The Effect of Lower Limb Cast Immobilisation on Calf Pump Function – A Simple Strategy of Exercise Can Maintain Flow

Foot & Ankle Category: Other

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Introduction
Patients treated with lower limb cast immobilisation are at risk of venous thrombo-embolism (VTE). This may result from localised endothelial damage or altered calf pump function causing venous stasis. In an audit of patients treated with lower limb cast immobilisation at our institution between 1/1/2010 and 11/5/2011, 20 patients sustained symptomatic VTE within 6 months after cast immobilisation. All except 1 occurred in the casted limb. Therefore, VTE appears to be localised to the injured/casted limb. Our aim was to determine the effects of below knee cast on calf pump function to help direct treatment to prevent VTE.

Methods
Twenty healthy participants were enrolled in this research and ethics approved prospective study. Four foot and ankle movements (toe dorsi-flexion, toe plantar flexion, ankle dorsi-flexion, ankle plantar flexion) were performed by participants pre and post application of a below knee cast. Baseline and peak systolic velocity was measured at the popliteal vein during each movement. Participants with peripheral vascular disease, varicose veins, deep venous thrombosis or previous foot and ankle surgery were excluded.

Results
The mean patient age was 31 years (range 21-58), eleven were female. With cast in situ all movements resulted in a statistically significant increase in peak systolic velocity (p=0.0001). Toe dorsi-flexion increased velocity from baseline 8.8cm/s (4.2-21.7) to 53.6 cm/s peak (12.8-152.8) pre cast and 59.1 cm/s peak (10.5-184.1) post cast (pre-post mean difference p=0.572). Toe plantar-flexion increased velocity from baseline 9.2 cm/s (5.8-17.6) to 49.7 cm/s peak (15.5-127.7) pre cast and 57.3 cm/s peak (20.9-108.3) post cast (pre-post mean difference p=0.299). Ankle dorsi-flexion increased velocity from baseline 10.3 cm/s (5.4-26.4) to 115.4 cm/s peak (31.5-189) pre cast and 88.2 cm/s peak (23.2-234.2) post cast (pre-post mean difference p=0.045). Although the post cast peak velocity was reduced compared to pre cast peak, the velocity still increased approximately 10 times from baseline. Ankle plantar-flexion increased velocity from baseline 11.4 cm/s (5.4-32.1) to 86.6 cm/s peak (39.9-158.9) pre cast and 112.9 cm/s peak (34.1-265.5) post cast (pre-post mean difference p=0.23).
Conclusion
This is the first study to examine the effect of lower limb cast immobilisation on calf pump function. Despite immobilisation, toe movements can increase popliteal vein velocity at least 5 times compared to measurement at rest. Ankle plantar flexion increased popliteal vein velocity at least 8 times compared to baseline, both pre and post cast immobilisation. Lower limb cast immobilisation did reduce the peak velocity achieved by ankle dorsi-flexion compared to pre-cast peak, however the post cast peak was still significantly greater than baseline (8x baseline velocity). Toe and ankle movement significantly increases calf pump function in participants with below knee cast immobilisation. We recommend that all patients treated with below knee cast immobilisation are advised to perform regular toe and ankle exercises to reduce venous stasis and risk of VTE. One limitation of our study is that measurements were performed on healthy participants. We are therefore currently performing a further study in patients who have had lower limb cast immobilisation to verify our preliminary findings.