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Medial Longitudinal Arch Balanced Analysis of the Calibration

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종족궁 내측아치 지지에 따른 균형능력 분석

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Abstract

We analyzed how insole affects the dynamic stability and the balance while a body moves or stops. Specially we've sorted out variations of individual balance ability while we make a longitudinal arch stop artificially as a usual situation(just standing and putting one's weight). We found ten men and girls each with suitable feet for our experimentation as the subject of investigation and made individual insole for them by measuring medial longitudinal arch. Then we compared before and after movement of the power point of application and a pattern of COP using the Tetrax balance equipment. We found out it is better for balance ability when we wear insoles. It turned out to be helpful for increasing balance ability of body to use insole which supports medial longitudinal arch of longitudinal arch well.

Key words : Insole, Balance, COP, Longitudinal arch, Medial longitudinal arch

요 약

신체의 이동과 정지 시 동적 안정성과 균형성에 영향을 미치는 인솔에 대해 분석하였다. 특히 종족궁의 아치를 인위적으로 서서 체중을 가한 상태와 같은 평상시와 동일한 상태로 지속적으로 지지하였을 경우에 개별적인 균형능력의 변화를 추적하였다. 정상적인 신체 조건과 발모양을 유지하는 20대 남녀 각 10명씩 20명을 대상으로 종족궁 내측아치를 측정하여 아치를 지지하는 인솔을 개별적으로 제작하였으며, Tetrax 균형성 평가 장비를 이용하여 COP의 변위 패턴과 힘점의 이동거리를 착용 전, 후 비교하였다. 아치를 지지하는 인솔을 착용한 실험군이 균형능력 평가에서 약 22% 정도 상승되는 결과를 나타내었다. 본 비교 실험을 통해 종족궁의 내측아치를 지지하는 인솔 착용이 신체의 균형능력을 향상시키는데 도움이 되는 것으로 나타났다.

중심단어 : 인솔, 내측 종족궁, 아치, 균형, COP

Ⅰ. Introduction

A normal foot consists of 26 bones and can be divided into Forefoot, Midfoot, and Hindfoot. And there are 19 muscles and tendons and 18 of them are located at the sole of the foot. 13 Lower limb Tendons are connected to each part of the foot. In total, 32 muscles and tendons are connected to a foot[1]. As you can see, the foot has very

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complicated structure. Recently, a lot of functional shoes are coming out because the body to standing, or if you move they can affect our foot quite much. The bottom of shoes can be divided into outsole, midsole, and insole. It is contact the insole directly to the body, where it affects most of the body. The arch is formed in a person's feet, it perform the role to absorb the shock at the time of the walk and upholds the body[2]. So if we are to add another function to it, to support arch would be the most adequate. While walking the Lower limb Joints make flexion and extension motion and it directly affects dynamic stability. A proper rotational motion of an ankle joint which contacts surface makes walking motion stable[3]. The arch is very important in this process. The arch can be divided into longitudinal arch and transverse arch and the longitudinal arch consists of medial longitudinal arch and lateral longitudinal arch. Normal arch upholds the body in the neutral position while moving, but it doesn't use any other muscle at that time. That's why it is important for the motion skill[4]. As a result we can estimate that right upholding of the arch can affect the balance.

The balance is maintained mostly by closed motion cycle and planned motion of joint, but constructive motion cycle and dynamic stability are also important. Lack of strength in joints, muscles can cause disintegration of balance too[5]. Structural settlement is important for maintaining the balance and it is also important for motion process.

Especially in this investigation, longitudinal arch is connected with upholding of body and when moving fatigue. The upholding of medial longitudinal arch prevents pronation of ankle joint[6]~[8]. But unless the insole is specially developed, it is difficult to uphold and the difference in position of arches among the people makes it even more difficult to set a standard in making insoles which also considers feeling of wearing. In this investigation individual medial longitudinal arches are measured. We would like to measure the change in balance ability after using the stable insole. We estimated how the temporary change in external environment affects individual balance ability and tried to find the kinetic point of view an explanation about the skill of insole.

Ⅱ. Research method

1. Investigation subjects

This investigation has enforced on 20 people in their twenties in D university.

We made sure that the people in the test subject group don't have any physical or mental problem. And we've explained enough about our purpose and the program. General features of subject are noted in table 1.

Table.1. General characteristics of subjects *p<.01

	Total(n=20)	M(n=10)	W(n=10)	t
Age(years)	23.9 ±1.97	25.27 ±1.70	22.53 ±1.07	9.94*
Height(cm)	171.39 ±9.21	178.98 ±5.30	163.80 ±4.80	6.72*
Weight(kg)	60.08 ±15.71	73.68 ±7.72	46.48 ±3.90	4.31*

2. Instrument and method

2.1 Measuring height of arch and making process of insole.

In this investigation we've done some review on literatures in order to measure the medial longitudinal arch, In the X-ray picture we named the line that connects the bottom of calcaneal tuberosity with the downside of sesamoid bone of the first metatarsals and drew lines from talonavicular joint, cuneonavicular ariticulation, tarsometatarsal of each joints to the line Y. We measured the length of each line and calculated its ratio to the line Y, which is expressed as CY, Ny and Ly[9]. So in the same situation and method we calculated average values of those ratios by measuring the feet of subjects standing

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vertically on a right-angled acryl pipe, finding a navicular on the foot by finger, and marking it.[Fig. 2] With those results we made insoles applying measured medial longitudinal arch.

Fig. 1. X-ray that is measured medial longitudinal arch.

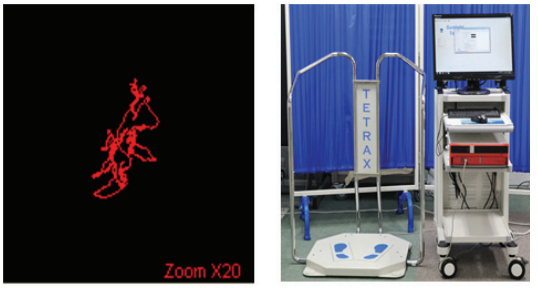
Fig. 2. Semblance of measuring the medial longitudinal arch.

Fig. 3. Production process of right insole.

2.2 Experiment using Tetrax

We applied individual height of measured medial longitudinal arch to insoles and tried to estimate the balance with those insoles. The balance experiment was implemented with Tetrax(Israel, Sunlight Co, 2009). First we made subjects wear a plane insole that is usually used and measured the balance skill. Then, we took the same process with insoles we made.

The result is shown in following picture 4 and we estimated and compared the distance of COP(Center of Position). COP indicates the distance of movement in power point to keep the balance so if it is short the balance ability would be better.



(a) Estimation pattern of balance ability

(b) Equipment(Tetrax)

Fig. 4. Tetrax balance ability test ;
(a) is a picture of the estimation of subjects' balance ability. When the values are concentrated to the red point, it means that the power point worked effectively, and thus the balance ability would be better.
(b) Tetrax balance equipment.

2.3 Analysis method

We applied technical figures of pared t-test to estimate the balance ability through upholding of longitudinal arch by its positions and the general features of subjects. We a used SPSS version 20.0 to organize the data at α=.05

Ⅲ. Result

The result shows the height of subject's medial longitudinal arch and that there is no difference between men and women in general feature. It also has been found out that there's not much correlation with the position of arch and the weight. Distance from navicular to base of support is 28.38 ~ 31.14㎜ so we could expect the height of arch support in insoles to be around 3cm.

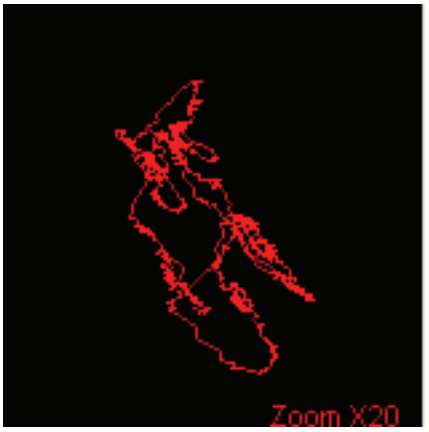
Table 2. Result of measurement in the height of medial longitudinal arch of longitudinal arch. (unit:㎝) *p<.01

	Total(n=20)	M(n=10)	W(n=10)	t
Cy	3.80±0.43	3.83±0.37	3.77±0.50	0.292*
Ny	3.44±0.46	3.36±0.38	3.52±0.53	0.751*
Lv	3.11±0.34	3.11±0.32	3.10±0.38	0.032*

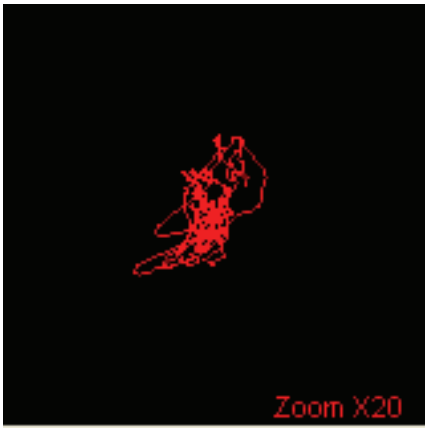
We could have used the average of estimated medial longitudinal arch of a longitudinal arch, but we used directly produced insoles instead, in order to estimate the balance which is affected by individual skills. As a result, the COP which indicates the balance ability shows noticeable decline in the side that supports height of longitudinal arch, as in table 3. When we consider the general characteristics of men and women, women were significantly more effective. Pattern of COP displacement was also evident, as shown in Fig. 5. After wearing the insole analysis mainly showed a pattern that was in the lower half to the right and move forward in the later. It explains move the body weight is concentrated in the second half arch charged is more stable role than the start of the first half of the initial evaluation.

Table 3. Distances Tetrax COP measurements of subjects (unit : ㎝) *p<.01

	Before Insole	After Insole	t
M(n=10)AVG.	14.58±2.24	10.76±1.13	6.76*
W(n=10)AVG.	15.18±2.86	11.55±1.63	6.69*
Total(n=20)AVG.	14.88±2.52	11.16±1.42	9.75*



(a) The COP pattern before insole wear



(b) The COP pattern after insole wear

Fig. 5. The change in COP (Average of COP displacement (㎝)) of insole wear patterns before and after.

Ⅳ. Discussion

The foot first contact when moving or stopped at on the ground have propulsive force and bearing power of throughout body. It is directly affected organ about coming out of the ground resistance. So last shoes to simple limited not only the ability to protect foot but also a lot of improvement has been studied for the purpose to improve Lower limb Joints and muscle fatigue, posture correction, low back pain[10]~[12].

In during the stop or move the resistance that occurs the focus in previous research is balance ability comes

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from bones and muscles that make up the foot, but in this study we should pay attention to the medial longitudinal arch of longitudinal arch. Navicular supports the longitudinal arch of the foot bones and it is a structure that receives the greatest support when we move. Navicular drop test that represent the complex measure about pronation is used as an indicator[13],[14]. Navicular is the most important bone that make up the arch but In general the drop of the navicular results in the arch collapsing and at the same time COP is delay as the study results. Through the X-ray images, we can see the arch collapsed pes planus when a serious drop of the navicular. This problem can occur in balance ability to respond to changing circumstances.

Currently, functional shoes are have been released but outsole of shoes for fall prevention is replaced by Anti-skid material, in case of insole considered by wearing feeling is all. Aging of the body may occur loss of dynamic stability because of the decline of muscle. In the functionality of the shoe insole of the aged, dispute drop of the navicular and it is important to improve the balance the medial longitudinal arch of longitudinal arch. Also research was done on the supporting structure something like pes planus and hip joint, internal rotation. It is important to maintain the arch because correlation has been demonstrated[15]. The study examined that relationship to the concept of prior studies how to effect balance ability of ongoing maintenance of the arch. In the future research how it affects to pelvis, and knee joint, hip joint, vertebrae on other organs in terms of the kinetic is required. Also it is needed to establish about arch height of muscle tissue, bone tissue and correlated with body.

Ⅴ. Conclusion

Balance ability test results through the support of the medial longitudinal arch caused a rise in overall. The height of the medial longitudinal arch was measured approximately 3.2cm except constructive pes planus and talipes cavus. This standard is applied to product personal medial longitudinal arch insoles. Result in COP indicators improve 30% and personal wearing feeling is satisfactory.

Thus, through research demonstrated that the support proper medial longitudinal arch of the longitudinal arch can be improve individual's balance ability.

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