Last's biomechanical function changes analysis for Marathone shoes last development

박승범, 서국웅, 김용제, 유석주, 이중숙

ABSTRACT

A toe spring and ball girth data, when marathon shoes research, development, and production in Korea, is an important point in athlete shoe research. It is clear from the results presented that any differences between MA3 and MA1, MA4 in 70%. 80% session in forepart last comparision. Especially the more 70%-80% session getting wide, the more 90% session getting up. Also, To development for high performance marathones shoes last, in all session, in korean style, 70%, 80%, and 90% session part function changed. It is suggested that comfort of fit is largely determined by the match of last shape to shoe shape and consequently there is a need for normative last data that describe foot, last shape, dimension. This leads to the conclusion that unique shoe lasts for both marathone shoes developed last comparison are required for optimal marathone shoe comfort. The more ball girth construction will wide in forepart in last, the more comfort characteristic will development. But relative with performance ability, it is need to research. The further study of Korea marathoner foot measurements(70% session ~ 90% session) among toe spring’s angular difference of marathone last to north american and Korea marathone shoes last is required to develop and improve athletes performance in an effective way of study and to prevent forefoot injury.

key words : Last, biomechanical function, Marathone shoes
I. Introduction

In modern society, sports have become religion and sporting equipment objects of devotion. Sports technology now pushes both professional and recreational athletes to levels of performance only recently thought to be insurmountable.

Today, athletic shoes evoke a fascination with power and style not unlike previous generations’ obsessions with cars. Marathon shoes is the most important part of the athlete’s equipment. In terms of footwear, it may also represent the highest form of the art of shoe making. Synonymous with its true international image and participation, the evolution of the running shoe has had contributions from many parts of the world. Technical progress in running shoes has been largely confined to the three countries that monopolize sports footwear at the present - Germany, Japan and the the United States. Progress in marathon shoe development and technology has taken runners through the vulcanized rubber flat-soled era of the mid-1800s, to the leather training shoes of the 1950s and 1960s, to our presentday nylon, rubber and polyethylene combinations. In this way the popularization in the late 1970s of the ancient and fanatically traditional sport of running led naturally to the commercialization of a formerly small, craft-oriented athletic shoe industry. Because athlete shoes do depon on function for credibility, shoe construction must yield optimum performance. Most of the major method of shoe construction are also used in the manufacturing of functional sport shoes. In the process of manufacturing any athletic shoe, all upper work is done around the "last"- a three-dimensional form based upon the shape and movements of the foot. The last, therefore, determines the shape, size and dimensions of the shoe. To help accommodate variations in foot shape, which occur with different movements of the foot leg during sports activities, the last is designed with several special features. The two major ones are the Toe Spring and Heel Pitch, which affect the rocker or pivoting motion of the foot, particularly important in shoes.

Research and development with respect to the design and function of sport shoes in the past two decades have centred upon the sole to last. The centerpiece of the shoe, the last, draws relatively little attention. This may be due to the complexity of the problems involved or to the fact that the development of the shoe last lies almost entirely in the hands of companies who do not like to share their experiences with others too openly.

The word last originates from old English 'laesk', which means sole, footprint, or track. The first lasts were chiselled out of stone, and later, whittled out of wood. In the early 19th century, the machine for shaping gunstocks was converted to become a last-turning lat(Rossi, 1980). Thus
it was possible to form a last with a machine, and the first last-making plant with lathes was established in Lynn, Massachusetts, in 1820. In 1969, the plastic last were developed by the Sterling Last Corporation, U.S.A. The form of the last has been a reason for complaints for centuries. The Greeks describes injuries which came from wearing shoes. Camper complained in 1783 that the same lasts were used for right and left shoes and hoped that his 'mockery' would help to improve the shoes. But the same 'straight' lasts were used until the end of the 19th century. Von Meyer's shoes looked inflated or curved in comparison to the straight lasts that were used at that time. This started an argument about straight or curved lasts which still continues today, although today's straight last has nothing to do with the straight last of the 19th century. When aligning the rearfoot of different running shoes (Cavanagh, 1980), even today's straight last looks curved. However, when connecting the two ends of the shoe sole with a line (toe-to-heel line), today's straight last 'looks actually straight'. Cavanagh (1980) suggested that the difficulty of explaining these curved or straight shoes lies in 'that the foot print resembles and inflated shoes, while the foot outline von Meyer's standard on today's shoes and find that probably none of these shoes would pass.

A marathon shoe must fit not only in overall length and ball width, but with respect to several other such as the instep, arch, top lines, and heel and toe curve. Each of these can be measured, but vary depending on the type of footwear, for example, jogging shoes, racing flats, fashionable shoes, and so on. Various small but important features are built into a last, for example, the toe spring and heel spring. The toe spring (often around 5mm) allows a slight rocking effect during take-off. It has to be carefully calculated, but in general, the higher the feel or the thicker the midsole, the more toe spring is required. The 'comfort of fit' characteristic has not been subjected to any great scientific scrutiny and largely been left in the hands of the last master, a highly skilled model maker who relies on and artistic sense of shape, size and proportion. Comfort of fit is arguably the most important aspect of sport design. Certainly, it is a major factor in the decision to purchase a particular pair of shoes it is evident that good comfort of fit characteristic with mitigate against many common abrasion and pressure related foot conditions that often characterize the use of new shoes (Nigg et al, 1986).

Examination of those elements that characterize comfort and fit suggests that one of the most important factors is the closeness of match of the shoe shape to that of the human foot, while recognizing that foot shape will vary under different conditions of load, motion and humidity. Shoe shape is determined by a 'last' which can be thought of as a smoothed model of the foot around which the 'upper' material is stretched and stitched or glued to the sole so the shoe
giving ti permanet shape. The match of the axis of the foot across the ball to to the axis of flex fo the shoe is a second important consideration for comfort of fit. The purpose of this study is to a Last’s biomechanical function changes analysis for Marathone shoes last development, for design marathone shoes of the ‘highest’ quality. This research was supported by the Fila Korea, Hwaseung Co and Sunhyung Last Co.

Fig. 1. Marathone shoes (ASICS, 2000)

Fig. 2. ASICS Marathone shoes Outsole, Midsole, Upper(1993)
II. Method

research plan

marathone shoes's last digitizing

shoes-foot-last relation research

last research, development and analysis  
last measurement

last construction function analysis in each session

Prototype development

Sample marathone shoes last

difference analysis  
characteristic analysis of marathone shoes last

marathone shoes last
Fig. 3. Marathone shoes last

III. Results & Discussion

4 different marathone shoes's last measured by the 3 dimensional digitizer. The 4 samples are shown(table 1) to be similar in stature.

<table>
<thead>
<tr>
<th>Table 1. Marathone Shoes Last Comparison</th>
<th>(unit : mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA1</td>
<td>%</td>
</tr>
<tr>
<td>-----</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>height</td>
</tr>
<tr>
<td>MA2</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>height</td>
</tr>
<tr>
<td>MA3</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>height</td>
</tr>
<tr>
<td>MA4</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>height</td>
</tr>
</tbody>
</table>
Fig. 4. A each session comparison in marathone shoe last
Fig. 4. A each session comparison in marathone shoe last

Fig. 5. determination of measuring points for marathore last
All of the measurements needed for developing lasts should be checked to determine whether they can be standardized. The most important areas of standardization are the heel, the contours of the Shank, the Shank spring, the curvature of the heel seat, and the cross section of the heel seat.

In modern shoe production, shoe lasts have to be standardized and coordinated if best results are to be obtained from certain manufacturing machines. Combining shoe component sizes in groups cuts down the cost in production. We recommend taking advantage of the experience of last and shoe-component specialists and advise against attempting to develop coordinates independently and with insufficient know-how. The following table and illustrations are only examples of possible introduction of Last norms. In section comparison, considering 705, 80% relative with flexibility in last, shown 100.1mm in 70% session (overall width), 90.7mm in 80% session 80%. MA-2 was shown 101.0mm in 70% session, 91.6mm in 80% session. MA-3 was shown 95.2mm in 70% session, 88.7mm in 80% session. MA-4 was shown 92.5mm in 70% session, 83.8mm in 80% session. The first test battery in 1977 included five objective evaluations: heel shock absorption, forefoot shock absorption, upper durability, sole durability, and forefoot shock absorption, upper durability, sole durability, and flexibility. Both the regular shoe industry and athletic shoe companies have used flexibility testing for many years. The flex path in the forepart of the shoe is an important feature.

Nike marathon last was shown in table 4 (heel height: 34mm, toe spring: 8mm, sock lining: 4mm, bottom width grade: 1/12) indicate that although there were statistical differences between.
Mizuno last was shown (270 size) in table 5 (bottom length: 270, bottom width: 91.4, stick length: 281.2, 60-70% ball girth: 256, toe thickness: 27.6, toe spring: 24.6).

The major factors affecting shoe flexibility are: materials used in the sole/midsole construction, outer sole pattern, the amount of toe spring in the last, the lasting method and upper design.

For testing flexibility, the shoe is mounted on a hinged platform or on two separate platforms with both the rear and front portions clamped to the testing jig under a fixed amount of pressure.

The shoe is carefully aligned with the flex point positioned at 60 percent of the distance from the heel to the toe. Different options exist as to the orientation of the flex path relative to the long axis for the front portion of the shoe. Some tests use a right angle while others have tried to establish an angle more compatible with the alignment of the metatarsal heads. In either case, once positioning is completed, the shoe is repeatedly flexed with some sort of cam and push-rod mechanism to a fixed angle (usually between 10 and 45 degrees) for a number of cycles.

V. Conclusions

A toe spring and ball girth data, when marathone shoes research, development, and production in Korea, is a important point in athlete shoe research. It is clear from the results presented that any differences between MA3 and MA1, MA4 in 70%. 80% session in forepart last comparision. Especially the more 70%-80% session getting wide, the more 90% session getting up. Also, To development for high performance marathones shoes last, in all session, in korean style, 70%, 80%, and 90% session part function changed. It is suggested that comfort of fit is largely determined by the match of last shape to shoe shape and consequently there is a need for normative last data that describe foot, last shape, dimension. This leads to the conclusion that unique shoe lasts for both marathone shoes developmented last comparison are required for optimal marathone shoe comfort. The comfort for fit characteristic has not been subjected to any great scientific scrutiny and has largely been left in the hands of last master.

The more ball girth construction will wide in forepart in last, the more comfort characteristic will development. But relative with performance ability, it is need to research.

The further study of Korea marathone forefoot measurements (70% session ~ 90% session) among toe spring’s angular difference of marathone last to north american and Korea marathone.
shoes last is required to develop and improve athletes performance in an effective way of study and to prevent forefoot injury.

Acknowledgement

This research was supported by the Fila Korea, Hwaseung Co and Sunhyung Last Co.
References

노민희등(1994). 인체해부학. 고문사
한국 신발, 피혁 연구소(1998), 스포츠화용 일체형 Sole 개발, pp. 295-297
한국신발연구소(1996), 마라톤화용 기능성 Sole 소재 개발, pp. 1-10
Martyn Shorten(1999), Biomechanically Driven Developments in sports shoe technology: the example of tuned air, In E. M. Hennig & D. Stefanyshin (Ed.), Fourth Symposium on Footwear Biomechanics, Canmore / Canada:
P. Freychat, N.Bouche(1999), Dynamic arch deformantion and its consequence on shoe design, In E. M. Hennig & D. Stefanyshin (Ed.), Fourth Symposium on Footwear Biomechanics, Canmore / Canada