

A STUDY OF LAST DEVELOPMENT IN THE MEN'S RUNNING SHOE

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INTRODUCTION

This study was designed to investigate the problem of the standard last development for the Korean men's shoe and to suggest some useful information for the better design, development and construction of a running shoe last. The subjects for this study are four male adults who had a rearfoot strike running pattern with normal feet.

METHODS

51 separate measurements of four running shoe lasts (N, R, AD, AS brands) were tested using a 3 dimensional measurement System (Microscribe, U.S.A.). Four different running shoes (size 8 US) and the barefoot condition were compared using pressure distribution measurement

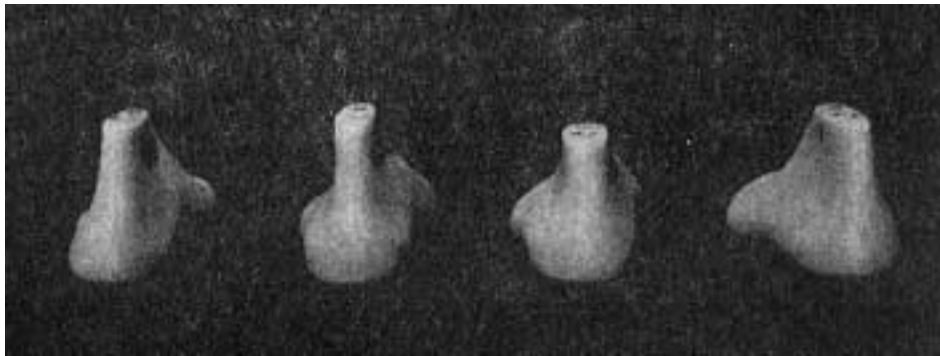


Figure 1. Running shoe standard lasts for the men's foot (From left, N, R, AS and AD)



Figure 2. Digitizing operation by using 3 dimensional measurement system

RESULTS & DISCUSSION

The differences in running shoe lasts are presented in Table 1 and show considerable variability in measures. In the regional peak pressure distribution of the four running shoes and the barefoot condition showed the biggest pressure distribution in the hallux. There was least pressure in the medial midfoot and lateral midfoot. In the instance of regional peak pressure, the barefoot and the running

shoes showed earlier peak pressure for the lateral heel. It was barely possible to measure pressure distribution in medial midfoot. With the percentage of peak pressure distribution measurement in each last, the running shoes on N last showed the longest duration of peak pressure in the medial heel, lateral heel, medial midfoot, lateral metatarsal and lateral toes. The AD last showed the longest peak pressure duration in the first metatarsal, second metatarsal and hallux, and the R last the pressure duration was longest in second toe. In the maximum force was for the barefoot condition was at the second metatarsal and for the R and AD lasts with running shoes, it was at the first metatarsal. In the time to peak pressure distribution measurement, the barefoot condition showed the most rapid peak pressure distribution in the lateral midfoot. The four last conditions with running shoes showed peak pressure distribution similar to the barefoot condition.

Table 2. Differences between the running shoes lasts

| N | Name | N | | R | | AD | | AS | |
|----|---------------------------------------|------------|----------------|------------|----------------|------------|----------------|------------|----------------|
| | | Diff. (mm) | Percentage (%) | Diff. (mm) | Percentage (%) | Diff. (mm) | Percentage (%) | Diff. (mm) | Percentage (%) |
| 1 | Last Length (TNO) | 0.00 | 0.00 | -1.84 | -0.68 | -4.26 | -1.57 | -0.67 | -0.25 |
| 2 | Stick Length (TNO) | 0.00 | 0.00 | -1.39 | -0.51 | -3.95 | -1.44 | -0.50 | -0.18 |
| 3 | Heel to Central Ball Length (TNO) | 0.00 | 0.00 | -3.11 | -1.69 | -0.26 | -0.14 | -6.19 | -3.36 |
| 4 | Centre Ball to Toe Length (TNO) | 0.00 | 0.00 | 1.26 | 1.44 | -4.00 | -4.59 | 5.52 | 6.32 |
| 5 | Effective Length (Clarks) | 0.00 | 0.00 | -2.27 | -0.83 | -4.60 | -1.68 | -1.33 | -0.49 |
| 6 | Stick Length (Clarks) | 0.00 | 0.00 | -1.31 | -0.48 | -3.87 | -1.41 | -0.35 | -0.13 |
| 7 | Ball Width (TNO) | 0.00 | 0.00 | -0.27 | -0.29 | -0.99 | -1.07 | 3.25 | 3.52 |
| 8 | Heel Width (TNO) | 0.00 | 0.00 | 2.04 | 3.25 | 2.08 | 3.31 | 3.59 | 5.70 |
| 9 | Ring Width (Clarks) | 0.00 | 0.00 | -0.20 | -0.22 | 0.11 | 0.12 | 1.54 | 1.65 |
| 10 | Tread Width (Clarks) | 0.00 | 0.00 | -0.67 | -0.76 | -2.45 | -2.78 | 0.07 | 0.08 |
| 11 | Heel Width (Clarks) | 0.00 | 0.00 | 2.96 | 4.75 | 4.97 | 7.97 | 76.26 | 122.21 |
| 12 | Toe Girth (TNO) | 0.00 | 0.00 | 2.11 | 0.89 | -7.13 | -3.01 | 11.99 | 5.06 |
| 13 | Ball Girth (TNO) | 0.00 | 0.00 | 1.23 | 0.52 | -4.38 | -1.86 | 7.28 | 3.08 |
| 14 | Waist Girth (TNO) | 0.00 | 0.00 | 1.03 | 0.43 | -4.17 | -1.73 | 4.29 | 1.78 |
| 15 | Instep Girth (TNO) | 0.00 | 0.00 | 2.19 | 0.87 | -2.16 | -0.85 | 8.88 | 3.52 |
| 16 | Heel Girth (Short) (TNO) | 0.00 | 0.00 | 0.83 | 0.22 | 0.10 | 0.03 | -0.69 | -0.18 |
| 17 | Heel Girth (Long) (TNO) | 0.00 | 0.00 | -8.82 | -2.01 | 5.38 | 1.23 | -9.01 | -2.05 |
| 18 | Ball-Heel-Ball Girth (TNO) | 0.00 | 0.00 | -6.04 | -1.54 | 1.68 | 0.43 | -10.38 | -2.64 |
| 19 | Joint Girth (Clarks) | 0.00 | 0.00 | 1.40 | 0.58 | -4.25 | -1.77 | 8.26 | 3.45 |
| 20 | Instep Girth (Clarks) | 0.00 | 0.00 | 1.85 | 0.78 | -4.20 | -1.78 | 11.55 | 4.88 |
| 21 | Heel Raise (TNO) | 0.00 | 0.00 | 2.40 | 15.05 | 2.98 | 18.71 | 2.37 | 14.87 |
| 22 | Toe Spring | 0.00 | 0.00 | -0.11 | -1.45 | -0.31 | -4.16 | 1.08 | 14.73 |
| 23 | Block Pitch (Clarks) | 0.00 | 0.00 | -0.10 | -0.43 | -0.29 | -1.32 | 1.09 | 4.88 |
| 24 | Toe Depth At Foot Length (Clarks) | 0.00 | 0.00 | -1.08 | -4.31 | -0.65 | -2.59 | -1.67 | -6.63 |
| 25 | Toe Depth At Growth Room (Clarks) | 0.00 | 0.00 | -1.08 | -4.31 | -0.65 | -2.59 | -1.67 | -6.63 |
| 26 | Toe Depth At 90% Foot Length (Clarks) | 0.00 | 0.00 | -1.00 | -3.20 | -0.48 | -1.54 | -1.83 | -5.83 |
| 27 | Big Toe (Clarks) | no cal. | no cal. | no cal. | no cal. | no cal. | no cal. | no cal. | no cal. |
| 28 | Big Toe Depth (Clarks) | no cal. | no cal. | no cal. | no cal. | no cal. | no cal. | no cal. | no cal. |
| 29 | Little Toe (Clarks) | 0.00 | 0.00 | -1.84 | -20.43 | -1.89 | -21.00 | -0.60 | -6.66 |
| 30 | Little Toe Depth (Clarks) | 0.00 | 0.00 | -0.72 | -2.35 | 0.57 | 1.86 | -0.64 | -2.09 |
| 31 | Heel To Centre Joint (Clarks) | 0.00 | 0.00 | -2.38 | -1.21 | -5.39 | -2.74 | -2.58 | -1.31 |
| 32 | Heel To Outside Joint (Clarks) | 0.00 | 0.00 | -2.46 | -1.27 | -1.36 | -0.70 | -0.87 | -0.45 |
| 33 | Heel To Inside Joint (Clarks) | 0.00 | 0.00 | -3.34 | -1.74 | 0.71 | 0.37 | -10.34 | -5.41 |
| 34 | Heel To Ball (Clarks) | 0.00 | 0.00 | -11.93 | -6.96 | -5.60 | -3.27 | -21.08 | -12.30 |
| 35 | Short Heel (Clarks) | 0.00 | 0.00 | -1.97 | -1.26 | -5.59 | -3.56 | -0.48 | -0.30 |
| 36 | Ring Width % Of Joint Girth (Clarks) | 0.00 | 0.00 | -0.31 | -0.79 | 0.75 | 1.93 | -0.68 | -1.74 |
| 37 | Tread Width % Of Joint Girth (Clarks) | 0.00 | 0.00 | -0.49 | -1.34 | -0.38 | -1.03 | -1.20 | -3.25 |
| 38 | Overall Length (FIA) | 0.00 | 0.00 | -2.75 | -1.02 | -4.54 | -1.68 | -1.75 | -0.65 |
| 39 | Horizontal Ball Width (FIA) | 0.00 | 0.00 | -0.37 | -0.39 | -1.19 | -1.27 | 3.00 | 3.19 |
| 40 | Heel to Inner Ball Length (FIA) | 0.00 | 0.00 | -11.74 | -6.78 | -5.66 | -3.26 | -20.63 | -11.91 |
| 41 | Ball Girth (FIA) | 0.00 | 0.00 | 5.82 | 2.35 | -4.78 | -1.93 | 17.27 | 6.97 |
| 42 | Heel Width (FIA) | 0.00 | 0.00 | 2.97 | 4.72 | 4.22 | 6.70 | 4.95 | 7.86 |
| 43 | Instep Girth (FIA) | 0.00 | 0.00 | 11.07 | 4.16 | -8.87 | -3.33 | 19.31 | 7.25 |
| 44 | Instep Height (RR) | 0.00 | 0.00 | 6.44 | 6.48 | -7.77 | -7.82 | 4.36 | 4.39 |
| 45 | Instep to Heel Girth (FIA) | 0.00 | 0.00 | -10.83 | -3.25 | 13.64 | 4.09 | -10.94 | -3.28 |
| 46 | Heel to Outer Ball (FIA) | 0.00 | 0.00 | -2.93 | -1.60 | -0.83 | -0.45 | -0.61 | -0.33 |
| 47 | Instep Opening Girth (FIA) | 0.00 | 0.00 | -8.23 | -2.73 | -8.60 | -2.85 | -7.98 | -2.65 |

| | | | | | | | | | |
|----|------------------------------|------|------|-------|--------|-------|--------|-------|--------|
| 48 | Inner mid-toe distance (FIA) | 0.00 | 0.00 | -2.38 | -18.02 | -2.79 | -21.14 | -2.05 | -15.53 |
| 49 | Outer mid-toe distance (FIA) | 0.00 | 0.00 | -2.13 | -2.17 | -5.22 | -5.31 | 2.14 | 2.17 |
| 50 | Waist Girth (FIA) | 0.00 | 0.00 | 5.81 | 2.47 | -5.14 | -2.19 | 3.98 | 1.69 |
| 51 | Heel to Toe | 0.00 | 0.00 | -2.87 | -1.06 | -5.26 | -1.95 | -0.95 | -0.35 |

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