Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XXI, ISSUE 2 Supplement, 2021, Romania
The journal is indexed in: Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST,
DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengage Learning, Cabell's Directories

Science, Movement and Health, Vol. XXI, ISSUE 2 Supplement, 2021
September 2021, 21 (2): 266 - 273
Original article

THEORETICAL ASPECTS REGARDING THE ANKLE SPRAIN

CULEA RODICA-GEORGETA[1], SIMION GHEORGHE[2]

Abstract

Problem statement. Acute ankle injury is one of the moste common musculoskeletal injuries. Ankle injuries have been identified as a primary injury concern, highlighting the need for injury prevention programmes to be implemented in an attempt to reduce their incidence and severity.

The aim of the research: The risk factors that involve the appearance of the sprain are: intrinsic factors and extrinsic factors. The intrinsic risk factors for sprains include the following: previous sprain; sex; height and weight; limb dominance; anatomic foot type and foot size; generalized joint laxity; anatomic alignment, ankle-joint laxity, and range of motion of the ankle-foot complex; muscle strength; muscle reaction time; and postural sway. Extrinsic risk factors that have been investigated through prospective studies include bracing and taping, shoe type, and the duration and intensity of competition and player position. Treatment for a sprained ankle depends on the severity of injury. The treatment goals are to reduce pain and swelling, promote healing of the ligament, and restore function of the ankle. Treatments for acute ankle injuries includes exercise therapy, immobilization and aquatic therapy.

Conclusion. Identification of injury risk factors, mechanisms and treatment can help to implement tailored injury prevention measures for both sexes at all age and skill levels.

Key words: ankle sprain, risk factors, prevention, recovery, treatment.

Introduction

Acute ankle injury is one of the moste common musculoskeletal injuries, say most specialist, including Polzer H., et al., (2012).

Bratu (2013), define that "sprain is a joint microtrauma that occurs under the action of divergent forces that exceed physiological limits of joint stability, but do not change the anatomical relationships of osteocartilaginous joint surface".

Farzin Halabchi, Mohammad Hassabi, (2020) estimated that almost 85% of ankle sprain involve the lateral ligaments. In almost 65% of cases, isolated injuries of the anterior talofibular ligament (ATFL) and in 20% there are injuries of the ATFL and calcaneofibular posterior ligament are unusual, (Ferran, Maffulli, 2006). There remain 15% involving ankle sprain at the syndesmotic and medial level after Doherty C., et al., (2014). For this form of sprain, Vuurberg et al., (2018) started that a syndesmotic sprain of the ankle is a lesion of one or more ligaments that compromise the distal tibiofibular junction and is commonly known as "high sprain of the ankle".

Etiology. The most common cause of ankle spain is inversion injury that occurs when the ankle is rotated outwar and the sole of the foot is brought inwar. This results in the stretching or rupture of the ligament between the talus and the fibula. It is the most common mechanism by which ankle sprain occur.

In an inversion injury, the ankle rotates inward and the sole of the foot outward, injuring the ligaments on the inside of the joint. Ligament injuries range from simple stretches to partial or complete ruptures. These are manifested in the following degrees: Grade I represents the stretching of the ligaments, showing a slight sensitivity, edema (swelling of the ankle) and stiffnes. There is pain when walking. Grade II is a partial injury of the ligaments with moderate pain, edema and bruising. Injured areas are sensitive to palpation and there is pain while walking. Grade III is complete rupture of the affected ligament accompanied by edema and severe bruising. Most of the time walking is impossible, with sever pain, although the initial pain may immediately decrease in intensity.

The risk factors that involve the appearance of the sprain, according to Bruce D., et al. (2002), are: intrinsic factors and extrinsic factors.

The *intrinsic risk factors* for sprains of the lateral ankle ligaments investigated through prospective

[1] "Ovidius" University of Constanta, Faculty of Physical Education and Sport, Romania
[2]University from Pitesti, Doctoral School in Science of Sport and Physical Education University of Pitesti, Romania
Corresponding author: rodyca_2004@yahoo.com
Received 04.06.2021 / Accepted 8.07. 2021

studies include the following: previous sprain; sex; height and weight; limb dominance; anatomic foot type and foot size; generalized joint laxity; anatomic alignment, ankle-joint laxity, and range of motion of the ankle-foot complex; muscle strength; muscle reaction time; and postural sway. *Extrinsic risk factors* that have been investigated through prospective studies include bracing and taping, shoe type, and the duration and intensity of competition and player position.

Previous Sprain. Perhaps the most frequently studied risk factor for lateral ankle-ligament sprains is a previous sprain of this complex. This is based on the fact that disruption of a ligament compromises an important biomechanical stabilizer and creates partial deafferentation of the ankle. Roos, et al. (2017) and Attenborough, et al. (2014) mention in their research that the high incidence rate of acute ankle sprains is due in part to the frequency of reinjury after an initial ankle sprain Authors of a systematic review (Attenborough et al. 2014) noted that a substantial proportion of all acute ankle sprains sustained during sports were recurrent. For example, 46% of acute ankle sprains that occurred in volleyball, 43% in American football, 28% in basketball, and 19% in soccer were recurrent injuries.

Other researchers identified the proportion of recurrent ankle sprains as 12% to 47%, Bridgman SA., et al. (2003), Kemler, et al. (2016), Pasanen, et al. (2017).

The literature is divided with regard to whether or not a previous sprain has an influence on the risk for a future sprain.

Sex. Hosea et al. (2000), affirm that the disparity of ankle-ligament sprains between the sexes appears to be much smaller in contrast with the incidence of knee injuries, particularly disruption of the anterior cruciate ligament,which is considerably greater for female athletes in comparison with male athletes after Arendt, Dick (1995) and Malone et al., (1993).

Female athletes were at 25% increased risk of suffering a grade I ankle sprain compared with male athletes; however, the relative risk between the sexes for the more serious grade II and III sprains, ankle fractures, and syndesmotic sprains was not significantly different. In their reaserch Harrer et al., (1998) they found that in addition, for both male and female athletes, the relative risk of suffering an ankle sprain doubled as the level of competition increased from high school to the collegiate level. This interesting finding is in contrast to anterior cruciate ligament tears, which increase substantially with increasing levels of competition for female athletes but not for males.

Height and Weight. In accordance with Bruce D. Beynnon, et al., (2002), height and weight have been implicated as risk factors: when an athlete is in an at-risk position for inversion ankle trauma, an increase in either height or weight proportionally increases the magnitude of inversion torque that must be resisted by the ligaments and muscles that span the ankle complex. Watson, (1999) found that male soccer athletes who sustained ankle sprains had greater height than those who did not.

Limb Dominance. Limb dominance has been implicated as a risk factor for lower extremity trauma because most athletes place a greater demand on their dominant limb, so Ekstrand and Gillquist, (1983) noted that the dominant leg sustained significantly more ankle injuries in male soccer players, with 92% of ankle injuries affecting the dominant leg.

Anatomic Foot Type and Foot Size. Barrett et al., (1993), found that the anatomic foot type (pronated, supinated, or neutral) does not appear to be a risk factor for ankle sprains, however, the classification system that characterizes anatomic foot type as pronated, supinated, or neutral may be inadequate for identifying abnormalities in foot biomechanics.

Generalized Joint Laxity, Ankle-Joint Laxity, Anatomic Alignment, and Range of Motion of the Ankle-Foot Complex. There are studies of this problem which affirmed that the laxity of the ankle joint is not a risk factor (Barrett et al., 1993), and some studies which say contrary (Baumhauer et al., 1995).

Beynnon et al., (2001) in a study of collegiate soccer, lacrosse, and field hockey athletes revealed that ankle injuries were more common among women with increased tibial varum and calcaneal eversion range of motion, while no such relationship was found for men. Thus, alignment of the hindfoot in combination with the lower extremity is important when evaluating risk factors for inversion injury of the ankle.

Ankle dorsiflexion and plantar-flexion range of motion does not appear to be related to the risk of suffering an ankle sprain among collegiate soccer, lacrosse, and field hockey athletes, say the same aothors. Wiesler et al., (1996) found that the ankle range of motion is also not associated with injury in ballet and modern dancers.

Muscle Strength and Muscle-Reaction Time. Although most would consider it intuitive that lower extremity strength is related to the risk of suffering an ankle-ligament sprain. Both the force and temporal response of the muscles that span the ankle are important to consider, (Watson, 1999). Muscle-reaction times for both modes of perturbation were not

predictive of injury in men; however, an interesting trend occurred in women.

Postural Sway There are studies that confirm the importance of postural sway and risk for ankle sprain injury and there are studies with contrary opinions.

Extrinsik factors. Ankle Bracing and Taping. Review of the prospective studies of the effect of bracing on reduction in ankle sprains revealed a consistent finding: athletes with a history of ankle sprains who use a brace or tape experienced a lower incidence of ankle sprains (McKay et al., 2001).

Shoe Type Another extrinsic risk factor that has undergone investigation is shoe type. One of the first studies revealed that the incidence and severity of knee and ankle injuries in high school football players were reduced when the length of the shoe cleats was reduced (Torg 1971). In contrast, 2 prospective studies have shown no correlation between shoe type and ankle sprains for military trainees and basketball players (Milgrom et al.,1991), (Barrett et al. 1993).

Duration and Intensity of Competition and Player Position. Although several prospective studies have recorded exposure data, (McKay et al., 2001), (Barrett et al. 1993), (Beynnon et al., 2001) only Ekstrand & Gillquist 1983 and Arnason et al., 1996, have separated their data by practices and games. Ekstrand et al., 1983, found that twice as many injuries occurred in soccer games as in practice, and there was no difference in risk of ankle injury among player positions. Arnason et al., 1966, reported 4,4 ankle sprains per 1000 hours of participation in soccer games and only 0,1 sprains per 1000 hours of practice. Similar to Ekstrand et al., 1983, Sitler et al., 1994, noted no difference in risk of ankle injury among basketball player positions, (Kerkhoffs, et al., 2012).

Time for recovery. According with Thompson, et al., (2017), one-third of individuals who sustain an acute lateral ankle ligament sprain suffer significant disability due to pain, functional instability, mechanical instability or recurrent sprain after recovery plateaus at 1 to 5 years post injury. The identification of early prognostic factors associated with poor recovery may provide an opportunity for early-targeted intervention and improve outcome.

The same autors specify that in their studies they noted that several authors specify that recovery can be achieved in 2 weeks, certainly talking into account the degree. The age and activity of the patients, and others autors specify that the recovery could not be performed in 2 weekes because non-recovery at 4 weeks was predicted by the combination of three baseline prognostic factors (Ankle Function Score-AFS $\leq$ 35, higher 0-10 severity grading by a doctor, and higher palpation / ligament stress test score) with a sensitivity and specificity of 81% and 80%, respectively (de Bie et al.,1997).

In the same study, the autors cite O'Connor et al., (2013), which reported that lower subjective ankle function at 4 weeks was significantly associated with the baseline prognostic factors of greater age ($\beta = -.32$), more severe injury grade ($\beta = -.23$), and poorer weight bearing status ($\beta = -.34$). O'Connor et al., (2013), found that greater age ($\beta = -.26$), poorer weight bearing status ($\beta = -.23$), and non-inversion injury mechanism ($\beta = -.25$) were prognostic factors for poorer subjective function at 4 months followup.

Treatment. Treatment for a sprained ankle depends on the severity of injury. The treatment goals are to reduce pain and swelling, promote healing of the ligament, and restore function of the ankle.

The use of ice and compression in the inflammatory phase after acute ankle injuries.

In the event of an acute ankle injury, the effect of ice (cryotherapy) is unclear. Bleakley et al., (2004). Ice combined with exercise therapy has a positive effect on the swelling in comparison with heat application, (Coté et al., 1988). The effectiveness of compression shows conflicting results. Intermittent application of ice has a signifi cant effect on short term
pain reduction (difference ± 1 cm in a visual analogue scale) in comparison with standard application of ice.

There are no indications that the use of ice only is effective to reduce swelling, increase function and reduce pain at rest in the event of an acute ankle injury, (Bleakley et al., 2006). The use of ice and compression, in combination with rest and elevation, is an important aspect of treatment in the acute phase of lateral ankle injury (LAI).

Analgesic and anti-inflammatory medications

Nonsteroidal anti-inflammatory drugs. Oral and topical nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly prescribed to decrease pain and inflammation in the acute phase of ankle sprain (Struijs & Kerkhoffs 2015).

Current studies indicate that the consumption of topical or oral NSAIDs in young and healthy athletes cause short-term improvement of pain and swelling (< 2 wk) without considerably raising the risk of unfavorable events compared with placebo (Vuurberg et al., 2018).

Regarding the selected NSAIDs for ankle sprains, a few studies have shown superior results for diclofenac at first and second days compared with piroxicam and ibuprofen for pain reduction in mild to severe acute sprains and equal side effects (Morán 1990).

Immobilisation after acute ankle injuries. Research from a systematic review (randomised

controlled trials (RCTs), N=2184) showed that a longer period of immobilisation in a lower leg cast (minimum of 4 weeks) is less effective compared with different functional treatments, (Kerkhoffs et al., 2002). However, due to great variation in methodological quality, the conclusions from this review should be interpreted with some caution. Recent evidence from RCT (N=584) states that a short period of plaster immobilisation (10 days) or rigid support for reduction of pain and swelling can still be considered of help in the treatment of LAI (Lamb et al., 2009).

A short period of plaster immobilization or similar rigid support facilitating a rapid decrease of pain and swelling can be helpful in the acute phase of the treatment of LAI.

Functional treatment for 4 to 6 weeks is preferable to immobilisation in a cast.

Optimal functional treatment after acute ankle injuries. A systematic review (9 RCTs, N=892) investigated the effect of different functional treatments for acute ankle injuries such as exercise therapy and immobilization by means of tape or brace (Kerkhoffs et al., 2002). Elastic bandages gave fewer complications than tape, but was associated with a delayed return to work and sports. Instability was reported more frequently compared with a semirigid ankle brace. A lace-up brace or a semirigid brace seems preferable to the use of an elastic bandage (Kerkhoffs et al., 2002). However, in this review, insufficient data were present to draw definite conclusions from literature. A lace-up brace or a semirigid brace is preferable and recommended.

Based on consensus in the committee in (professional) sports also the use of tape can be considered.

Manual mobilisation after acute ankle injuries. Three systematic reviews were identified, (Brantingham et al., 2009) the most recent review included all trials from the other two reviews (Van der Wees et al., 2006). There are limited positive (very) short-term effects (dorsalflexion, ROM, propriocepsis) in favour of manual mobilisation of the ankle (6 RCTs, N=224), (Bleakley et al., 2008). However, the clinical relevance of these findings is limited since the effects had disappeared 2 weeks after injury.

Exercise therapy after acute inversion injury. Besides three recent RCTs, (Bleakley et al., 2010) four systematic reviews of sufficient quality were found on this subject. Exercise therapy seems to prevent a recurrence in patients with LAI (2 RCTs, n=130) (RR 0.37; 95% 0.18 to 0.74) on the long term (8 to 12 months). Exercise therapy seems to have no (significant) effect on balance on the medium term (6 to 9 months) (2 RCTs, n=78) (SMD 0.38; 95%–0.15 to 0.91), (Van der et al., 2006).

Exercise therapy should be comprehensive and progressive and include ROM, flexibility (stretching), resistance (strengthening), neuromuscular and proprioceptive, and finally sport-specific functional exercises (Bellows R., Wong CK., 2018).

*Range-of-motion (ROM) exercises***:** Early ROM exercises should be started as soon as pain permits (Kerkhoffs et al., 2003). Such a program can frequently be commenced immediately in grade I and II injuries but may need to be postponed in a grade III injury (Welck et al., 2015). As soon as the pain permits, individuals should begin weight-bearing and ROM rehabilitation (Tiemstra 2012).

Stretching exercises: These exercises should be started with open-chain ankle motions for all planes and non-weight bearing dorsiflexion stretch with upper extremity assist and progress to standing calf stretch and generalized ankle stretching in the closed chain (Reider et al., 2014,).

Strengthening exercises: After restoration of normal ROM, starts this phase, beginning with isometric exercises against an immobile object in both frontal and sagittal planes. Afterward, progresses to isotonic resistive exercises using weights, elastic bands or manual resistance by the therapist for dorsiflexion, plantar flexion, inversion, and eversion as tolerated by pain. It is recommended to start with dorsiflexion and plantar flexion isotonic exercises in the early phases, which do not compromise the ligaments (Prentice, 2015).

Neuromuscular and proprioceptive exercises: The next phase of rehabilitation involves neuromuscular and proprioceptive training to restore the balance and postural control (Hupperets et al., 2009).

In the early phases, neuromuscular (sensorimotor) exercises may be started with intrinsic foot motion (toe extension with ankle plantar flexion/toe flexion with ankle dorsiflexion) and exercises performed on a foam surface, wedge board, Bosu or DynaDisc in the seated position (Wester et al., 1996).

Sport-specific exercises: The last phase of the rehabilitation process involves sport-specific training. In a volleyball player, it may consist of plyometric training with jumping maneuvers and for a soccer player, this would include running and cutting drills (Mattacola et al., 2002). Application of a brace or tape may be warranted during the early period of sport-specific training (Welck et al., 2015).

Aquatic therapy is a new name for a treatment method. Health care practitioners have used various terms for the therapeutic and rehabilitative benefits conferred by water. Early functional rehabilitation of

the sprain ankle should include aquatic range-of-motion exercises and isometric and isotonic strength-training exercises. In the intermediate stage of rehabilitation, a progression of proprioception-training exercises should be incorporated.

Other therapies after acute ankle injuries. In literature, no effect was found of ultrasound, laser therapy (De Bie et al., 1998) and electrotherapy in the treatment of acute ankle injuries (The Hague: Health Council of the Netherlands, 1999). Short-wave therapy also seems ineffective (Pasila et al., 1978).

Some other therapies like homeopathic therapy (Struijs et al., 2015), hyperbaric oxygen therapy (Bennett et al., 2005), or prolotherapy (Rabago et al., 2010) were not effective or there was not sufficient data to support their use in the treatment of acute ankle sprain.

lthough a review concluded that acupuncture might have a therapeutic effect to decrease acute symptoms, evidence on the effectiveness of acupuncture is also inconclusive due to large heterogeneity between studies (Kim et al., 2014).

Prevention. Several measures have been studied as possible interventions for lowering the incidence of recurrent ankle sprains. However, the evidence is limited and mostly concentrated on bracing, taping, and neuromuscular training (Farzin Halabchi, Mohammad Hassabi, 2020).

Sport incidence. Farzin Halabchi, Mohammad Hassabi (2020) started that acute sprained ankle is the most common injury of the lower limbs in athletes and accounts for 16%- 40% of all sports-related injuries.

According to Edvardsson Ivarsson, Johnson (2012), who cites (Bauer and Steiner 2009) an estimated 8 milion medical treated sport injuries annually in Europe. Refereing to a study by Ekstrand et al. (2011) focused on elite European football, the same autors found that on average players suffered two accidents per season. In the United States, it is estimated that the prevalence of football accidents reported by emergency hospitals is approximately 88,000 children between the ages of 5 and 14. (anhttps://www.stanfordchildrens.org/en/topic/default?id=sports-injury-statistics-90-P02787).

A study made by Pinyao et al., (2019) found that during 2010–2016, approximately 2.7 million annual ED (emergency department) visits for sports injuries were made by patients aged 5–24 years. The top five most frequent activities that caused ED visits for sports injuries were football (14.1%), basketball (12.5%), pedal cycling (9.9%), soccer (7.1%), and ice or roller skating or skateboarding (6.9%).

An epidemiological study by the autors Yeung, Chan So, Yuan (1994) was conducted on three categories of Chinese athletes in Hong Kong: national teams, competitive athletes and recreational athletes. This study shows that up to 73% of all athletes had recurrent sprained ankels and 59% of these athletes had significant disabilities and residual symptoms that affected their performance and indicates that an appropriate approach to injury prevention was needed and a comprehensive rehabilitation program.

Conclusion

Identification of injury risk factors, mechanisms, treatment can help to implement tailored injury prevention measures for both sexes at all age and skill levels.

Old injuries, not fully recovered, can cause recurrences, as in the case of sprains on the ankle joint. The severity of the injuries that occur during the practice of various sports is determined not so much by the resulting injuries, but especially by the fact that injured athletes are force to give up competitive activity for a long time.

REFERENCES

Arendt E., Dick R., 1995, Knee patterns among men and women in collegiate basketball and soccer: NCAA data and review of the literature, Am. J. Sports Med. 1995; 23:694–701.

Arnason A., Gudmundsson A., Dahl HA., Johannsson E., 1996, Soccer injuries in Iceland, Scand J Med Sci Sports. 1996;6:40–45.

Atteborough AS., Hiller CE., Smith RM., Stuelcken M., Greene A., Sinclair P.J., 2014, Chronic ankle instability in sporting populations, Sports Med. 2014; 44(11):1545–1556.

Barrett JR., Tanji JL., Drake C., Fuller D., Kawasaki RI., Fenton RM., 1993, High-versus low-top shoes for the prevention of ankle sprains in basketball players: a prospective randomized study, Am. J. Sports Med. 1993;21:582–585.

Baumhauer JF., Alosa DM., Renstrom PA., Trevino S., Beynnon B., 1995, A prospective study of ankle injury risk factors, Am. J. Sports Med. 1995;23:564–570.

Bennett M., Best TM., Babul S., Taunton J., Lepawsky M., 2005, Hyperbaric oxygen therapy for delayed onset muscle soreness and closed soft tissue injury, Cochrane Database Syst Rev. 2005:CD004713

Beynnon BD., Renstrom PA., Alosa DM., Baumhauer JF., Vacek PM., 2001, Ankle ligament injury risk factors: a prospective study of college athletes, J. Orthop. Res. 2001;19:213–220.

Bleakley C., McDonough S., Macauley D., 2004, The use of ice in the treatment of acute soft-tissue injury: a systematic review of randomized controlled trials, Am J. Sports Med 2004;32:251–61.

Bleakley C., McDonough S., Macauley D., et al., 2006, Cryotherapy for acute ankle sprains: a randomized controlled study of two different icing protocols, Br. J. Sports Med 2006;40:700–5; discussion 705.

Bleakley C., O'Connor SR., Tully MA., et al., 2010, Effect of accelerated rehabilitation on function after ankle sprain: randomised controlled trial, BMJ 2010;340:c1964.

Bleakley C., McDonough S., Macauley D., 2008, Some conservative strategies are effective when added to controlled mobilisation with external support after acute ankle sprain: a systematic review, Aust. J. Physiother 2008;54:7–20.

Bellows R., Wong CK., 2018, The effect of bracing and balance training on ankle sprain incidence among athletes: A systematic review wiyh meta-analysis, Int J Sports Phys Ther. 2018;13:379–388.

Bratu M., 2013, Recovery in sports traumatology, University Publishing House, Bucharest, 2013:69.

Bridgman .A., Clement D., Downing A., et al., 2003, Population based epidemiology of ankle sprains attending accident and emergency units in the West Midlands of England, and a survey of UK practice for severe ankle sprains, Emerg. Med. J. 2003;20(6):508–510.

Bruce D., Beynnon, Darlene F., Murphy, and Denise M. Alonsa, 2002, Predictive Factors for Lateral Ankle Sprains, A Literature Review J. Athl. Train. 2002 Oct-Dec; 37(4): 376–380.

Cote DJ., Prentice WE. Jr., Hooker DN., et al., 1988, Comparison of three treatment procedures for minimizing ankle sprain swelling, Phys Ther 1988;68:1064–76.

De Bie R.A.,. De Vet HC,. Van Den Wildenberg FA, Lenssen T., Knipschild PG., 1997, The prognosis of ankle sprains, Int J Sports Med. 1997;18(Suppl 4):285–9.

De Bie R.A.,. De Vet HC,. Van Den Wildenberg FA, Lenssen T., et al., 1998, Low-level laser therapy in ankle sprains: a randomized clinical trial, Arch Phys Med Rehabil 1998;79:1415–20.

Doherty C., Delahunt E., Caulfie B., Hertel J., Ryan J., Bleakley C., 2014, The incidence and prevalence of ankle sprain injury: a systematic review and meta-analysis of prospective epidemiological studies, Sports Med; 44:123-140;PMID: 24105612 DOI: 10.1007/s40279-013-0102-5

Edvardsson A., Ivarsson A., Johnson U., 2012, Is a cognitive-behavioural biofeedback intervention useful to reduce injury risk in junior football players?, Journal of Sports Science and Medicine 11, 331-338. http://www.jssm.org

Ekstrand J., Gillquist J., 1983, Soccer injuries and their mechanisms: a prospective study, Med Sci Sports Exerc. 1983;15:267–270.

Ekstrand J. et al., 2011, Injury incidence and injury patterns in professional football: the UEFA injury study, Br J. Sport Med. 45(7):553-558.doi:10.1136/bjsm.2009.060582

Ekstrand J., Gillquist J., Moller M., Öberg B., Liljedahl S.O., 1983, Incidence of soccer injuries and their relation to training and team success, Am J Sports Med. 1983;11:63–67.

Farzin H., Mohammad H., 2020, Acute ankle sprain in athletes: Clinical aspects and algorithmic approach, World J Orthop December18;11(12):534-558DOI: 10.5312/wjo.v11.i12.534

Ferran NA., Maffulli N., 2006, Epidemiology of sprains of the lateral ankle ligament complex, Foot Ankle Clin; 11: 659-662, PMID: 16971255 DOI: 10.1016/j.fcl.2006.07.002.

Gino M., Kerkhoffs, Michel Van Den Bekerom, Leon AM. Elders, Peter A., Van Beek, Wim AM. Hullegie, Guus MF., Bloemers, Elly M. De Heus, et al., 2012, Diagnosis, treatment and prevention of ankle sprains: an evidence-based clinical guideline, Br J Sports Med: first published as 10.1136/bjsports-2011-090490 on 20 April 2012. Downloaded from http://bjsm.bmj.com/ on November 6, 2019 by guest. Protected by copyright.

Harrer MF., Hosea TM., Berson L., Leddy TP., 1998, The gender issue: epidemiology of knee and ankle injuries in high and college players, Presented at: American Academy of Orthopaedic Surgeons 65th Annual Meeting Proceedings; March 19–23, 1998; New Orleans, LA.

Hosea TM., Carey CC., Harrer MF., 2000, The gender issue: epidemiology of ankle injuries in athletes who participate in basketball, Clin Orthop. 2000;372:45–49.

Hupperets MD., Verhagen EA., Van Mechelen W., 2009, Effect of unsupervised home based

proprioceptive training on recurrences of ankle sprain: randomised controlled trial, BMJ. 2009;339:b2684.

Thompson JY, Byrne C., Williams MA., Keene DJ., M.Maia Schlussel, Lamb SE., 2017, Prognostic factors for recovery following acute lateral ankle ligament sprain: a systematic review, 2017 Oct 23;18(1):421, PMID: 29061135, PMCID: PMC5654104, DOI: 10.1186/s12891-017-1777-9

Kemler E., Thijs KM., Badenbroek I., Van De Port IG., Hoes AW., Backx FJ., 2016, Long-term prognosis of acute lateral ankle ligamentous sprains: high incidence of recurrences and residual symptoms, Fam Pract. 2016;33(6):596–600.

Kerkhoffs GM., Rowe B.H., Assendelft WJ., et al., 2002, Immobilisation and functional treatment for acute lateral ankle ligament injuries in adults, Cochrane Database Syst Rev 2002;3:CD003762.

Kerkhoffs GM., Struijs PA., Marti RK., et al., 2002, Different functional treatment strategies for acute lateral ankle ligament injuries in adults, Cochrane Database Syst Rev 2002;3:CD002938.

Kerkhoffs GM., Struijs PA., Marti RK., et al., 2003, Functional treatments for acute ruptures of the lateral ankle ligament: a systematic review, Acta Orthop Scand. 2003;74:69–77.

Kim TH., Lee MS., Kim KH., Kang JW., Choi TY., Ernest E., 2014, Acupuncture for treating acute ankle sprains in adults, Cochrane Database Syst Rev. 2014:CD009065.

Lamb SE., Marsh JL., Hutton JL., et al., 2009, Mechanical supports for acute, severe ankle sprain: a pragmatic, multicentre, randomised controlled trial, Lancet 2009;373:575–81.

Malone TR., Hardaker WT., Garrett WE., Feagin J.A., 1993, Bassett F H. Relationship of gender to anterior cruciate ligament injuries in intercollegiate basketball players, J. South Orthop. Assoc. 1993;2:36–39.

Mattacola CG., Dwyer MK., 2002, Rehabilitation of the Ankle After Acute Sprain or Chronic Instability, J Athl Train. 2002;37:413–429.

McKay GD., Goldie PA., Payne WR., Oakers BW., 2001, Ankle injuries in basketball: injury rate and risk factors., Br J Sports Med. 2001;35:103–108.

Milgrom C., Shlamkovitch N., Finestone A., et al., 1991, Risk factors for lateral ankle sprain: a prospective study among mil

Moran M., 1990, An observer-blind comparison of diclofenac potassium, piroxicam and placebo in the treatment of ankle sprains, Curr Med Res Opin. 1990;12:268–274.itaryrecruits. Foot Ankle. 1991;12:26–30.

O'Connor SR., Bleakley CM., Tully MA., McDonough S., 2013, Predicting functional recovery after acute ankle sprain, PLoS One. 2013;8(Suppl 8):e72124.

Pasanen K., Ekola T., Vasankari T., et al., 2017, High ankle injury rate in adolescent basketball: a 3-year prospective follow-up study, Scand J. Med. Sci. Sports. 2017;27(6):643–649.

Pasila M., Visuri T., Sundholm A., 1978, Pulsating shortwave diathermy: value in treatment of recent ankle and foot sprains, Arch Phys Med Rehabil 1978;59:383–6.

Prentice WE., 2015, Rehabilitation Techniques for Sports Medicine and Athletic Training, SLACK Incorporated, 2015.

Pinyao R., Ashman JJ., and Akinseye A., 2019, Emergency Department Visits for Injuries Sustained During Sports and Recreational Activities by Patients Aged 5–24 Years, 2010–2016, National Health Statistics Reports, Nov.15.No.133.

Polzer H., Kanz KG., Prall WC., Haasters F., Ockert B., Mutschler W., Grote S., 2012, Diagnosis and treatment of acute ankle injuries: development of an evidence-based algorithm. Orthop Rev (Pavia); 4:5 PMID: 22577506 DOI: 10.4081/or.2012.e5

Rabago D., Slattengren A., Zgierska A., 2010, Prolotherapy in primary care practice, Prim Care. 2010;37:65–80.

Reider B., Davies G., Provencher MT., 2014, Orthopaedic rehabilitation of the athlete: Getting back in the game, Elsevier Health Sciences, 2014.

Roos KG., Kerr ZY., Mauntel TC., Djoko A., Dompier TP., Wikstrom, 2017, The epidemiology of lateral ligament complex ankle sprains in national Collegiate Athletic Association sports, Am J Sports Med. 2017;45(1):201–209.

Sitler MR., Ryan J., Wheeler B., et al., 1994, The efficacy of a semirigid ankle stabilizer to reduce acute ankle injuries in basketball: a randomized clinical study at West Point, Am J Sports Med. 1994;22:454–461.

Struijs PA., Kerkhoffs GM., 2015, Ankle sprain: the effects of non-steroidal anti-inflammatory drugs, BMJ Clin Evid. 2015;2015:1115.

The Hague, Health Council of the Netherlands, 1999, Effectiveness of physical therapy; electrotherapy, laser therapy, ultrasound therapy, The Hague: Health Council of the Netherlands, 1999.http://www.gezondheidsraad.nl/sites/default/fi les/99@20N.PDF

Tiemstra JD., 2012, Update on acute ankle sprains, Am Fam Physician. 2012;85:1170–1176.

Tropp H., Ekstrand J., Gillquist J., 1984, Stabilometry in functional instability of the ankle and its value in predicting injury, Med Sci Sports Exerc. 1984;16:64–66.

Torg JS., Quedenfeld T., 1971, Effect of shoe type and cleat length on incidence and severity of knee injuries among high school football players. Res Q. 1971;42:203–211.

Van Der Wees Ph.J., Lenssen AF., Hedndriks HJM., et al., 2006, Effectiveness of exercise therapy and manual mobilisation in acute ankle sprain and functional instability: a systematic review, Aust J Physiother 2006;52:27–37.

Vurberg G., Hoorntje A., Wink LM., et al., 2018, Diagnosis, treatment and prevention of ankle sprains: update of an evidence-based clinical guideline, Br J Sports Med; 52: 956 [PMID: 29514819 DOI: 10.1136/bjsports-2017-098106].

Yeung MS., Chan KM., So CH., Yuan WY., 1994, An epidemiological survey on ankle sprain, BMJ Journal, Vol 28, issue 2, http://dx.doi.org/10.1136/bjsm.28.2.112

Watson AW., 1999, Ankle sprains in players of the field-games Gaelic football and hurling, J. Sports Med Phys Fitness 1999;39:66–70.

Welck M., Rafferty M., Eltz S., Al-NAammari SS., Eseonu KC., 2015, Management of ankle injuries, BMJ. 2015;351:h6698.

Wester JU., Jespersen SM., Nielsen D., Neumnn L., 1996, Wobble board training after partial sprains of the lateral ligaments of the ankle: a prospective randomized study. J Orthop Sports Phys Ther. 1996;23:332–336

Wiesler E.R., Hunter MD., Martin DF., Curl WW., Hoen H., 1996, Ankle flexibility and injury patterns in dancers, Am J Sports Med. 1996;24:754–757.

https://www.stanfordchildrens.org/en/topic/default?id=sports-injury-statistics-90-P02787

.