RUNNING SHOES DEVELOPMENT USING A FINITE ELEMENT ANKLE/JOINT MODEL

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INTRODUCTION

It is very important to study cushioning and stability of a running shoe during its development. Generally, it is said that cushioning conflicts with stability. However, it is very important to ensure these two characteristics are compatible in a running shoes.

REVIEW AND THEORY

A three-dimensional ankle joint model using a finite element method has been facilitated by the progress in computer technology in recent years. The objective of this study is to simulate cushioning and stability using a finite element ankle joint model (FEA foot model) and to develop a running shoe which will have more cushioning and stability. The model will provide an understanding of stress and acceleration generated inside the running shoes and at each bone that has never previously been known.

PROCEDURES

A FEA model of the foot was developed which consisted of bone, joints and soft tissue. The three-dimensional running shoe model consisting of a wave type plate was prepared and inserted in the heel. From these FEA models, impact phenomena (Figure 1) and pronation phenomena (Figure 2) during running was simulated. An acceleration of the lateral malleolus was introduced to represent a cushioning parameter, and calcaneal angle was used as a stability parameter.

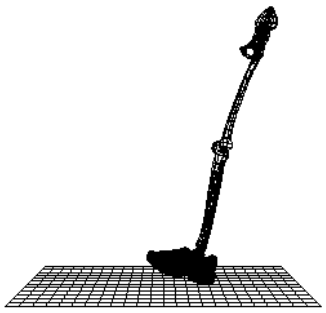


Figure 1: Cushioning analysis model

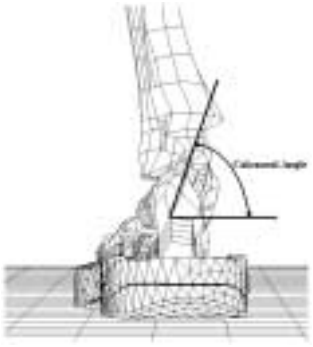
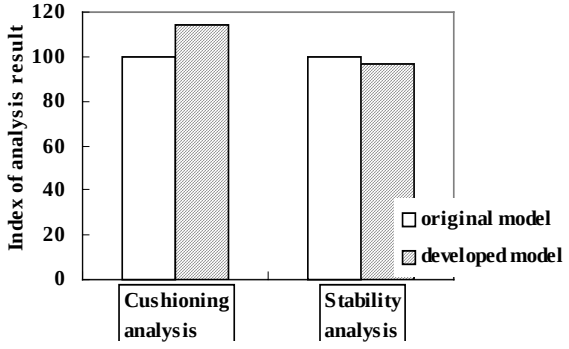


Figure 2: Stability analysis model

RESULTS AND DISCUSSION

At first analysis, it was possible to understand the area where large stresses were generated at a wave type plate. Therefore, the shape and



material property of the area was modified. After this modification, stability was reduced by 4%, but cushioning was improved 14% (Figure 3). Furthermore, the area of stress on tibia was decreased. It had never previously been known about the stresses that were generated at wave type plate and on each bone. These data were clarified by using this method.

Figure 3: Analysis of Results

SUMMARY

Cushioning and stability analyses using both a foot and shoe FEA model were demonstrated. The modification of a wave type plate was executed by simulating the pressure distribution information on the wave type plate. Modified shoes showed better cushioning but slightly reduced stability performance than original shoe.

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