A Preliminary Investigation into the Effect of Radial Shockwave Therapy on Lower Limb Functional Mobility

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Introduction

Lower limb injury can impact heavily on quality of life particularly in terms of functional mobility. By introducing exercise early in the rehabilitation process a quicker return to activity may be possible. (Abrahamson *et al.*, 2010). Maximising or regaining functional mobility following injury is a key goal of therapeutic intervention and early rehabilitation is paramount in preventing time lost in competitive sport or physical activity.

Radial Shockwave Therapy (RSWT) emerged from orthopaedic medicine and has quickly become established within mainstream clinical practice as a non-invasive treatment modality. The therapeutic application of shockwaves to musculoskeletal tissues is a modality that has the potential to treat an expanding range of musculoskeletal pathologies (Rozenblat, 2012). The therapy is widely acclaimed to be effective in the treatment of many musculoskeletal disorders as it can shorten a period of treatment and can produce a powerful analgesic effect (Notarnicola and Moretti, 2012). Radial Shockwave therapy emits pulses of energy targeted at damaged tissues to stimulate increases in local blood flow, cellular regeneration and in the reduction of pain. Although the therapeutic effect of RSWT has been reported most research evaluates the modality utilising subjective pain scales and focuses on the analgesic outcomes following treatment (Furia et al., 2012).

There has been limited research measuring the short term neuromuscular performance outcomes following RSWT (Lohrer *et al*., 2010). For this reason research that evaluates short term functional mobility outcomes, during, and immediately after RSWT may be beneficial to the practitioner. Such research could provide practitioners and patients with valuable information for consideration during a course of RSWT and inform post treatment aftercare. It could also contribute to the longer term rehabilitation of an injury following RSWT. As such empirical research and evidence around the functional outcomes of RSWT could inform clinicians and patients about the choice of treatment modality and respective treatments post RSWT.

Aim

The aim of this study was to evaluate the functional mobility of patients, presenting with lower limb injury, following a short course of radial shockwave treatment.

Method

Twenty participants (n=20) with a lower limb injury for which a course of RSWT was appropriate were recruited to take part in the preliminary study. Participants were from a population of patients attending two clinics providing treatment and rehabilitation for lifestyle or sports musculoskeletal injuries. The participants had a broad range of pathologies with causations not limited to a sporting activity. A control group (n=10) received a course of 'conservative' treatments while the experiment group (n=10) were treated with a standard course of radial shockwave therapy. The Lower Extremity Functional Scale (LEFS) questionnaire was used as a self-reporting tool to record each patient's assessment of their functional mobility at three stages during the course of treatment (pre, during and post).

The experimental group received RSWT using either a BTL-5000 SWT Power, or a Storz Medical MP100 Ultra radial shockwave device by therapists trained and experienced in the use of this equipment. The application parameters of all RSWT treatments were patient dependent and administered according to manufacturer guidelines. The control group were given a range of therapeutic modalities in their treatment plan according to the individual patient including therapeutic ultrasound, manual therapy (massage), transcutaneous electrical nerve stimulation (TENS) and mechano-therapy (exercises including eccentric stretching and loading).

Following informed consent, and University ethical approval, all participants were managed through a thorough clinical assessment and systematic examination to reach a clinical diagnosis. Patients were screened to confirm they had a lower limb injury that met the inclusion criteria for the research study indicating suitably for RSWT. Patients who presented with contraindications to the treatment were eliminated.

The LEFS questionnaire was completed for each participant to gather baseline data on perceived functional mobility, referred to as 'Stage 1'. The patient was then treated according to their individual treatment plan and the modalities according to their respective group. Patients for whom RSWT was contraindicated were offered conservative therapeutic modalities as an alternative to RSWT and formed part of the control group.

This process of delivering the LEFS questionnaire was repeated at the second appointment 7-10 days after the first treatment, referred to as 'Stage 2' and again at seven days following the second treatment (Stage 3). The timing of this intervention

was guided by the RSWT manufacturer treatment parameters that indicated the frequency of treatments within 5-10 days (BTL, 2014).

An analysis of the data collected, via the LEFS questionnaire, was undertaken using a one way repeated measures analysis of variance (ANOVA,) across the 3 data collection stages. The differences before, during, and after treatment, within and across each group were compared.

Results

The 20 question Lower Extremity Functional Scale (LEFS: Binkley et al. 1999) measures the participants perceived level of functional mobility, across a number of day to day activities, on a revised Likert Scale. The scale ranges from 0 (Extreme difficulty or unable to perform the activity) to 4 which indicates no difficulty in doing the activity. The higher the score the less difficult the activity is as perceived by the participant.

Table 1: LEFS scores for control group across the treatment periods

LEFS Questionnaire Scores for Control Group			
Participant	LEFS score before treatment (Stage 1)	LEFS score before second treatment (Stage 2)	LEFS score after course of treatment (Stage 3)
1	61	75	75
2	68	69	75
3	72	76	80
4	22	67	69
5	32	25	20
6	38	69	69
7	67	66	64
8	54	58	64
9	65	57	62
10	41	41	50
Mean	52.00	60.30	62.8
StDev	5.53	5.08	5.44

Table 1 indicates a 10.8 score difference from stage 1 to stage 3 of the treatment period for the control group. The treatment therefore had a positive effect on the mobility of the participants in the control group. However statistical analysis revealed no significant change in perceived mobility as measured by the LEFS ($p>0.05$) across the 3 stages.

Table 2: LEFS scores for the experimental group across the treatment periods

Participant	LEFS score before treatment (Stage 1)	LEFS score before second treatment (Stage 2)	LEFS score after course of treatment (Stage 3)
1	55	60	64
2	23	55	69
3	47	55	59
4	41	55	71
5	45	63	62
6	60	66	69
7	57	70	74
8	46	54	60
9	59	62	63
10	54	73	77
Mean	48.7	61.3	66.8
StDev	10.91	6.75	6.03

The experimental group reported an 18.1 point difference between stages 1 and 3 of the RSWT treatment period. This difference was noted as a significant improvement across the three stages of treatment ($p<0.05$). Post-hoc analysis noted that significant changes were noted between all the stages of the treatment period suggesting significant improvement in perceived mobility, from stage 1 to stage 2 and stage 2 to stage 3.

Figure 1 illustrates a graphical comparison of the LEFS scores between the two groups.

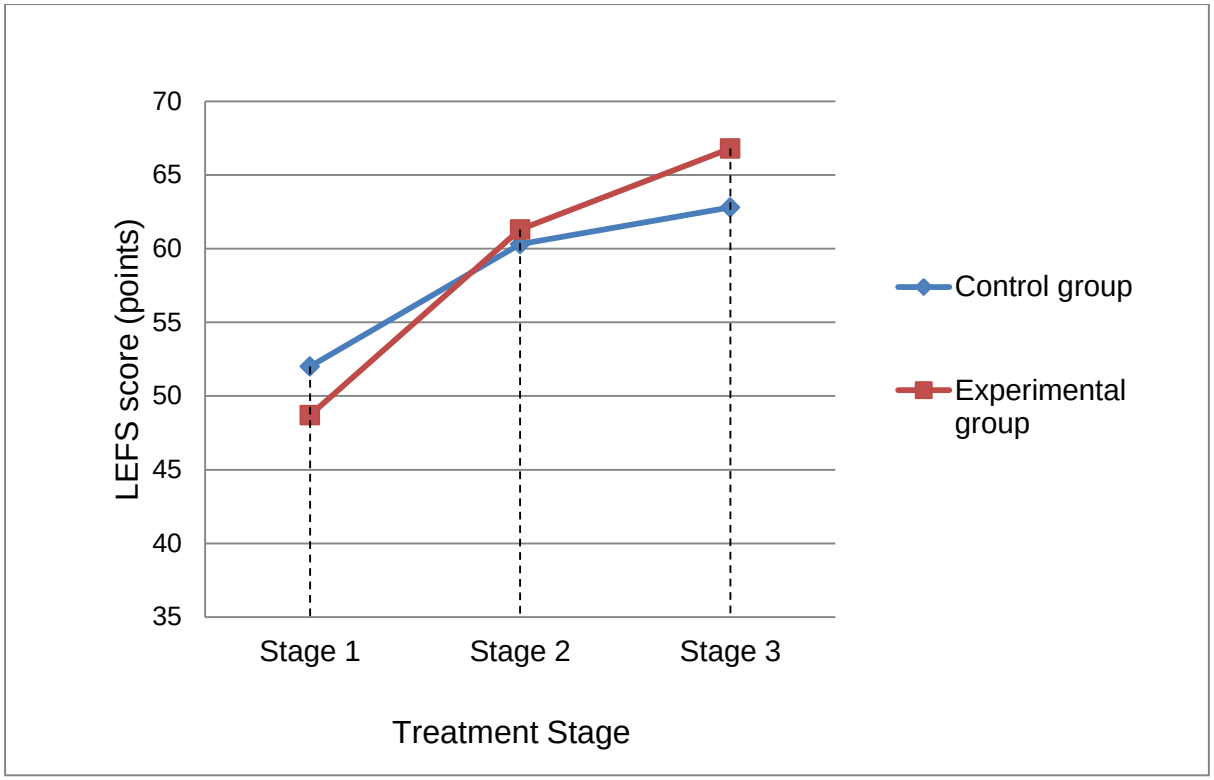

Figure 1. Mean LEFS scores for both groups across the treatment stages.

Discussion and Clinical Implications

The data presented from the experimental group suggests that, based on the LEFS perceived scores, a course of radial shockwave therapy (RSWT) report significantly improved levels of functional mobility for patients with lower limb injury. The largest reported improvements in functional mobility were noted after the first treatment in both groups (experimental = 32.9% improvement compared to 28.5% improvement in the control group). At 'stage 3' the RSWT group mean score indicates that functional mobility improved by a further 9.53% (from stage 2) while the control group showed only a small gain of 3.5%. Over the full course of treatment for both groups, the mean reported improvement in functional mobility for patients receiving RSWT was 47.5%, compared with a value of 33.3% for those receiving conservative physical therapy. For participants receiving RSWT the overall mean LEFS score improved by 18.1 points which was twice the value for the control group participants.

There are various factors that could be responsible for the initial gains in functional mobility followed by a gradual tapering of improvement. In this study the RSWT group reported an improvement in functional mobility over the course of the three treatments and that the initial gain was sustained at almost every stage. This suggests an accumulative progression in gains of functional mobility and mirrors the accumulative analgesic effect of multiple RSWT treatments reported by Takahashi, et al., (2006). Furthermore Furia et al., (2012) concluded that one application of RSWT in the treatment of patella tendinopathy was effective. The implication of the

findings is that RSWT is highly likely to lead to a perception of increased functional mobility above that perceived through usual treatment modalities.

Clinical Application

The clinical significance of this study surrounds not only the speed at which functional mobility is perceived to improve but the magnitude of that improvement. Radial shockwave therapy appears to lead to quicker short term increases in functional mobility and that improvement occurs at an earlier stage in a course of treatment than is otherwise widely reported. This rapid gain in functional mobility was also reported by Avancini- Dobrović *et al.,* (2011) who in treating calcific tendinitis with RSWT measured statistically significant improvements in both range of motion and in muscle strength.

This increased functional mobility from RSWT treatment may give the clinician and patient opportunity to introduce early mechano-therapeutic opportunities, to potentially load tissue earlier and even possibly during the RSWT course of treatment. There is strong contemporary emphasis on active rehabilitation following injury and the use of therapeutic interventions that use mechano-transduction principles to load musculoskeletal tissue (Khan and Scott, 2009). Early functional mobility following an injury facilitates the beneficial aspects of early tissue loading such as advancing collagen synthesis and tissues, particularly tendons, respond favourably (Heiderscheit *et al*., 2010; Mangine *et al*., 2012). The proposition of using RSWT in union with exercise based rehabilitation is highlighted by Leeuwen *et al.,* (2009) who suggest the analgesic element of the treatment influences the functional improvement.

Conclusion

Based on the findings of this preliminary study radial shockwave therapy has an effect on perceived functional mobility as reported by patients with lower limb injury. RSWT may not wholly replace the established effective therapies however the use of RSWT to obtain quicker gains in functional mobility, specific to lower limb injury, at an early stage of treatment may well allow the patient to engage with a carefully managed rehabilitation plan enabling mechano-therapeutic intervention and the earlier resumption of activity. The results of this study could inform patient and clinician awareness of the rapid potential improvements in functional mobility that can occur following RSWT treatment.

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