Effect of Different Shoe Lacing Pattern on Different Types of Foot in Recreational Runners

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Abstract

Background: There has been an increase in the overall prevalence of obesity in India. There has been a 26% rise in the obesity among the young adults of India. At the same time, an awareness about fitness and health has also been on a rise in our country. Jogging and running have been on a rise in popularity among the youth of India. Heel-to-toe drop, styles of running, brand, fit and shoe lacing are some other factors that affect running. Out of these shoe lacing is one of the simplest factors to modify. It can be done by anybody and is an extremely cost effective measure.

Methodology: An experimental study is being conducted with a sample size of 33 subject in karad. The population under study is Recreational runners age group of 20-40 years both male and female subjects. VAS and Foot Posture Index were the outcome measures used.

Result: There was a significant effect of modifying shoe lacing patterns on FFI scores. ($p = <0.001$) There was also a significant effect on FPS ($p < 0.001$) and FDS ($p < 0.001$) subscales whereas there was no significant effect on ALS subscale ($p > 0.05$). A significant decrease in pain was also noted. ($p < 0.05$)

Conclusion On the basis of the results of the study, it was concluded that there was a significant effect of modifying shoe lacing patterns on amateur runners.

Keywords: Amateur, Runners, shoe lace, foot type

Introduction

There has been an increase in the overall prevalence of obesity in India.[1] There has been a 26% rise in the obesity among the young adults of India.[2] At the same time, an awareness about fitness and health has also been on a rise in our country.[3] The number of fitness centres and health awareness programs have in turn increased as well.[4] However, not everybody has the means necessary to avail the benefits of these facilities.

Jogging, on the other hand, does not require any form of equipment except for a pair of shoes. This makes it easily accessible to a large portion of our population. Thus, jogging and running have been on a rise in popularity among the youth of India.[5]

Choosing the perfect shoe is dependent on many factors other than the size or brand of the shoe.[6,7] It is very important to first assess the type of your foot i.e. the anatomical basis of the foot. There are mainly 3 types of foot; Pronated foot, Neutral foot and Supinated foot.[8]

The pronated foot is characterized by a very low or flat arch, the supinated foot has a very high and rigid arch and the neutral foot is between the pronated and the supinated type. It is the most common type of foot.[8]

Normally, while running the foot lands on the heel first and the rolls forward, until the impact is distributed evenly across the forefoot.[9] The neutral foot follows this same pattern while the pronated foot rolls inwards and the supinated foot restricts the impact of the stride largely to the outer edges of the foot.

Heel-to-toe drop, styles of running, brand, fit and shoe lacing are some other factors that are also considered. Out of these shoe lacing is one of the

simplest factors to modify.[10,11] It can be done by anybody and is an extremely cost effective measure. Using the right lacing technique and proper knots will significantly improve the individuals running. Despite being a minor issue, getting the lacing perfectly will make a big difference in the overall support and comfort of the shoes. It can alleviate pain, prevent injuries and relive foot problems.[12]

However, it is often left out and forgotten by most. There is a vast variety of shoe lacing patterns that are available. They are categorized based on the types of foot and the type of running performed by the individual. The conventional method of lacing is the crisscross to the top of the shoe, which works best for the majority of people.[13]

Many modifications exist, such as in heel slippage, if your heel slips too much or you need a little more toe room, a lace lock can be made at the top of the shoe. This will pull the foot back into the heel of the shoe and help stop the slippage for a more comfortable fit.

In a supinated foot, the shoe generally fails to provide enough volume for the foot to fit. Thus, a more spread out pattern of lacing increases the available space for the foot to move. In a pronated foot, the exact opposite occurs. There is more space in the shoe compared to the size of the foot which causes the foot to slide around too much inside the shoe. Here, a more snug pattern of lacing is used to avoid this problem.[13,14]

To assess the effect of these lacing pattern we used the Foot Function Index(FFI). It is a self-administered index consisting of 23 items divided into 3 sub-scales which helps measure impact of foot pathology on function in terms of pain, disability and activity restriction.[15] Both sub-scale scores and total scores are calculated. Test-retest reliability of the FFI total and subscale scores ranges from 0.87 to 0.69.[16]

Visual Analogue Scale (VAS) was also used to assess the amount of pain and discomfort experienced by the runners. VAS was used before and after administration of the treatment to determine the difference in the individual's pain. VAS is sufficiently reliable to be used to assess acute pain.[17]

Provision of guidance regarding something as simple as tying a shoelace may prove to be effective in improving the individuals performance and reducing their risk of injury and pain at the same time. According to our knowledge, few studies have been performed to assess the effect of lacing in non-professional runners. Thus, it is important to conduct this study to improve the knowledge of the common man and provide them with better dynamics or running.

Methodology: The ethical clearance was taken from the institutional ethical committee of KIMSDTBU, Karad. An experimental study was conducted with a sample size of 33 subject in karad. The population under study is Recreational runners age group of 20-40 years both male and female subjects. The material used in this study include foot posture index, goniometer data collection sheet and consent form. VAS pain scale and Foot Posture Index are the outcome measure that are going to be used. The subject will pre and post assessment can taken. The data will be collected and analysed.

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

1. **Age wise distribution:**

Age Group	Group A		
	Players	Percentage	Mean SD
20-24	34	85%	21.741.46
25-30	6	15%	25.830.75
Total	40	100%	22.35 0.02

Interpretation: Table no.1 shows the age wise distribution of runners.

2. **Gender wise distribution:**

Gender	Players	Percentage
MALE	26	65%
FEMALE	14	35%
Total	40	100%

Interpretation: Table no.2 shows the gender wise distribution

3. **Distribution according to type of foot:**

Type of foot	Players	Percentage
High arch	7	17.50%
Neutral arch	18	45%
Low arch	15	37.50%
Total	40	100%

Interpretation: Table no.3 shows the distribution of runners according to type of foot

4. **Pain score**

	Mean SD		Paired t- test	
Pain Score(VAS)	Pre Intervention	Post Intervention	t- value	p- value
	6.53 0.99	3.93 1.64	2.663	<0.05(S)

Table 4: Distribution and association of pain score

Interpretation: Table no.4 shows the distribution and association of pain score pre and post intervention

5. **Foot Function Index Score according to Subscales:**

FFI Subscales	Mean SD		Paired t- test	
	Pre Intervention	Post Intervention	t- value	p- value
Foot Pain subscale	35.34.35	15.51.96	19.352	<0.001(VS)
Foot Disability Subscale	51.82.64	26.821.91	24.409	<0.001(VS)
Activity Limitation Subscale	5.130.33	5.050.22	0.07330	>0.05(NS)

Table 5: Distribution and association of FFI subscale scores

Interpretation: Table no.5 shows the distribution and association of FFI subscale scores

6. **Foot Function Index Score:**

	Mean SD		Paired t- test	
Foot Function Index	Pre Intervention	Post Intervention	t- value	p- value
	42.51±11.54	23.40±6.30	18.672	<0.001(VS)

Interpretation: Table no.6 shows the distribution and association of FFI scores

Discussion

The aim of this study was to study and find the effectiveness of various shoe lacing patterns in amateur runners. The objectives of this study were to determine the effect of administration of shoe lacing patterns according to their foot type on their performance and foot pain. An effort to find the association between the effects of shoe lacing patterns on runners before and after its administration was made.

In this study, 40 individuals who ran for recreation were taken. Individuals in the age group of 20-40 years were included in this study, out of which 34 (85%) individuals were in the (20-24) age group and 6 (15%) individuals were in the (25-30) age group.

The reason behind such a significant discrepancy in the distribution of age groups may be due to the fact that generally the young adults between the ages of 20-24 years are more conscious about their health and appearance thus leading to an increase in their interest in running. Whereas, those between the ages of 25-30 years normally belong to the working class and seldom get time or have the motivation to run.

They were also divided according to their gender. Out of the total 40 runners, 26 (65%) were male and remaining 14 (15%) were female.

Our study is male dominant, maybe because the region included in our study is a rural-urban area where not many women are exposed to recreational activities. Thus, the female population engaging in running as a hobby/ recreational activity is less compared to the males.

Their foot type was also classified. 7 (17.50%) runners had a high arch or a supinated foot, 18 (45%) runners had a neutral arch or a normal type of foot and 15 (37.50%) runners had a low arch or a pronated type of foot out of the total of 40 runners.

Pain score according to Visual Analogue Scale(VAS) and Foot Function Index score of subjects of both the groups were taken before the treatment/intervention was given.

The mean pain score measurements prior to the intervention was 6.53 and after the intervention was 3.93. Statistical analysis of the pain score before and after intervention was done. The comparison for pre and post pain scores was found to have a p-value of (<0.05)

which was significant.

The reason behind such a significant difference between the pre and post scores may be due to the fortifying effect of the shoe lacing patterns which reinforce the movement of the foot within the shoes. This in turn improves comfort and also reduces the risk of the foot being injured while running due to slippage. Thus, there is an overall increase in comfort and reduction in pain.

To analyse the impact of foot pathology on function in terms of pain, disability and activity restriction of foot was done by using the Foot Function Index(FFI). It is divided into 3 subscales viz; Foot Pain subscale(FPS), Foot Disability subscale(FDS) and Activity Limitation subscale(ALS) which consists of 23 items. Same as Pain score, measures of FFI were taken before and after the treatment. The mean score of FFI pre intervention according to the FPS was 35.3, FDS was 51.80 and ALS was 5.13, and post intervention, FPS was 15.50, FDS was 26.82 and ALS was 5.05. Here, the difference in scores of FDS was found to be more among the three subscales. Statistical analysis was done to compare the mean pre and post intervention scores of Foot Function Index subscales to confirm whether they were significant or not and FPS was found to have a p-value of (<0.001) which was very significant, FDS had a p-value of (<0.001) which was very significant and ALS had a p-value of (>0.05) which was not significant.

We have already seen that there was a significant reduction in pain thus in relation to that the FPS scores also have a significant reduction in them. Here, the difference in scores of FDS was found to be more among the three subscales. This may be due to the disability subscale consisting of questions related to activities of daily living such as walking, climbing and descending stairs, getting up from a chair etc. All of these activities involves use of the foot dynamically thus aggravating pain. Hence, the scores already were very high for FDS and due to that a very significant difference can be seen in the score post treatment. ALS did not have any significant change in their scores maybe due to the fact that it involved questions which were relevant only when the pain and disability were extremely high and in our study the participants did not have a high pain score to begin with.

The mean scores of pre and post intervention of FFI were 42.51 and 23.40 respectively. Statistical analysis

was done to compare the mean pre and post intervention scores of Foot Function Index to confirm whether they were significant or not and was found to have a p-value of (<0.001) which was very significant.

According to Hagan & Hennig, 2009 and Hagan et al., 2008, lacing variations can improve shoe fit-to-foot, optimize biomechanical assistive components of footwear, and influence perceived comfort and stability without affecting mass of the shoe, They also concluded that the amount of motion of the foot in a shoe can alter biomechanical efficiency and perceived comfort. The results of these studies also show that foot movement in heel–toe running is influenced by the lacing pattern of the shoe. Therefore, shoe lacing has to be considered when undertaking biomechanical comparisons of running shoes.[9,10]

Another study by Hong et al., 2011 also had similar findings in their research where they studied changes in running mechanics using conventional shoelace versus elastic shoe cover.[18]

Thus, it can be said that modifying the shoe lacing patterns in recreational runners has a significant impact on their performance as well as on the prevention of injuries and reduction of pain. This small modification will in turn encourage the runners to participate more and will give them the ability to modify their shoes by themselves. It will also improve the specificity of the fit of the shoe as it can be changed according to the individual needs of the runners.

Conclusion

On the basis of the results of the study, it was concluded that there is a significant effect of modifying shoe lacing patterns on amateur runners. The effect was most profound on foot disability, then on foot pain and the least on activity limitation. The pain score of individuals who had undergone shoe lacing modification was significantly lower compared to the pre intervention pain score.

Conflict of Interest: There were no conflicts of interest in this study

Ethical Clearance: Ethical clearance was taken from institutional committee of Krishna Institute of Medical Sciences, Deemed to be University, Karad.

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