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REVIEW

# An update on the role of podiatrists in sports medicine

## Actualización del rol del podólogo en la medicina deportiva

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**ABSTRACT**

**Introduction**: sports medicine is certainly the domain of physicians, whereas, there are some places where it is that of nonphysicians. With the general increase in sporting activities there has been an increase in sports injuries, both from acute and from overuse trauma. Podiatry emerges as solution for athletes and sports players. The objective was to characterize the role of podiatrists in sports medicine.
**Method**: a literature review was conducted, where 19 articles in English and Spanish were selected, published in the last five years on the subject, in databases such as: Scopus, PubMed, Researchgate, Springer.
**Results**: podiatry has its peak in this area when sports lesions were addressed not only preventively but also via biomechanical methods. The physician recognizing and addressing the biomechanical abnormality may potentially prevent an injury that could have led to a subsequently missed competition. The role of prevention in athletes is centered on a comprehensive biomechanical examination combined with an understanding of the risk factors for common overuse or traumatic injuries. The fit feet exam is a screening of the lower extremities of Olympics athletes. It includes musculoskeletal, dermatological and biomechanics evaluations.
**Conclusions**: the evaluation of an athlete finds it base in a deep understanding of the feet biomechanics. Physical examination allows to recognize the patient´s needs and identify possible pathologies. The treatment includes conservative and non-conservative indications, most popular are medication, footwear modifications and orthoses.

**Keywords**: Podiatry; Footwear Modification; Biomechanics; Orthoses; Injury Prevention.

**RESUMEN**

**Introducción**: la medicina deportiva se encuentra en dominio de los médicos, sin embargo, en algunos lugares se encuentra en manos de personal no médico. Con el incremento generalizado de las actividades deportivas ha habido un consecuente incremento de las lesiones deportivas, incluyendo sus formas agudas o crónicas. La podología emerge como una solución para atletas y deportistas. El objetivo fue caracterizar el rol de los podólogos en la medicina deportiva.
**Método**: una revisión de literatura fue llevada a cabo, donde 19 artículos en español e inglés fueron seleccionados, los mismos fueron publicados en los últimos cinco años en su mayoría, disponibles en las bases de dato: Scopus, PubMed, Researchgate y Springer.
**Resultados**: la podología alcanza su auge cuando las lesiones deportivas comienzan a ser tratadas no solo de forma preventiva, sino valorando también aspectos biomecánicos. El reconocimiento por parte de los médicos de anomalías en la biomecánica del tren inferior puede prevenir lesiones que pueden provocar malos resultados en competiciones. La prevención de enfermedades en atletas se centra en una evaluación de la biomecánica combinada con un entendimiento de los factores de riesgo predisponentes para lesiones traumáticas o desgaste. El examen de un pie de deportista incluye

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evaluaciones del aparato musculo esquelético, dermatológico y biomecánica.

**Conclusiones**: la evaluación de un atleta se basa en un profundo conocimiento de la biomecánica del pie; el examen físico permite reconocer las necesidades del paciente, así como la identificación de posibles patologías. El tratamiento incluye medidas conservativas y no conservativas, entre las indicaciones más comunes se encuentran los medicamentos, modificaciones en el calzado y órtesis.

**Palabras clave**: Podología; Modificaciones del Calzado; Biomecánica; Órtosis; Prevención de Lesiones.

## INTRODUCTION

Around the world, sports medicine is certainly the domain of physicians, whereas, there are some places where it is that of nonphysicians (athletic trainers, physical education instructors, physiologists). Early in the twentieth century, mainstream medicine left behind the concept of prevention and instead embraced the more exciting areas of surgery and pharmaceutical therapies.[1] However, nowadays preventive medicine is preferred to therapeutic medicine.

Professional and nonprofessional sportiest are traditionally known as healthy and sane people, but they are not extent of diseases. With the general increase in sporting activities there has been an increase in sports injuries, both from acute and from overuse trauma.[2]

After the recognizing of Podiatric medicine's, it´s mainstream prominence was due, in part, to the emergence of podiatric medicine as a major player in sports medicine. It can be argued that podiatric physicians possess a greater armamentarium for confronting injuries, especially with regards to the biomechanical therapies noted earlier.[1]

With a built-in focus on one area of the body, the lower extremities, no other specialty can claim such an immersion into just the lower extremity and in some cases the foot only. This focus results in markedly greater knowledge, skills, and experiences relevant to specialization in comparison to a clinician who may be responsible for multiple areas of the body such as an orthopedist.[1]

Musculoskeletal disorders are one of the most expensive workplace illnesses to manage. Burnout, high staff turnover rates, and poor job satisfaction have been attributed to health care workforce shortages and musculoskeletal disorders.[3] It´s not a surprise that many Olympics athletes suffer from foot and ankle pain or deformities that impair their performance.[4] When an sport player suffers from a musculoskeletal disorder, the implications has a negative impact in the personal life and the economic ambit for bout the player and the sport company.

Some statistics consulted showed that in the United Kingdom the cost of workplace injury was estimated to be £4,9 billion in 2013/14. In Australia musculoskeletal disorders account for 60 % of serious workplace compensation claims. The point prevalence of work-related musculoskeletal disorders in podiatry has previously been reported to be between 66 and 88 % in the UK and Australia in samples between 32 and 347 podiatrists.[3]

On the other side epidemiological studies report that between 25 % and 75 % of all runners will sustain an injury in any 1-year period. These injuries are predominantly caused by overuse.[5]

Prevention of injury and its reoccurrence are among the important concerns of practice and rehabilitation.[6,7] Players with any type of injury require medical treatment and rehabilitation; moreover, it takes a long time for players to return to play with sufficient physical function.[8]

Know that, this investigation was carry out and it had as objective to characterize the role of podiatrists in sports medicine.

## METHOD

A bibliographic investigation was carried out. To this end, a search was conducted in databases such as PubMed, Scopus, and Springer using the following keywords: podiatry; footwear modification; biomechanics; orthoses and injury prevention. These terms were used in combination with the connector "and." A total of 16 articles were selected, more than 60 % of which were published in the last five years, in both Spanish and English. Relevant information was extracted, and after organizing and synthesizing it, a well-structured development was achieved.

## RESULTS

It is considered conventional wisdom that those podiatrists strongly involved in sports medicine tend to have a better-than-average interest and/or expertise in biomechanics.[1] Some authors consider that podiatry has its peak in this area when sports lesions were addressed not only preventively but also via biomechanical methods.[1]

Sports medicine arises in the last century as a gold rock for assure the success of athletes. The worldwide spreading of this practice has improve the outcomes for Olympics companies and has prolonged the duration of an athlete competition lifetime.

The physician recognizing and addressing the biomechanical abnormality may potentially prevent an injury that could have led to a subsequently missed competition. Diagnosing to the best of their abilities, providers can prevent tragic career-ending injuries in athletes, who may have otherwise faced a worst-case scenario had it not been for the well-versed clinician.[9]

### Biomechanics

Root biomechanical theory served as the unquestioned foundation of lower extremity biomechanics for decades. Root theory

is based on core principles, albeit still applicable to surgical intervention, but seems to be fading for biomechanical treatment of lower extremity disorders.[9] Others existent theories try to describe foot biomechanics, but root biomechanical theory is wildly more accepted.

The role of prevention in athletes is centered on a comprehensive biomechanical examination combined with an understanding of the risk factors for common overuse or traumatic injuries.[9] The knowledge for reach the stander this kind of medicine demand can only be provided by a podiatrist.

Greater rearfoot eversion, and corresponding lowering of the medial longitudinal arch, is thought to increase strain within the flexor digitorumlongus, tibialis posterior, and soleus muscles as well as the deep crural fascia. This strain could then be transmitted through the tissues, resulting in higher forces at the bony insertions.[5] Body mass index has been associated with injury risk in runners, although the results are inconsistent. Surprisingly, body mass as such has hardly ever been considered a potential risk factor for a running injury.[10]

The excessive biomechanical demands directly imposed on local structures and tissues may contribute to develop malformations and chronic foot pathologies.[11] Most sports related injuries develop progressively, resulting from an imbalance between repetitive loading of the musculoskeletal system and tissue load capacity.[10] Several analyses have been made as an effort for understand the correct via o physiopathology for foot disorders in athletes, however the result is that non-theory is superior from another, but they´re mixed according the patient characteristics.

Just to cite examples, structural and functional failure of the ankle after a sprain results in the prolonged instability of the ankle joint;[8] the identification of the kicking foot and the jumping foot is also essential.[12] Abnormal foot and ankle biomechanics are implicated in a wide range of foot and lower limb disorders managed by podiatry and other allied health professions.[13]

Authors agree with this sentence: the podiatry assessment is an integral part of the routine physical examination performed on athletes. The analysis and evaluations of static and dynamic postural asymmetries are recommended for podiatrists to perform for the correction of imbalances and to better de sign foot orthotics.[12]

**Feet exam**

The fit feet exam is a screening of the lower extremities of Olympics athletes. It includes musculoskeletal, dermatological and biomechanics evaluations. The process include education on preventative foot care for the athletes, coaches and family as well as an appropriate referral for evaluation and treatment of abnormal findings.[4] Including the family as a crucial factor for any treatment guaranties the success of the therapy.

The analysis and study of plantar support and foot actions, during the walking cycle, seem quite difficult, due to the high complexity of the foot's anatomy. This is due to the number of small joints that interact with each other;[14] however, the physical examination dictates the quality of a good medicine practice.

Some athletes suffer from severe symptoms without any clear biomechanical abnormality in their extremities, and some in turn may show clear malalignment but absolutely no symptoms.[2] That's the main reason why healthcare providers for sport medicine, prioritizes prevention and it occurs through a regular control of the patient, symptomatic or asymptomatic.

The clinical biomechanical examination of the athlete should be started from his or her shoes. The wear pattern of the athletic shoes may give a good hint of a correct biomechanical diagnosis. General shoe deformation and heel tilting to valgus is frequently found in the hyperpronation syndrome. In hypersupination the heel tilting of the shoe is to varus. [2]gait cycle, lower extremities and, especially, the talocrural, subtalar and more distal joints of the ankle and foot. The basic (clinical Inspection is the first technique applied while examining, and it is present during all the examination parts.

The clinical tests include static and dynamic morphology observations, articular range of movement analysis, muscle testing, and foot specific sports shoes analysis… During the exam, based on the clinician decision some additional tests are performed such as the test of Bassani and the posturodynamic test which are easy to perform in clinical practice or on the athletic field as they do not require any particular equipment. These tests provide a global, time effective analysis as well as clinically indicated spinal segmental articular analysis.[12]

A basic physical exam includes bones and muscular parts. This conception assures the detection of anomalies either o no manifested in the sportiest. In the examination of the lower extremities, leg length measurement is important. Traditionally, the clinical measurement of the leg length inequality is performed by measuring from both sides the distance between the anterosuperior iliac spine and medial malleolus, but its accuracy has been criticized. General examination of the lower extremities also includes a rough evaluation of muscle strength and tightness in the major muscle groups- iliopsoas, piriformis, hamstrings, quadriceps, iliotibial band, adductors, and calf and foot extensor muscles.[2]

In a clinical environment the goniometric measurement of passive joint range allows the qualification of amplitude and also passive joint symmetry. These data allow us not only to make inferences about the relation between the analyzed joint and the adjacent joints, but to detect eventual alterations to its normal functioning, which can increase the appearance of pathologies.[14]

Some of the clinical examination techniques of the foot and ankle in particular have been questioned in the literature, there is still merit in evaluating things such as forefoot deformity and rearfoot position because they are linked to risk factors for injury.[9] The examination of the ankle and foot begins with inspection from front, sides and behind in non-weightbearing and weightbearing. If a mirror table (podoscope) is available, the footprints can be analyzed.[2]

Mere qualitative analysis during clinical evaluation is insufficient for the correct diagnosis of the different pathologies that affect the locomotor system. Therefore, the use of quantitative evaluation methods becomes important, either in sedestation or during walking.[14] The physical examination orientates the physician in the need of supplementary tests, like imaging, ultrasound, or more

deep analysis. A complete valuation of the athletes.

Foot mapping study (surface and pressure distribution) demonstrates an asymmetry in muscular tone and the use of myostatic regulatory feedbacks in response to positioning foam under the plantar surface of the foot.[12]

Foot pressure analysis is performed with a computerized podometry system providing plantar pressure mapping. It quantifies muscular activity and evaluates the relationship between the distribution and modification of foot pressure and particular pathologies such as lumbalgia. It is noted that in long distance walkers' population, an increase of heel pressure correlates with the incidence of low back pain during physical activity.[12]

**Common injuries**

While risk factors for running related injuries are not well understood, there is some evidence that previous injury and particular training errors, increases in training volume or intensity, may be contributors; however, the evidence for this relationship is inconsistent.[15] Medial tibial stress syndrome and Achilles tendinopathy are 2 examples of such injuries and have been consistently reported as among the 5 most common injuries sustained by runners.[5]

The change of the normal distribution of plantar pressures is responsible for the appearance of pain, plantar ulceration and stress fractures of the metatarsus.[14] Plantar fasciitis is one of the most common musculoskeletal injuries presenting to the podiatric physician and is commonly treated with orthoses.[16]

Ankle sprain is one of the most common injuries among athletes, especially in sports with frequent jumps, landing on one foot and sharp cutting maneuvers for instance basketball.[6] Recent studies have reported that individuals with chronic ankle instability experienced a lack of dynamic postural control ability, landing kinematics and weakness in their knee and hip muscles.[8]

Atypical lower limb alignment and bio mechanical function are proposed to play a role in the development of lower limb injury.[15]

Plantar heel pain is a common condition affecting the foot of an athlete. A varus hind foot, a varus knee position, a cavus foot type, spiked footwear and middle-distance running are the most important risk factors for developing this condition. As other sports pathologies, it is usually treated conservatively, and there are many recommended interventions, including foot orthoses.[17] Sometimes the pathology is diagnosed but there aren't manifestations in the athlete besides low developing of abilities, fatigue, loss of gained marks. Pain and malfunction are basics symptoms but its presence isn't obligated.

Diagnosis of symptoms and observed malalignment leads to efforts to normalize foot position, to keep the subtalar joint in its neutral position under weightbearing. These efforts consist of muscular training, stretching and foot orthotics.[2]

**Shoe´s related indications**

Podiatric physicians have been using in-shoe appliances and varied theories and therapies to treat gait related symptoms since the profession began to develop in the 18th century.[16,18] In the recent years, no relationship has been found between the cushioning properties of modern running shoes and injury risk, and the role of body mass has never been considered.[10]

Footwear is a modifiable factor that may help reduce the injury risk. Over the last few decades, different solutions of shoe cushioning have been developed to attenuate impact peak forces and the loading rate, for example, by modifying the hardness of the shoe midsole.[10] It´s frequent to find a patient being treated with non-conservative therapies but basics modifications in lifestyle factors aren't considered.

For runners, choosing suitable footwear is considered a basic requirement of running and a mean of improving running economy (RE). The advancement of footwear technology aims to maximize RE and minimize energy loss. Different footwear characteristics, such as mass, cushioning performance, motion control performance, and comfort, can affect RE.[19]

**Foot orthoses**

Exercise and foot orthotic treatment approaches are commonly based on an assessment of a patient's foot biomechanics.[13] The fundamental reason for prescribing functional foot orthoses is to improve symptomatic gait dysfunction. This may be caused by one or a combination of factors resulting in a failure of the foot to function as a stable pivot or to allow normal transverse plane hip motion.[16] The prescription of an orthosis lies in many factors, according the diagnosed entity, but the main consideration to made is if the patient is consent of the importance of this therapy election.

During orthotics manufacturing, the podiatrist takes foot laterality into consideration (the kicking vs. Jumping foot), specific corrections according to clinical and kinetic data collected into account, the sports activity into account (foot placement in ice hockey is different from fencing), and the functional constraints on the feet into account (acrobatic gymnastics where each foot can alternatively become the kicking or the jumping foot vs. handball the jumping foot remains the same) into account.[12] The corrective elements available for the manufacturing of orthotics provide different outcomes according to their specific location under the plantar surface of the foot resulting from the level of pressure applied.[12] One advantage of this treatment is it´s personalization capability.

Ideally, successful pain relief by correction of the observed abnormality with an orthotic device completes the diagnostic procedure, especially if symptoms return soon after the removal of the device.[2]

Some limitations of the present study are it´s bibliographic nature, that it wasn´t focused in any specific pathologies. So, future research has to be oriented to clarify these aspects.

## CONCLUSIONS

Podiatric physicians possess a greater armamentarium for confronting injuries, this specialist arises as a major player in sports

medicine. The evaluation of an athlete finds it base in a deep understanding of the feet biomechanics. Physical examination allows to recognize the patient´s needs and identify possible pathologies. The treatment includes conservative and non-conservative indications, most popular are medication, footwear modifications and orthoses.

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## CONFLICT OF INTEREST

None.

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## BIBLIOGRAPHIC REFERENCES

1. Jenkins D. The Podiatrist as a Member of the Sports Medicine Team. Clinics in Podiatric Medicine and Surgery 2015;32. https://doi.org/10.1016/j.cpm.2014.11.001.

2. Kannus VP. Evaluation of abnormal biomechanics of the foot and ankle in athletes. Br J Sports Med 1992;26:83–9. https://doi.org/10.1136/bjsm.26.2.83.

3. Williams CM, Penkala S, Smith P, Haines T, Bowles K-A. Exploring musculoskeletal injuries in the podiatry profession: an

international cross sectional study. Journal of Foot and Ankle Research 2017;10:3. https://doi.org/10.1186/s13047-016-0185-y.

4. Jenkins DW, Cooper K, O'Connor R, Watanabe L, Wills C. Prevalence of podiatric conditions seen in Special Olympics athletes: Structural, biomechanical and dermatological findings. The Foot 2011;21:15–25. https://doi.org/10.1016/j.foot.2010.10.004.

5. Becker J, James S, Wayner R, Osternig L, Chou L-S. Biomechanical Factors Associated With Achilles Tendinopathy and Medial Tibial Stress Syndrome in Runners. Am J Sports Med 2017;45:2614–21. https://doi.org/10.1177/0363546517708193.

6. Faraji E, Daneshmandi H, Atri A, Onvani V, Namjoo F. Effects of Prefabricated Ankle Orthoses on Postural Stability in Basketball Players with Chronic Ankle Instability. Asian Journal of Sports Medicine 2012;3:274–8. https://doi.org/10.5812/asjsm.34551.

7. Pucheta-Xolo G, Tegoma-Ruiz VM, Sánchez-Hernández JR, Santiago-Mijangos AD, Chiu-Cruz YS. Loss of sensation and trophic lesions in the feet of people with type 2 diabetes mellitus. Salud, Ciencia y Tecnología 2024;4:617. https://doi.org/10.56294/saludcyt2024617.

8. Tamura A, Shimura K, Inoue Y. Lower-Extremity Kinematics of Soccer Players with Chronic Ankle Instability during Running: A Case-Control Study. Biomechanics 2023;3:93–102. https://doi.org/10.3390/biomechanics3010009.

9. DeHeer PA, Desai A, Altepeter JH. Lower Extremity Biomechanical Examination of Athletes. Clinics in Podiatric Medicine and Surgery 2020;37:171–94. https://doi.org/10.1016/j.cpm.2019.08.012.

10. Malisoux L, Delattre N, Urhausen A, Theisen D. Shoe Cushioning Influences the Running Injury Risk According to Body Mass: A Randomized Controlled Trial Involving 848 Recreational Runners. Am J Sports Med 2020;48:473–80. https://doi.org/10.1177/0363546519892578.

11. Xu Y, Yuan P, Wang R, Wang D, Liu J, Zhou H. Effects of Foot Strike Techniques on Running Biomechanics: A Systematic Review and Meta-analysis. Sports Health 2021;13:71–7. https://doi.org/10.1177/1941738120934715.

12. Janin M. Correlation between clinical and kinetic testing in sport podiatry. Revista Terapia Manual Posturología 2012;10:7–11.

13. Jarvis HL, Nester CJ, Jones RK, Williams A, Bowden PD. Inter-assessor reliability of practice based biomechanical assessment of the foot and ankle. J Foot Ankle Res 2012;5:14. https://doi.org/10.1186/1757-1146-5-14.

14. Martiniano J, Roupa I, Lafuente G, Abrantes J. Biomechanics and Clinical Interactions in Podriatry Assesment. British Journal of Medicine & Medical Research 2015;10:1–20. https://doi.org/10.9734/BJMMR/2015/19153.

15. Peterson B, Hawke F, Spink M, Sadler S, Hawes M, Callister R, et al. Biomechanical and Musculoskeletal Measurements as Risk Factors for Running-Related Injury in Non-elite Runners: A Systematic Review and Meta-analysis of Prospective Studies. Sports Medicine - Open 2022;8:38. https://doi.org/10.1186/s40798-022-00416-z.

16. Harradine P, Bevan L. A Review of the Theoretical Unified Approach to Podiatric Biomechanics in Relation to Foot Orthoses Therapy. Journal of the American Podiatric Medical Association 2009;99:317–25. https://doi.org/10.7547/0980317.

17. Whittaker GA, Munteanu SE, Menz HB, Tan JM, Rabusin CL, Landorf KB. Foot orthoses for plantar heel pain: a systematic review and meta-analysis. Br J Sports Med 2018;52:322. https://doi.org/10.1136/bjsports-2016-097355.

18. Rodríguez P, Mamani B. Educational intervention in diabetic older adults of Jujuy. Community and Interculturality in Dialogue 2021;1:2. https://doi.org/10.56294/cid20212.

19. Xu L, Wang Y, Wen X. The role of footwear in improving running economy: a systematic review with meta-analysis of controlled trials. Scientific Reports 2025;15:3963. https://doi.org/10.1038/s41598-025-88271-2.