A Randomized Controlled Trial Using Neuromuscular Electrical Stimulation with Pelvic Fracture Rehabilitation: An Interim Analysis

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Purpose: The acute management of pelvic fractures has seen significant improvements in recent years; however, there remain no formal guidelines or evidence for rehabilitation. Patients will often suffer from muscle atrophy following long periods of non-weight-bearing. Neuromuscular electrical stimulation (NMES) has been proven to minimize muscle loss and enhance recovery; however, it has not yet been investigated after pelvic fracture. The aim of the study was to investigate the efficacy of NMES in postoperative rehabilitation within pelvic fractures.

Methods: 41 participants with surgically fixed pelvic fractures were randomly allocated into two groups postfixation. The intervention group completed 10 weeks of NMES. The placebo group used transcutaneous electrical nerve stimulation (TENS). Muscle strength was measured using the Cybex HUMAC machine and peak torque was calculated in the operated limb at 12 weeks using the nonoperated limb as a baseline. A EuroQol (EQ)-5D questionnaire was given to patients at 6 weeks and 12 weeks postfracture to assess the participant's quality of life. Gait analysis was performed on all participants at 12 weeks postfracture using a CODA motion analysis system (Charnwood Dynamics) at a sampling rate of 200 Hz. A customized MATLAB (MathWorks)-based algorithm was used to extract joint movements of the ankle, knee, hip joints, and the pelvis during patients' gait cycles. Compliance data were obtained from prerecorded sessions on the NMES machines and from a compliance diary the participants completed.

Results: The first 26 participants' data were available to analyze for preliminary findings in which a Mann Whitney U test was performed on peak torque and EQ-5D results. Within the intervention group there was minimal difference in muscle strength between operated and nonoperated limbs, which was not of clinical significance for abduction (2 Nm) and adduction (8 Nm) 12 weeks postfracture ($P < 0.5706$ and $P < 0.3642$, respectively). Within the placebo group there was a large difference in muscle strength between operated and nonoperated limbs for both abduction (25 Nm) and adduction (36 Nm) with a significant difference ($P < 0.0164$ and $P < 0.0191$, respectively). A clinical and

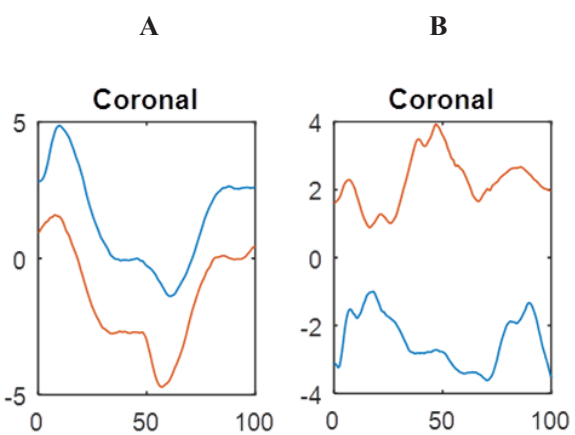

Figure 1.
Pelvic Rotation in the intervention group (A) and placebo group (B)
(blue non-operated and red operated side).

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significant difference was found between the intervention and placebo group with regards to EQ-5D scores at 6 weeks postoperation. Participants scored higher and more independent scores within the intervention group compared to the placebo group which was of significant difference ($P < 0.0498$). Gait analysis results show a decrease in pelvic rotation within the coronal plane for the intervention group between operated and nonoperated limbs when compared to the placebo group.

Conclusion: This investigation is the first randomized controlled trial to investigate the effects of NMES following a traumatic pelvic fracture. NMES has been shown to be a useful adjunct to standard bed exercise rehabilitation in an under-researched population. This study indicates that within the intervention group, participants have maintained their muscle strength using NMES despite the long periods of non-weight-bearing, compared to the placebo group. The EQ-5D results indicate participants could potentially feel better and more independent as early as 6 weeks postoperation compared to the placebo group. The participants' gait was analyzed with a small population for the interim analysis. This demonstrates minimal pelvic coronal rotation within the intervention group indicating less of a Trendelenburg gait. This is potentially due to stronger hip abductor strength compared to the placebo group. Although a small sample size was analyzed for the interim results, the clinical and significant differences achieved at this early stage indicate promising results that require further investigation with more participants in which recruitment is ongoing.