

A new shoe desing in wrestling

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ABSTRACT. Wrestling as a performance sport needs to be physically healthy and having well balance as well as physiological, psychological, technical, tactical, and basic motoric properties. The balance in wrestling is very important and the structure of the sole of the foot plays an important role in the balance of the wrestlers. It is seen that the wrestling shoes are not considered so much in terms of the degree to which athletes' health affects during the first years when they were officially worn.

The aim of the study was to examine the effectiveness of a new wrestling shoe design and prototype on the wrestlers.

Dynamic foot motion analysis and detection of foot sensor with bluetooth sensor were used. 80 randomly selected wrestlers age 14 and 30 who were active and living in province of Malatya and Kahramanmaraş were examined.

It is known that the shoes used in wrestling sport are officially unchanged from the first days until today. In these shoes, it was found that there is no heel elevation and orthopedic arch support. It is thought that this situation affects the prevalence of flatfoot in wrestlers. For this reason, the redesign of wrestling shoes that have been used for more than 100 years is among the priority targets of protecting athletes' health. Therefore, it is expected that this new wrestling shoe to be designed will reduce the prevalence of flat feet in wrestlers and improve the quality of life of individuals dealing with wrestling.

Dynamic foot pressure analysis was made for the all wrestling shoes. Plantar pressure distribution of the fore and rearfoot was computed in dynamic conditions by means of force cells located on the insole. At the end of the analysis, it was only seen in the new designed wrestling shoe that body weight did not transferred through the arch region of the foot and follows the ideal transition route from back of the foot towards the front throughout the lateral side of the foot. At the end of analysis, the gait line and the center of pressure of the wrestlers were seen to be most ideal level in the new designed shoe.

Thus, increasing the performance and success of the athletes are possible by using the most innovative products. The main aim of our future research is to design a new generation of wrestling shoe which provides the athlete with the highest athletic performance by allowing the human foot to act according to its anatomical structure with unique functionality.

Keywords: Wrestling, wrestling shoe, Pes planus (flat feet), shoe design.

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Новий дизайн взуття для борців

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АНОТАЦІЯ. Боротьба як вид спорту висуває вимоги до наявності спортсмена фізичного здоров'я і гарного балансу тіла, а також таких факторів підготовленості, як фізіологічної, психологічної, технічної і тактичної. Баланс тіла в боротьбі дуже важливий, а структура підошви стопи грає важливу роль у рівновазі борців. Відомо, що взуття для боротьби не так важливо з точки зору ступеня впливу на здоров'я спортсменів, особливо в перші роки її носіння. **Мета.** Вивчити ефективність нового дизайну і прототипу взуття для борців.

Методи. Динамічний аналіз руху стопи і виявлення датчика стопи за допомогою системи FWD2=SPORT. Вибірка складалася з 80 випадково вибраних борців 14–30 років, які вели активний спосіб життя проживали в провінції Малатія і Кахраманмараш.

Результати. Взуття, яке використовується в боротьбі, офіційно не змінювалося з перших днів використання. У цьому взутті відсутні підвищення для п'яти і ортопедична опорна арка. Вважається, що ця ситуація впливає на розвиток плоскостопості у борців. Модернізація спортивного взуття, яке використовувалося понад 100 років, є одним із пріоритетних завдань захисту здоров'я спортсменів. Отже, очікується, що нове борцівське взуття зменшить розвиток плоскостопості у борців і поліпшить якість життя людей, які займаються боротьбою.

Динамічний аналіз тиску в ногах було зроблено для всіх борцівських черевиків. Розподіл подошвового тиску передньої і задньої частин стопи розраховували в динамічних умовах за допомогою силових осередків, розташованих на устілці. Наприкінці аналізу тільки в новому взутті для боротьби було видно, що вага тіла не передається через арокну область стопи і впливає у напрямку переходу від задньої частини стопи до передньої частини і по всій бічній стороні стопи. У процесі проведеного аналізу було запропоновано ідеальне взуття на основі центру тиску і лінії ходи у борців.

Висновки. Підвищення продуктивності та успіху спортсменів можливо завдяки використанню інноваційних підходів. Основна мета наших майбутніх досліджень – розробка борцівською взуття нового покоління, яка забезпечує спортсмена високими спортивними характеристиками, дозволяючи нозі людини діяти відповідно до його анатомічної структури.

Ключові слова: боротьба, взуття для боротьби, плоскостопість, дизайн взуття.

Introduction

When the historical process is examined, it is stated in the various sources that shoes used in daily activities are used in sport activities but the change started in shoe designs with the use of rubber on the sole of shoes at the beginning of 1800s [5]. It is known that the production of sports shoes started in 1900s [7] and the first wrestling shoes were worn in the 1908 Olympics.

Wrestling is a combat sport for two people to bring each other's back to the ground or to gain technical superiority by using all the physiological and psychological forces on a certain area within a certain time period without using any materials or vehicles [1]. Wrestling as a performance sport needs to be physically healthy and having well balance as well as physiological, psychological, technical, tactical, and basic motoric properties. The balance in wrestling is very important and the structure of the sole of the foot plays an important role in the balance of the wrestlers.

It is seen that the wrestling shoes are not considered so much in terms of the degree to which athletes' health affects during the first years when they were officially worn. Because, in the International Wrestling Rules book published by the International Wrestling Federations Union, it is stated that *"Wrestlers should wear shoes to support their wrists. Used shoes should be without heeled, with claws, without paws, no clasps, no metallic parts and without laces. Shoes with shoelace should be wrapped in a bandage so as not to be untied during the competition. Each contestant is obliged to check the bandage of his shoes before coming to the mat"* [3]. This rule was written not to damage the opponent during the wrestling competition but no information was given about the ergonomics or structural features of the wrestling shoes.

In our pilot study, the rate of flatfoot prevalence in the wrestlers was found to be twice as high as in other sports branches. Considering that the shoes used in the wrestling have not changed much since long time, it is necessary to design the shoes that protect the athlete's health.

Therefore, the aim of this study was to design a new wrestling shoe that would not only harm the opponent during the competition but also prevent the athlete from becoming a flatfoot.

Materials and method

Dynamic foot motion analysis and detection of foot sensor with bluetooth sensor F-VScan/ Versatek Wireless/Data Logger system (FWD2-SPORT) was made on brand computer software (Fig. 1–2).

Wrestler in Turkey constituted the population of the study and the sample of the study consisted of 80 randomly selected wrestlers who were active and living in province of Malatya and Kahramanmaras. The age of participants who agreed to participate the study voluntarily was between 14 and 30.

Because of its reliable, simple and easy to apply, sole of the foot type of the participants were determined by podoscope (Chinesport S.p.a., Udine, Italy) as seen in Figure 3 (Kanatli



FIGURE 1 – Dynamic foot analysis system with bluetooth and sensor



FIGURE 2 – Image of foot pressure analysis

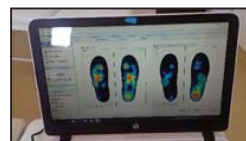


FIGURE 3 – Image of Podoscope

ve ark., 2001; Aydoğ, 2004; Volpon, 1996; Igbigbi, 2002). Pressure of the foot during movement was measured with FlexinFit system, which is composed of flexible foot sensors, wireless data logger and software (Sensor Medica, Roma, Italy). FlexinFit system is the evolution in the biomechanical and postural analysis, to date tied to the almost exclusive use of baropodometric platforms. With more than four hundred sensors, the system allows to perform precise analyses inside the patient's shoe, to check the exam development in real time and to record the data flow up to four hours (Fig. 1). Dynamic medial and lateral plantar pressures were also calculated (Fig. 2). Gait analysis were performed to determine foot pronation by following the center of pressure gait line.

Results

Gait analysis with different wrestling shoes

New designed wrestling shoe has different sole, arch height, vamp and wrist wrapping design from other wrestling shoes (Fig. 4a). Whereas the most preferred wrestling shoe by wrestlers is Adidas Combat Speed 4 (Fig. 4b), One of the latest model wrestling shoes produced by Adidas is JS John Smith (Fig. 4c).

Dynamic foot pressure analysis was made for the all wrestling shoes. Plantar pressure distribution of the fore and rearfoot was computed in dynamic conditions by means of force cells located on the insole (Fig. 5). At the end of the analysis, it was only seen in the new designed wrestling shoe that body weight did not transferred through the arch region of the foot and follows the ideal transition route from back of the foot towards the front throughout the lateral side of the foot (Fig. 5a). However, in other two shoes, it was seen that it passed through the arch region



FIGURE 4 – Different types of wrestling shoes:

(a – new designed wrestling shoe; b – Adidas Combat Speed 4-D65552; c – Adidas JS John Smith-017831

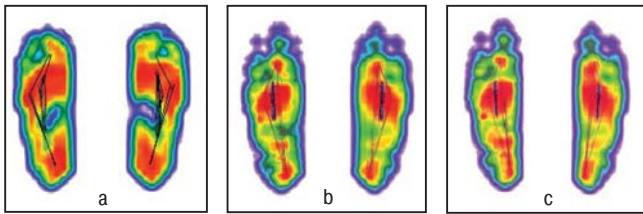


FIGURE 5 – Dynamic foot pressure analysis: a – New designed wrestling shoe, b – Adidas Combat Speed 4 - D65552; c – Adidas JS John Smith-017831

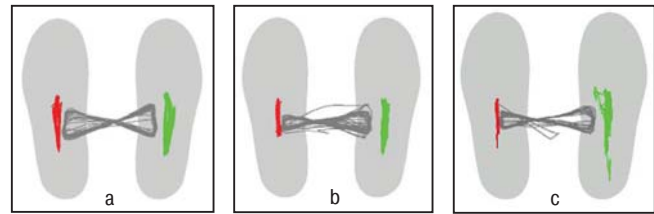


FIGURE 6 – Gait line and displacement of center of pressure: a – New designed wrestling shoe; b – Adidas Combat Speed 4-D65552; c – Adidas JS John Smith – 017831

and most of the weight of the wrestler centered to the front region of the foot (Fig. 5b, c)

At the end of analysis, the gait line and the center of pressure (COP) of the wrestlers were seen to be most ideal level in the new designed shoe (Fig. 6a). But, it was seen that gait line of the wrestlers was on the arch region and limited to small area on other shoes (Fig. 6b, c). Moreover, COP of the wrestlers was not balanced and scattered between the feet.

Discussion

The idea of designing a new wrestling shoe was born from a need. As a result of the pilot studies, it was found that the prevalence of flatfoot was very high in the wrestlers. It is also seen that there are problems related to the sole designs of the existing wrestling shoes. When the related literature is examined, it has been reported that more than 3-4 times of body weight is put on the feet when exercising. For this reason, one of the most important material used in sports is sports shoes.

The middle part of the shoe sole should provide the cushioning and balance function as in the shock absorbers in cars [6]. For this reason, functionality in shoe designs, fulfilling the needs of the user and contributing to technical performance are among the main features of today's design approach [8]. If the shoes are suitable for the sports branch and athletes, they can improve the performance of the athlete. On the contrary, they can reduce performance and damage the athlete. In this respect, incorrect shoe design or choice can cause irritating and pain-enhancing results. It is also likely to cause foot deformations if used long-term. Therefore, appropriate ergonomics applications and selection is a complementary element in athletic performance and health [2]. In this respect, the anatomical

structure of the foot and the ergonomic elements for the type of sport are effective in determining the design.

Freestyle wrestlers tend to lean forward while wrestling, and the center of gravity of the wrestlers is constantly shifting when the pushing and pulling actions applied by opponent in different directions, i.e. forward, backward, right or left, to disrupt the balance during wrestling. At this time, the sole of the foot extends the contact surface area with the mat to provide the balance. However, due to the flexibility of the mat or sole of the shoe, more than the desired surface of the foot touches the mat. This situation is thought to cause more flatfoot prevalence in freestyle wrestlers.

Moreover, wrestling shoes wrapping the ankle and the laces tied firmly around the ankle limit the functions of the Achilles tendon and tibialis posterior muscle. This situation strengthens the belief that freestyle wrestling cause the prevalence of flat foot. For this reason, it has been thought that wrestling shoes which have been used for a long time should be redesigned and athletes' health should be protected.

In the investigations, it was found that the sole of the Adidas 017831 JS John Smith brand wrestling shoe had a very narrow surface. Enes [4] proposed that the outer surface of the shoe sole should be covered with the material suitable for the floor characteristics and designed to the branch of sports. Considering these points, it is believed that current wrestling shoes are not suitable for wrestling.

Conclusion. Therefore, increasing the performance and success of the athletes are possible by using the most innovative products. As a conclusion, we designed a new generation of wrestling shoe which provides the athlete with the highest athletic performance by allowing the human foot to act according to its anatomical structure with unique functionality.

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