Can the RSscan footscan® D3D™ orthotic reduce lower limb injury in an initial Military training setting

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Introduction

Lower limb injuries are common in initial military training (1,2). Institute of Naval Medicine studies at Commando Training Centre Royal Marines show a lower limb injury rate of 36% (3,4). Running has been demonstrated to be a significant cause of over use injuries as demonstrated that in any 12 month period between 30 and 70% of both recreational and competitive runners sustain injuries (5,6). Unpublished data (7) from Britannia Royal Naval College reports a lower limb injury rate of 27% (n=280) with respect to diagnoses Anterior Knee Pain, Ilio-tibial band syndrome, Patello-femoral disorder, Medial tibial stress syndrome, Stress fracture tibia/metatarsal, Plantar fasciitis, Achilles tendonopathy.

Any method of reducing injuries in initial training is of great interest both in terms of public health, and individual morbidity and career success.

Aim

The aim of this study was to determine whether the footscan® prescribed D3D™ orthotic reduced injury in the target population

P - male military new entry trainees assessed as high or medium risk of injury
I - prescription of the D3D™
C - no intervention
O - change in incidence of injury, as determined by the outcome measure of 2 or more lost training days

Methods

400 male participants gave written informed consent. Participants were asked to walk across the 18m track of 0.02m EVA covered in a 0.005m rubber track, at a natural gait.
5 recordings of both right and left foot plantar pressure data were taken using the RS Scan International plate 1m x 0.4m x 0.02m, 64 lines at 500Hz and 4 sensors per cm^2 (Total of 8192 resistive sensors)

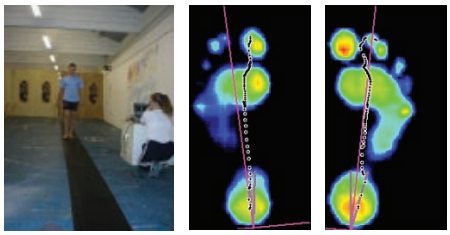
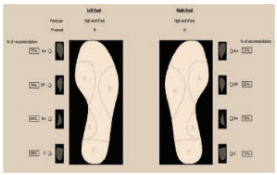


Figure 1. Testing procedure and Pressure plate screen shot

The footscan® system works by measuring vertical force over a number of sensors (8192 sensors on a 1m plate). This allows the pressure to be calculated by knowing the area that the force is being applied over. The system measures the vertical force that is applied by the body through the foot to the ground during the stance phase.

By dividing this contact up into different foot zones, the system can look at maximum pressures/forces applied in these different areas, and the timing of this application of force. This allows a detailed analysis of when/where force is being applied during the stance phase. If there is an imbalance occurring in any of these key stages, the D3D™ section of the software will highlight where the imbalance is, and the type of correction suggested.

The recommended orthotic prescription, if applicable, was graded (Fig.2) and those at high and medium risk were randomized to either receive a custom D3D™ orthotic or no intervention.



HIGH	One or more corrections suggested by D3D™ on BOTH feet
MEDIUM	One correction suggested by D3D™ on ONE foot
LOW	No correction

Figure. 2 Biomechanical risk grading

Participants were followed up after the 14 week initial training phase for lower limb injury.
Definition of injury was a lower limb injury resulting in missing training for 2 days or more, excluding ankle inversion injury

Ethics

The study went ahead with Human Ethical approval from the Ministry of Defence Research Ethics Committee Registration 0727/112. Full compliance with Data Protection Act and Caldicott Confidentiality Guidance

Inclusion/Exclusion

All new entry officers were given a presentation on the trial and given the opportunity to take part, as part of their joining procedure. Participants were excluded if they had existing orthotic prescription (n=3), declared existing lower limb injury (n=2) or withdrew their consent (n=1)

Results

Group	Category	N/640	Injury (n=82)	%
Control	High/Medium	200	49	59
Orthotic	High/Medium	200	8	9
Background	Low/No risk	240	25	32

Absolute Risk Reduction	0.59-0.09 = 0.50 (50%)
Number needed to treat	1/0.50 = 2

Figure. 3 Comparison of injury rates in control to intervention group

Statistical analysis

Pilot studies suggested, using the background injury rate of 17% that the sensitivity and specificity were 87% and 69% respectively. Power calculations were performed to a sample size of 400 was sufficient to detect difference between groups for $p<0.05$ with 80% power.
PASS software (2005) was used and McNemar's test was applied to correlated data. Statistical analysis was performed using the SPSS statistical package Version 15.0 (SPSS inc, Chicago, Ill, USA). Fischer's test was used for non parametric data and confirmed a significant difference between the two cohorts ($P<0.01$)

Discussion

As far as the author's are aware, this is the first randomised controlled trial to compare orthotic use with a view to reduction of injury.
Numerous studies have been completed in the quest of physical, measurable factors predictive of injury in sports. These include flexibility (8), joint laxity (9,10) and biomechanical variables (11,12,13). Although none of these have successfully allowed prevention of injury.
In shoe orthotic devices raise much discussion in the Sports Medicine world as to whether they can confer an actual change in kinematics.
Nigg has published extensively on the actual benefit of orthoses and suggests (14,15) that the true benefit is not in producing a rigid control or reduction in range of motion, but in the change of muscle use to modify kinematics.
The authors would agree that it would appear that the increased muscle activation of lower limb stabilisers that contribute to the reduced injury rate

Limitations

The subjects were not blinded as to the nature of the insole, although the end point of the study was reporting of injury. The thickness and structure of any dummy 'non prescription' insole was felt to add too great a confounding variable as this would contribute to altered kinematics.
The non intervention group were unaware of their status as to low risk on control.

Conclusions

Prescription of the D3D™ orthotic reduced injury rate (ARR) by 31% in those categorised as High and medium risk. This gave NNT of 3.2.
In an Initial Military training population, the footscan® D3D™ orthotic device is able to significantly ($P<0.01$) reduce lower limb injury.

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