

A Step in the Right Direction: Orthotics in the Military



Capstone Project

ORTHOTICS FOR THE PREVENTION OF OVERUSE INJURIES DURING BASIC TRAINING

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Injuries During Basic Military Training



Marching is an essential part of basic training.

Recruits completing basic military training (BMT) are at high risk for developing exercise related injuries. The intense nature of BMT causes overuse injury rates around 14 to 42% for men and 27 to 61% in

women. Most of the training related injuries sustained are to the lower extremities. The high incidence of injuries causes a burden on the military's manpower, finances, and healthcare system.¹

Prevention of training related injuries is an important topic in today's military environment. Military research has shown that there are many factors that predispose a recruit to injury. One unmodifiable factor is the recruit's anatomy specifically the foot and leg. Lower extremity conditions such as high arches or leg length discrepancies

put the recruit at greater risk for injury. The use of orthoses are often used to help control abnormal biomechanics caused by lower extremity problems or conditions.¹

The current literature on orthoses for prevention of overuse injuries during BMT is highly variable. The purpose of this review is to outline the current knowledge on lower extremity injury prevention programs in the military population.

There are eight investigations that explore custom orthoses and their use for preventing injuries during BMT. Five were randomized control trials (RCT), two were cohort studies, and one was a quasi-experimental laboratory study. The level of evidence was between II and III for the literature. The most relevant RCTs and cohort studies are examined here.

Royal Australian Air Force Recruits

The first investigation explored the effects of custom made flexible biomechanical shoe orthoses on recruits diagnosed with pes planus (flat feet) in the Australian Air Force.²

The 47 recruits determined to have pes planus were randomly assigned to either orthoses or control group.² The recruits were followed through their 8 week training and at the end measurements of lower limb pain, training injuries, foot pain and health (Foot Health Status Questionnaire), and quality of life (World

Health Organization Quality of Life) were taken.²

The investigation provided no statistically significant results. The recruits that wore the orthoses did tend to have reduced pain and increased foot health. The investigation's results were limited by the small sample size of recruits and their narrow definition of training injury (>3 days off duty).² A wider definition might have produced significant results.

Most Common Injuries during BMT¹

- LOW BACK PAIN
- TENDINITIS
- SPRAIN
- MUSCLE STRAIN
- STRESS FRACTURE
- OVERUSE KNEE INJURY

Literature Review:

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During US Army BMT (“White Phase” weeks 4-6) recruits are expected to complete 4 and 6 mile road marches with sacks and gear (can exceed 100 lbs).

New Zealand Army Personnel

The investigators working with the New Zealand Army used a foot adaptability screening protocol (rearfoot posture, postural stability, and forefoot stability) to identify foot dysfunction. Based on the recruits screening score they received either no foot intervention, prefabricated orthoses, or a custom made orthoses.³

Of the 102 new recruits, 47 were issued orthoses. Over the next 3 months all of the recruits’ records were surveyed for injury (stress fractures, chronic pain or discomfort, overuse injuries, or plantar fasciitis). The incidence of injuries of the new recruits was then compared to a control group consisting

of 807 active duty personnel.³

The investigation revealed decreased stress fractures of the foot, shin, and low back, reduced incidence of plantar fasciitis, and less chronic pain of the hip, knee, and low back. The screening protocol and prescription of orthoses appears effective in reducing injury rates in this population.³

This 2-arm feasibility study did a poor job reporting information of type and fabrication of orthoses as well as recruit demographics. Further research needs to be completed with an equivalent control group (other BMT recruits) and a large orthoses sample to validate these findings.

Orthotic Companies Used Across Literature

- FORMTHOTICS
- PROLAB ORTHOTICS
- ESHED ADVANCED ORTHOPEDICS LTD.
- D3D
- TAFNIT ORTHOPEDICS
- COMFORTFIT

Denmark Military Conscripts

In the next investigation, the use of custom semi-rigid biomechanical shoe orthoses for the prevention of back and lower extremity injuries was studied in the Denmark military.⁴

All 146 conscripts, regardless of foot shape/dysfunction, were randomly assigned to either orthoses or control group. After 3 months the outcome measures of self-reported back/lower extremity pain, specific problems, number of conscripts requiring 1 day off training, and total days

off training were determined.⁴

For conscripts that actually wore their orthoses throughout training there was a significant reduction in back/lower extremity injuries, reduced prevalence of shin splints, and decrease in number of off duty days.⁴

Custom orthoses distributed within the general conscript population reduced injuries. The investigators concluded that the intervention was not economically feasible. They did not take into account potential savings in healthcare costs.⁴



Plantar Pressure system used to determine orthotic prescription.

Britannia Royal Naval College Cadets

Investigators evaluated the use of custom soft biomechanical shoe orthoses (D3D) for at risk cadets to reduce incidence of injury for Britannia Royal Naval cadets. Cadets were screened using a pressure plate protocol in order to identify those at medium or high risk for injury based on foot dynamics.⁵

Data on cadets was collected until 200 cadets were issued custom orthoses and 200 were could be used as controls (400 total). Surveillance of lower limb overuse injuries

(out of physical training >2 days) was completed over the 7 weeks of training.⁵

Results demonstrated a statistically significant reduction in lower extremity injuries with use of orthoses. The number of injuries per training hour was also less for the orthotic group.⁵

A plantar pressure protocol and D3D orthotic system may be difficult to implement in the military due to costly equipment and expense of the custom D3D orthotic.⁵

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Israeli Infantry Conscripts

Israeli conscripts have been the subjects of two different investigations focusing on orthoses and injury prevention during training.^{6,7} The first examined the effects of custom soft or custom semi-rigid biomechanical shoe orthoses (BSO) on the incidence of stress fractures.⁶ The second determined differences in types of BSOs, four combinations, on injury incidence and comfort for conscripts.⁷

The 404 conscripts were distributed to custom soft BSO, custom semi-rigid BSO, or a sham shoe insert. The conscripts were evaluated by every 2 weeks for signs/symptoms of a stress fracture and comfort of orthoses until the end of training at 14 weeks.⁶

Overall the combined orthoses groups had significantly lower rates of stress fractures compared to no orthoses. Conscripts reported higher comfort scores with the soft orthoses than the semi-rigid orthoses or the sham insoles.⁶

Limitations

Although there are many well designed studies examining the effects of custom orthoses the variability between investigations makes drawing a general conclusion difficult. The methodology ranged in the screening processes, fabrication, and types of orthoses used.

The feasibility of prophylactically distributing orthoses to new recruits/conscripts was not addressed in the majority of articles (time for

Conclusion

The primary outcome measure across most of the literature was injury incidence rates. The majority of investigations demonstrated a reduction in lower extremity injuries or stress fractures; although not always considered significant. Some research also proved that recruits had higher comfort scores and were more likely to complete their training in custom soft biomechanical shoe orthoses compared to semi-rigid or prefabricated.

The use of custom soft orthoses provides enhanced comfort without diminishing the preventative quality of the orthoses (compared to semi-rigid). The investigation limited since it did not examine any other lower extremity injuries.⁶

The second investigation involved two cohorts of 451 and 423 conscripts divided into four groups: custom soft BSO, custom semi-rigid BSO, prefabricated soft orthoses, and prefabricated semi-rigid orthoses. The results, after 14 weeks, showed the greatest comfort scores in the soft custom group. There were no difference in injury incidence between groups⁷

The use of soft custom orthoses may improve compliance to regimen due to comfort. This second study had no true control group which to compare incidence rates therefore no conclusion about injury reduction can be made.⁷

screening, time required to make orthoses, and cost). Only one investigation analyzed cost and determined that orthoses were not economically feasible although there were flaws in their analysis.⁵

The results of the investigations may not generalize to other military populations because of unique requirements and training periods for various military institutions.

The current research appears to provide a foundation for the prophylactic use of orthoses in the military population for reduction of lower extremity injuries during basic military training. Further research and refinement of results needs to be completed in order to discover exact parameters of a successful program. There needs to be consistency in the literature before this conclusion can be fully supported.



Israeli infantry boots.

Future Research:

- CONSISTENCY IN:
 - SUBJECTS INVOLVED
 - TRAINING
 - ORTHOTIC TYPE
 - MANNER OF ORTHOTIC DISTRIBUTION
 - OUTCOME MEASURES
- NARROW STUDY
- PARAMETERS
- FOLLOW-UP INVESTIGATIONS ON POSITIVE FINDINGS



Conditioning and Confidence Obstacle Courses are completed throughout US Army BMT ("Red Phase" weeks 1-3, "White Phase" weeks 4-6).

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