# INVESTIGATION OF ENERGY RETURN FOOTWEAR

**Karak,A.,Stewart,R.,Contoyannis,B.**

**REHAB***Tech* - Monash University, Victoria, AUSTRALIA

# INTRODUCTION

In walking and running the foot is subjected to high loads. Conventional approaches rely on shock absorbing materials such as EVA foams & rubbers. However energy is lost during loading due to the visco elastic properties of these materials. A mechanism that absorbs and returns the correct amount of energy is required that will not deteriorate as quickly over time.

# AIM

The aim of the investigations was to further develop a sole that will provide energy return, reduce impact loads and fatigue. The sole should eventually be built to a ideal stiffness depending on a person's body weight and height. The model is to be designed to suit existing lasts and so optimal stiffness can be determined via objective and subjective testing without building numerous inserts. We also aimed to create a more comfortable designed insert than previously designed.

Previous Design

Testing Shoe

# METHOD

A shoe was built with the insert extending to the metatarsal heads and the back open to allow different spring combinations to be placed in it.

Drop tests were performed on a Kistler force plate with different spring combinations and also on existing commercial casual and orthopaedic footwear. Tests were also recorded with the subjects walking. Bioware software was used recording impact data.

Subjective feedback was recorded with different stiffness's applied to the heel. Shock absorption and energy return was calculated and compared with the subjective feedback.The stiffness of each spring combination was measured K=F/u (stiffness = load/deflection) and the ideal stiffness was determined and compared with previous results.

# RESULTS

All spring combinations showed higher energy return and impact absorption by up to 20% over commercial and orthopaedic shoes tested. The best combination had a high energy return, impact absorption and good subjective feedback. This combination also showed a good stiffness value of 290 N/mm. The best average stiffness value was 400 N/mm but deemed to uncomfortable via our subjective feedback. This feedback indicated that the spring combinations that felt good to walk in also were the ones that showed better stiffness and percentage of energy return values.

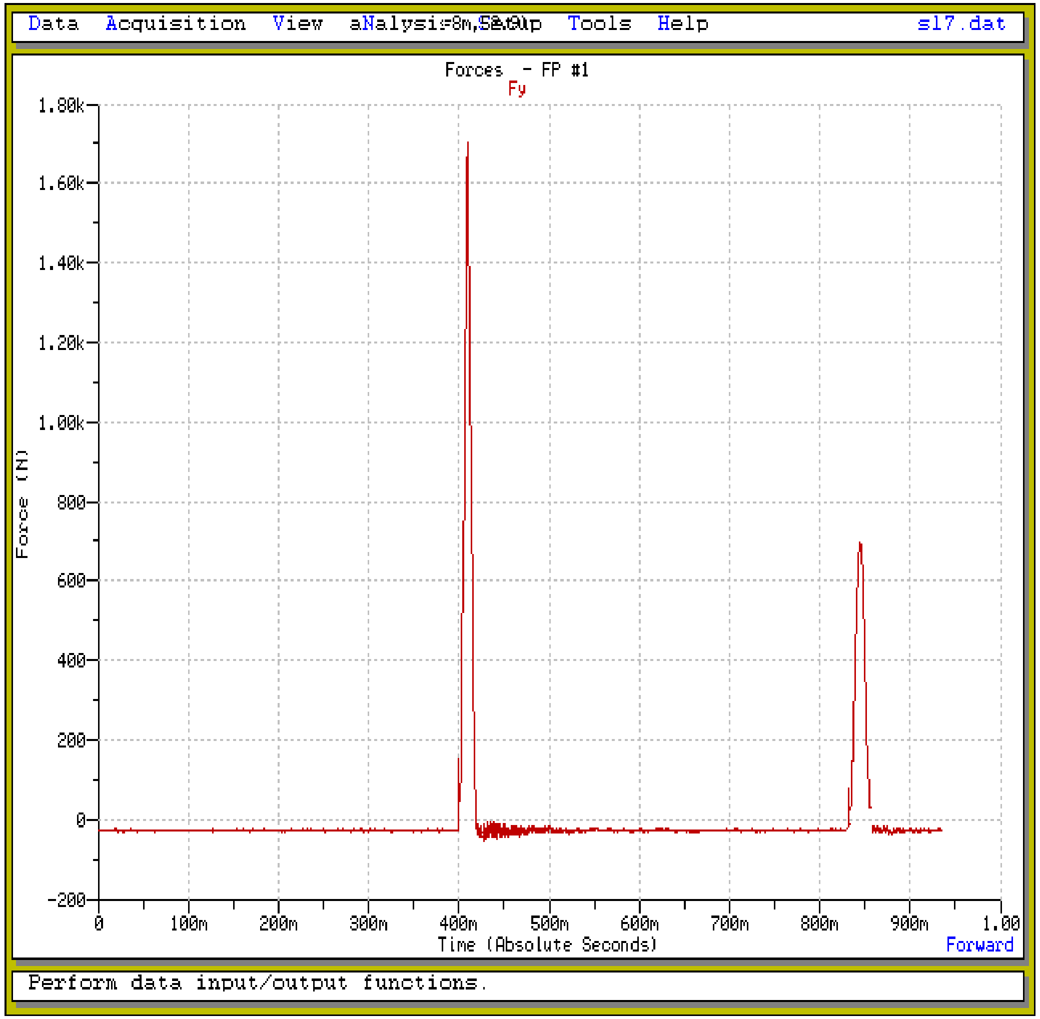
The wedge also did not create a end point feel under the medial longitudinal arch as did the first wedge prototypes.

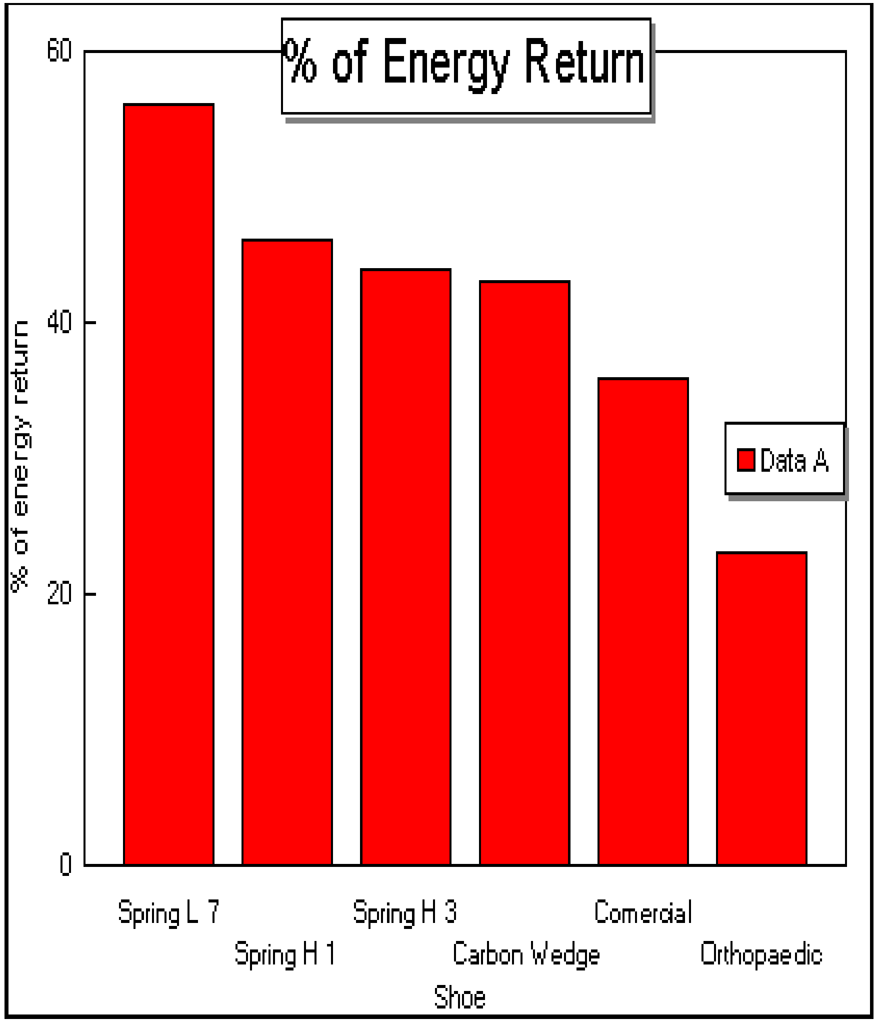
| Insert Type | Energy Return | First Impact (N) | Stiffness K(N/mm) | Subjective Feedback |
|---|---|---|---|---|
| SL1 | 40.7% | 1816.5 N | 131 | Too Light |
| SH1 | 46.9% | 1194.0 N | 277 | Good |
| SL2 | 45.4% | 1223.2 N | | Good |
| SH2 | 38.4% | 1533.2 N | | Average |
| SL3 | 36.4% | 1816.5 N | | Average |
| SH3 | 44.0% | 1206.8 N | | Average |
| SL4 | 36.3% | 1477.5 N | | Average |
| SHL4 | 42.0% | 1261 2 N | | Average |
| Wedge | 43.3% | 1381 .0 N | 404 | Too Stiff |
| SL7 | 56.0% | 1697.6 N | 291.12 | Good |

# CONCLUSIONS

The new insert provides greater energy return and impact absorption than casual and orthopaedic shoes.

The subjective data has to be considered and does not always reflect the best objective data recorded. Further studies need to occur testing what effect having better energy return and impact absorption does to the body and how much is good or bad? Initial tests show that it may have a limitless applications in the treatment of injuries.




Impact Test

Energy Return