

Prospectively Measured Plantar Pressure Characteristics in Subsequently Injured and Non-Injured Royal Marines Candidates During Training

Louise Baker¹, Joanne L. Fallowfield², Chris Byrne¹, Sharon J. Dixon¹

¹The University of Exeter, England

²Institute of Naval Medicine, England

Email: LB1039@exeter.ac.uk

Summary

Lower limb injuries (LLI) are problematic during Royal Marines (RM) initial military training. Plantar pressure assessment—at the start of military training—may identify trainees at increased risk of LLI. This study observed that RM trainees who sustained a LLI during training exhibited differences in plantar pressure variables of interest compared with non-injured trainees. Thus, evidence is presented to support future interventions aiming to reduce LLI risk.

Introduction

RM training is considered the most arduous UK Armed Forces initial military training programme, where trainees are at risk of suffering a LLI [1]. Previous prospective studies have identified differences in plantar pressure measures in trainees experiencing LLI during training, compared with those who complete training non-injured [2]. This research primarily focussed on stress fractures. It is not known whether plantar pressure measures differ for those at risk of other injury types.

This study investigated whether aspects of plantar pressure differed between trainees completing training without (injury) interruption compared with those who developed any LLI.

Methods

Prior to commencing RM training, baseline barefoot plantar pressure data were collected for 404 Potential Royal Marines Course candidates (aged 21 ± 3 years, body mass 77 ± 8 kg). Participants walked and ran across a 2-m pressure plate (Materialise, Belgium) to record three walking and five running steps bilaterally. Medical records of LLI were maintained during RM training, from which 175 trainees were identified as experiencing LLI, and 229 trainees remained non-injured.

Foot progression angle (°) and midfoot contact (%) were obtained from walking trials, and foot pressure medial-lateral balance and the peak magnitude of load on anatomical areas were obtained from running trials.

A binary logistic regression model was developed to predict injury risk compared to remaining non-injured. Candidate variables for an initial model were identified from independent t-tests (those with a p value < 0.10).

Results and Discussion

This prospective study identified that body mass, maximum heel medial-lateral balance (left-side) and maximum medial heel pressure (left-side), differed between injury and non-injured groups, suggesting these variables may be associated with the development of LLI (Table 1).

Table 1: Binary Logistic Regression Predicting Likelihood of Injury based on Anthropometric and Plantar Pressure Variables.

Variable	Mean (SD)		p
	Injured	Non-Injured	
Mass (kg)	75.2 (7.9)	78.5 (7.8)	0.010
L Ankle width (mm)	74.9 (3.5)	76.4 (3.9)	0.602
R Ankle width (mm)	75.1 (3.2)	76.8 (3.8)	0.680
L Axis Angle (°)	9.56 (5.0)	8.4 (4.6)	0.246
L Heel Medial-Lateral Balance (%)	14.4 (8.3)	13.0 (7.6)	0.036
R Heel Medial-Lateral Balance (%)	14.7 (8.2)	12.5 (7.1)	0.071
L Max Medial Heel Pressure (N.cm ⁻²)	15.0 (5.2)	14.1 (4.8)	0.050
R Max Medial Heel Pressure (N.cm ⁻²)	14.6 (5.1)	13.6 (4.4)	0.417
L Max Lateral Heel Pressure (N.cm ⁻²)	14.2 (4.6)	13.4 (4.5)	0.421
R Max Lateral Heel Pressure (N.cm ⁻²)	14.2 (4.8)	13.4 (4.5)	0.268
L Max Metatarsal 2 Pressure (N.cm ⁻²)	21.0 (6.2)	22.2 (6.3)	0.066
L Max Metatarsal 3 Pressure (N.cm ⁻²)	21.0 (6.2)	22.2 (6.3)	0.986
R Max Metatarsal 3 Pressure (N.cm ⁻²)	21.9 (6.9)	23.0 (6.1)	0.481
L Max Metatarsal 4 Pressure (N.cm ⁻²)	14.3 (4.1)	15.2 (4.2)	0.540

The observation that a low body mass was a risk factor for LLI agrees with previous literature from this population [2]. Nunns *et al.* proposed that greater muscle mass and bone stature offer protection against physical training demands [2].

Heel medial-lateral balance has been used as an indicator of rearfoot eversion; a component of pronation. Thus, a higher value in the injury group implies greater pronation, which has been identified as a LLI risk factor [3].

The greater maximum heel pressure in the injury group suggests higher loading at initial contact as a LLI risk factor in RM trainees. This is consistent with previous literature [4], where repetitive microtrauma can contribute to LLI.

Conclusions

Candidates who sustained a LLI during RM training exhibited different plantar pressure characteristics. Further investigation is required to determine whether these modifiable risk factors can be mitigated through targeted intervention.

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