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Effect of Customized Foot Insoles on Low Back Pain and Energy Expenditure in Prosthetics and Orthotics Professionals with Flat Feet

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ABSTRACT

Background: Low Back pain (LBP) in both developed and developing countries is the most prevalent occupation-related problem. 60%-80% of the general population at some time in their lives suffers from LBP. The existing evidence on Allied Health professions suggests that prosthetists/orthotists are likely to be at risk of low back pain development which has not been explored. Feet disorders and deformities are among the possible causes of LBP that have been introduced. It seems that there is a link between foot deformity and spinal performance in terms of the principles of biomechanics. Proper treatment with customized foot orthosis is more effective for improving low back pain symptoms than treatment with standard treatment methods.
Aims and Objectives: The present study evaluates the effect of customized foot insoles in reducing the pain and energy expenditure among prosthetics and orthotics professionals with mechanical low back pain.
Methodology: 30 prosthetics and orthotics professionals of age 25-35 years with mechanical low back pain and flat feet participated in the study which was a pre-test post-test experimental study design. LBP was evaluated by a Visual Analog Scale. The energy expenditure was evaluated using physiological cost index. Pre-test data of pain and energy expenditure was recorded without intervention. Then the customized foot insoles were given to the subjects for the duration of 4 weeks and post-test data of pain and energy was collected.
Results: The results showed a significant improvement in low back pain (mean ± SD =6.16 ± 0.94 to 5.03 ± 0.76, p= .000), and in the energy expenditure (mean ± SD = 0.08 ±0.02 to 0.06 ±0.02, p= 0.000).
Conclusion: This study provides evidence that customized foot insoles reduce pain and energy consumption among prosthetics and orthotics professionals with low back pain and flat feet.

Key Words: Mechanical low back pain, flat feet, energy consumption, prosthetics and orthotics professionals, customized foot insoles.

INTRODUCTION

Low Back pain in both developed and developing countries is one of the most common complaints and over half the people around the world suffers from LBP. LBP is the most common disease. It was identified in high and low-income countries as the most prevalent occupation-related problem. Some 60%-80% of the general

population some time in their lives suffers from LBP.[1,2]

LBP is typically categorized into specific and non-specific types. The non-specific LBP (NSLBP), consisting of 90% of the LBP cases, has no identified cause. The remaining ten per cent of these cases are known as LBP-Specific and are caused by fractures, cancer, infections and cauda equina syndrome. The non-specific LBP is further classified as more disabled, acute (less than 12 weeks) and chronic (over 12 weeks). The same is likely to be reported in the future again in patients who have previously reported symptoms of LBP.[3]

The first episode takes place between the ages of 20 and 40 and has a high prevalence of between the ages of 30 and 60. No clear consensus is reached on etiology despite its high incidence. An abnormal foot function is one possible cause.[4]

Efforts in health care to increase understanding of relevant job hazards related with the development of low back pain have been concentrated on nursing, with physiotherapists and occupational therapists receiving only a limited amount of attention. Some professions, such as prosthetists and orthotists, have yet to be well investigated, with minimal research into their working environment or associated risks of negative health outcomes, such as low back pain.[5,6]

There is evidence that the frequency and severity of low back pain are related to spinal loading. It was also discovered that regular daily activity places greater strain on the lumbar spine. This increase in loads is transferred from the foot during heel strike to the lower extremity and then to the spine.[7–10]

It is assumed that there is a link between the anatomical shape of the foot and foot pain or low back pain. There is a physiological link between the feet and the back muscles. The thoracolumbar fascia is a vital link between these two structures, transmitting loads from the upper extremities to the back and from the back to the lower extremities and the ground. Farzad Amouzadeh Omrani et al found that flatfoot could be linked to mechanical chronic LBP development in their study.[11,7]

For many years, insoles have been used. They make the individual feel more at ease. This effect is achieved by lowering the point pressure by 30-50% (This varies according to the material of the insole). Insoles have also been shown in electromyography studies to reduce the fatigability of the back muscles.[7]

Proper treatment with customized foot orthosis is more effective for improving low back pain symptoms than treatment with standard treatment methods. After about one year of standard treatment, up to 70% of patients with disabilities experience a repeat episode. Most of the treatment options deal only with acute inflammations and are not useful for long-term pain management. Surgery has little success, and it is best done for leg pain radiculopathy and not for the lower back pain. The cost of low back pain treatment in the US alone is tens of trillions of dollars annually. Podiatric medical doctors have long understood that using foot orthosis can help reduce pain.[12]

However, the international and national clinical guidelines for management of non-specific mechanical LBP do not currently consider foot orthosis and insoles and remain controversial because of little evidence.[13] Thus, the present study is an effort and contribution to add evidence proof to the available literature.

METHOD

Selection of Subjects: The study was conducted in New Delhi, India. A Convenience sample of 30 prosthetics and orthotics professionals who voluntarily participated in the study (descriptive information) given in Table 1. Out of thirty prosthetics and orthotics professionals that were selected according to the inclusion criteria 17 were male and 13 were female with mean age of 30.10 ± 2.78 years.

***Study design*:** Pre-test post-test experimental.

Inclusion Criteria: Subjects working as prosthetists and orthotists, age range- 25-35 years, subjects with musculoskeletal or mechanical low back pain, subjects having bilateral pronated feet which was assessed through navicular drop test and any measurement greater than 10mm was considered as hyper pronated, VAS score 4-7(moderate), BMI normal- 18 to 25 kg/m^2, both male and female prosthetists and orthotists.

Exclusion criteria: Pregnant women, infections such as Osteomyelitis, menstrual cycle-related low back pain, leg length discrepancy greater than 5mm, previous back or lower extremity surgery, and use of any pain reliever or medication for low back pain.

Procedure: The subjects were invited to take part in the research. The subjects were evaluated and screened in accordance with the inclusion criteria. The procedure was explained in detail to the subjects. The consent form was signed by the subject who agreed to participate in the study. The experimental group's pre-intervention data for low back pain and energy consumption were collected using the Visual analogue scale and the Physiological cost index, respectively. The subjects were then instructed to wear orthotic insoles (closed cell rubber or MCR) for four weeks. Similarly, after a 4-week intervention period, post-intervention data were collected.

Statistical Technique: The statistical package for social sciences (SPSS) 23 version was used to analyze the data. The paired t-test was used to determine the difference between pre and post pain and energy consumption readings. A significant level of $P < 0.05$ was set.

RESULT

A total of 30 prosthetics and orthotics professionals with mechanical low back pain and pronated feet as per the eligibility criteria participated in this study. The descriptive statistics of the demographic data has been given in the Table 1. It shows the descriptive data of mean age, Height, Weight and BMI. The mean and S.D value age of the entire population was 30.10 ± 2.78, mean and S.D values of Height 167.43±8.00, mean and S.D values of weight 61.93±7.16, mean and S.D value of BMI 22.02±1.14.

Table 1. Descriptive Data of Mean Age, Height, Weight and BMI

Subjects' characteristics	N	Mean± Std. Deviation
Age	30	30.10 ± 2.78
Height	30	167.43 ± 8.00
Weight	30	61.93 ± 7.16
BMI	30	22.02 ± 1.14

**Significant at 0.05 level*

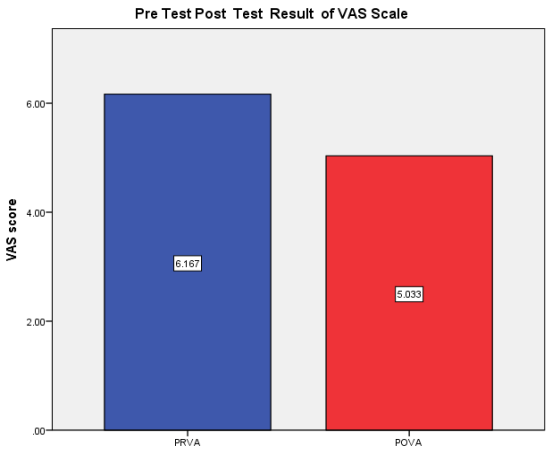
The analysis with paired sample t tests showed a statistically significant improvement from baseline to 4 weeks in both Low back pain and Energy expenditure ($p < 0.05$). There was an improvement in low back pain (mean ± SD =6.16 ± 0.94 to 5.03 ± 0.76, p= .000), and in the Energy expenditure (mean ± SD = 0.08 ±0.02 to 0.06 ±0.02, p= 0.000). (Table 2)

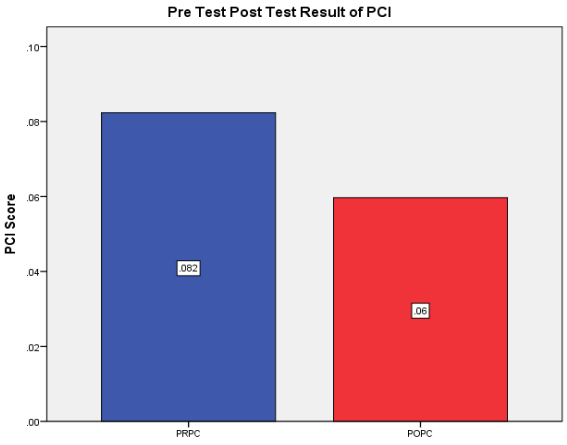
Table 2. Before and after intervention values of VAS score and PCI score

	Before intervention (Mean ± S.D)	After intervention (Mean ± S.D)	t-value	p-value
VAS score	6.16 ± 0.94	5.03 ± 0.76	12.23*	0.000
PCI score	0.08 ± 0.02	0.06 ± 0.02	7.38*	0.000

Values are represented as mean ± SD
** Significance at 0.05 level**

Graph 1 and 2 show that there was a significant improvement in post-intervention low back pain and Energy expenditure (mean ± SD=5.03 ± 0.76 and mean ± SD =0.06 ± 0.02) as compared to pre- intervention score (6.16 ± 0.94 and0.08 ± 0.02) which indicates significant improvement in low back pain and energy expenditure.





DISCUSSION

The purpose of the study was to evaluate the effect of customized foot insoles on pain and energy expenditure among prosthetics and orthotics professionals with mechanical low back pain.

The data analysis showed that there was a significant difference in both the outcome measurements. The obtained results validated our hypothesis that the intervention of customized insoles will lead to a statistically significant improvement in low back pain and energy expenditure respectively.

The result of the present study suggested that orthotic intervention has a positive impact on the low back pain as there was a significant improvement in post-intervention low back pain score mean=5.03 ± 0.76, p-value=0.000 as compared to pre-intervention score mean=6.16 ± 0.94. These findings have been consistent with that of S. Shabat et. al. who reported that insoles cause improvement of low back pain for subjects with repetitive loading.[7]

The relationship between insoles, foot pain, and low back pain was studied primarily in professional athletes and people whose jobs require a lot of standing. It was discovered that 74% of the examinees found the insole to be comfortable and reported a reduction in their foot and lower back pain.[7,14–16]

Chuter V et al. discovered that excessive foot pronation causes prolonged internal rotation of the lower limb and disrupts the body's sagittal plane forward progression during gait. This puts a strain on the sacroiliac and lumbosacral joints, which contributes to the development of LBP. The use of customized foot insoles corrects foot pronation, which in turn corrects the disrupted alignment of the lower limb, reducing stresses on the lumbar spine and reducing lower back pain.[17,1]

Improvement in energy expenditure after orthotic intervention of customized foot insoles, as there was a significant change in post- intervention physiological cost index score mean ± SD = 0.06 ± 0.02, as compared to pre-intervention score 0.08 ± 0.02.

These findings were consistent with those of Yu-Ping Huang et al., who concluded that arch support insoles significantly reduced peak VO2.[18]

According to Haykowsky et al., high-intensity exercise results in a significant increase in peak VO2 when compared to moderate-intensity exercise. In other words, peak VO2 can be thought of as an intensity index of body loading. In terms of physiology, arch support insoles have the potential to reduce the loading on the human body. As a result, people with flat feet who wear arch support insoles may be able to participate in recreational activities more easily.[19]

The fact that the insoles reduced the rate of low back pain demonstrates their ability to absorb some of the force produced

by repetitive walking. Windle and colleagues demonstrated that shoe insoles reduce peak pressure at heel strike during running and marching when compared to a "no insole" condition. Light et al. found that wearing insoles reduced the amplitude of shock waves transferred to the tibia. This reduction in load, which transfers less energy to the upper part of the lower extremity and the lumbar spine, is most likely the cause of the decrease in low back pain.[7,20,21]

CONCLUSION

The significant improvement in parameters leads to an increase in the overall efficiency of prosthetics and orthotics professionals in terms of their performance and quality of life, and makes it easy for them to perform their workshop activities. This study provides preliminary evidence that customized foot insoles reduce pain and improves energy consumption among P & O professionals and it can be concluded foot insoles can be prescribed for patients with low back pain and pronated foot. In addition, this study will help to improve the design and enhance the performance in prosthetists and orthotists as use of customized foot insoles with closed cell foam rubber (MCR) as it is more shock absorbing and prescription for reducing low back pain and decreased energy consumption

Clinical Implications

The study's findings indicate that customized foot insoles are effective in reducing pain and thus functional disability, as well as improving energy consumption in prosthetics and orthotics professionals with mechanical low back pain and pronated feet. As a result, it demonstrates that customized foot insoles are an effective prescription as an internal shoe modification in P & O professionals with pronated feet suffering from moderate mechanical low back pain. Customized foot insoles are also less expensive and easier to use than other treatments for low back pain, which increases the working ability of Prosthetists and Orthotists while decreasing stress.

Limitations & Future Indications

Limitations of the study are as follows: limited numbers of subjects were included, no control over type of footwear used by the subjects and duration of use of insoles was also not controllable by the investigator. These entire aspects act as limitations of the study because such aspects have prominent impact on the changes in the parameters includes in the study post intervention use.

The study can be done with a greater number of subjects so as to statistically conclude that customized foot insoles are pretty effective and should be implacable for professionals like prosthetists and orthotists who spent maximum time actively on their feet.

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Ethical Approval: Approved

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