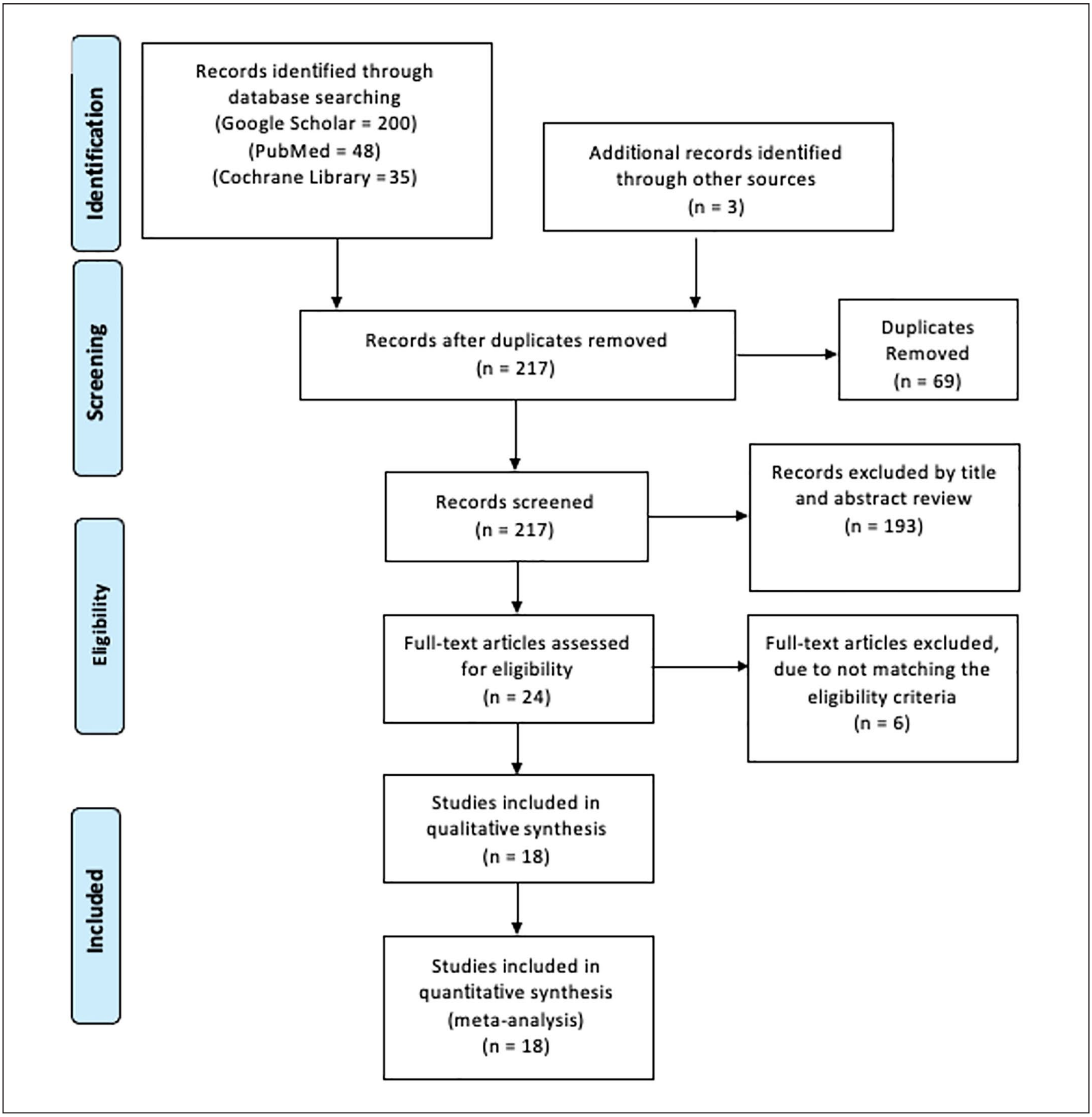

Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart.

Results

Study Selection and Study Characteristics

Search criteria identified 283 articles and 69 of them were eliminated as duplicates. Titles and abstracts of the remaining 217 articles were reviewed. There were 24 articles that met criteria for full-text review. Subsequently, 6 more articles were excluded after full-text review and the remaining 18 articles were eligible for inclusion in the meta-analysis. The PRISMA flowchart is displayed in Figure 1. The characteristics of the included studies are summarized in Table 1.

Quality Assessment

Nine of the cohort studies scored a minimum of 3 stars for the selection domain and 7 scored the maximum score of 2 stars in the comparability domain. Eight of the studies received the maximum score of 3 stars for the outcome

Table 1. Characteristics of Included Studies.

Study	Country	Design	Level of Evidence	N	Injury Grade	Treatment	RTP %	Mean Time to RTP	Sport
Boytim et al, 1991[1]	USA	Retrospective cohort	III	15	N/A	Conservative	100%	1.4 games	Football
Gerber et al, 1998[6]	USA	Prospective cohort	II	16	I-III[a]	Conservative	100%	N/A	Mix sports (military cadets)
Nussbaum et al, 2001[21]	USA	Case series	IV	60	N/A	Conservative	100%	13.4 d	NCAA
Wright et al, 2004[32]	USA	Retrospective cohort	III	14	N/A	13 conservative 1 surgical "1 screw"	100%	45 d	Ice hockey
Taylor et al, 2007[29]	USA	Case series	IV	6	III[a]	Surgical "1 screw"	100%	41 d	Lacrosse, ice hockey& football
Howard et al, 2012[10]	USA	Case series	IV	17	N/A	Conservative	100%	30.1 d	Football
Miller et al, 2012[17]	USA	Case series	IV	20	I[b]	conservative	100%	15.5 d	Football
Osbahr et al, 2013[22]	USA	Retrospective cohort	III	36	I-II[a]	Conservative	100%	15.4 d	Football
Laver et al, 2015[15]	USA	Randomized controlled trial	II	16	III[a]	PRP injection vs control	100%	PRP 40.8 d Control 59.6 d Overall 49.5	Professional athletes
Sman et al, 2014[27]	Australia	Prospective cohort	II	32	N/A	Conservative	100%	Median 62.5 d	Rugby
Calder et al, 2016[2]	UK	Prospective cohort	II	64	IIA-B [a]	IIA conservative IIB surgical "suture button"	100%	IIA 45 d IIB 64 d	Mix sports
Samra et al, 2015[25]	Australia	Longitudinal cohort	III	21	II-IV[c]	PRP injection Vs control	100%	PRP 48.6 d Control 69.3 d	Rugby
Latham et al, 2017[14]	UK	Case series	IV	18	N/A	Surgical "Double suture buttons"	100%	64 d	Rugby
Jain et al, 2018[12]	UK	Case series	IV	12	N/A	8 conservative 4 surgical "suture button"	100%	Surgical 102 d Nonsurgical 61.25 d Overall 74.8 d	Soccer
Mollon et al, 2019[19]	Canada	Case series	IV	105	N/A	N/A	100%	Median 22.5 d	Ice hokey
D'Hooghe et al, 2020[4]	Qatar	Longitudinal cohort	III	110	IIB-III[a]	Surgical "suture button"	100%	103 d	Soccer
DeFroda et al, 2021[3]	USA	Retrospective cohort	III	533	N/A	NA	89.70%	80.5 d	Football
Kim et al, 2021[13]	South Korea	Retrospective cohort	III	22	IIB-III[a]	Anatomical AITFL repair	95%	102.9 d	Soccer, basketball, and handball

Abbreviations: AITFL, anterior inferior tibiofibular ligament; NCAA, National Collegiate Athletic Association; PRP, platelet-rich plasma; RTP, return to play.
[a]West Point.[6]
[b]Edwards and Delee.[5]
[c]Sikka et al.[26]

Table 2. Quality Assessment of Included Studies According to the Newcastle-Ottawa Scale.

Study	Selection [a]	Comparability [b]	Outcome [c]
Kim et al, 2021[13]	***	**	**
DeFroda et al, 2021[3]	*	**	***
D'Hooghe et al, 2020[4]	***	*	***
Smara, 2015	****	**	***
Calder et al, 2016[2]	**	_[d]	***
Sman et al, 2014[27]	****	**	**
Osbahr et al, 2013[22]	***	*	***
Miller et al, 2012[17]	***	**	***
Wright et al, 2004[32]	****	**	***
Gerber et al, 1998[6]	****	**	***
Boytim et al, 1991[1]	***	*	**

[a]Scored out of 4 potential * judging representativeness of the exposed cohort, selection of nonexposed cohort, ascertainment of exposure, and demonstration that the outcome of interest was not present at the start of the study.
[b]Scored out of 1 potential * judging comparability of cohorts based on design or analysis.
[c]Scored out of 3 potential * judging assessment of outcome, adequacy of follow-up length, and loss to follow-up.
[d]No * awarded.

domain (Table 2). There were 6 case series that were assessed using the JBI critical appraisal tool. Detailed results are summarized in Supplementary Table S1. The only randomized controlled trial by Laver et al[15] showed low risk of bias on the RoB-2 tool.

Treatment

Four studies managed their patients with surgical intervention, 9 articles reported nonsurgical management, and 3 articles used either surgical or nonsurgical methods. Two studies did not specify management method; these studies were included for determining the overall rate of RTP but not utilized for pooled data analysis.[3,19] The indication for surgical intervention was high-grade isolated syndesmotic injury in professional athletes. Regarding the surgical techniques, 1 of the 14 patients reported by Wright et al[32] was managed with a single syndesmotic screw. Similarly, Taylor et al[29] used 1 syndesmotic screw in a series of 13 professional athletes with grade III injuries. D'Hooghe et al[4] and Calder et al[2] managed grade IIB and III syndesmotic injuries with a single suture button, whereas Latham et al[14] reported the use of 2 suture buttons in a series of 18 rugby players. Kim et al[13] directly repaired the anterior inferior tibiofibular ligament using suture anchors in athletes with IIB and III injuries. The nonsurgical management included different postoperative rehabilitation protocols. In summary, most of the rehabilitation protocols focused on early functional rehabilitation with short periods of protected weightbearing and gradual advancement of range of motion and proprioception exercises, in addition to sport-specific exercises. In rehabilitation protocol for elite hockey players reported by Wright et al,[32] they focused on maintaining ankle range of motion and strength, progressing from stationary bike to simple skating when pain subsided followed by advanced skating drills. Similarly, Howard et al[10] reported early functional rehabilitation with muscle strengthening and range of motion exercises in professional football players. Progressing to running in water after pain subsidence followed by dryland running. Additionally, Laver et al[15] and Samra et al[25] studied the effect of platelet-rich plasma (PRP) on conservatively treated syndesmotic injuries.

Return to Play

Our results showed that the pooled rate of return to play (RTP) was 99% (95% CI 0.96, 1.00, $P < .001$; Figure 2). The RTP percentage was 100% in all of the included studies except for Kim et al[13] and DeFroda et al,[3] which reported 95% and 89.7% RTP, respectively; on further analysis, the study by DeFroda et al[3] reported that higher age of patient at the time of injury and the years of experience before the injury were the only significant factors affecting RTP.

Seventeen of the included studies reported the time for return to play among its participants. The overall pooled mean for RTP was 52.32 days (95% CI 39.01, 65.63, $P < .001$; Figure 3). The highest mean time for RTP was reported by D'Hooghe et al and Kim et al as 103 days in both studies.[4,13] On the other hand, the lowest mean for RTP was reported by Nussbaum et al[21] (13 days), Osbahr et al,[22] and Miller et al[17] (15 days). Moreover, the pooled RTP for surgically treated cases was 70.94 days (95% CI 47.04, 94.85, $P < .001$), whereas it was 39.33 days (95% CI 28.78, 49.88, $P < .001$) for nonsurgical management (Figures 4 and 5). Among surgically treated cases, the lowest mean for RTP was reported by Taylor et al[29] (41 days), whereas the highest means for RTP were reported by Jain et al,[12] Kim et al,[13] and D'Hooghe et al[4] (103 days). Furthermore, among the studies that used the nonsurgical approach, the lowest mean for RTP was reported by Nussbaum et al[21] (13 days), and the highest mean for RTP was reported by and Sman et al[27] (61 days).

Return to Training

Time to return to training was reported in 3 studies. The investigation by D'Hooghe et al[4] reported that the mean return to training was 37±12 days. Boytim et al[1] reported that the median of missed or limited practices among its participants was 6.3 (range 2-21); Kim et al[13] reported the time to start jogging was 62.0 ± 15.2 days. D'Hooghe et al[4] and Kim et al[13] reported that the mean time return to group practice was 72±28 and 89.3 ± 18.5 days, respectively.

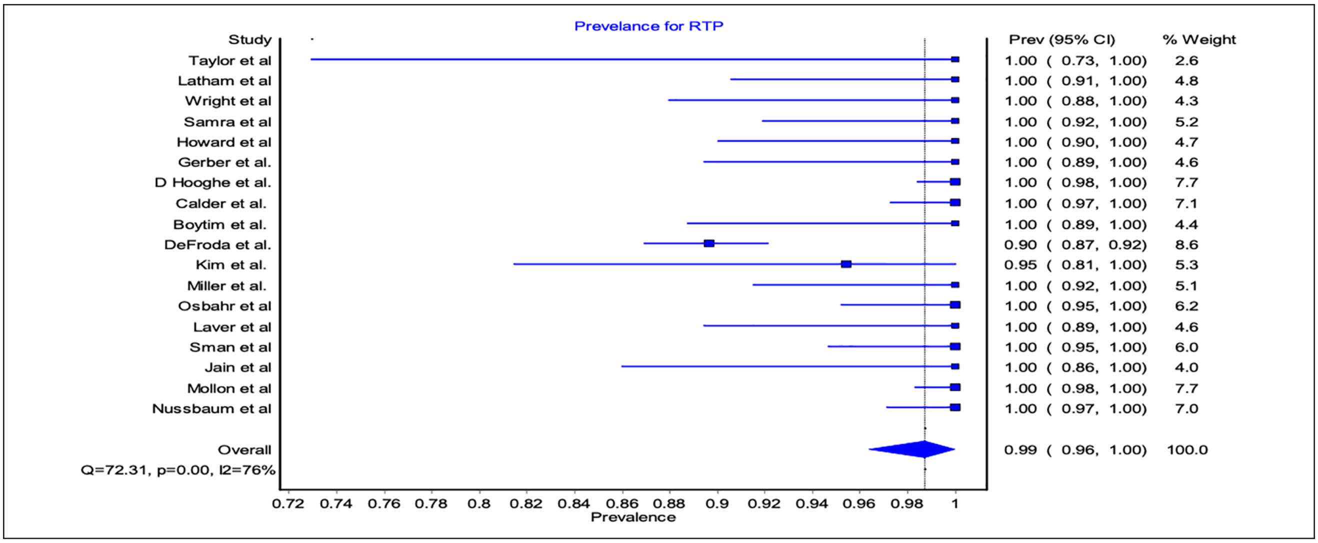

Figure 2. Overall rate of return to play (RTP).

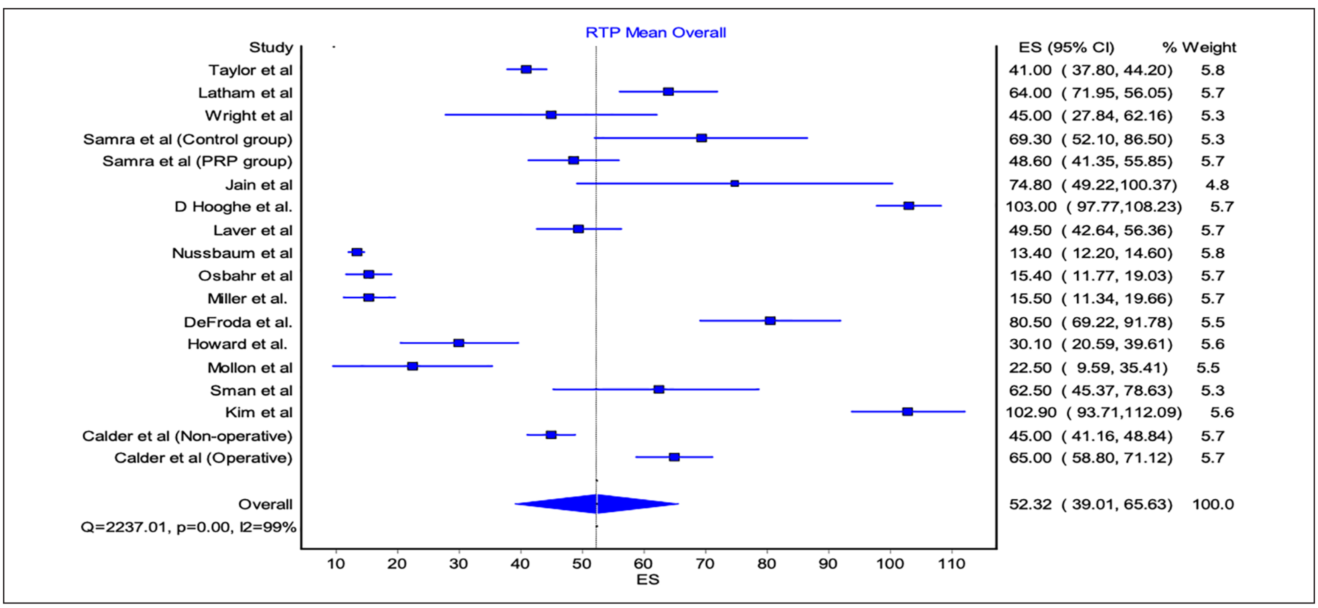

Figure 3. Overall time to return to play (RTP) (days).

Recurrent Injury

Five studies reported the recurrent injuries that occurred among their patients with syndesmotic injuries. Kim et al[13] reported 2 ankle sprains after RTP; 1 patient suffered an eversion sprain and was able to RTP after 2 weeks, another player sustained a recurrent anterior inferior tibiofibular ligament injury and was treated with allograft reconstruction. Osbahr et al[22] reported 2 recurrent syndesmotic sprains, both injuries occurred during a competitive match and resulted in 4 and 16 days of time lost from participation for a recurrent grade I and grade II sprain, respectively. In addition, Wright et al[32] stated that only 1 patient had recurrent syndesmotic injury during a training camp. Nussbaum et al[21] reported 3 patients with recurrent ankle sprains. No recurrent injuries were reported in the study conducted by Taylor et al.[29]

Complications

Postoperative complications were reported by 5 studies. Taylor et al[29] reported that only 1 patient had screw breakage with removal; 2 patients had mild degenerative changes. The study conducted by Latham et al[14] reported that 2 patients had surgical site infection, 2 patients had ankle stiffness, 1 patient suffered from calf tightness, 1 patient

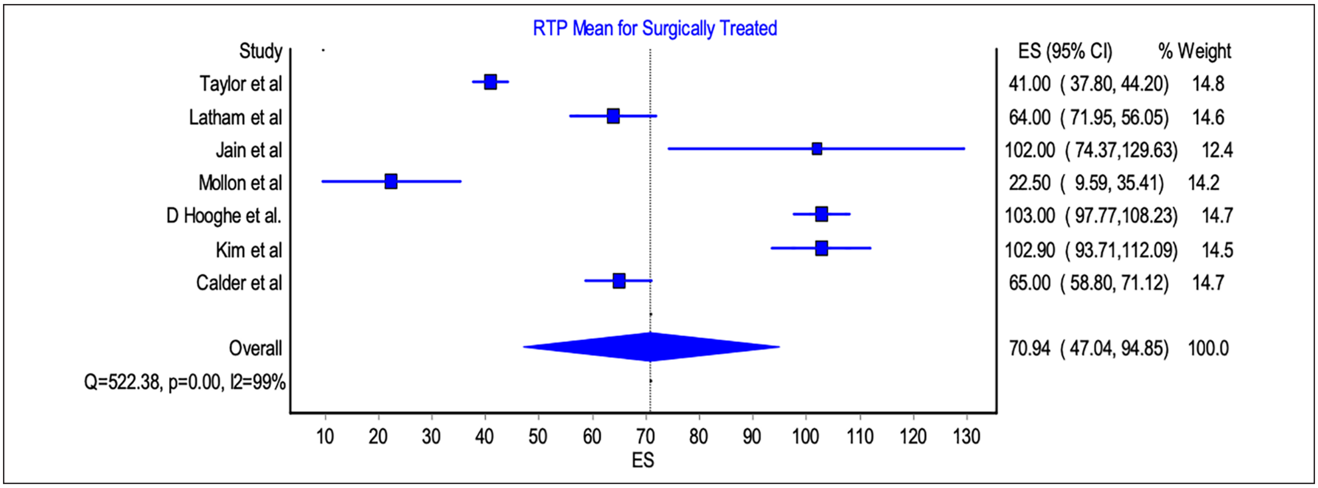

Figure 4. Time to return to play (RTP) for surgically treated patients (days).

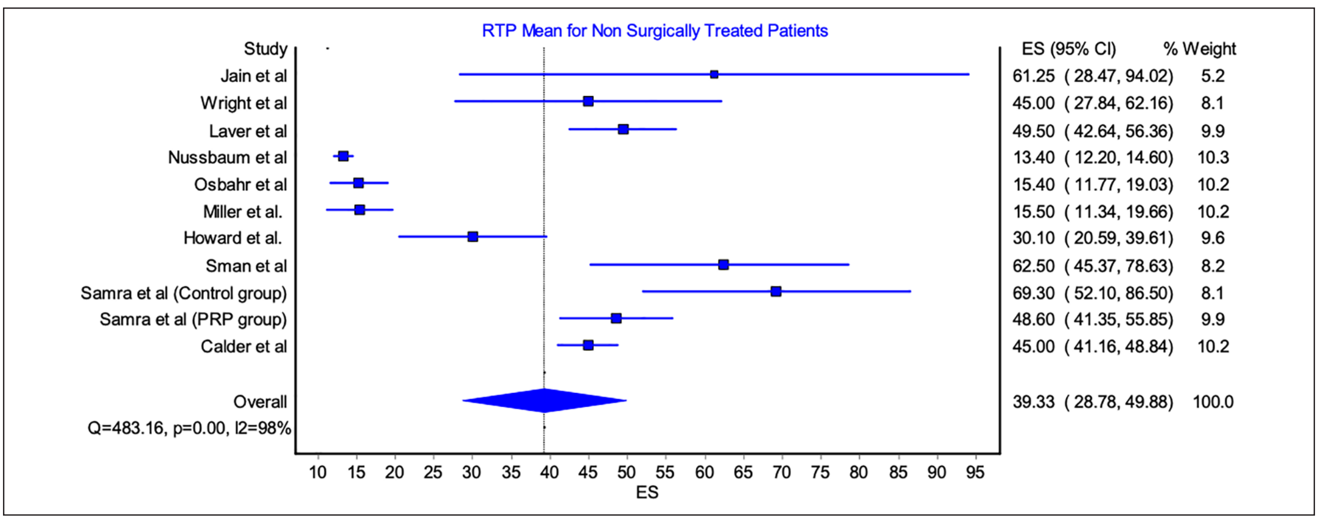

Figure 5. Time to return to play (RTP) for nonsurgically treated patients (days).

suffered from hip pain, and 1 patient complained from button site irritation. D'Hooghe et al[4] illustrated that only 5 patients experienced delayed wound closure. In addition, Calder et al[2] reported that only 2 of observed patients experienced complications, which were superficial wound infections. Kim et al[13] reported 1 reoperation. Additionally, Nussbaum et al[21] reported 1 patient with heterotopic ossification after conservative management of syndesmotic injury; this mostly was due to the injury itself and not related to the treatment. No other complications were reported in nonoperatively treated athletes.

Discussion

The current meta-analysis has shown a high overall RTP rate after high ankle sprains in athletes; almost 99% of the players were able to return to their respective sport with an average RTP in 52 days. As expected, because of the likely higher grade of injury, a longer period of missed games was found in surgically treated cases with a pooled mean of 71 days compared to an average of 39 days in the nonsurgical arm. A low incidence of recurrence and postoperative complications were reported.

Ankle injuries are some of the most common musculoskeletal injuries seen in the general population.[23] This is even more relevant in athletes, where ankle injuries account for 40% of sports-related trauma cases.[7] Even though syndesmosis injuries make up only 10% to 20% of ankle sprains in athletes, these injuries often result in increased time lost from athletic activities and a longer RTP time when compared to other types of ankle sprains.[9,19] In the study by Wright et al[32] on ankle injuries in National Hockey League players, a mean RTP time in syndesmosis sprains was 45 days whereas that of lateral sprains was only 1.6

days. Given this disparity, it is exceedingly important to study factors that can shorten the RTP time and optimize syndesmotic injury management.

When surveyed, physicians and trainers caring for professional sports athletes reflected that syndesmosis injuries are the most challenging ankle injury that they regularly manage.[24] This difficulty is due to the variations in the extent of the injuries, difficulty in diagnosing the extent of the injuries, and inadequate evidence supporting optimal treatment. Additionally, the variability of the mechanism of injury and the sport played by the athlete makes it extremely challenging not only to determine the best management plan, but also to predict the time it will take for the athlete to be fit enough to return to play safely.

Athletes are often able to recover from ankle syndesmotic injuries and return to play at the level prior to injury with an RTP across all studies of 99%. Of note, 16 of the 18 included studies in this review had a 100% of RTP, with only 2 studies reporting less than perfect return to play rates.[3,13] This suggests that the RTP with syndesmotic injuries is very good; however, more difficult to predict and more important for patient counseling is the time to RTP. The mean RTP time across all the articles included in the present study was found to be 52 days. This shows that, on average, the time lost from athletes after enduring a syndesmotic injury is greater than 7 weeks, which is particularly substantial for any athlete participating in a sport with competition relegated to a single season. Syndesmosis sprains occurring early in the athletic season have been shown to potentially result in a prolonged disability with the possibility of preventing the athlete from returning to their sport during the season.[29]

Management of syndesmotic injuries can be divided into nonsurgical and surgical modalities, and it becomes necessary to compare the outcomes of both methods in terms of reduction of the RTP time. There seems to be a scarcity of literature directly comparing surgical vs nonsurgical management. In our results, the mean RTP time for the studies using a surgical approach was longer than that of the studies that used nonsurgical methods of treatment. In fact, the mean RTP for the surgical approach was 72.09 days, twice as long as that of a nonsurgical approach, which was identified as 38.13 days. This could be explained by the higher injury grade and different restrictions or rehabilitation protocol of the surgically treated cases. In the only prospective comparative study, Calder et al[2] compared the surgical fixation of IIB syndesmotic injuries to the nonsurgical management of IIA injuries. The authors reported 64 days to RTP in the surgical group compared to 45 days in the nonsurgically treated athletes. Similarly, in a case series of professional soccer players reported by Jain et al,[12] the surgically treated athletes needed an average of 102 days to RTP compared with 61 days in the conservative group. On the other hand, many authors are still advocating nonsurgical management of high-grade syndesmotic sprains even in elite professional athletes. In the only randomized controlled trial in this review, Laver et al[15] reported 100% RTP after an overall average of 49 days in athletes with grade 3 syndesmotic sprains. The use of ultrasound-guided PRP injection appears to possibly reduce the time missed to play, with only 1 patient in the no-PRP control group needing surgical intervention after RTP because of sustained pain and instability. Similarly, Samra et al,[25] in a cohort of rugby players with high-grade syndesmotic sprains, reported that players who received a single PRP injection returned to play after an average of 47 days compared to 69 days in a historical control group. No recurrent cases were reported at 3 months after RTP.

Limitations

To our knowledge, this is the first meta-analysis and the most updated systematic review on the return to play after syndesmotic injury in athletes after the one conducted by Vancolen et al.[31] However, several limitations should be acknowledged. The low number of included participants limited the generalizability of this systematic review and meta-analysis. Moreover, the heterogeneity of the included studies in terms of methods of treatment, grade of injury, and the sports played limited the ability to draw firm conclusions. In addition, the wide diversity of rehabilitation protocols in either the surgical or nonsurgical groups creates difficulty determining the optimal conservative management for time to RTP. The inclusion of comparative and noncomparative studies likewise made it difficult to meta-analyze the comparative studies alone to directly compare between the treatment methods. Additionally, many of the included studies did not report the level of performance or the residual symptoms after return to play.

Unfortunately, with the data available we were unable to perform a subanalysis of the high-grade syndesmotic injuries treated operatively and nonoperatively to determine the optimal treatment for the athletic population with high-grade tears. Further studies are necessary to determine correct diagnostic criteria for operative indications, and comparative studies are necessary to determine if there is a benefit for time to RTP with operative treatment of high-grade syndesmotic injuries. In addition, optimal rehabilitation protocols and modalities to accelerate RTP need to be further investigated.

Conclusion

This systematic review and meta-analysis showed high rates of return to play after syndesmotic sprains in professional athletes regardless of surgical vs nonsurgical treatment, with surgically treated athletes needing more time to return to play compared with those treated nonsurgically. PRP injections appear to be safe and may improve time to RTP but their overall benefit is difficult to determine. Future high-level comparative studies with larger sample sizes are required for better determination of the benefit and indications for operative treatment, and determination of optimal rehabilitative protocols for isolated ligamentous syndesmotic injuries to accelerate time to RTP.

Ethical Approval

Ethical approval was not sought for the present study because approval from the ethics committee is not required for systematic reviews.

Declaration of Conflicting Interests

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Supplementary Table S1. Quality Assessment of Included Case Series According to the Joanna Briggs Institute Critical Appraisal Tool.

Question	Crowley, 2019	Howard et al, 2012[10]	Jain et al, 2018[12]	Latham et al, 2017[14]	Mollon et al, 2019[19]	Nussbaum et al, 2001[21]	Ogilvie-Harris, 1997	Taylor et al, 2007[29]
Were there clear criteria for inclusion in the case series?	UC	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the condition measured in a standard, reliable way for all participants included in the case series?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Were valid methods used for identification of the condition for all participants included in the case series?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Did the case series have consecutive inclusion of participants?	Yes	Yes	UC	Yes	Yes	Yes	Yes	Yes
Did the case series have complete inclusion of participants?	UC	Yes	UC	Yes	Yes	Yes	Yes	Yes
Was there clear reporting of the demographics of the participants in the study?	UC	Yes	No	Yes	UC	Yes	Yes	Yes
Was there clear reporting of clinical information of the participants?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Were the outcomes or follow-up results of cases clearly reported?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was there clear reporting of the presenting site(s)/clinic(s) demographic information?	No	Yes	No	No	UC	Yes	UC	Yes
Was statistical analysis appropriate?	UC	Yes	UC	Yes	Yes	Yes	Yes	Yes

Abbreviation: UC, unclear.