The Effectiveness of Deep Oscillation Therapy on Reducing Swelling and Pain in Athletes With Acute Lateral Ankle Sprains

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Clinical Scenario: Ankle sprains are the most prevalent athletic-related musculoskeletal injury treated by athletic trainers, often affecting activities of daily living and delaying return to play. Most of these cases present with pain and swelling in the ankle, resulting in decreased range of motion and strength deficits. Due to these impairments, proper treatment is necessary to avoid additional loss of play and prevent future injuries. Recently, there has been an increased use of deep oscillation therapy by clinicians to manage pain and swelling following a variety of injuries, including ankle sprains. However, very little evidence has been produced regarding the clinical effectiveness of deep oscillation therapy, limiting its application in therapeutic rehabilitation of acute lateral ankle sprains. **Clinical Question:** Is deep oscillation therapy effective in reducing pain and swelling in patients with acute lateral ankle sprains compared with the current standard of care protection, rest, ice, compression, and elevation? **Summary of Key Findings:** The literature was searched for studies of level 2 evidence or higher that investigated deep oscillation therapy on pain and inflammation in patients with lateral ankle sprains. Three randomized control trials were located and appraised. One of the 3 studies demonstrate a reduction in pain following 6 weeks of deep oscillation therapy compared with the standard of care or placebo interventions. The 2 other studies, 1 utilizing a 5-day treatment and the other a 1 time immediate application, found no differences in deep oscillation therapy compared with the standard of care. **Clinical Bottom Line:** There is inconclusive evidence to support the therapeutic use of deep oscillation therapy in reducing pain and swelling in patients with acute lateral ankle sprains above and beyond the current standard of care. In addition, the method of treatment application and parameters used may influence the effectiveness of deep oscillation therapy. **Strength of Recommendation:** Level B.

Keywords: HIVAMAT, effusion, visual analog scale

Clinical Scenario

Ankle sprains are the most prevalent athletic-related musculoskeletal injury treated by athletic trainers, often affecting activities of daily living and delaying return to play.¹ Most of these cases present with pain and swelling in the ankle, resulting in decreased range of motion and strength deficits.¹ Due to these impairments, proper treatment is necessary to avoid additional loss of play and prevent future injuries. Recently, there has been an increased use of deep oscillation therapy by clinicians to manage pain and swelling following a variety of injuries, including ankle sprains. However, very little evidence has been produced regarding the clinical effectiveness of deep oscillation therapy, limiting its application in therapeutic rehabilitation of acute lateral ankle sprains.

Clinical Question

Is deep oscillation therapy effective in reducing pain and swelling in patients with acute lateral ankle sprains compared with the current standard of care protection, rest, ice, compression, and elevation?

Summary of Key Findings

- The literature was searched for studies of level 2 evidence or higher that investigated deep oscillation therapy on pain and inflammation in patients with lateral ankle sprains.

- Three randomized control trials were located and appraised.
- One of the 3 studies demonstrate a reduction in pain following 6 weeks of deep oscillation therapy compared with the standard of care or placebo interventions.
- The 2 other studies, 1 utilizing a 5-day treatment and the other a 1-time immediate application, found no differences in deep oscillation therapy compared with the standard of care.

Clinical Bottom Line

There is inconclusive evidence to support the therapeutic use of deep oscillation therapy in reducing pain and swelling in patients with acute lateral ankle sprains above and beyond the current standard of care. In addition, method of treatment application and parameters used may influence the effectiveness of deep oscillation therapy.

Strength of Recommendation

Based on the Oxford Centre for Evidence-Based Medicine scale, level B evidence exists. Although each article examined was a randomized control trial, low PEDro scores and methodological limitations (ie, lack of parameter reporting, variety in length of interventions used, inconclusive results, etc) hinder the immediate application of deep oscillation therapy in the clinical setting for reducing pain and swelling in patients with acute lateral ankle sprains. Further research is needed and is likely to have an important impact on the recommendation on deep oscillation therapy use.

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Search Strategy

Terms Used to Guide Search Strategy

- Patient/client group: ankle sprains AND athlete
- Intervention (or Assessment): deep oscillation therapy
- Comparison: cryotherapy AND compression
- Outcome(s): reduction in swelling, pain

Sources of Evidence Searched

- The Cochrane Library
- PubMed
- PEDro Database
- MEDLINE
- CINAHL
- SPORTDiscus

Inclusion and Exclusion Criteria

Inclusion

- Limited to English language
- Limited to humans
- Limited to the last 10 years (2008–2018)
- Level 2 evidence or higher
- Studies investigating common treatments of acute lateral ankle sprains

Exclusion

- Studies investigating multiple lower-extremity pathologies
- Studies investigating adolescents

Results of Search

Three relevant studies^{2–4} were located and categorized as shown in Table 1 (based on levels of evidence, Centre for Evidence Based Medicine).⁵

Best Evidence

The following studies were identified as the “best” evidence and selected for inclusion in the critically appraised topic (CAT) (Table 2). These studies were selected because they had a level of evidence grade of at least 2, randomly compared deep oscillation therapy with standard of care treatment of ankle sprains and explained the effect of deep oscillation on pain and swelling.

Table 1 Summary of Study Designs of Articles Retrieved

Level of evidence	Study design/methodology	Number located	Author
Ib	Randomized control trial	3	Winkelmann et al ² Aliyev ³ Friesen ⁴

Implications for Practice, Education, and Future Research

Deep oscillation therapy is a modality that uses repetitive electrostatic oscillations that is theorized to improve relief from pain and swelling by mobilizing lymph fluid and swelling back into body circulation.⁶ The low-frequency electrostatic field is thought to produce a pulsating effect in underlying tissues, directly enhancing the movement of swelling via the lymphatic system and bringing more blood to the affected area.^{6,7} However, the results of the current CAT do not support the use of deep oscillation therapy for the purpose of reducing pain and swelling following an acute lateral ankle sprain.

Each of the 3 reviewed articles only included patients with low-grade acute lateral ankle sprain, within 48 to 72 hours^{2,3} and up to 1 week³ following injury, meaning these results are generalizable to a specific patient population. Of the 3 studies reviewed in this CAT, only 1 study³ described statistically significant reduction in swelling and pain after acute ankle sprains in the deep oscillation therapy condition compared with the standard of care. The study above states that on the visual analog scale (0–10), patients in the treatment group improved from 9 (2) to 2 (2) compared with the control group whose pain decreased from 8 (2) to 5 (3). This same study found that after a 6-week treatment protocol, the treatment group had 0.2 cm of swelling remaining compared with 0.8 cm from the control group, as measured at the smallest circumference of the lower leg, ankle, and instep of the navicular bone.³ According to this study, deep oscillation therapy is effective at reducing pain and swelling, while promoting joint stability.

Despite the significant results from the study above, 2 other studies were statistically inconclusive on whether deep oscillation therapy has an effect on pain and swelling.^{2,4} Winkelmann et al² determined that immediately following 1 treatment of deep oscillation therapy, there was an immediate reduction in pain and swelling, but no difference between deep oscillation therapy and the standard of care.² Similarly, Friesen⁴ found reductions in pain and swelling following the first treatment, but no significant reductions in days 2 to 5 following injury, similar to the standard of care. These findings indicate that deep oscillation therapy does not conclusively reduce the swelling and pain in athletes suffering from lateral ankle sprains after a single treatment or a 5-day protocol of deep oscillation therapy.^{2,4} Conversely, Aliyev³ used a 6-week conservative treatment protocol that demonstrated a significant reduction in pain and swelling, while also improving patient reported outcomes and patient satisfaction, making it possible that longer applications of deep oscillation therapy could be beneficial.

It should also be noted here that detailed information regarding the parameters used in the included studies were lacking. Reported frequencies ranged from 150 to 165 Hz; however, the authors do not report if higher or lower frequencies produced a greater benefit, and 1 study omitted frequency altogether.³ Treatment duration in 2 studies^{2,3} was set for 20 to 25 minutes but not reported in the third investigation.⁴ Unfortunately, this paucity of information lead to an overall low methodological quality (as measured by PEDro scores) and does not allow for the development of clinical recommendations into which parameters would be best for deep oscillation therapy. Adequate parameters for deep oscillation therapy, such as frequency, duration, and length of intervention, warrant further investigation.

Although the scope of this CAT was to assess the effectiveness of deep oscillation therapy on pain and swelling, the included

Table 2 Characteristics of Included Studies

	Winkelmann et al ²	Aliyev ³	Friesen ⁴
Study design		Randomized control trial	
Participants	38 male and female college athletes and recreationally active individuals (18–24 y) Subjects were randomized into experimental or control groups Subjects were eligible if they had suffered a grade 1 or 2 lateral ankle sprain by an athletic trainer within 48 h of injury Subjects were excluded if they were currently taking any nonsteroidal anti-inflammatory medication within the past 24 h Groups comparable at the start of the study	43 male (70%) and female amateur athletes (20–28 y) Subjects were randomized into treatment or control groups Subjects were eligible if they had suffered from their first ankle sprain within the last week and were willing to go through a 6-wk treatment protocol Subjects were excluded if they had a bony injury of the ankle joint with surgical treatment, concomitant injury present, grade 3 sprain, and radiographic degenerative disease of the ankle joint Groups comparable at the start of the study	21 healthy, physically active, college students with acute ankle sprains (18–25 y) Subjects were randomized into treatment or control groups Subjects were eligible if they had suffered any inversion ankle injury within 3 d that resulted in swelling and point tenderness Subjects were excluded if they had any of the following contraindications: acute infection, active tuberculosis, infectious skin disease, untreated thromboses, heart complaints, and cardiac pacemakers. Groups comparable at the start of the study
Intervention investigated	Deep oscillation with Hivamat® 20 min (150–165 Hz and 1:1 pulse to pause time) 20 min of standard of care including ice, compression wrap, and elevation at 45° of hip flexion Control group received 20 min of deep oscillation with placebo Hivamat® prior to start of care	Both groups continuously wore an Aircast® brace for 6 wk outside of treatments. During treatments both groups had ice with elevation and compression Control group received 20 min of placebo deep oscillation, whereas treatment group received 20–25 min of deep oscillation (no other parameters reported)	Control group received 20 min of cold/intermittent compression via Game Ready® at 50–55°C and 20.32 cm Patients then received placebo deep oscillation treatment for 20 min followed by doing the following rehabilitation exercise: 2 sets of writing the alphabet, 15 clockwise and 15 counterclockwise circles, and 4-way ankle range of motion exercises at 3 sets of 10. Treatment group received above rehabilitation plan, but had deep oscillation via Hivamat® (150 Hz)
Outcome measure(s)	Primary outcome: impact of Hivamat® on pain and swelling Secondary outcome: plantarflexion and dorsiflexion range of motion	Primary outcome: reduction of pain and inflammation in patients Secondary outcome: self-reported stability plantarflexion range of motion	Primary outcome: effectiveness of deep oscillation therapy to decrease swelling following ankle sprains Secondary outcome: effectiveness of deep oscillation therapy to decrease pain following ankle sprains
Main findings	Pain intensity significantly decreased ($F_{1,35} = 27.80$; $P < .001$, $\eta_p^2 = .44$); however, no interaction term was found Swelling had a significant decrease ($F_{1,34} = 12.35$; $P = .01$, $\eta_p^2 = .27$), but no interaction term was found Significant increases were found for plantarflexion range of motion ($F_{1,35} = 4.52$; $P = .04$, $\eta_p^2 = .01$ and dorsiflexion ($F_{1,35} = 1.06$; $P = .31$, $\eta_p^2 = .03$) within participants; yet, no interaction term was found	The subjective assessment of symptoms (pain numeric rating scale) improved significantly ($P < .001$) from 9.1 to 2.1 points after treatment 91% of patients in the treatment group were satisfied compared with 72% of control group after 6 wk of treatment	A significant difference between groups was found on day 1 of the treatment for pain reduction ($F_{1,24} = 4.477$, $P = .045$) No significant differences were found on days 2–5 A significant difference between groups was found on day 4 of the treatment for girth reduction ($F_{1,20} = 4.951$, $P = .04$)
Level of evidence	1b	2b	2b
Validity score (if applicable)	PEDro 6/10	NA	PEDro 4/10
Conclusion	A single session of deep oscillation therapy does not significantly improve the benefits above and beyond that of the standard care for acute lateral ankle sprains	The conservative treatment consisting of Aircast® brace and deep oscillation show statistical significance in reducing pain and inflammation	The addition of deep oscillation therapy to cryotherapy and compression is not statistically significant in reducing pain and swelling over a 5-d period in acute ankle sprains

articles did report other outcomes in these patients. One study included ankle range of motion in their assessment through goniometry and also assessed balance through the balance error scoring system.² This study found that patient plantarflexion and

dorsiflexion ROM significantly improved equally for both groups over a 5-day span. Friesen⁴ also concluded that the average balance error scoring system score showed no improvement after deep oscillation therapy, indicating that deep oscillation therapy had no

additive benefit to the standard of care.^{2,4} However, the readers should note that this was not the direct clinical question answered by this CAT; therefore, the effectiveness of deep oscillation therapy on other clinical outcomes needs to be investigated further.

Currently, there is no clinical link connecting deep oscillation therapy to the reduction of pain and inflammation in patients with lateral ankle sprains. The literature describes that using the standard of care (protection, rest, ice, compression, and elevation) has the same benefit as deep oscillation therapy in reducing pain and swelling.^{2,4} As deep oscillation therapy is a relatively new modality, more research is warranted to determine the effectiveness of deep oscillation therapy on pain and swelling, as well as other aspects of musculoskeletal injuries, such as patient-reported outcomes. In addition, further evaluation of deep oscillation therapy for other types of tissue injuries (ie, muscle, tendon, ligament) would add valuable information for its clinical utility in the future.

Clinicians incorporating deep oscillation therapy into lateral ankle injury rehabilitation programs should be aware of the lack of evidence supporting its use. Due to its lack of evidence in decreasing pain and swelling in ankle injuries, clinicians should consider an exercise-based approach using therapeutic exercise and muscle activation to increase lymphatic drainage and reduce swelling in the joint, coupled with cryotherapy for the reduction in pain.^{8,9} This CAT should be reviewed in 2 years to determine whether additional best evidence has emerged in the literature that may change the clinical bottom line for this clinical question.

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