



Return to Sport After Ankle Syndesmotic Injury: A Systematic Review

Seline Y. Vancolen, BHSc,[†] Ibrahim Nadeem, BHSc,[†] Nolan S. Horner, MD,[‡]
Herman Johal, MD, MSc, FRCSC,[‡] Bashar Alolabi, MD, MSc, FRCSC,[‡]
and Moin Khan, MD, MSc, FRCSC*[‡]

Context: Ankle syndesmotic injuries present a significant challenge for athletes due to prolonged disability and recovery periods. The optimal management of these injuries and rates of return to sport in athletes remains unclear.

Objective: The purpose of this study was to evaluate return to sport for athletes after ankle syndesmotic injuries.

Data Source: The electronic databases MEDLINE, EMBASE, and PubMed were searched for relevant studies from database inception to January 15, 2017, and pertinent data were abstracted.

Study Selection: Only studies reporting return-to-sport rates after ankle syndesmotic injuries were included.

Study Design: Systematic review.

Level of Evidence: Level 4.

Data Extraction: Two reviewers extracted data from the included studies, which were stored in a standardized collection form (Microsoft Excel). Recorded data included demographics (eg, author, year of publication, study design), descriptive statistics (eg, patient age, percentage male, number of athletes, sample size), and outcomes (eg, time to return to sport, proportion of those who returned to sport, the self-reported questionnaire the Olerud-Molander Ankle Score).

Results: A total of 10 studies and 312 patients with ankle syndesmotic injuries were included in this systematic review. The rate of return to preinjury or any injury level of sport after ankle syndesmotic injuries was $93.8\% \pm 1.2\%$ and $97.6\% \pm 1.5\%$, respectively, for the corresponding 7 and 3 studies that reported this characteristic. The mean time to return to sport was 46.4 days (range, 15.4-70 days), with 55.2 ± 15.8 and 41.7 ± 9.8 days for operative and nonoperative management, respectively.

Conclusion: This systematic review found a high rate of return to any as well as preinjury level of sport after ankle syndesmotic injury in both operative and nonoperative treatment groups. However, further high-level studies are required to compare operative and nonoperative treatment groups associated with return to sport after ankle syndesmotic injury.

Keywords: ankle syndesmotic injury; high ankle sprain; return to sport

The ankle syndesmosis comprises the interosseous ligament (IOL), the anterior inferior tibiofibular ligament (AITFL), posterior inferior tibiofibular ligament (PITFL), and the transverse ligament.¹⁴ The ankle syndesmosis is crucial in maintaining the structural integrity of the joint. Syndesmotic disruption typically occurs at the ankle after external rotation or dorsiflexion injuries.^{7,14} Athletes aged 18 to 34 years are at the greatest risk for sustaining an ankle syndesmotic injury, with the incidence falling between 10% and 20%, and increasing for those who participate in contact sports, such as football and

hockey.⁷ Syndesmotic injuries present a significant challenge for athletes due to prolonged disability, recovery periods, and uncertainty regarding the ideal treatment approach.^{8,12} Furthermore, malreduction of the ankle syndesmosis is of particular concern, and it is commonly underrecognized and associated with poor outcomes.^{2,14}

Treatment of syndesmotic sprains varies and depends on several factors, including injury severity.^{3,12} The West Point Ankle Grading System is used to categorize the degree of ankle sprains to aid in management.³ Grade I ankle syndesmotic injuries occur

From [†]McMaster University, Hamilton, Ontario, Canada, and [‡]Division of Orthopaedic Surgery, Department of Surgery, McMaster University, Hamilton, Ontario, Canada

*Address correspondence to Moin Khan, MD, MSc, FRCSC, McMaster University Medical Centre, 1200 Main Street West, 4E15, Hamilton, Ontario, L8N 3Z5, Canada (email: moinkhanmd@gmail.com).

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with a sprain to the AITFL and are generally treated nonoperatively due to relative stability.³ Grade II injuries, whereby rotational forces tear the AITFL and the IOL,^{2,14} may necessitate stabilization if the ligamentous injury is severe enough.³ Grade II injuries pose a particular challenge to clinicians when determining operative or nonoperative treatment. This is mostly because of inadequate diagnostic methods to differentiate a stable and unstable syndesmosis. Grade III injuries require operative management, as they involve complete disruption of the ankle syndesmosis and present with syndesmotic instability and diastasis.^{3,20} They involve complete injury to the lateral ligaments, including the AITFL, IOL, and PITFL, as well as deltoid ligament avulsion medially.² Magnetic resonance imaging (MRI) is used to image structures of the syndesmosis and is therefore useful in diagnosing syndesmotic injuries.¹⁸ In contrast to confirmation of syndesmotic injuries by ankle arthroscopy, studies have indicated that MRI has higher sensitivity and specificity values, indicating greater accuracy.¹⁸ The challenge remains in adequate recognition of the degree of disruption, particularly with standard, static radiographic imaging. This has likely contributed to the variation in treatment strategies that has been described across all grades of syndesmotic injuries.^{12,18} For those with an unstable ankle syndesmosis, the most common surgical treatment has been trans-syndesmotic screw fixation; however, this has been associated with complications such as malreduction or hardware failure resulting in secondary postoperative syndesmotic diastasis necessitating hardware removal. More recent surgical treatments such as suture button with adjustable loop fixation have demonstrated potentially more favorable clinical outcomes, with lower rates of malreduction and reoperation.⁴ Compared with lateral ankle sprains, syndesmotic injuries require longer rehabilitation periods, with a minimum of 6 to 8 weeks for recovery.^{2,12,15}

For many athletes who suffer these injuries, determining an appropriate and safe return to sport is fundamental to ensuring a complete recovery. This review aims to systematically assess return-to-sport rates and associated performance in athletes who experience ankle syndesmotic injuries.

METHODS

Search Strategy and Eligibility

PubMed, EMBASE, and MEDLINE were searched for literature on return to sport after ankle syndesmotic injuries from data inception to January 15, 2017. The search terms included *ankle*, *syndesmosis*, and *return to play* as well as additional similar phrases related to the topic (see Table A1 in the Appendix, available in the online version of this article). Inclusion criteria consisted of (1) all levels of evidence, (2) athletes with ankle syndesmotic injury (pure ligamentous injury), (3) reporting of rate or time to return to sport, (4) studies published in English in a peer-reviewed journal, and (5) studies on humans. Exclusion criteria were (1) lateral ankle sprains; (2) reviews, conference proceedings, opinion pieces, or letters to the editor; (3) case reports; and (4) studies not published in English.

Screening

In accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), screening was done in duplicate by 2 independent reviewers for both title and abstract as well as full-text screening stages. The reviewers were blinded to study author and publication origin. Inconsistencies that arose during the title and abstract stage were resolved by automatically including them in the full-text stage. Discrepancies were resolved through discussion and agreement between both reviewers. Where agreement was not reached, a third blinded reviewer assisted in the decision-making process.

Data Extraction

Two reviewers extracted data from the included studies, which were stored in a standardized collection form (Microsoft Excel). Recorded data included demographics (eg, author, year of publication, study design), descriptive statistics (eg, patient age, percentage male, number of athletes, sample size), and outcomes (eg, time to return to sport, proportion of those who returned to sport, the self-reported questionnaire the Olerud-Molander Ankle Score [OMAS]).

Statistical Analysis

Two reviewers used the Methodological Index for Non-Randomized Studies (MINORS) appraisal tool to evaluate quality of included studies.¹⁷ A score of 0, 1, or 2 was given for each of the 8 categories of the tool, with a maximum of 16 for included noncomparative studies. A score of 0 to 6 indicated very low quality of evidence, 7 to 10 indicated low quality, 10 to 14 indicated fair quality, and >16 good quality. The kappa (κ) statistic was used to assess interreviewer agreement. Additionally, the intraclass correlation coefficient (ICC) was calculated for the quality assessment using the MINORS criteria.¹⁷ Agreement was characterized as follows: κ /ICC of 0.81 to 0.99 as excellent agreement, κ /ICC of 0.61 to 0.80 as substantial agreement, κ /ICC of 0.41 to 0.60 as moderate agreement, κ /ICC of 0.21 to 0.40 as fair agreement, and κ /ICC value of 0.20 or less as slight agreement.

RESULTS

Eligibility

The initial search generated 1306 studies, of which 10 full-text articles met the inclusion criteria (Figure 1). There was substantial agreement between reviewers at the title screen ($\kappa = 0.792$), and excellent agreement at the abstract and full-text screens ($\kappa = 0.892$ and $\kappa = 0.910$, respectively).

Study Characteristics

Included studies were conducted between 1998 and 2016, of which 5 (50%) were published in the past 5 years. A total of 312 participants had syndesmotic injuries; 38.8% (121/312) were athletes playing sport at an amateur level, and 40.1% (125/312) played sport at a professional level. The level of play for the remaining 66 patients was not specified. The most commonly

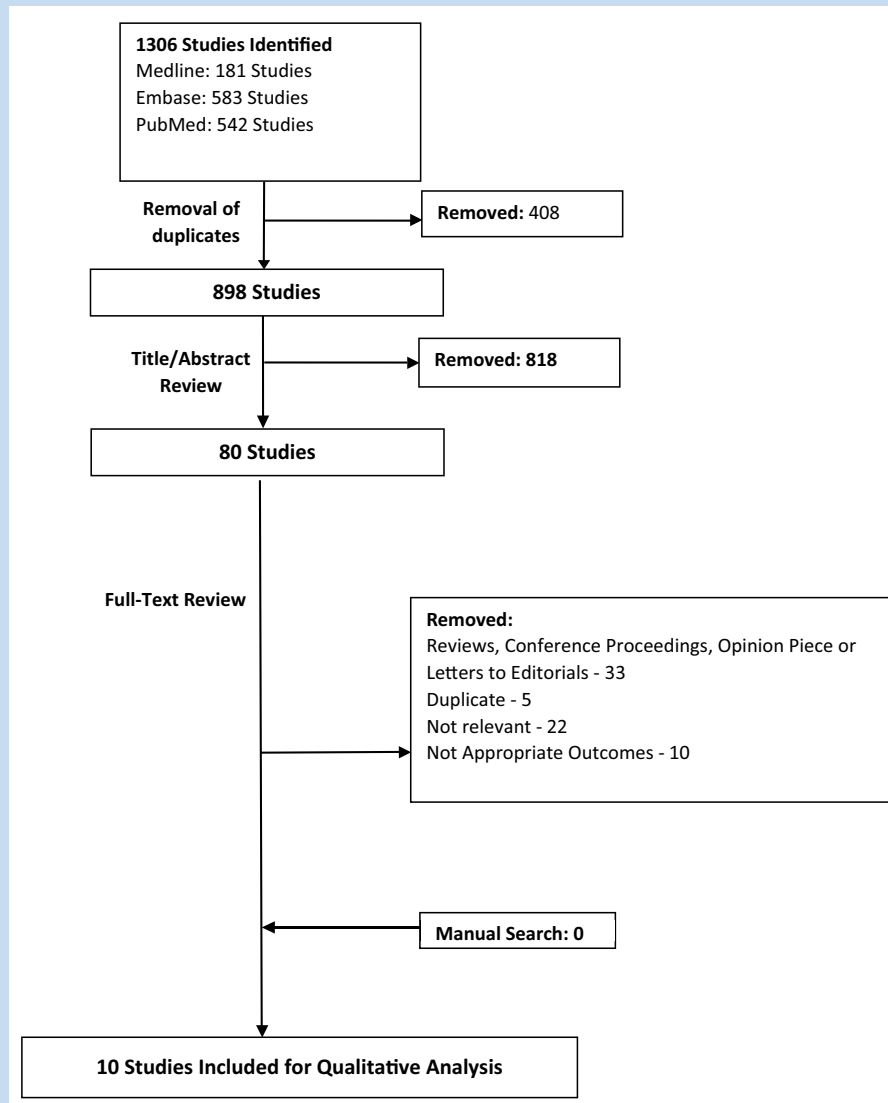


Figure 1. Outline of systematic search strategy used.

played sport at the amateur and professional levels was American football ($n = 10$; 8.3%) and rugby ($n = 40$; 30.1%), respectively. Grade I ankle syndesmotic injuries occurred in 8.0% (25/312) of athletes, grade II injuries occurred in 28.8% (90/312) of athletes, and grade III injuries occurred in 2.2% (7/312) of athletes. The mean total sample size per included study was 33.5 patients (range, 5-126 patients). Of the studies that reported patient sex and age characteristics, the average proportion of males was 79.3%, with a mean age of 26.7 ± 8.3 years. The mean follow-up across the 5 studies that reported on it was 34.1 months (Table 1).

Study Quality

All studies in this systematic review were nonrandomized in design. The studies were level 4 ($n = 5$), level 3 ($n = 2$), and level 2 ($n = 3$) evidence (Table 2), and the remaining studies included case series. There was a substantial level of agreement

among quality assessment scores using the MINORS criteria (ICC, 0.932). The mean MINORS score was 9.7 ± 2.0 for noncomparative studies, which indicates low quality of evidence for nonrandomized studies. Overall, there was a high rate of prospective collection of data. However, few studies had a clear stated aim and appropriate endpoints to the aim of the study. Additionally, studies lacked reporting of whether an unbiased assessment of study outcomes was performed, appropriate follow-up period, and prospective calculation of study size.

Surgical Technique

Four studies described the surgical management of syndesmotic injuries, with a primary focus on grade II and III injuries.^{11,16,19,20} An additional 2 studies described both surgical and nonsurgical methods being used to treat varying grades of syndesmotic

Table 1. Characteristics of included studies

Primary Author	Year	Study Design (Level of Evidence)	Total Sample Size, n	Syndesmotic Injuries, n	% Male	Mean Age (Range), y	Mean Follow-up, mo	Consensus MINORS Score ^a
Steinmetz	2016	Retrospective cohort (4)	126	126	61	45 ± 15.7 (16-86.5)	70.8 ± 5.9	10
Calder	2016	Prospective cohort (2)	64	64	NR	NR	37 (range 24-66)	13
Sman	2014	Prospective cohort (2)	32	32	90.6	21.4 ± 3.3	NR	9
Osbahr	2013	Retrospective cohort (3)	36	36	NR	NR	NR	8
Porter	2014	Case series (4)	27	27	70.4	18.1 ± 5.9 (12-37)	28 (range 12-43)	11
Taylor	2007	Case series (4)	6	6	100	19	34.3	12
Flik	2005	Prospective cohort (3)	113	5	100	NR	NR	8
Wright	2004	Retrospective cohort (4)	14	14	NR	NR	NR	8
Gerber	1998	Prospective cohort (2)	16	16	NR	20 (17-24)	3.75 (range 1.5-6)	8
Ogilvie-Harris	1997	Case series (4)	100	7	54	29 (17-51)	33	10

MINORS, Methodological Index for Non-Randomized Studies; NR, not reported.

^aScore range is 0 to 16 for noncomparative studies.

injuries.^{3,21} Surgical treatment involved variations of trans-syndesmotic procedures (n = 3) and adjunct arthroscopic surgery to treat syndesmotic instability (n = 1). Three studies reported on nonoperative techniques in the form of immobilization in a walking boot with progression to weightbearing.^{6,12,18}

Rehabilitation Protocol

Detailed rehabilitation protocols were used for both operative and nonoperative treatment groups. Studies employed a progressive rehabilitation protocol that progressed coordination, muscular endurance, and motor control. This was supplemented with increasing focus on balancing and coordination exercises. In some studies, patients were advised to use a removable walking boot, thereby enabling progressive weightbearing as well as therapy to increase range of motion.^{3,4,18} Return to sport, when reported, was permitted when the athlete was able to perform a complete sport-specific functional progression program.¹⁸

Overall Return to Sport

Four studies (n = 91) reported 100% return to sport at the pre-injury level. Of these, 1 study focused solely on surgical management²⁰ while another was nonoperative.⁶ Flik et al⁵ did

not specify whether an operative or nonoperative technique was utilized but reported 100% return to sport at the preinjury level. Only 2 studies in this group described using both surgical and nonsurgical techniques to manage grade IIb and IIa syndesmotic injuries, respectively.^{3,21} Sman et al¹⁸ did not report on return to sport. The remaining studies reported that 83.6%, 96.3%, and 77.8% of athletes returned to sport at their preinjury level, respectively.^{11,16,19} Three studies reported a mean 97.6% of athletes returning to any level of sport.^{11,12,21} Seven studies reported on the mean time to return to sport (the recovery period), which was 55.2 ± 15.8 and 41.7 ± 9.8 days for operative and nonoperative management, respectively.^{3,5,11,12,18,19,20} The overall mean time to return to sport was 46.4 days (range, 15.4-70 days).

Calder et al³ included both operative and nonoperative management for grade IIb and IIa syndesmotic injuries, respectively. The nonoperative group (n = 28) was treated with a boot and rehabilitation, while the operative group (n = 36) required syndesmotic stabilization using the suture button fixation technique. All patients returned to sport at the preinjury level, with a mean return to sport of 45 days (range, 23-63 days) in the nonoperative group and 65 days (range, 27-104 days) in the operative group ($P < 0.0001$).

Table 2. Return-to-sport rates and management type

Primary Author	Year	Sample Size, n	Returned to Sport at Any Level, %	Returned to Sport at Preinjury Level, %	Management Type
Steinmetz	2016	126	NR	83	Operative
Calder	2016	64	NR	100	Operative (grade IIb, n = 38) and nonoperative (grade IIa, n = 26)
Sman	2014	32	NR	NR	Nonoperative
Osbahr	2013	36	100	NR	Nonoperative
Porter	2014	27	NR	96.3	Operative
Taylor	2007	6	NR	100	Operative
Flik	2005	5	NR	100	NR
Wright	2004	14	93	NR	Operative (n = 3), nonoperative (n = 11)
Gerber	1998	16	NR	100	Nonoperative
Ogilvie-Harris	1997	7	100	77.8	Operative

NR, not reported.

Steinmetz et al¹⁹ employed screw fixation methods and reported that 4% and 5.6% of syndesmotom screws had broken and resulted in rediastasis at the syndesmosis at 5- and 18-month follow-up, respectively. In another study, syndesmotom screws were removed in all patients once healing was complete, defined as when the athlete was able to complete a sport-specific functional progression program.⁸ Athletes were not permitted to return to competition until syndesmotom screws had been removed. Taylor et al²⁰ reported hardware removal at an average of 74 days (range, 52-97 days) postoperatively, with 1 screw having broken prior to removal.

Functional Outcomes

Functional outcomes were reported in 2 studies. Steinmetz et al¹⁹ (n = 126), reported the following mean values: visual analog scale (VAS), 0.8 ± 1.3 (range, 0-6); American Orthopaedic Foot and Ankle Society (AOFAS) score, 93 ± 9 (range, 49-100); and OMAS, 93 ± 10 (range, 45-100). These can be interpreted as patients essentially reporting minimal or no pain (VAS) with excellent foot-specific function (AOFAS and OMAS). Taylor et al²⁰ (n = 6) reported an Edwards and DeLee Ankle Rating of 0.8. This score is related to slight pain with excessive activity. Functional outcomes were effective in analyzing posttreatment results; however, reported outcomes mainly pertained to surgical intervention groups.

Recurrent Injuries and Complications

Complications were reported by Osbahr et al,¹² where 2 of 36 athletes experienced recurrent sprains; however, this did

not affect return to sport at the preinjury level. Minimal acute postoperative complications occurred in the same study¹² (n = 2) and included instances of suspected infection.

DISCUSSION

For athletes with an ankle syndesmotom injury, the literature supports a high level of return to sport at the preinjury level. Because of the lack of comparative studies, it is difficult to definitively comment on the role of surgical intervention in improving return to sport after such injuries. Return-to-sport rates were outlined by Calder et al³ when comparing operative and nonoperative groups for grade IIa and IIb injuries. In that study, all patients returned to sport at the preinjury level, with a mean return to sport of 45 days in the nonoperative group and 65 days in the operative group.

Return to sport at the preinjury level is particularly important for athletes competing at a professional level. We identified that a mean of 93.8% of all athletes returned to sport at the preinjury level. Osbahr et al¹² reported that, although syndesmotom sprains are less common than lateral ankle sprains, they are associated with increased morbidity given the prolonged recovery period.⁴ In the study by Sman et al,¹⁸ which reported on lateral ankle sprains, the mean recovery period was stated as 15 days. Additionally, Osbahr et al¹² found a mean recovery period of 6.5 ± 11.1 days for lateral ankle sprains. Comparatively, in this review, the mean time to return to sport for ankle syndesmotom injuries was 46.3 days (range, 15.4-70 days). Such substantial

variability in time to return to sport may be due to the variation in how return to sport was defined.^{3,11,12,16,18,19,20} For instance, in the study by Ogilvie-Harris et al,¹¹ the determination of return to sport was decided using various subjective assessments, which included evaluation on preoperative sporting activities and subsequent satisfaction surveys. In the study by Osbahr et al,¹² the authors stated that it was difficult to differentiate between athletes' return-to-play level related to preinjury performance level. Finally, in the study by Oztekin et al,¹³ determination of return to sport was made by a single clinician using a subjective criterion, which included completion of the rehabilitation protocol, a final clinical examination, and an on-field observational test performed by an individual surgeon.

This is in comparison with another study that implemented unbiased and safe return to sport through functional progression programs, including movement without any pain or discomfort.¹⁹ Return to sport is often defined as return to preinjury level, or return at any level across studies included in this review.^{3,5,6,11-13,16,18-21} It is evident from our findings that reported return-to-sport rates are variable and dependent on the study methodology and outcome definitions used. This highlights the importance of uniform diagnostic and return-to-play criteria.

More recent surgical treatments such as suture button fixation have demonstrated favorable clinical outcomes and may potentially lower complication rates. Suture button fixation obviates the need for routine implant removal to avoid potentially statically locking the syndesmosis in a malreduced position, making it an effective new technique that provides dynamic fixation.¹⁰ For this reason, some argue outcomes to be more favorable than commonly used trans-syndesmotom screw fixation, as it facilitates the stable natural motion at this complex joint without rigidly fixing it in place.⁹ However, this technique may be costly, and recent small case series have reported high soft tissue complication rates.¹⁹ A randomized trial by Andersen et al¹ highlighted that patients treated with a suture button fixation had higher AOFAS and OMA scores and a lower VAS score for pain compared with patients treated using a single syndesmotom screw. The study underlined that there was improved syndesmotom reduction in the suture button patient group.²¹ Although this study highlights important findings, future larger prospective studies are required to definitively identify the optimal fixation technique with regard to return to sport.

Controversy exists with regard to the management of grade II injuries, which involve partial tearing of the syndesmotom ligaments. We found variability with respect to the management of such injuries in included studies. Grade IIb injuries include deltoid ligament injury, tenderness along the anterior interosseous membrane, a positive external rotation with a positive squeeze test, and suspicion of a widened syndesmosis on radiographs.³ The literature highlights disagreements between surgeons regarding diagnosis, appropriate treatment, and return to play. For example, in the study by Calder et al,³ 26 athletes with grade IIa injury were treated nonoperatively while 38 athletes with grade IIb injury were treated operatively. Thus,

it is clear that this is an area that demands future research and elaboration.

It is important to note the wide spectrum of injury patterns associated with syndesmotom injuries. As such, a deltoid ligament injury may have a direct impact on treatment decision-making. Calder et al³ reported that indications for surgery include injury to the medial deltoid, given findings of an unstable syndesmosis with arthroscopic examination. Additionally, our review found patients with injuries to both the AITFL and deltoid ligament take longer to return to sport than those with an isolated AITFL injury.³ Thus, it is clear that deltoid ligament injuries may be important in predicting whether early stabilization is required as well as the timeline for athletes' expected return to sport. Our study found that purely ligamentous syndesmotom injuries had high return to preinjury and any level of sport rates. However, the majority of included syndesmotom injuries may have been stable and focused on AITFL. Thus, the results do not accurately encapsulate more chronic situations, including involvement of the superficial deltoid and late chondral injury.

Strengths and Limitations

The main strengths of this article lie in its rigorous study methodology and strict adherence to the PRISMA guidelines. Our search covered multiple databases, and all stages of screening were done in duplicate with reviewers being blinded when able, to minimize reviewer bias.

The systematic review is limited by the relatively small sample size. Additionally, the majority of studies were noncomparative, which meant that a meta-analysis was not possible. The studies included were heterogenous with regard to both grade of injury as well as treatment type, thereby making it difficult to compare studies. Furthermore, the lack of comparative studies made it difficult to determine whether there was a superiority of certain treatment methods over others. However, in the case of ankle syndesmotom injuries, it is difficult to analyze comparative studies, as different grades of injuries may necessitate either surgical or nonsurgical management.

Additionally, many of the studies included elaborated on neither the specifics of the surgeries nor the rehabilitation protocols implemented. Furthermore, return to sport was defined differently across the literature, thereby making it difficult to ascertain a standardized recovery period measure before return to sport. Moreover, the studies that reported on the return-to-sport timeline rarely commented on the length of the sport seasons and subsequent athletes' recovery periods. Sman et al¹⁸ reported that health care providers were responsible for clearing athletes during the competition season; however, during the off-season, athletes used their own perception of recovery to determine whether they were fit to play. Furthermore, variations existed in the type of sport played, thus affecting season lengths. An additional weakness of included studies is the lack of detail regarding return-to-sport rates. For example, Gerber et al⁶ reported that only 44% of the syndesmosis group had acceptable outcomes yet also stated that all patients were able to return to full activity. Thus, the 100%

return-to-sport rate and residual symptoms make it difficult to draw conclusions that reflect the athlete's healing progress. To better be able to assess return-to-sport rates and to determine ideal treatment approaches, future high-quality prospective comparative studies with large sample sizes are necessary.

CONCLUSION

This systematic review showed a high rate of return to preinjury and any level of sport after ankle syndesmotom injury in patients receiving both operative and nonoperative treatment. Overall, an average of 93.8% of athletes were able to return to sport at the preinjury level. However, there is an inability to comment on whether there is a significant difference between management groups due to the lack of comparative studies. The strength of these conclusions is restricted by the inconsistencies in reporting outcomes as well as the quality of the available literature.

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