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Proprioceptive Training for the Prevention of Ankle Sprains: An Evidence-Based Review

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Reference: Schiftan GS, Ross LA, Hahne AJ. The effectiveness of proprioceptive training in preventing ankle sprains in sporting populations: a systematic review and meta-analysis. *J Sci Med Sport*. 2015;18(3):238–244.

Clinical Question: Does the use of proprioceptive training as a sole intervention decrease the incidence of initial or recurrent ankle sprains in the athletic population?

Data Sources: The authors completed a comprehensive literature search of MEDLINE, CINAHL, SPORTDiscus, and Physiotherapy Evidence Database (PEDro) from inception to October 2013. The reference lists of all identified articles were manually screened to obtain additional studies. The following key words were used. Phase 1 population terms were *sport**, *athlet**, and a combination of the two. Phase 2 intervention terms were *propriocept**, *balance*, *neuromusc* adj5 train**, and combinations thereof. Phase 3 condition terms were *ankle adj5 sprain**, *sprain* adj5 ankle*, and combinations thereof.

Study Selection: Studies were included according to the following criteria: (1) the design was a moderate- to high-level randomized controlled trial (>4/10 on the PEDro scale), (2) the participants were physically active (regardless of previous ankle injury), (3) the intervention group received proprioceptive training only, compared with a control group that received no proprioceptive training, and (4) the rate of ankle sprains was reported as a main outcome. Search results were limited to the English language. No restrictions were placed on publication dates.

Data Extraction: Two authors independently reviewed the studies for eligibility. The quality of the pertinent articles was assessed using the PEDro scale, and data were extracted to calculate the relative risk. Data extracted were number of participants, intervention, frequency, duration, follow-up period, and injury rate.

Main Results: Of the initial 345 studies screened, 7 were included in this review for a total of 3726 participants. Three analyses were conducted for proprioceptive training used (1) to prevent ankle sprains regardless of history (n = 3654), (2) to prevent recurrent ankle sprains (n = 1542), or (3) as the primary preventive measure for those without a history of ankle sprain (n = 946). Regardless of a history of ankle sprain, participants had a reduction in ankle-sprain rates (relative risk [RR] = 0.65, 95% confidence interval [CI] = 0.55, 0.77; numbers needed to treat [NNT] = 17, 95% CI = 11, 33). For individuals with a history of ankle sprains, proprioceptive training demonstrated a reduction in repeat ankle sprains (RR = 0.64, 95% CI = 0.51, 0.81; NNT = 13, 95% CI = 7, 100). Proprioceptive training as a primary preventive measure demonstrated significant results (RR = 0.57, 95% CI = 0.34, 0.97; NNT = 33, 95% CI = 16, 1000).

Conclusions: Proprioceptive training programs were effective in reducing the incidence rates of ankle sprains in the athletic population, including those with and those without a history of ankle sprains.

Key Words: balance, coordination, reinjury

COMMENTARY

Ankle sprains are the most common injuries managed by athletic trainers.[1,2] Physically active individuals participating in activities that require jumping, changing direction, and pivoting are at increased risk for ankle sprain.[3,4] After an initial ankle sprain, the joint's passive (eg, joint capsule) and dynamic (eg, muscle) restraints are weakened, leaving the joint unprotected and at risk for reinjury.[2] Ankle sprains and the repetitive trauma often associated with the condition can lead to long-term disability, time lost from activity, and economic burdens for patients.[4] Although the cost of treatment after a single ankle sprain is low, compounding expenses for extended care to address repetitive sprains in patients with conditions such as chronic ankle instability can increase the economic burden.[5] These costs, coupled with the declining physical activity levels and health-related quality-of-life deficits experienced by these individuals, highlight the importance of developing preventive strategies.[5]

Proprioception is defined as the neural process by which the body takes in sensory input from the surrounding environment and integrates that information to produce a motor response.[3] Examples of proprioceptive training for the ankle joint include balancing on a single leg with the eyes closed, balancing on a wobble board or ankle disk, and balancing on a single leg while completing a task such as catching or throwing a ball.[1–4] These types of exercises can enhance the sensorimotor system's ability to adapt to a changing environment and subsequently protect the body from injury.

The authors of this systematic review and meta-analysis examined the isolated role of proprioceptive training in preventing ankle sprains. In evaluating the prophylactic effectiveness of proprioceptive exercises regardless of ankle-sprain history, the researchers identified a reduction

in ankle sprains (relative risk [RR] = 0.65, 95% confidence interval [CI] = 0.55, 0.77; numbers needed to treat [NNT] = 17, 95% CI = 11, 33). The first meta-analysis (n = 3654 participants) demonstrated a significant decrease ($P = .46$) in ankle sprains, with an NNT of 17. This means that for every 17 patients (regardless of ankle-sprain history) who complete proprioceptive training, clinicians can prevent 1 ankle sprain from occurring. Furthermore, the RR of 0.65 indicates that individuals who completed prophylactic proprioceptive training had a 35% reduction in the risk of ankle sprain compared with those who did not. The second meta-analysis showed a significant reduction in the incidence of recurrent ankle sprains for groups treated with proprioception to an NNT of 13. In addition, participants with a history of ankle sprains had a 36% reduction in risk for subsequent ankle sprains (RR = 0.64). The final meta-analysis illustrated a reduction for individuals without a history of ankle sprain who completed proprioceptive training (to an NNT of 33). The analysis of risk indicated a 43% reduction in the risk of ankle sprain for those with no history of ankle sprain (RR = 0.57). However, this number should be interpreted cautiously because it had the widest CI: reductions in risk were from 3% to 66%, with the 95% CI = 0.34, 0.97. In this situation, a clinician who implements a proprioception-based ankle-training program for a typical National Collegiate Athletic Association Division I football team of 85 athletes can expect to prevent 2 to 3 ankle sprains, assuming no one on the team has a history of ankle sprains.

The prophylactic proprioceptive training programs included in the systematic review lacked standardization. Durations ranged from 5 to 30 minutes, frequencies ranged from 1 to 5 times per week, and lengths ranged from 4 weeks to an entire athletic season.[6–9] In addition, the preventive exercises ranged from balancing on a stable surface with the eyes closed to balancing on a tool such as a wobble board or DynaDisc (Exertools, San Rafael, CA) and could be included as a warm-up, rehabilitative session, or home-based program.[6–9] Furthermore, the control groups did not complete a prophylactic training program, but they did participate in normal presport activities such as warm-ups or strengthening exercises.[6–9] These variations and the lack of reporting by some investigators make it difficult to offer concrete recommendations. Yet the authors of the systematic review[4] suggested that proprioceptive training programs of longer length may be more effective. A longer proprioceptive training program may be best introduced as part of a sport team's warm-up before physical activity.[4] This is a relatively simple and effective mechanism for a preventive strategy.[4] Although longer-lasting programs are recommended, it is important to note that relatively short proprioceptive training programs that used limited equipment have also demonstrated preventive effects.[3,4,6] A proprioceptive training program can be ideal for clinicians working in settings with large numbers of athletes who could benefit from preventive interventions.

Patient compliance with a rehabilitation program is a key factor in preventing injuries and returning to participation appropriately after injury.[4] Several of the studies in the present review[7–9] had noncompliance levels between 10% and 40%, which reflect compliance in clinical practice.[11] The authors of the systematic review[4] hypothesized that the effects of the preventive proprioceptive training programs might have been larger if the level of compliance had been greater. Although supervised programs initially lead to more favorable subjective outcomes than home-based programs, evidence[7] indicates that ankle-sprain reinjury rates were similar 1 year after initial injury. However, these data were from an acute lateral–ankle-sprain rehabilitation program, not a primary injury-prevention protocol. Thus, patient compliance may differ under these circumstances, which can influence the effectiveness of preventive strategies. This knowledge is helpful to clinicians as they decide whether to implement prophylactic proprioceptive programs in the clinic or at home.

In conclusion, proprioceptive training reduced a patient's risk of sustaining a first-time or recurrent ankle sprain.[4] Because the implementation details varied so greatly, clinicians should consider the amount of daily time they have to dedicate to a patient, the equipment available to them, and the treatment time span, given that no strong conclusions can be drawn from the literature.[4] Proprioceptive training is a cost- and time-effective intervention that can benefit patients who have sustained a previous ankle sprain during physical activity and can subsequently reduce the risk of further complications.[4,5]

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