ABSTRACT

Title: THE ACUTE EFFECT OF PERCUSSIVE THERAPY ON POSTURAL STABILITY AND MUSCLES ACTIVATION IN PEOPLE WITH CHRONIC ANKLE INSTABILITY AND CONTROLS

Subjects: In recent years, the percussive therapy technique, and its associated massage guns (TheraGun^{TM}) have appeared on the massage market. This relatively easily accessible form of self-massage was associated with soft tissue relaxation, improved range of motion, and direct activation of the massaged muscles before or after physical activity. Muscle tightness has been related to postural instability and higher risk of lower limb injuries. However, there is still lack of evidence about effects of percussive therapy on postural stability and muscle activation in people within various musculoskeletal conditions, like chronic ankle instability (CAI), where postural stability and movement initiation may be compromised. With each distortion or luxation of the ankle, the possibility of re-occurrence of this type of injury increases, as well as associated complications such as absence from the training process or disruption of normal stereotypes. Among other things, chronic ankle instability can be a compelling reason for the absence of physical activities, to which many health-maintaining factors are linked. Therefore, this project aims to examine the effect of percussive therapy on postural stability and muscle activation during static and dynamic movement in subjects with the history of CAI and without.

Methods: The project was implemented as a single-blinded randomized controlled trial. The number of participants was determined using a power analysis with a predicted medium effect size - F2 = 0.15; with a significance level of $\alpha = 0.05$ and a test power of $1-\beta = 0.8$) to (n=44). Intentional allocation of participants into 2 groups (Group 1 – n=10 CAI YES / n= 11 CAI NO; Group 2- n=10 HEALTHY YES / n=11 HEALTHY NO). Initial measurements of 30 s postural stability test on pressure platform FootScan (FS) before and after (non)TheraGun application in standing on both legs with open eyes (OE), on both legs with eyes closed (CE), Flamingo stand on the dominant (DOM) lower limb (FL_{DOM}) and the non-dominant (NON) lower limb (FL_{NON}). This was followed by total of 4 trials of individual heel raises (6s data collection on FS during heel rise, 10 seconds rest between trials). Electromyographical (EMG) activity in the calf region was simultaneously recorded in all performed tests. EMG sensors were attached to the m. gastrocnemius vastus lateralis during the first test and remained affixed to the skin for the second test. Consequently, followed by a

1:30min pause – massage (the 30s each m. triceps surae) with TheraGun^{TM}. The same principle was followed for the control groups except for the TheraGun^{TM} massage part.

Results: Primary statistical analysis before PT treatment found significant difference ($p=0.014$) in the EMG parameter of bilateral asymmetry between dominant and non-dominant lower limb during heel rise performance between HEALTHY and CAI groups (32.94±19.93 % vs. 48.07±28.08 %). No other difference in selected parameters was found before PT treatment.

Within experiment protocol and comparison between pre and post-tests in postural stability, we found significant differences ($p<0.05$) in OE tests mainly between the HEALTHY and CAI groups. Specifically, post-hoc analysis revealed significant difference ($p=0.014$) between CAI NO PRE (CNP) and HEALTHY YES POST (HYPO) and between the CAI NO POST (CNPO) vs. HYPO ($p=0.05$). The only statistical difference ($p=0.045$) within CAI group was found in CNP vs. CAI YES POST (CYPO). Since there was no significant difference in the pre-tests between any of the groups (CNP and CYP), we may confirm the hypothesis of the effect of PT in postural stability (OE) test.

In contrast, in the CE test, this change was observed between groups CNPO and CYPO ($p=0.05$). Since there was no pre-test difference between the CAI groups in CE parameter, we may also confirm the effect of PT in CE test, even though the intragroup outcomes between pre and post-test weren't sensitive enough to find significant ($p<0.05$) improvement.

Unilateral postural stability surveyed in relation to PT showed increased bilateral asymmetry between DOM and NON in Flamingo test (expressed as %). Especially HYPO group revealed risen asymmetry after PT when compared to CNPO ($p=0.007$), CNP ($p=0.015$) and CYPO ($p=0.05$). Key finding was measured significant difference in intragroup parameter between HYP vs. HYPO ($p=0.014$), which confirmed increased bilateral asymmetry in unilateral postural stability HEALTHY subjects before and after use of PT, but not in CAI.

In terms of muscle activation (sEMG), we found increased bilateral asymmetry during OE (DOM vs NON %) between the CYPO and CNP ($p=0.041$), with risen asymmetry during OE in group using PT (72.52%) than in group without PT in pre-test (47.94%). However, both CAI groups showed risen asymmetry in post-test, while only PT group (CYPO) showed significant difference from CNP. Thus, there is low indication that PT could increase muscle activation asymmetry in CAI during static postural stability.

In muscle activation during heel rise in DOM, we found lowered EMG activation after PT use in the CYPO group when compared to HYPO ($p=0.026$) and HYP ($p=0.026$). HEALTHY groups showed no change ($p>0.05$) before or after PT (or no PT) use. However, CAI group without PT during pre-test showed almost significant difference ($p=0.067$) when compared to CAI group with PT in post-test (121.77±58.16 $\%RMS_{max}$ vs. 79.66±35.64 $\%RMS_{max}$). This indicate that CAI subjects may have got lower muscle activation in the DOM during movement after PT use.

In terms of bilateral asymmetry of muscle activation during heel rise, the significantly higher asymmetry was found in CAI group after PT use (approximately 66%) when compared to HYPO (18%) ($p=0.008$) and HYP (26%) ($p=0.025$). Conversely, HEALTHY group after PT use showed lower asymmetry (18%) during heel rise when compared to CNPO (54%) ($p=0.043$) and HEALTHY group without PT use in post-test (HNPO; 54%) ($p=0.044$), but HEALTHY groups did not differ in pre-test.

Conclusion: The aim of this master thesis was to examine the acute effect of percussive therapy on the postural stability and muscle activation in subject with and without CAI. The analysis showed high variance within individual results, thus high standard deviations across the study. Nevertheless, we found significant differences between the analyzed groups before and after the application of percussive therapy. However, not all results showed clear indications of therapy effect in terms of intragroup (pre vs. post-test within same groups). It seems, that there exist differences between CAI and non-CAI subjects, and also that PT may affect postural stability and muscle activation in both groups with different outcomes. Results indicated, that within dynamic movement performance, PT may affect HEALTHY subject positively in terms of lowering bilateral asymmetry, while negatively in CAI, by rising the difference between dominant and non-dominant lower limb muscle activation in calf area. Conversely, positive effect of percussive therapy on static postural stability in CAI subjects was found, with improvement in the group using PT in close stand tests with or without open eyes. Other observed parameters such as postural stability changes during unilateral stand or muscle activation did not show clear significant changes in patients with CAI who used PT. Thus, it seems from our results, that a significant change after PT use in people with CAI affect static and dynamic performance differently. Besides lower homogenous participants number and only one analyzed muscle part within calf area, we are aware of study limitations within unclear results and high individual differences. However, increased motor strategies required for unilateral standing and dynamic movements may affect the results, regardless of percussion therapy. Thus, more sensitive testing procedures in

the calf area in larger homogenous population is recommended in the future research, while more dynamic movements could be analyzed. These results should add to the knowledge about the percussive therapy used in CAI population and its use within postural stability control pre-activation.

Keywords: Lateral Gastrocnemius; Electromyography; Muscle Activation; Heel Rise; TheraGun