Return to Sports Following Lateral Ankle Sprain in Professional Athletes: A Review of Articles

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Abstract

Introduction: Lateral ankle sprain (LAS) is one of the most common injuries during physical activity. The present study investigated the return to sport after lateral ankle sprains in professional athletes due to the high prevalence of this injury and the need to pay attention to athletes' return to the same level of sports performance as before the injury. **Materials and Methods:** In this study, a comprehensive review of the published papers have been done considering English specialized keywords, including physical therapy, sport-specific movement, return to sport, ankle injuries, ligament injuries, return to play, lower extremity, ankle sprain, recurrent injury, ankle, sports injury, lateral ankle instability, chronic ankle instability, athlete, lateral ankle sprain. Therefore, databases, i.e., Science Direct, Scopus, Pedro, Google Scholar, PubMed, SID, ISC, Madlib, Magiran, and Irandoc, were explored, and those researches were published between 2000 to April 2022 about the return to sport and LAS injuries were studied. **Results:** After searching in the mentioned databases, the abstract of 370 articles on return to sport after LAS was first found, and then the full text of 148 related papers was studied. After reviewing them based on the inclusion and exclusion criteria and eliminating duplicate items, 47 articles were scrutinized. Finally, 11 papers about the return to sport after LAS injury were identified. Most studies reported that the recommended methods reduce the time to return to sport. In this regard, some studies set a time to return to sport, and some did not report the exact time. Studies emphasized using specific tests and criteria for evaluating athletes to enter the final stage of rehabilitation as the most important principle of safely returning to sport. **Conclusion:** Athletes' return to physical activity should be followed to allow them to safely return to sport while minimizing the risk of recurrent injuries. Determining specialized criteria and tests for high and diverse populations in sports, especially those involved with lateral ankle sprains, is the key to success in a safer return to sport. However, most studies have been conducted in limited populations and disciplines, and researchers must perform more research in this area.

Keywords: Ankle Joint; Athlete; Chronic Instability; Lateral Sprains; Return to Sport

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Highlights

Due to the high prevalence of Lateral Ankle Sprains in athletes and the need to pay attention to the return of athletes to competition and training levels before the injury, the present study was conducted to study the return to sports after lateral ankle sprains**.** In this regard, some studies set a time to return to sports, and some did not report the exact time. Studies emphasized using specialized tests and criteria for evaluating athletes to enter the final stage of rehabilitation as the most important principle of safe return to sports. Determining specialized criteria and tests for high and diverse populations in sports, especially those involved with lateral ankle sprains, is the key to success in returning to sports safer and more secure**.**

Plain language summary

Lateral Ankle Sprain (LAS) is one of the most common injuries in sports. It is also one of the most common lower extremity injuries associated with participation in exercise. It has the highest recurrence rate, leading to Chronic Ankle Instability if symptoms persist .Instability may lead to recurrent sprains in a professional athlete, which may lead to the need for surgery and thus greater distance from exercise.Athletes with LAS are often cared for, but emphasizing a rapid return to exercise has been considered one of the most fundamental issues in professional sports today.

A quick return to exercise can be a possible mechanism to increase athletes' risk of re-injury and long-term symptoms. Most studies were conducted in a limited community.Due to this

discrepancy in the results, especially the timing of return to exercise, there is a need for further studies in this regard. Studies have also examined training methods that can provide appropriate solutions to reduce costs. But the important issue that seems to be considered more than anything else is the discussion of defining criteria for determining the level of readiness of the injured athlete to enter any rehabilitation stage and ultimately return safely to exercise. Given the importance of athletes' performance in professional sports, injury is considered an acute stage in terms of sports, social and psychological period of the athlete, and the most important goals for the athlete are to return faster, safer and safer to the same level of sports performance as before the injury. Therefore, reviewing and determining the criteria for returning to sports is essential for this issue.

Introduction

The foot and ankle areas are among the most common sites for acute and chronic injuries in athletes and other active individuals (1). Lateral Ankle Sprain (LAS) is one of the most common injuries in sports (2-6). It is also one of the most common lower limb injuries associated with sports participation, and Lateral ligaments of the ankle are involved in 38% to 48% of ankle injuries (7). Most acute ankle sprains occur during Plantar Flexionand excessive inversion, leading to damage to the lateral ligaments, especially the weaker ones (1, 4, 8, 9).According to the known mechanism, this injury is more common in sports requiring jumping, landing and changing direction movements, such as football, volleyball, and basketball (10, 11). In the acute phase of this injury, the affected individuals experience pain, loss of function, and inability to perform activities fully (12). Recurrence of LASinjury is one of the most common musculoskeletal injuries (5, 13, 14). Evidence also shows that at least 40% of people who get ankle sprain for the first time retain the symptoms, often referred to as chronic ankle instability (CAI)(5, 15).Chronic ankle instability is also considered the most common complication of acute ankle sprain(16). It's also associated with recurrent events, decreased function, decreased physical activity, recurrent ankle sprain, and early onset of ankle osteoarthritis (3, 5, 17). It has been reported that 5 to 33% of people would still experience pain and instability during the first period after the ankle sprain, which negatively affects their daily activities and athletic performance (12).

LAS often reduces neuromuscular control and loss of proprioception of joints (6, 18). Neuromuscular control helps maintain the ankle's functional stability, while proprioception affects the position of the ankle joint and the sense of movement. Disorders in any of these functions reduce the ankle joint's dynamic balance and reaction time while doing sports exercises or during competitions (6, 19). CAI generally occurs for two main reasons: mechanical and functional. Mechanical instability results from pathological laxity, arthrokinematic disorders, and degenerative joint changes. Functional instability may be due to neuromuscular control, lack of strength, and postural control system, which could be prevented by performing and following appropriate functional rehabilitation protocols (20). Functional instability of the ankle refers to the tendency of the ankle to empty and frequent sprains, which is caused by the inability to maintain the stability of the ankle joint during activities (16).

Despite the high cost of treating this injury, LAS is still not considered a severe injury (5). Due to the several effects of this injury on various aspects of the sport, financial, social, etc., and considering its clinical aspects, the desired treatment and rehabilitation have not yet been established. One of the main reasons for being away from training and playing for a long time is the lateral ligament injury of a professional athlete (21). Instability may lead to recurrent sprains in a professional athlete, which may increase the need for surgery and thus cause more distance from exercise (21, 22). Despite using other tools and instruments such as the lateral ankle scaffolds or rehabilitation protocols, some of which have been proven effective, proper LAS treatment is still controversial (23).

Among the athletes, LAS patients often receive care. Still, the emphasis on the rapid Return to Sport (RTS) has been considered one of the professional sport's most fundamental and up-to-date issues (5). Rapid RTS can be considered a possible mechanism to increase the risk of re-injury and long-term symptoms among athletes (5). Managing LAS injury and decisions on the RTS requires many aspects to be considered. A rapid return to activity is often emphasized, and the time to RTS is used as the criteria for the success of rehabilitation (24). However; such an approach cannot have a positive result because if some aspects of the protocol or treatment method are not considered, the patient would be injured again after RTS and can predispose the person to instability. It was reported that LAS patients had increased ligament weakness, function limitation in the form of self-report anddecreased dorsiflexion range of motion. Also, they have some restrictions in controlling the dynamic position of their involved limb relative to the non-involved limb, even when returning to sport (5, 25). What has not yet been clarified or addressed in a comprehensive and integrative manner is determining the treatment modalities such as rehabilitation protocols for treating and healing LAS, especially in athletes, for a safer RTS. In a few cases, some methods or protocols have been approved by researchers, but the same methods have not

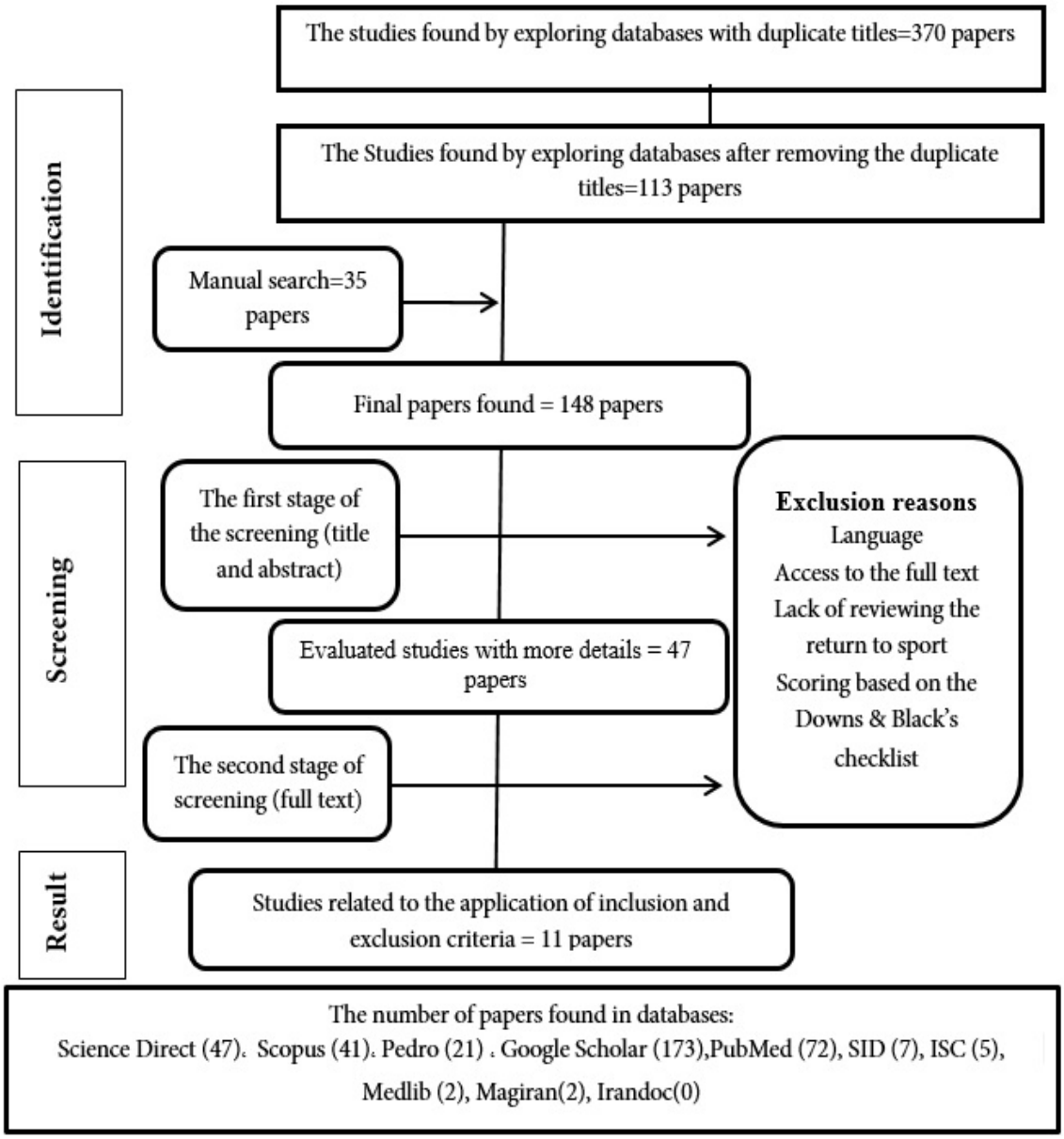

Figure 1. The paper selection procedure

been studied for a long time, or their long-term effect has not been measured. Therefore, the present study tried to answer this question or provide a clearer picture of this issue by collecting research related to RTS's study after LAS injury. Target groups can use these results to design their training programs to prevent these injuries more accurately.

Research Method

In the present study, the researches published between 2000 to April 2022 that were conducted to investigate the RTS after LAS injury were explored. Search for the related papers was done considering the specialized English and Persian keywords in the specialized English and Persian databases such as Science Direct, Scopus, Pedro, Google Scholar, PubMed, SID, ISC, Madlib, Magiran, and Irandoc. The keywords included physical therapy, sport-specific movement, return to sport, ankle injuries, ligament injuries, return to play, lower extremity, ankle sprain, recurrent injury, ankle, sports injury, lateral ankle instability, chronic ankle instability, athlete, lateral ankle sprain.

Assessing the methodological quality of primary studies is an essential component of systematic reviews. To assess methodological

Table 1. Scoring the papers based on Downs & Black's modified checklist

Author	Reporting (10)	External validity (3)	Internal validity		Total (27)
			Bias Interventional (7)		
Green *et al.* (28)	8	3	6	7	24
Ardèvol *et al.* (29)	8	2	5	6	21
Hupperets *et al.* (30)	7	2	6	6	21
Ismail *et al.* (10)	9	3	6	6	23
Van Der Linde and Oschman (31)	8	2	6	6	22
McKeon *et al.* (32)	8	3	6	6	23
Bendahou *et al.* (23)	7	2	6	6	21
White, *et al.* (21)	7	2	5	6	20
Punt *et al.* (13)	8	2	5	6	21
Lee *et al.* (12)	8	2	5	5	24
Akbari *et al.* (33)	8	2	6	6	22

quality, a commonly used numerical rating scale (Downs and Black) was also used to evaluate the included studies, and comparisons were made between the quality ratings assigned using this method. Papers were explored first electronically andthen manually from among the papers published in the mentioned databases. The entry criteria for selected papers were as follows: be in English or Persian; being published in a scientific-research journal; research has been done on the LAS and RTS. The exclusion criteria also included not being on the LAS and RTS after that, considering just the prevention or rehabilitation programs and the treatment of injuries. The quality of the papers was also scored using Downs and Black's Modified Checklist(26), shown in Table 1.This checklist was arranged to evaluate the methodology of random and non-random papers. There are 27 items on this checklist. The first part of reporting consists of 10 items. The second part, *i.e.*, the external validity, consists of 3 items. The third part, *i.e.*, the internal validity (divided into two parts: bias and intervener), consists of 14 items. For example, the reporting section asks if the hypotheses, research objectives, or interventions in question are clearly explained. Based on this checklist, papers are divided into four levels. If the score of a paper was between 24 and 28, its level was excellent, 19 to 23 was good, 14 to 18 was relatively good, and papers with less than 13 were considered poor (27).

After exploring the mentioned databases, 370 papers were found on RTS after LAS injury. After reviewing the title, abstract, and keywords of the studies, removing the duplicate items, following the instructions of Prism, and scoring based on Downs & Black's checklist, the full text of 47 papers was scrutinized. The results of searches based on inclusion and exclusion criteria ultimately led to the identification of 11 papers. If the papers met the inclusion and exclusion criteria, their results would be used in the review study and otherwise discarded.

Results

The results of the research studies have been presented in Table 2. This study aimed to review the published papers about the RTS after the ankle sprain injury and provide an appropriate summary of the results of previous studies. Therefore, papers were searched in the specialized databases, and 11 related papers were selected based on the inclusion and exclusion criteria.

Some studies have compared the training methods (9, 28-30). The other studies examined proprioception training methods (31) or used the available rehabilitation tools (23, 30, 32). Two studies examined the return to activity following the surgery and doing the exercise and physiotherapy afterward (11, 21). Also, one study discussed a new Wii Fit™ exercise therapy (12).

Different results were obtained from the studies, considering the time of RTS. Some studies reported periods for the time of RTS based on their findings. Of course, by adding training methods in the treatment protocol (adding talocrural mobility (talotibial joint) to the RICE protocol or functional treatment) (11, 12, 21, 23, 28, 32). The other studies did not report a specific time for the RTS after their observations; however, they stated that following the protocol (plyometric exercises or proprioceptive training) or using their suggested tools (JumpStretch Flex Band (JSFB) program) would reduce the time to RTS (9, 29-31). A study also has reported that assessments, especially specialized ones, should be considered to determine the athletes' readiness for RTS (5).

Discussion

Professional athletes who feel a significantly greater load on their ankle joints may experience more severe injuries in these areas (33). The foot is the base of the kinetic chain of the lower quarter of the body, so if the rehabilitation and treatment would not be managed

Table 2. Details of studies and the results of their review

Author(s)	Title	Research population	Intervention	Results	Return to Sport
Green *et al.* (28)	A randomized controlled trial of a passive accessory joint mobilization on acute ankle inversion sprains	41 patients with acute ankle inversion (degree of injury not defined), 26 males and 12 females with a mean age of 25 years old	The control group used the RICE protocol, and the intervention group used the painless anterior-posterior mobility in addition to the RICE protocol. Both groups were treated for 14 days	Adding talocurial mobility (talotibial joint) to the RICE protocol when managing ankle inversion injuries requires fewer treatments to achieve painless dorsiflexion and improve the gait speed over RICE alone	Patients in the intervention group (n = 13) returned to the sport after 12.2 days, and patients in the control group returned to the sport after 13.4 days (n = 16)
Ardèvol *et al.* (29)	Treatment of complete rupture of the lateral ligaments of the ankle: a randomized clinical trial compared cast immobilization with functional treatment.	121 patients with grade III acute ankle sprain under the age of 35 (93 males and 28 females)	One group was immobilized with a cast. The second group performed functional exercises (weight-bearing training, strapping, and proprioception training) (with follow-ups of 3, 6, and 12 months for the re-sprain injury).	The functional group returned to physical activity significantly earlier and better, and functional treatment also showed a better reduction in joint laxity.	At 3-month and 6-month follow-ups, the functional group had better returns and fewer symptoms; however, there was no difference after 12 months.
Hupperets *et al.* (30)	Effect of unsupervised home-based proprioceptive training on ankle sprain recurrences: a randomized controlled trial.	522 athletes, 12-70 years old, 256 individuals in the intervention group (120 females and 136 males) and 266 individuals in the control group (128 females and 138 males)	8 weeks of unattended proprioception training at home with a one-year follow-up	Ankle re-sprain was significantly (35%) decreased in the intervention group compared to the control group. Also, according to the subject report, the danger of re-risk was doubly decreased, and the time to return to activity became less	Reduce the time of returning to activity
Ismail *et al.* (10)	Plyometric training versus resistive exercises after an acute lateral ankle sprain	22 athletes (11 females and 11 males) with an average age of 26 years old with I or II degree one-way sprain in two groups	6 weeks of plyometric training and the other group 6 weeks of resistive exercises	The performance test criteria of the plyometric group were significantly higher than the resistive group	Increase in the speed of improving the performance of athletes
Van der Linde and Oschman (31)	Comparative ultrasound study of acute lateral ankle ligament injuries rehabilitated with conventional and jump stretch flex band programs	25 Athlete patients with an acute ankle sprain, 18-40 years old	Jump Stretch Flex Band (JSFB) program and the conventional ankle rehabilitation program	Ligaments return to normal with the JSFB program sooner than the conventional ankle rehabilitation programs	In acute grade I and II ankle ligament injuries, the return to the competitive level of the sport with the JSFB program was shorter with the initial start of rehabilitation. Ligaments returned to normal with JSFB program sooner than the conventional ankle rehabilitation programs
McKeon *et al.* (32)	Return-to-play probabilities following new versus recurrent ankle sprains in high school athletes	Ankle sprains were classified based on the lost time of the competition (same day return, next day return, 3-day return, 7-day return, 10-day return,	Observational study	204 injuries out of 479,668 injuries involved ankle sprains (13.5%).Among the cases followed up by the athlete, 163 were new	History of previous injury and new ankle sprain injury did not differ significantly in terms of timing until return to play (especially for the possibility of returning to play after 3 days)

		22-day return, no return)		cases, and 35 cases were recurrent Ankle sprains were classified based on the lost time of the competition (same day return, next day return, 3-day return, 7-day return, 10-day return, 22-day return, no return)	
Bendahou *et al*. (23)	Compression stockings in ankle sprain: a multicenter randomized study	126 patients, 18-55 years old with an ankle sprain, including 66 males and 51 females	Compression stockings group, placebo group with 90 days follow-up	No significant difference was observed in terms of pain	The time to return to exercise was much shorter in patients in the compression stockings group, and the meantime was 38 (60-60) days and 60 (35-81) days for the placebo group.
White *et al.* (21)	Return to sport following acute lateral ligament repair of the ankle in professional athletes	42 athletes with grade 3 ankle injury with a mean age of 22 years old (16 to 31 years old)	Two weeks after surgery, reconstruction of the lateral ligaments of the ankle and physiotherapy began with an emphasis on active range-of-motion exercises, followed by strengthening and proprioception exercises.	The mean return to exercise and sport for the isolated injuries was 63 days (40-110) and 77 days (56-127), respectively. However, the concurrent injury outcomes were 86 days (63-152) and 105 days (82-178)	Lateral ligament reconstruction is a safe and effective treatment for severe acute rupture that holds the ankle in place and is expected to return to sport in approximately 10 weeks. Despite returning to the same level of competition, the club and the player should be aware that injuries may postpone the return, and symptoms continue.
Punt *et al.* (13)	Wii Fit™ exercise therapy for the rehabilitation of ankle sprains: Its effect compared with physical therapy or no functional exercises at all	90 patients with an ankle sprain in three groups (30 people in each group), including the control group, physiotherapy exercises group, and the Wii fit group	6 weeks of the Wii Fit and the physiotherapy exercises	Leg and ankle strength and pain were improved in the groups. However, no difference was observed between the effect of the Wii Fit exercises and the physiotherapy exercises with the noexercise group	In the Wii Fit group (83%), the physiotherapy group (80%), and the no exercise group (77%), they returned to the sport after 6 weeks
Lee *et al.* (12)	Return to play after modified Broström operation for chronic ankle instability in elite athletes	60 athletes with chronic ankle instability with a mean age of 19 years old	Evaluation of athletes after Bostrom surgery	The sequence of three phases of rehabilitation: the start of personal training, the start of team training, and the start of the first official game after recovery, were measured. Faster return to play was 83.3% at 4 months after lateral ankle ligament repair and 100% at 8 months after surgery.	The mean time of the return to personal training was 1.9 months, the return to team training was 2.9 months, and the return to the competitive game was 3.9 months.
Akbari *et al.* (33)	Comparison of the effect of 2 physiotherapy methods in improving the grade I and II traumatic strain of lateral ankle ligaments	30 patients with ligament strain	One group had 10 sessions of the traditional method; the second group had 10 sessions of treatment with the new method	Proprioception, static and dynamic balance improved in both groups, but more improvement was observed in the new method group.	Reduction in the time toRTS in a new method with an emphasis on improving the proprioception and balance

properly, an injury to the foot or ankle can ultimately lead to secondary injuries elsewhere in the chain. Research has shown that biomechanical changes and sensory-motor deficits occur in people with chronic ankle instability and can reduce people's activity level throughout life and lead to erosive ankle injuries (1).

Lateral ankle sprains and, as a result, injury to the external capsuloligamentous complex of the ankle can lead to the consequences such as repeated ankle sprains. This action reduces the ankle function and also brings a feeling of lethargy. This symptom after the injury is classified as chronic ankleinstability (34). Athletes with chronic ankle instability may have limited function in their lower limbs, which may affect their athletic performance(6, 35). Chronic ankle instability is associated with the various perceptual, sensory-motor, and structural changes that are thought to increase the risk of re-injury and osteoarthritis(36). In terms of the clinical severity of the injury, ankle sprains are classified as grade I (one, mild), grade II (two, moderate), and grade III (three, severe). Grade I injury includes minor swelling and low tenderness, minimal or no functional loss, and lack of joint mechanical instability. Whereas grade II injury has moderate pain, swelling in most of the involved structures, and loss of some joint movements with moderate joint instability. Grade III injury includes complete tearing of the ligaments along with the marked swelling, bleeding and tenderness to touch, loss of function, loss of joint movement, and instability(4, 9, 37).

There was a great deal of inconsistency in the results of the studies on RTS after lateral ankle sprain injury. One of the most important reasons is the difference in the participants. Most studies were conducted on a limited population. Given this inconsistency in the results, especially in determining the time of RTS, there is a need for further studies on this topic. Some studies have also examined the training methods that can provide appropriate solutions to reduce costs(12). Identifying some criteria for determining the injured athlete's readiness to enter any rehabilitation stage and ultimately return safely to sport is an important issue that should be considered more than anything(3, 5).Considering the importance of athletes' performance in professional sports, injury is considered an acute stage in terms of sports, social and psychological period of the athlete's life, and the most important goals for the related athlete are to return faster and safer to the same level of sports performance as before the injury (38). Therefore, reviewing and determining the criteria on RTS is an important criterion for this issue.

The epidemiological trend associated with chronic ankle instability suggests that the current rehabilitation approaches may be inadequate(3). All clinical cases should be considered when controlling foot and ankle injuries (including the type of injury, severity, and recovery time, the type and level of activity, etc.). Still, it is also important to consider the other factors, such as the anatomical condition of the foot, biomechanics, shoes worn during the activity, and external supports such as the braces or straps (tape)(1). In the lateral ankle sprain, the severity of ligament injury determines the course of treatment(1). According to the best available evidence, four key factors have been identified for the effective treatment and rehabilitation strategies, including reducing pain with medication and ice, compressing and holding the limb early in the rehabilitation phase, lateral ankle support for about 1 year, returning gradually to move and avoiding the prolonged immobility and coordination exercises as soon as bearing the weight(3, 15, 39-41). Due to the high prevalence of the ankle injuries, care and rehabilitation are recommended in the early stages(42). Because a little amount of function has been left in the grades I and II sprains, rehabilitation could be started immediately using the functional exercises (1, 43, 44).

Ligament injury to the foot and ankle repeatedly causes muscle weakness in the injured leg (9). The training aimed at muscle strengthening can improve neuromuscular function, thereby reducing the time required to produce strength and also improving output strength and athletic performance(45). Studies have determined that after an ankle injury, the sensory receptors in the ankle joint do not function properly. As a result, a person with an ankle sprain has a deficit in proprioception. As part of a rehabilitation protocol, balance and coordination training can reduce proprioceptive deficits and the risk of recurrent injury and improve postural control (46, 47). Chronic ankle instability can have a harmful effect on the balance, thereby altering an athlete's performance and success. So, it has been recommended to consider injury prevention training, especially balance ones, as a suitable way to maintain the optimal condition of the athlete (48). Kerkhoffs *et al.* (40) reported that people with functional training showed a faster RTS and work, less swelling, and improved mobility. They also expressed greater satisfaction than those who experienced only immobility. Also, Pant *et al.* (12) believed that rehabilitation methods using virtual reality equipment potentially help people more in terms of the time of training and more variety of sports training, and can also increase the motivation of people and reduce treatment and care costs as well, compared to the conventional techniques. The prevalence of this condition among athletes of various disciplines and staying away from training and sports competitions are considered an important motivation to know the factors affecting the occurrence of this injury, and it seems necessary to know the methods of identifying this condition. It is important to gain a full range of motion, strength, and neuromuscular

coordination during rehabilitation in lateral ankle sprains. Those not in the weight-bearing phase can perform isometric exercises and the range of motion in the open chain (28).

After the lateral ligamentous injury, it is difficult to predict precisely when the athlete can return to sport (4). Decisions on RTS can also be influenced by stakeholders (for example, sufferers, parents, and coaches) (5). The time required for RTS after the LAS depends on several factors, including the severity of the injury, the athlete's ability, and the rehabilitation features (4). Depending on the severity of the ankle sprain, fear avoidance may change the form of the athlete's play and put him/her at a higher risk for re-injury or injury to another part of the body. Also, some sport-specific skills may need to be reviewed. Participation in sport should start with non-collision training and progress with the contact drills and finally should reach the complete form of the play (1).

When analyzing an athlete's ability to RTS activity, all functional limitations resulting from injury should be recovered; cardiovascular fitness should be equal to or greater than the pre-injury status. There should be no doubt about the safety of the athlete's health on the part of him/her or the other rehabilitation team members (4). Full return to activity should be done gradually to apply pressure to the ligaments without further harm. Full activity should begin once the athlete has a complete range of motion, 80 to 90 percent of the pre-injury strength, and a normal walking pattern, including the ability to perform sport-specific tasks such as cutting and landing movement without any injury. At this stage, the athlete should be able to perform a full practice without pain and swelling (1). The time before returning to sport is the time elapsed from the day of the injury to the first day of the full training session (32). Allowing the athlete to RTS after injury involves a multifaceted decision-making process. For ankle sprain, individuals must be provided with self-assessment tools that have been tested for validity and reliability in detecting the remaining disability of the injury. Special functional tests must also be performed to evaluate the improvement and recovery of the dynamic ankle joint's stability (20).

Moreover, the residual disability due to ankle sprain is often caused by an inadequate rehabilitation program and RTS in the early stages and in an incorrect manner (49). Schedule of competitions and training season, expectations from the athlete, load on the ankle during training, personal history, level of readiness and play of the athlete, time from injury to diagnosis, type of injury, and access to the medical facilities are among the features Which should be considered when evaluating especially for acute injuries such as complete rupture (50). Athletes experience permanent side effects from ankle sprains because they may return to sport before fully recovering from the injury. The decision to RTS is sometimes made outside the realm of rehabilitation, which may be a factor to put more pressure on the athlete (20).

Athletes' sporting level when returning to physical activity after the injury is assessed based on the number of hours spent exercising per week and whether the same physical activity is performed before the injury or not(32). Based on the obtained professional consensus, sport-specific movements must be evaluated when determining the RTS for an athlete after LAS injury. The Hop test is a standard and recommended test used to evaluate sports movements (5). Other functional tests such as the simple single-leg stance test (51) to the more complex star excursion test (52), the Y balance test (53), and the T-test of agility (54) could also be used to assess the player's results and progress in the rehabilitation stages. These tests must be used in the decision to RTS for athletes with lateral ankle ligament injuries (4). After weight-bearing, mid-stage rehabilitation begins, including balance and neuromuscular exercises and range of motion exercises in weight-bearing conditions. Balance exercises should progress from the dual limb mode to single limb mode and from a rigid surface to unstable surfaces (1).

In the early stages of return to play, using external support (bracing or taping) may reduce the risk of re-injury and may also be psychologically effective. The brace is the most common support for preventing ankle injuries (38, 39, 55). It has also been reported that using tape can improve athletes' dynamic balance (7). However, comfort and optimal performance are the most important concerns when using support for some players and sports, including football, which the player may not be willing to use. In a sense, the intervention would be effective only if it is adherent (56). Rehabilitation of sports injuries and their resulting defects requires a functional approach to be used eventually (16).

Conclusion

Athletes' return to physical activity, which includes sport-specific movements, must be followed in a way that allows them to return safely to the sport while minimizing the risk of recurrent injuries. So far, studies conducted in specific and limited populations have examined this issue due to the diversity of sports and the demographics of athletes. It does not make sense for everyone to use the recommended methods. But an important issue that might be effective in solving this problem is setting criteria for evaluating the injured athletes for a safer and faster RTS. Some studies have mentioned some criteria for LAS injury, considering the models of RTS for injuries to other body parts. In the final stages of rehabilitation and the initial RTS after the injury, assessment has

been considered and recommended through sport-specific tests and some balance and coordination tests. However, it is noteworthy that the need to specialize some criteria on a large scale is felt more than ever due to the diversity of sports and competitive levels.

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Authors' contributions

All authors made substantial contributions to the conception, design, analysis, and interpretation of data.

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