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REHABILITATION AFTER AN ATHLETE'S ANKLE INJURY

Original research

ABSTRACT

Introduction: A bone fracture is a break in the continuity of bone tissue, caused by the action of an external or internal force on the bone. Ankle sprains are one of the most common injuries among athletes. Physically active people who participate in activities that require jumping, changing direction, and turning have an increased risk of ankle sprains. Ankle sprains and the repetitive trauma often associated with this condition can lead to long-term disability, lost time from activity, and financial burdens for athletes.

Methods: The work is non-experimental (qualitative research), i.e. a review of scientific literature. The search included an overview of the relevant databases: Medline, PubMed, Google Scholar, Research Gate. The literature review includes 4 randomized clinical trials and 1 randomized single-blind trial. The mentioned databases were searched with the help of keywords: athletes, injury, ankle joint, rehabilitation.

Results: Through a scientific review of the literature, the results of the significance and productivity of the application of rehabilitation in athletes with an ankle injury are presented. The results include the presentation and analysis of five published scientific papers in the period 2018-2020. The studies used for this review were published in India, Saudi Arabia, Iran, United States, Austria.

Conclusion: By reviewing the scientific literature, it can be concluded that there are improvements in the quality of life of athletes after an ankle injury. The greatest improvements were noted in strength, balance and functional task performance. The application of the rehabilitation program plays an important role in reducing pain and stabilizing the knee joint.

Keywords: athletes, injury, ankle joint, rehabilitation.

INTRODUCTION

A bone fracture is a break in the continuity of bone tissue, which is caused by the action of an external or internal force on the bone (Bukvić et. al. 2016). Bone, although it is the hardest tissue, behaves as a very flexible organ and can change its properties in response to high loads (Bošković et. al., 2003). The fracture can be complete (with a break in the continuity of the periosteum) or incomplete when the periosteum is preserved. The force that acts on the bone and leads to a fracture can be direct when the blow is caused by a blunt object and can be an indirect force (Bukvić et. al., 2016). When a bone is fractured, the formation of new bone starts from the periosteum, which, among other things, allows the bone to grow in width (Platzer et. al., 2003). Children have

more flexible (elastic) bones and greater resistance to stress (i.e. plastic deformation), a thicker periosteum, which is more loosely attached to the bone than in adults, and the possibility of remodeling and faster healing of fractures. A fracture is similar to breaking a green twig that is bent by force (Kapetanović et. al., 2005). The frequency of bone fractures is increasing. Fractures are one of the most common accidents in work injuries or traffic accidents. About 30% of fractures in men, 66% of fractures in women, and 70% of fractures in the hospital are potentially osteoporotic (Court-Brown et. al., 2006). There is also an increasing incidence of ankle fractures in older people. As the proportion of elderly people increases and the population ages, it is predicted that the number of injuries will

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triple by 2030 (Keene et al., 2019). The success of the application of physical therapy will certainly depend on the necessary individual and adapted approach of the individual, the type of injury and the personal needs of the patient with the aim of returning to daily life activities as quickly as possible (Uremović et al., 2018). Rehabilitation procedures should start immediately and be carried out continuously, with the necessary intensity until the assumed best possible recovery (Potočnjak et al., 2016).

The key to the success of rehabilitation is the early start and continuity of treatment, the patient's motivation, timely prevention and treatment of complications, and an adequate selection of kinesitherapy and other physical therapy procedures. The dominant place in rehabilitation belongs to kinesitherapy, and the procedures prescribed during rehabilitation are aimed at improving the outcome of treatment and rehabilitation. A doctor specializing in physical medicine and rehabilitation is the coordinator of an interdisciplinary rehabilitation team in which a physiotherapist plays an extremely important role (Uremović et al., 2018). The modern physiotherapy approach is focused on a comprehensive analysis of the level of structure and level of function, on the basis of which a direct and/or indirect approach to physiotherapy intervention can be implemented, often by connecting different techniques and methods, which has proven to be successful in rehabilitation (Potočnjak et al., 2016). During physical treatment, numerous physical therapy procedures are used, in different phases of the rehabilitation process, in order to improve or completely restore functional ability (Nikolic T., 2020). Fractures of the lower extremities are particularly involved in potential damage to both physical and emotional health, as well as the impossibility of work, social and leisure activities. Damages that occur are likely to have a negative impact on health-related quality of life (Fonseca et al., 2019).

METHODS

Systematic literature search of relevant databases, Medline, PubMed, Google Scholar, Research Gate which is harmonized within the framework of the system of PRISMA (Moher D., 2009) by keeping the main search keywords: athletes, injury, ankle joint, rehabilitation from 2018 to 2020. Articles were also selected from references of relevant articles, by searching on different websites of magazines. Without any restrictions in terms of time period, vocabulary, religiosity, all those studies that will cover certain criteria will be included: (1) athletes; (2) injury; (3) ankle joint; (4) rehabilitation.

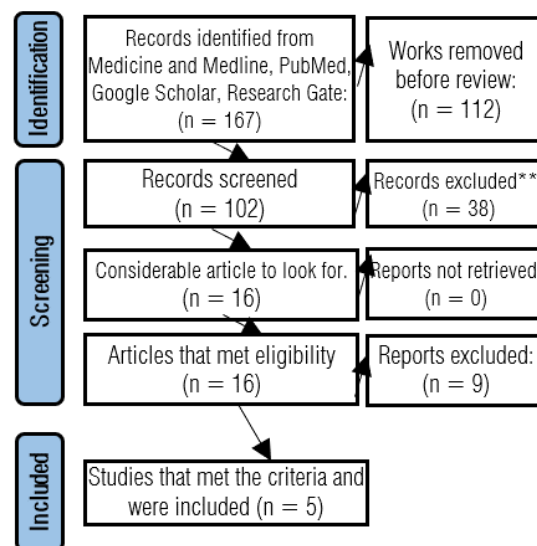
CRITERIA FOR INCLUSION AND EXCLUSION

Articles were selected from relevant databases, journal website searches, and manual searches. Without limitation on time, ethics or geographic region included studies that met the following criteria: (1) athletes; (2) injury; (3) ankle joint; (4) rehabilitation. Animal studies, records and case series, conference abstracts, or undated letters were excluded.

STUDY SELECTION AND DATA EXTRACTION

Articles that met the criteria for inclusion in the systematic literature review were subjected to a detailed evaluation. The extracted data are: first author's name, study design, country of research, number of respondents in the research, gender and age structure of respondents, year of research, publication, main objectives, research methods and instruments, research results and conclusions.

Figure 1. PRISM DIAGRAM OF RESEARCH INCLUDED IN THE REVIEW



RESULTS

Through a scientific review of the literature, the results of the importance of the application of ankle joint injury rehabilitation in athletes. 167 papers, published in the period from 2018 to 2020, extracted from 4 databases, were taken into account. After finishing the copies of studies and publications that are irrelevant, 102 papers were further processed, while only 16 papers were read in full, only 5 papers satisfied the 4 criteria for implementation in the scientific literature review. Four studies were randomized clinical trials and one randomized single-blind study. The review of these 5 studies showed that there is a great importance of applying rehabilitation after ankle joint injury in athletes as shown in Figure 1.

Table 1. Summary of study characteristics

References	Country	Main aim and purpose	Materials and methods	Results	Conclusion
Hall, E.A., et al. (2018)	India	To demonstrate whether the offered strength and balance training protocol amplifies balance, strength and functional performance deficits associated with CAI.	39 volunteers participated in the study with CAI, which was confirmed with the help of a questionnaire to identify functional ankle instability. They were randomly divided into 3 groups. Balance training protocol, strength training protocol and control group. 2 groups participated in a 20-minute exercise program, three times a week for a period of 6 weeks. Control group was doing moderate training on a bicycle. Eccentric and concentric isokinetic exercises in each ankle movement, balance and strength were tested.	Improvement was noted in balance training and strength training in concentric and eccentric inversion and plantar flexion. Strength training improved only in the eccentric version. No variables improved in the control group.	Improvements in strength, balance and functional performance were noted in both training protocols.
Alghadir, A. H., et al. (2020)	Saudi Arabia	To assess the impact of chronic ankle sprain on range of motion, static and dynamic balance, pain and proprioception in athletes.	80 athletes, divided into 2 groups, ankle sprain grades 1 and 2, who reported unwanted symptoms in the last 12 months group 1. In group 2 were healthy athletes without any changes in the ankle joint. Outcome measures were static and dynamic balance, pain, range of motion, and proprioception with the help of a visual analog scale, semicircular goniometer of foot position sense, single leg holding time, and Y balance test.	Athletes in group 1 reported mild pain and statistically significant deficits in foot proprioception, static and dynamic balance improved. No difference was demonstrated in the range of motion of the active ankle joint.	Foot proprioception, static and dynamic balance even after a period of time after one year can be a limiting factor in the dynamic defense system of the ankle joint, which causes constant repetitive injuries of the joint. Focusing on mechanical and functional deficiencies can prevent the risk of repeated injuries.
Ardakani, M. K., et al. (2019)	Iran	To determine whether the stabilization of the ankle joint changes with the help of jump-landing biomechanics.	28 basketball players with CAI were divided into two groups, the first jumping test group and the second control group. The program lasted 6 weeks of controlled jump stabilization training, which consisted of 18 training sessions. Kinetics and kinematics of the lower extremities during jumping and landing training as well as self-assessed function before and after a 6-week training program.	Stabilization of the jump led to an improvement of the self-assessment function in the sagittal plane of the hip and knee, as well as greater dorsiflexion of the ankle joint compared to the control group. In the joints where the frontal plane was reduced in the hip, knee and ankle joint with a decrease in the ground reaction force and a longer time to the peak of the ground reaction force was observed in the jumping group compared to the control group.	A 6-week jump stabilization training program changed the biomechanics of the jump as well as the landing in basketball players with CAI. These results may serve to mechanically improve the joint and reduce the risk of injury after rehabilitation that will include jump stabilization exercises.
Willeford, K., et al. (2018)	United States of America	To examine the effectiveness of braces and self-adhesive tape on the ankle joint to improve dynamic balance before and after football training.	29 football athletes, each athlete wore a self-adhesive tape on the ankle and a brace on the opposite leg. Dynamic balance and range of motion testing was performed 3 times for each leg during the testing session. Ankle ROM for range of motion and Y balance was used to assess dynamic balance at the same time points.	Both interventions were effective in reducing ROM in all directions of range of motion compared to ankle baseline, while dynamic balance did not change between tape and brace conditions.	Adhesive tape and an ankle brace provided ROM limitation before and after exercise, without changes in dynamic balance.
Maetzler, M., et al. (2020)	Austria	Effectiveness of manual fascial manipulation on walking pain and ankle dorsiflexion range of motion in the first 4 days after ankle injury.	A total of 19 subjects who suffered a grade 1-3 ankle sprain. Ankle dorsiflexion was imaged in a standardized position and calculated using Dartfish® Advanced Video Analysis Software, and SPSS® (version 17) was used to compare pre- and post-treatment data.	After one treatment session, a large number of subjects walked without pain, while a very small number of subjects walked with little pain. A moderate improvement in ankle dorsiflexion was noted.	The earliest work of the fascia around the injured ankle improves dorsiflexion of the foot and reduces pain when walking.

DISCUSSION

By reviewing the scientific literature, 5 studies were selected in which different results of many authors were observed on the rehabilitation of athletes after an ankle injury. Moseley et al conducted a study to determine the effectiveness of rehabilitation after ankle immobilization. Of the 214 randomized subjects, 194 (90.7%) were followed up at 1 month, 173 (80.8%) at 3 months, and 170 (79.4%) at 6 months. On average, the subjects were middle-aged, there were more women than men, and more subjects had less severe fractures. The participants were divided into two groups, a rehabilitation group and a control group. The control group of subjects received advice on exercises and return to activities from a physiotherapist after removal of immobilization, while the subjects of the

rehabilitation group received the same advice but also participated in supervised programs with individually adapted exercises in the hospital's outpatient physical therapy service. Initially, subjects had significant activity limitation (mean value 30 out of 0-80 on the lower extremity functional scale) and low quality of life (mean value 0.5 out of 0-1 on the quality-of-life scale). The groups were similar in all demographic and clinical variables and outcomes. Mean activity limitation increased from 30.1 (SD, 12.5) to 64.3 (SD, 13.5) for the counseling group and from 30.2 (SD, 13.2) to 64.3 (SD, 15.1) for the rehabilitation group. Mean quality of life increased from 0.51 (SD, 0.24) to 0.85 (SD, 0.17) over 3 months for the counseling group and from 0.54 (SD, 0.24) to 0.85 (SD, 0.20) for the rehabilitation

group. After 3 months, the rehabilitation group had an average of 0.4% less activity limitation and 0.01% lower quality compared to the counseling group. In conclusion, the authors state that a supervised exercise program and counseling did not produce significant benefits in improving activity limitations or quality of life compared to the counseling group (Moseley et al. 2015).

Painter et al. conducted a study in which 11 subjects between the ages of 18 and 64 participated, after removing the joint immobilization they were treated for an average of 6.6 sessions (range 3-10 sessions) for an average of 46.1 days (range 13- 81 days). There were statistically significant and clinically significant improvements in the lower extremity functional scale score ($P = .001$; mean change, 21.9 points; 95% confidence: 10.4, 33.4) and in the joint drop test ($P = .001$; mean change, 7.8). cm; 95% confidence: 3.9, 11.7) for 4 weeks, which agrees with our statistical results (Painter et al. 2015).

Holbrook et al conducted a study with the aim of determining gender differences in quality of life after a major injury. The research involved subjects aged 18 and older, they examined the quality of life using the well-being scale and concluded that women have a lower quality of life in relation to health, which does not correlate with our research (Holbrook et al., 2004).

In the research conducted by Kaye et al., they found out that the frequency of lower extremity fractures increases with age, and the frequency of lower extremity fractures is higher in older women than in older men (Kaye et al., 2004).

Singram (2019) conducted research by searching the literature of Science Direct, Cochrane Libraries, BMJ Online, PubMed, Jstor, SpringerLink, Emerald Insight and Ebscohost Research and Google Scholar databases from 1990 to 2017 with the aim of examining the impact of long bone fractures on psychological, social, financial, professional, and physical health of adults. With this research, they concluded that long bone fractures have a significant impact on many aspects of the subjects' lives, there is a difference in normal social interaction and functioning compared to before the injury (Singaram et al., 2019).

CONCLUSION

By reviewing the scientific literature, it can be concluded that there are improvements in the strength, balance and functional performance of athletes with ankle injuries. Focusing on mechanical and functional deficiencies can prevent the risk of repeated injuries. Also, the mechanical improvement of the joint reduces the risk of injuries.

Conflict of Interest

The authors do not have any conflicts of interest to disclose. All co-authors have reviewed and concurred with the manuscript's content, and no financial interests need to be reported.

REFERENCES

- Alghadir, A. H., Iqbal, Z. A., Iqbal, A., Ahmed, H., & Ramteke, S. U. (2020). Effect of chronic ankle sprain on pain, range of motion, proprioception, and balance among athletes. *International journal of environmental research and public health*, 17(15), 5318. doi: 10.3390/ijerph17155318.
- Ardakani, M. K., Wikstrom, E. A., Minoonejad, H., Rajabi, R., & Sharifnezhad, A. (2019). Hop-stabilization training and landing biomechanics in athletes with chronic ankle instability: a randomized controlled trial. *Journal of athletic training*, 54(12), 1296-1303. doi: 10.4085/1062-6050-550-17.
- Bošković SM Human anatomy, descriptive and functional. Scientific KMD. Belgrade; in 2003
- Bukvić N, Lovrić Z, Trninić Z. Traumatology. Zagreb; 2016
- Court-Brown, C. M., & Caesar, B. (2006). Epidemiology of adult fractures: a review. *Injury*, 37(8), 691-697.
- de Andrade Fonseca, M., Matias, A. G. C., de Freitas Gomes, M. D. L., & Matos, M. A. (2019). Impact of lower limb fractures on the quality of life. *Ortopedia Traumatologia Rehabilitacija*, 21(1), 33-40.
- Hall, E. A., Chomistek, A. K., Kingma, J. J., & Docherty, C. L. (2018). Balance-and strength-training protocols to improve chronic ankle instability deficits, part I: assessing clinical outcome measures. *Journal of athletic training*, 53(6), 568-577. doi: 10.4085/1062-6050-385-16.
- Holbrook, T. L., & Hoyt, D. B. (2004). The impact of major trauma: quality-of-life outcomes are worse in women than in men, independent of mechanism and injury severity. *Journal of Trauma and Acute Care Surgery*, 56(2), 284-290.
- Kapetanović NH, Pecar D. Guide to rehabilitation. Sarajevo: Light; in 2005
- Kaye, J. A., & Jick, H. (2004). Epidemiology of lower limb fractures in general practice in the United Kingdom. *Injury prevention*, 10(6), 368-374.
- Keene, D. J., Costa, M. L., Tutton, E., Hopewell, S., Barber, V. S., Dutton, S. J., ... & Lamb, S. E. (2019). Progressive functional exercise versus best practice advice for adults aged 50 years or over after ankle fracture: protocol for a pilot randomised controlled trial in the UK-the Ankle Fracture Treatment: Enhancing Rehabilitation (AFTER) study. *BMJ open*, 9(11), e030877.
- Maetzler, M., Ruescher, M., Punzenberger, F., Wang, W., & Abboud, R. J. (2020). Progressive rehabilitation of the sprained ankle: A novel treatment method. *The Foot*, 43, 101645. doi: 10.1016/j.foot.2019.09.007.
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group*. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of internal medicine*, 151(4), 264-269.
- Moseley, A. M., Beckenkamp, P. R., Haas, M., Herbert, R. D., Lin, C. W. C., & EXACT Team. (2015). Rehabilitation after

- immobilization for ankle fracture: the EXACT randomized clinical trial. *Jama*, 314(13), 1376-1385.
- Nikolić T. Fracture rehabilitation - when, how and why? 2020. Available at from: <https://www.dietpharm.com/blog/rehabilitation-prijeloma-savjeti>
- Painter, E. E., Deyle, G. D., Allen, C., Petersen, E. J., Croy, T., & Rivera, K. P. (2015). Manual physical therapy following immobilization for stable ankle fracture: a case series. *Journal of orthopaedic & sports physical therapy*, 45(9), 665-674.
- Platzer W. A handbook of anatomical atlas (in three volumes): the organ system to boot. Zagreb: Medicinska naklada; in 2003
- Potočnjak J, Kiseljak D. (2016). Rehabilitation using modern physiotherapy methods. Book of Abstracts of the 1st Health Professions Conference. Zagreb;
- Singaram, S., & Naidoo, M. (2019). The physical, psychological and social impact of long bone fractures on adults: A review. *African Journal of Primary Health Care and Family Medicine*, 11(1), 1-9.
- Uremović M, Davila S et al, editors. (2018). Rehabilitation of Locomotor System Injuries (Rehabilitacija ozljeda lokomotornog sustava). Zagreb: Medicinska naklada, pp. 202–210.
- Willeford, K., Stanek, J. M., & McLoda, T. A. (2018). Collegiate Football Players' Ankle Range of Motion and Dynamic Balance in Braced and Self-Adherent–Taped Conditions. *Journal of athletic training*, 53(1), 66-71.