Evidence-based treatment for ankle injuries: a clinical perspective

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The most common ankle injuries are ankle sprain and ankle fracture. This review discusses treatments for ankle sprain (including the management of the acute sprain and chronic instability) and ankle fracture, using evidence from recent systematic reviews and randomized controlled trials. After ankle sprain, there is evidence for the use of functional support and non-steroidal anti-inflammatory drugs. There is weak evidence suggesting that the use of manual therapy may lead to positive short-term effects. Electro-physical agents do not appear to enhance outcomes and are not recommended. Exercise may reduce the occurrence of recurrent ankle sprains and may be effective in managing chronic ankle instability. After surgical fixation for ankle fracture, an early introduction of activity, administered via early weight-bearing or exercise during the immobilization period, may lead to better outcomes. However, the use of a brace or orthosis to enable exercise during the immobilization period may also lead to a higher rate of adverse events, suggesting that this treatment regimen needs to be applied judiciously. After the immobilization period, the focus of treatment for ankle fracture should be on a progressive exercise program.

Keywords: Ankle injuries, Evidence-based practice, Rehabilitation, Systematic review, Therapy

Injuries to the ankle are common. In a recent systematic review, the ankle was found to be the most common site of injury in 24 of the 70 sports studied.¹ In addition, 22% of sports injuries presenting to emergency rooms were ankle injuries, among which sprain was the most common injury followed by fracture (the ratio of sprain to fracture is 8:1).² In the general population, the incidence of ankle sprain and fracture has been reported to be 600–700³ and 107–187^{4–7} per 100 000 person years, respectively.

Lateral ankle sprains account for 85% of all ankle sprains, the most common mechanism of injury being inversion of the plantar-flexed foot.⁸ After a sprain, persistent symptoms remain in up to 30% of individuals.⁹ Furthermore, a history of ankle sprain is the most common predisposing factor to the occurrence of ankle sprain.¹⁰ Similarly, after ankle fracture, symptoms such as pain, joint stiffness, and limitation in lower limb activities occur and may persist into the long term¹¹.

Sequelae after ankle injuries highlight the importance of effective treatment for these conditions. The purpose of this paper was to conduct a narrative review of two of the most common ankle injuries:

ankle sprain (including treatment for acute sprain and chronic instability) and ankle fracture.

Ankle Sprain

The management of ankle sprain is usually conservative and involves symptom management during the acute phase followed by a period of rehabilitation. The therapist is also often involved in the treatment of the main sequelae of ankle sprain: chronic ankle instability. In recent years, there have been a number of systematic reviews and randomized controlled trials of treatment of ankle sprain, which are considered here. It should be noted that all studies in the acute ankle sprain section are of a non-specific selection of ankle sprain unless stated.

Evidence-based treatment of acute ankle sprain

Functional support is preferable to immobilization for most ankle sprains. Functional support involves the use of a removable and variable immobility device and therefore often includes an exercise component in the treatment. A meta-analysis found significant differences in favor of functional support, which included brace, elastic bandage, tape, softcast, or wrap over immobilization.¹² Differences in favor of functional support included a higher percentage of people returning to sports, shorter time to return to work, less persistent swelling, and greater range of

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motion. However, neither Kerkhoffs *et al.*¹² nor a subsequent review¹³ found a difference in rate of instability, either objective or subjective, or recurrent sprain between immobilization and functional support.

In contrast to these results, a recent large pragmatic randomized controlled trial comparing immobilization for 10 days in a below-knee cast with tubular bandage, a Bledsoe boot or an AircastTM brace, found that people with the cast had better clinical benefits at three months post-injury;¹⁴ however, all differences had disappeared by 9 months. While this study appears to contradict the previous reviews and current practice, it needs to be noted that this study exclusively recruited patients with severe ankle sprain (unable to weight-bear for at least 3 days). In addition, there are a number of limitations that should mitigate decision making during practice. Outcomes were by self-reports so there was no assessor blinding. The drop-out rate was 17% before the first follow-up, and the compliance rate with the functional supports was unknown. Therefore, current practice of using functional support rather than immobilization for most ankle sprains should remain in place until follow-up of the latest trial confirms the result.

The type of functional support that is preferable to use may depend on the main outcome desired. A systematic review comparing the use of one type of functional support with another (included elastic bandage, tape, semi-rigid support, and lace-up ankle support) found them equally effective in reducing pain, swelling, ankle instability, and preventing recurrent sprain.¹⁵ A semi-rigid support appeared more effective for earlier return to sport, and tape resulted in more skin complications. A more recent comparison of an Aircast ankle brace with elastic support bandage group demonstrated a significant improvement in ankle joint function at 10 and 30 days when using the ankle brace.¹⁶

There is fairly consistent evidence that the use of non-steroidal anti-inflammatory drugs during the first 2 weeks following ankle sprain, administered orally or topically, is more effective than a placebo.^{17,18} Only one study followed patients for a longer period;¹⁹ it reported that Piroxicam taken for 1 week significantly improved function at all time points up to 6 months compared with a placebo. However, the study also reported greater range of motion restriction and mechanical instability in the intervention group in the short term.

The extent and quality of the available evidence for the effects of electro-physical agents for treatment of acute ankle sprains are limited. Ultrasound does not appear to be effective although as the tested dosage range and treatment times are limited, there may be an effect using untested variables.^{17,20} The use of laser

has conflicting evidence of effectiveness. In one study, low-level laser with rest, ice, compression, and elevation (RICE) was shown to reduce swelling up to 3 days after the treatment when commenced within 8 h of injury and given twice a day, compared with RICE alone, or RICE and placebo laser.²¹ Another study showed that neither high nor low-level laser was more effective than placebo in reducing pain.²² Furthermore, those in the placebo group had significant improvements in some outcomes compared to those who received laser, most markedly on the re-uptake of work and sports.

Manual therapy in a number of forms has been shown to have positive effects after acute^{23,24} and subacute ankle sprain.^{25,26} However, this evidence is weak (generated from small randomized controlled trials or cross-over studies) and the effects may be short-lasting (Table 1). Following acute ankle sprain, a passive anteroposterior glide of the talus was better at increasing dorsiflexion range of motion than rest, ice, compression, and elevation at the end of the treatment period.²⁴ The addition of osteopathic ankle manipulation to standard care reduced swelling and pain at the end of the treatment session.²³ These effects appeared clinically worthwhile but disappeared at the short-term (5–7 days) follow-up. During the subacute phase, both Mulligan's mobilization with movement²⁵ and a chiropractic mortise adjustment technique²⁶ increased dorsiflexion range immediately following treatment in participants with Grade II and Grades I and II sprains, respectively. Manual therapy also increased ankle function up to 1 month following the treatment.²⁶

Three systematic reviews of the effect of exercise compared with usual care concluded that exercise resulted in less risk of recurrent sprain^{27,28} (relative risk: 0.37, 95% CI = 0.18–0.74),²⁸ and there was limited evidence of a greater reduction in swelling and faster return to work.²⁹ Since the publication of the systematic reviews, two randomized controlled trials have been published. Contrary to the results of previous systematic reviews, van Rijn *et al.*³⁰ showed that supervised exercises (including balance, walking, and running) in addition to usual care did not reduce the rate of recurrent ankle sprain or improve subjective recovery. This finding was consistent regardless of the severity of the sprain.³¹ However, data reported from the study suggested a large amount of variance in the results (e.g. the relative risk of the rate of recurrent ankle sprain is 0.88 for supervised exercises at the 12 month follow-up, 95% CI = 0.47 to 1.63),³⁰ possibly due to the small number of resprains (29 in a total cohort of 102 participants). In a larger study ($n = 522$), Hupperets *et al.*³² found that adding balance exercises to usual care reduced the rate of recurrent ankle sprain (relative risk: 0.63, 95% CI = 0.45–0.88). This study and results of previous

Table 1 Effects of manual therapy after ankle sprain

Study	Groups	Manual therapy	Follow-up time points	Outcomes and between-group differences* [mean (95% CI)]
Collins <i>et al.</i> ²⁵	<ul style="list-style-type: none"> • manual therapy; • placebo manual therapy (manual contact only); • control (control stance in treatment position); • $n = 16$; • cross-over trial 	<ul style="list-style-type: none"> • Mulligan's mobilization (anterior-posterior glide) with movement in weight-bearing dorsiflexion with seatbelt; • three sets of 10 to end of pain-free range; • one session for each treatment condition only. 	Post-treatment	Ankle dorsiflexion ROM (degrees): <ul style="list-style-type: none"> • manual therapy versus placebo = 6.9 (−23.7–37.4); • manual therapy versus control = 12.5 (−16.3–41.3)
Eisenhart <i>et al.</i> ²³	<ul style="list-style-type: none"> • manual therapy, RICE, analgesics, Jones compression ($n = 28$); • RICE, analgesics, Jones compression ($n = 27$) 	<ul style="list-style-type: none"> • individualized osteopathic manipulative treatment for 10–20 min in supine; • one session only. 	Post-treatment and 5–7 days later	Ankle dorsiflexion ROM (degrees): <ul style="list-style-type: none"> • post-treatment = 16.8 (10.4–23.2); • 5–7 days = 3.5 (−6.0–13.0) Pain (visual analog scale, /10): <ul style="list-style-type: none"> • post-treatment = −3.15 (−4.3 to (−2.0)); • 5–7 days = −0.4 (−1.8–1.1) Ankle dorsiflexion ROM (degrees): <ul style="list-style-type: none"> • 7.1 (1.3–12.9)
Green <i>et al.</i> ²⁴	<ul style="list-style-type: none"> • manual therapy plus RICE ($n = 19$); • RICE only ($n = 19$) 	<ul style="list-style-type: none"> • Maitland anterior-posterior talocrural mobilization with pain-free force at pain-free limit of dorsiflexion; • three sets of 60 s, up to six sessions over 2 weeks; • chiropractic mortise separation adjustment; • up to eight treatments over 4 weeks. 	End of first and last treatment	
Pellow and Brantingham ²⁶	<ul style="list-style-type: none"> • manual therapy ($n = 15$); • detuned ultrasound ($n = 15$) 		End first and last treatment session, 1 month	Ankle dorsiflexion ROM (degrees): <ul style="list-style-type: none"> • last treatment = 4.3 (0.2–8.3); • 1 month = 5.2 (2.5–7.9) Pain (numerical rating scale, %) <ul style="list-style-type: none"> • last treatment: −7.4 (−20.6–5.8); • 1 month: −8.5 (−19.2–2.1) Disability (Kaikonen scale): <ul style="list-style-type: none"> • last treatment = 13.7 (4.5–22.8); • 1 month = 14.3 (7.5–21.2)

Note: *All studies are randomized controlled trials unless otherwise stated. Only primary outcomes are reported. For studies that did not distinguish outcomes as primary or secondary, pain intensity, disability, and range of motion outcomes (if available) are reported. Timing of the outcomes is for the end of treatment period and end of follow-up (if available). RICE = rest, ice, compression and elevation; ROM = range of motion.

systematic reviews suggest that exercise may be beneficial in reducing the risk of recurrent sprain.

Evidence-based treatment of chronic ankle instability

Manifestations of chronic ankle instability include recurrent ankle sprains, the sensation of the ankle 'giving way', pain, impaired performance during functional tasks, and perceived difficulties with activities of daily living. The main interventions for chronic ankle instability are external ankle supports and exercise. The use of external ankle supports has been the subject of two systematic reviews,^{33,34} which concluded, with fairly strong evidence, that the use of supports during sporting activity results in a decreased risk of recurrent ankle sprain.³⁴

A combination of factors may contribute to chronic ankle instability, including diminished neuromuscular control, proprioception and postural control deficits, muscle weakness, impaired joint position sense, and ligament laxity.^{8,35,36} A number of recent systematic reviews demonstrated balance and proprioceptive deficits in patients with chronic ankle instability,³⁷⁻³⁹ and exercise as well as neuromuscular and balance interventions appeared to be effective in addressing these deficits.^{27,39,40} However, the relationship between improving these deficits and the effect on subjective or objective instability or recurrent sprain was unclear. While programs that included balance and muscle strengthening exercises were effective in decreasing the incidence of 'giving way' episodes, reducing recurrent sprain and improving function in participants with chronic ankle instability,^{28,41} the quality of the studies were low.²⁸ A number of recent randomized controlled trials have demonstrated an improvement in balance and severity of chronic instability, but there was no long-term follow-up so the effect on recurrent sprain rate was unknown.^{40,42,43} Owing to the heterogeneity of the various rehabilitation programs, it is difficult to pinpoint the potentially effective components of the programs. A common clinical thought is that wobble board or disk training is the essential component, but there is no direct evidence to support this.

Ankle Fracture

The management of ankle fracture usually involves surgical or conservative fracture reduction, followed by a period of immobilization and rehabilitation.⁴⁴ Rehabilitation for ankle fracture may start during the immobilization period, for example, with commencement of weight-bearing or exercise. More often, rehabilitation for ankle fracture starts after the immobilization period. Recently, there has been one systematic review⁴⁵ and one Cochrane review⁴⁶ on treatments for rehabilitation after ankle fracture.

Evidence-based treatment for ankle fracture during the immobilization period

Most of the randomized controlled trials examining treatment for ankle fracture during the immobilization period included only subjects who had had surgical rather than conservative orthopedic management.⁴⁶ There is some evidence that an early introduction of activity during this period may be beneficial for people after surgical fixation.^{45,46} For example, the use of a removable type of immobilization (e.g. orthosis and brace) so that gentle ankle exercise is possible improved function, pain, and ankle range of motion; allowing early weight-bearing during the immobilization period also improved ankle range of motion. However, the use of a removable type of immobilization combined with early exercise may also lead to a higher rate of adverse events. These adverse events were generally minor (e.g. changes in skin sensation), but there were a few cases where revision surgery was required. The higher rate of adverse events indicates that this treatment needs to be applied judiciously in clinical practice, for example, only in patients who are able to comply with the regimen. The use of a compression stocking in addition to a cast, or electro-physical agents (ultrasound, electrical muscle stimulation or interferential) during the immobilization period did not improve outcomes after surgical fixation.⁴⁶

Since the publication of these reviews, one additional randomized controlled trial has been published; it investigated the effects of an orthosis that allowed some ankle movement after surgical fixation.⁴⁷ The results were comparable to previous studies on removable immobilization combined with ankle exercise, that is, there was an improvement in function and ankle range of motion when this treatment was compared to cast immobilization. However, one case of impaired wound healing required surgical revision in the treatment group.

Evidence-based treatment for ankle fracture after the immobilization period

Treatments prescribed for ankle fracture after the immobilization period typically include exercise, manual therapy, progression of mobility, and a gradual increase in activities.⁴⁸ The Cochrane review identified two randomized controlled trials that examined the effectiveness of stretching or manual therapy.⁴⁶ Adding stretching exercises to a general exercise program did not improve outcomes after ankle fracture.⁴⁹ A small study ($n = 10$) provided some preliminary results on manual therapy; when applied in addition to exercises, manual therapy (Kaltenborn-based) did not improve function but did increase dorsiflexion range of motion compared to exercise alone⁵⁰ (mean = 4.2°, 95% CI = 0.9–7.5, Table 2).

We further investigated the effectiveness of manual therapy (large amplitude anterior–posterior glides of the talus) in a randomized controlled trial of 94 participants.⁵¹ There were no clinically worthwhile differences between the treatment (manual therapy plus exercise) and control (exercise only) groups in all outcomes, including function and ankle range of motion (Table 2). These findings were consistent regardless of the severity of fracture. Furthermore, although the overall costs did not differ between groups, participants in the treatment group incurred more out-of-pocket costs. Our findings may only apply to the specific manual therapy technique used; however, there is some evidence in recurrent ankle sprain showing that different techniques do not lead to a difference in outcomes.⁵²

Thus, current evidence on treatments for ankle fracture after the immobilization shows that the addition of stretching or manual therapy to exercises did not enhance outcomes. This suggests that treatment for ankle fracture after the immobilization should be focused on a progressive and structured exercise program.

Prognostic factors

Studies on factors that can predict or influence outcome in ankle fracture may assist clinicians in allocating treatment resources and advising patients according to the expected prognosis. Factors found to be associated with outcomes after ankle fracture include the type of orthopedic management (surgical or conservative),^{11,53–57} fracture severity,^{11,54,58–64} ankle range of motion,^{54,65} and pain⁶⁵. While ankle fracture managed surgically achieves better anatomical reduction than conservative means,^{53,55,56} the implication of this on clinical outcomes is unclear with some authors finding no difference between surgical or conservative management,^{11,53,56} some favoring surgical management,⁵⁵ and others favoring

conservative management.^{54,57} Similarly, it is not clear whether the severity of ankle fracture, classified using the Weber system,⁴⁴ predicts outcomes, due to conflicting findings in the literature.^{11,58,60–64} Methodological flaws, such as retrospective data collection and significant losses of subjects to follow-up, may have contributed to the conflicting results.

Classifying fracture severity according to the number of malleoli fractured appears to provide a more reliable prediction of outcome. Unimalleolar fracture has been consistently shown to be associated with better outcomes than bimalleolar or trimalleolar fracture.^{54,58,60,62} There is also some indication that baseline ankle dorsiflexion range of motion and pain are independent predictors of function, perceived recovery, and dorsiflexion range of motion in the short and medium term.^{54,65} However, further research is required to investigate whether modifying these factors, or selectively providing patients with significant problems in dorsiflexion range of motion and pain with a more intensive rehabilitation program, will lead to better outcomes.

Conclusion

Evidence-based treatment of acute ankle sprain should consist of functional support, possibly augmented by non-steroidal anti-inflammatory drugs in the early phases after injury. Manual therapy may also provide very short-term benefits after ankle sprain. Recent studies showed the additional benefits of exercise, particularly balance exercises, in reducing the risk of a recurrent sprain. The use of electro-physical agents does not appear to enhance, and may even negate, outcomes. In the case of chronic ankle instability, balance and strengthening exercises may be advantageous in reducing ‘giving way’ episodes and improving function. After ankle fracture, current evidence supports an early introduction of activity to enhance outcomes. This can be administered via the

Table 2 Effects of manual therapy after ankle fracture from randomized controlled trials

Study	Comparison	Manual therapy	Follow-up time points	Outcomes and between-group differences* [mean (95% CI)]
Lin <i>et al.</i> ⁵¹	Manual therapy plus exercise (<i>n</i> = 47) versus exercise only (<i>n</i> = 47)	<ul style="list-style-type: none"> • large amplitude (grade III) anterior–posterior glides of the talus in supine or long sitting; • 3–5 sets of 60 s, two times a week for 4 weeks 	4, 12, and 24 weeks	Disability (lower extremity functional scale, /80): <ul style="list-style-type: none"> • 4 weeks: −0.3 (−5.1–4.5); • 24 weeks: −1.0 (−5.9–3.9) Health-related quality of life (assessment of quality of life): <ul style="list-style-type: none"> • 4 weeks: 0.9 (−0.5–2.3); • 24 weeks: 1.3 (0.1–2.5)
Wilson ⁵⁰	Manual therapy plus exercise (<i>n</i> = 5) versus exercise only (<i>n</i> = 5)	<ul style="list-style-type: none"> • Kaltenborn-based manual therapy (including traction and gliding mobilization) to the talocrural and talocalcaneal joints, and other hypomobile lower limb joints; • three times a week for 5 weeks 	5 weeks	Disability (modified Olerud–Molander ankle score, /100): <ul style="list-style-type: none"> • 21 (−1.4–43.40) Ankle dorsiflexion ROM (degrees): <ul style="list-style-type: none"> • 4.2 (0.9–7.5) Ankle plantarflexion ROM (degrees): <ul style="list-style-type: none"> • −7.4 (−16.34–1.54)

Note: *Only primary outcomes are reported. For studies that did not distinguish outcomes as primary or secondary, pain intensity, disability, and range of motion outcomes (if available) are reported. Timing of the outcomes is for the end of treatment period and end of follow-up (if available). ROM = range of motion.

commencement of exercise or weight-bearing during the immobilization period in patients who will comply with this treatment regimen. After the immobilization period, adding adjunct treatments to a comprehensive exercise program may not improve outcome, and hence the focus of the treatment should be on exercise.

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