The Effect of Plantar Massage on Static Postural Control in Patients With Chronic Ankle Instability: A Critically Appraised Topic

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Clinical Scenario: Patients with chronic ankle instability (CAI) demonstrate deficits in both sensory and motor function, which can be objectively evaluated through static postural control testing. One intervention that has been suggested to improve somatosensation and, in turn, static postural control is plantar massage. Clinical Question: Does plantar massage improve static postural control during single-limb stance in patients with CAI relative to baseline? Summary of Key Findings: A search was performed for articles exploring the effect of plantar massage on static postural control in individuals with CAI. Three articles were included in this critically appraised topic including 1 randomized controlled trial and 2 crossover studies. All studies supported the use of plantar massage to improve static postural control in patients with CAI. Clinical Bottom Line: There is currently good-quality and consistent evidence that supports the use of plantar massage as an intervention that targets the somatosensory system to improve static postural control in patients with CAI. Future research should focus on incorporating plantar massage as a treatment intervention during long-term rehabilitation protocols for individuals with CAI. Strength of Recommendation: In agreement with the Center of Evidence-Based Medicine, the consistent results from 2 crossover studies and 1 randomized controlled trial designate that there is level B evidence due to consistent, moderate- to high-quality evidence.

Keywords: static balance, ankle injury, therapeutic massage

Clinical Scenario

Lateral ankle sprains are the most common musculoskeletal injury experienced by those who participate in physical activity, with approximately 23,000 people sustaining an ankle sprain each day in the United States. After completing supervised rehabilitation, 15% to 64% of patients who sprain their ankle do not report a full recovery within 3 years of their first sprain. Patients who develop lingering symptoms are more likely to have recurrent sprains and experience the feeling of “giving way.” Chronic ankle instability (CAI) is defined as having a history of at least 1 significant ankle sprain, a history of the previously injured ankle joint “giving way” and/or recurrent sprain and/or feelings of instability, and self-reported disability. Ultimately, CAI can significantly decrease physical function, health-related quality of life, and physical activity levels over the lifespan.

Although patients with CAI exhibit many impairments, one of the most common long-term deficits is diminished static balance. Patients with CAI have also demonstrated reduced sensitivity on the plantar aspect of their foot, which may contribute to their balance deficits. Plantar massage is an intervention hypothesized to stimulate the plantar cutaneous receptors and increase tactile acuity. By augmenting sensory input, massage should improve the efficacy of motor output, and this sensorimotor alteration could be illustrated in the form of postural control measurements. Despite the potential benefits of plantar massage, few investigations have studied the isolated effects of this intervention on static postural control in individuals with CAI. Clinically, it is important to improve static postural control in hopes of potentially mitigating the self-reported symptoms associated with CAI while potentially improving these patients’ health-related quality of life. Therefore, the aim of this critically appraised topic (CAT) was to identify, synthesize, and critically evaluate the evidence that has examined the effect of plantar massage on static postural control in patients with CAI. This will better assist health care professionals in applying evidence-based treatment strategies to address residual static balance impairments following an ankle sprain.

Focused Clinical Question

Does plantar massage improve static postural control during single-limb stance in patients with CAI relative to baseline?

Search Strategy

A computerized search was performed in February 2020. The search terms used were:

- Patient/client group: CAI OR ankle instability
- Intervention/assessment: massage OR plantar massage
- Comparison: none (not included in search)
- Outcomes: static postural control OR center of pressure (COP) OR time to boundary

Sources of Evidence Searched

- CINAHL with full text
- MEDLINE
- SPORTDiscus

Inclusion Criteria

- Studies published in English
- Studies published in the last 10 years
• Studies that used human subjects
• Studies that included patients with CAI
• Studies that examined outcomes following a plantar massage intervention
• Studies that objectively evaluated static postural control using a force plate

Exclusion Criteria
• Studies that examined healthy populations
• Studies that used balance training in conjunction with plantar massage
• Studies that used only subjective postural control outcomes
• Studies that were systematic reviews or meta-analyses

Evidence Quality Assessment
The Physiotherapy Evidence Database (PEDro) rating scale was used to systematically examine the research included to determine each study’s methodological quality and usability for clinical decision making. The PEDro includes 10 criteria, therefore the maximum score an article can receive is 10. The rating scale identifies both the trial’s internal validity and statistical reporting. Two authors (K.L.H. and K.A.B.) independently reviewed and evaluated each study according to the PEDro scale. After the independent review, the 2 authors came to an agreement about the quality of each study. Studies scoring ≥60% on the PEDro were considered “moderate to high quality” evidence.

Results of Search
Summary of Search, Best Evidence Appraised, and Key Findings
• A literature search was conducted in February 2020 to identify peer-reviewed articles that examined the use of plantar massage in participants with CAI and followed the inclusion and exclusion criteria listed earlier.
• The literature search yielded 7 articles. After review of the abstracts, 4 studies were excluded as they did not meet the inclusion criteria for this CAT (Figure 1). Two crossover studies\(^9,\)\(^12\) and 1 randomized controlled trial\(^13\) met the inclusion criteria. Study characteristics are listed in Table 1.

Results of Evidence Quality Assessment
The PEDro was utilized on each included study (Table 1). Each study scored a 6/10. All studies lacked the same criteria, including the lack of blinding of the participants, clinicians delivering the intervention, or the assessors. In addition, none of the studies explicitly stated that they used concealed allocation when determining the group assignment or treatment sequences.

Clinical Bottom Line
There is currently moderate- to high-quality, consistent evidence that plantar massage improves static postural control in individuals with CAI relative to baseline measures. These improvements were identified immediately following treatment in all studies.\(^9,\)\(^12,\)\(^13\) In agreement with the Center of Evidence-Based Medicine, the consistent results from 2 crossover studies\(^9,\)\(^12\) and 1 randomized controlled trial\(^13\) designate that there is level B evidence to support the use of plantar massage to improve static postural control in those with CAI.

Implications for Practice, Education, and Future Research
Our aim was to appraise the current evidence to determine whether plantar massage was an effective treatment for improving static postural control in patients with CAI. This CAT revealed moderate- to high-quality and consistent evidence that plantar massage improved static postural control in individuals with CAI relative to baseline measures. The articles included in this CAT utilized different plantar massage interventions and treatment volumes in patients with CAI. Wikstrom et al\(^12\) identified statistically significant differences between COP velocity and COP 95% area ellipse after each intervention session, with each session utilizing a different massage technique. Although this study found significant decreases in COP velocity and COP 95% area ellipse, it did not differentiate COP trajectories by direction.\(^12\) However, both clinician-delivered and patient-delivered massage improved outcome measures, indicating that there may not be a need for clinicians to...
provide one-on-one massage interventions. LeClaire and Wikstrom found statistically significant improvements in COP velocity and COP sway in both AP and ML directions with eyes open immediately after 5 minutes of plantar massage in patients with CAI. No significant differences were seen between static balance outcomes with eyes closed. Finally, McKeon and Wikstrom reported statistically significant improvements in COP velocity in both AP and ML directions with eyes closed immediately following plantar massage.

Abbreviations: AII, Ankle Instability Instrument; Ant, anterior; AP, anterior–posterior; CAI, chronic ankle instability; COP, center of pressure; COP-V, COP velocity; FAAM, Foot and Ankle Ability Measure; FAAM-S, FAAM—Sport; LE, lower extremity; ML, medial–lateral; MSK, musculoskeletal; PEDro, Physiotherapy Evidence database rating scale; PL, posterolateral; PM, posteromedial; R-COP, resultant COP; SEBT, star excursion balance test; TTB, time to boundary.

*All studies follow the guidelines set forth by the International Ankle Consortium.
reported different conclusions when individuals were required to close their eyes, indicating that there is no consensus on the effect of plantar massage when vision is occluded. Therefore, the added constraint created by the removal of visual input may offset the potential benefits of plantar massage. However, despite the differences in outcome measures examined and testing procedures performed, each study found an improvement in postural control outcomes following plantar massage treatment. Therefore, the current evidence suggests that including plantar massage is associated with improvements in static postural control, regardless of differences in treatment protocol and outcome measure, when treating patients with CAI compared with other interventions.

Although all 3 studies supported plantar massage as a way to improve static postural control, each study utilized different elements of study and experimental design. Both Wikstrom et al.12 and LeClaire and Wikstrom9 used crossover designs to evaluate several different massage interventions or techniques. Wikstrom et al.12 focused exclusively on plantar massage using 3 different methods: manual massage, a patient-delivered ball massager, and a patient-delivered sensory brush. All treatments were 5 minutes in duration with static and dynamic postural control measures assessed at the beginning and end of each session. LeClaire and Wikstrom9 compared static postural control with eyes open and eyes closed following 5 minutes of clinician-delivered plantar massage or calf massage. Each study had washout periods between treatment sessions to mitigate the chance for carryover effect. McKeon and Wikstrom13 compared the effects of different sensorimotor interventions on single-limb balance while on a force plate. Participants were randomly assigned to 4 different treatment groups: control, joint mobilization, plantar massage, or calf stretching. Participants received six 5-minute treatments over a 2-week period. Participants completed static postural control testing immediately after the first session of treatment and at the completion of all 6 treatments. Although McKeon and Wikstrom13 may be able to draw a stronger association between plantar massage and improved balance outcomes, as each patient received multiple treatment sessions, they only identified statistical significance immediately following the first treatment but not following 2 weeks of the intervention. Although each study investigated plantar massage in a unique way, all came to the same conclusion that plantar massage improves static postural control immediately following treatment when comparing preintervention and postintervention postural control.

Clinically, the critical appraisal of these studies demonstrates that plantar massage may be beneficial as an intervention during the rehabilitation of patients with CAI.9,12,13 Plantar massage is an intervention that does not require extra equipment and, therefore, can be easily integrated into a rehabilitation progression for patients following an ankle sprain to improve balance. Although the underlying mechanism to the development of CAI is unknown, it is apparent that minimizing static postural control deficits after an ankle sprain through rehabilitation is an important step in reducing the risk of long-term consequences.16 Multiple investigations have found reduced reinjury rates following the completion of balance and other sensorimotor training programs.17,18 It is also known that individuals who receive rehabilitation following an acute ankle sprain have better self-reported function.19 Although the outcomes and methods used in each study design are slightly different, all 3 investigations provided quality evidence that indicated that plantar massage acutely improved static balance in those with CAI. Therefore, for the purpose of this CAT, there is sufficient evidence to support the use of plantar massage to create immediate improvements in static postural control in patients with CAI.

This CAT is not without limitations. Wikstrom et al.12 and LeClaire and Wikstrom9 only investigated the immediate effects of plantar massage and other interventions on balance, whereas McKeon and Wikstrom13 examined balance after a single treatment as well as after several treatment sessions. Each study also had differing testing procedures. In addition to this, there was one consistent author for all 3 studies, which may limit the generalizability of the findings in this CAT.

Future research should examine postural control measures following plantar massage intervention with both a CAI group and a control group. This would improve the quality of evidence and, therefore, may strengthen the level of recommendation. Future research should also focus on determining long-term effects of plantar massage on patients with CAI and incorporating it with other sensorimotor interventions. Ankle instability is not a condition that can be rehabilitated in one treatment session. Therefore, research should expand in ways that are more applicable to clinical practice, allowing clinicians to provide patients with the best outcomes possible. This could include more research examining the effect of postural control on dynamic balance. Finally, future research should also investigate postural control outcomes in acute ankle sprain patients who receive sensorimotor-directed rehabilitation immediately following their injury. Examining these ankle sprain patients long-term could help identify whether sensorimotor rehabilitation could potentially mitigate the balance deficits seen in patients with CAI. The clinical bottom line of this CAT was based on 3 moderate-to-high-quality studies: 1 randomized controlled trial and 2 crossover studies. This recommendation should be revisited if further evidence becomes available within the area of this clinical question.

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References


