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Proprioceptive exercises balance ankle stability and activity

The combination of exercises may reduce the chance of recurrent ankle sprains and reinjury.

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Chronic ankle instability, usually a result of recurrent sprains, is an ongoing problem, especially among active individuals. According to Holme et al,¹ lateral ankle sprains are common and account for nearly 15% of all sports injuries. Ankle sprains vary in severity and consequential disability based on the degree to which the ligaments are damaged. In most cases, ankle sprains are graded as mild, moderate, or severe.² The incidence of recurrent ankle sprain is high and leads to further ligamentous damage as well as damage to the mechanoreceptors.³ Long-term effects of repetitive ankle trauma leave an individual more susceptible to degenerative changes.³ Because of the degenerative changes and a reduction in proprioceptive awareness, a correlation to postural instability may exist,⁴ leading to a sense of not being coordinated and a loss of movement control. In order for an ankle to have control, muscles and nerves must function synergistically. If there is a deficiency in any area, a perceived sense of instability may be noted. An altered sense of balance will heighten functional ankle instability because of increased movement at the body's periphery, away from the center of gravity.⁵

Proprioception is defined as the ability to establish a sense of position in space, especially at a joint.² Kinesthesia means to detect movement.² Both of these functions are associated with the joint mechanoreceptors and are interrelated. If the mechanoreceptors are damaged when an ankle sprain occurs, proprioception will be affected, which results in a reduction in the body's ability to balance. Thus, proprioception will not be an effective mechanism for reducing the chance for further injury. Reeducation of the mechanoreceptors becomes a vital key to returning an individual to a perceived sense of stability.

Based on clinical experience, the majority of physical therapy clinics and athletic training rooms incorporate both strengthening and proprioception exercises to return patients and clients to activities of daily living or competitive athletics. Numerous studies have looked at the effects of strengthening exercises, proprioceptive exercises, or a combination of both on returning a patient to functional activity.⁶⁻¹¹ Methods of proprioceptive rehabilitation include single leg stance and ankle disk training. Both help to improve the neuromuscular control in the patient, client, or athlete, which results in a reduced likelihood of future ankle sprains.

Single leg stance

The single leg stance exercise is one of the mostly commonly used techniques for increasing proprioception. Single leg stance requires the individual to balance on one leg, generally without additional support. During rehabilitation, this method is used both for a baseline measurement of balance and to progress patients as they recover. A level of progression might be to take away vision (eyes closed), making the single leg stance more difficult. As a person progresses through various techniques, the single leg stance can be made more challenging by changing surfaces and other ambient factors. Throughout the literature, the single leg stance has been used in conjunction with other rehabilitation and proprioceptive techniques. No specific study published between 1995 and September 2005 and available on PubMed or EBSCO has looked solely at the effectiveness of single leg stance. On the other hand, single

leg stance appears to have been a key element in every proprioceptive program reviewed.

Ankle disk training

An ankle disk, commonly used in research studies,⁶⁻¹¹ is generally described as a circular platform with a half ball underneath used for balancing exercises. The exercises might involve using one or two legs to move the disk in multiple directions. The ankle disk is used to move an individual's ankle or ankles (single leg or double leg stance) through dorsiflexion/plantar flexion, inversion/eversion, and clockwise/counterclockwise directions. Because of its circular design, the ankle disk allows for multiplanar movement and a wide variety of exercises.

Ankle disk training has been shown to help improve balance in a single leg stance.⁶⁻¹¹ Studies have been performed using both healthy^{7,10} and previously injured^{6,8} subjects to determine the effectiveness of the device. Sheth and colleagues¹⁰ used healthy subjects to simulate an ankle sprain and assess its effects on various muscles. After eight weeks of training with the ankle disk, the subjects showed improvement in muscle contraction that may reduce the chance of a lateral ankle sprain. An earlier study by Hoffman and Payne⁷ found significant improvements after using the ankle disk three times per week for 10 weeks on healthy subjects. Both studies used reproducible research methods. Hoffman and Payne used stabilometry recordings to determine how well an individual can balance, while Sheth and colleagues used fine-wire electrodes to see how quickly muscle contractions occur.^{7,10} Although different in design, the aims of both studies were similar: to determine the increased neuromuscular control and proprioception benefits of ankle disk training for a healthy subject.

Studies have also been conducted to determine the effectiveness of ankle disk training in helping to reduce the chance of further injury for patients with previous ankle sprains. Eils and Rosenbaum used a multistation proprioceptive training program, including ankle disk training, for a period of six weeks.⁶ They looked at postural sway, joint position sense, and muscle reaction times and found significant improvements in plantar flexion angle of reproduction and all aspects of postural sway and a slight increase in muscle reaction times after completion of the training program. Slightly more comprehensive in the number of exercises used for its proprioceptive exercise program, this study did involve the ankle disk and overall results were favorable.

Another study used electromyographic (EMG) recordings to determine muscle onset latency.⁸ The procedure used was identical to that of Sheth and colleagues, but the subjects were individuals with a history of ankle sprains. They used the ankle disk for a period of eight weeks before being retested. The results showed a significant decrease in the muscle onset latency of the anterior tibialis, peroneus longus, flexor digitorum longus, and posterior tibialis. This study shows that an ankle disk program can be effective in decreasing muscle onset latency in particular muscles after ankle sprain.

Most research involving ankle instability has been done within a clinical setting. Stasinopoulos conducted a study on Greek female volleyball players. The study involved three interventions: technical training, proprioceptive training on a balance board, and use of a sport-stirrup orthosis.¹² Players who had experienced an ankle sprain during the 1998-1999 season were included in the study during the 1999-2000 season. Randomly assigned to one of the three interventions, the players followed their respective program for the entire season. The proprioceptive group had three ankle sprains among 17 subjects. Results of the study showed that each of the three preventive methods was effective at reducing the number of ankle sprains reported.

Ankle disk training, based on evidence from some of the studies cited, can help improve various aspects of balance and muscle reaction time. The long-term effects of this proprioceptive training technique, however, are not known. Stasinopoulos looked at injury rates over an entire season, but would the numbers improve over a second or third year of continuous proprioceptive training? Further research is needed to determine whether ankle disk training will be effective over an extended period of time or whether additional methods need to be added as an individual becomes competent in performing the given technique.

Clinical implications

Studies involving lower leg proprioception play a key role in the implementation of programs for those with stable and unstable ankles. The majority of research indicates that proprioceptive training is effective at developing better balance and reducing the chance of further injury.^{5-8,10-13} Studies have shown that balance and coordination training reduce the chance of recurrent ankle sprains.^{6-8,10,11} However, other studies indicate that proprioceptive exercise may not be effective at reducing the chance of an ankle sprain.^{3,9}

The goal behind proprioceptive exercises is to help the patient restore stability and neuromuscular control. Fu and Hui-

Chan looked at recurrent ankle sprains among basketball players and their effect on postural sway and found that as the number of ankle sprains increased, so did the number of errors in ankle positioning and postural sway.⁴ They concluded that there was a need for rehabilitation and proprioceptive training among those with recurrent ankle sprains. Unfortunately, only a few studies have used EMG to look at how well the neuromuscular system works in preventing or reducing acute or chronic ankle sprains.^{3,6,7,10} The majority of these studies found improvement in muscle reaction time as it related to an induced ankle sprain;^{6,7,10} however, there is not enough research from which to draw a conclusion. More studies are needed to show the overall benefits of proprioceptive exercise for both the stable and unstable ankle.

Conclusion

Chronic ankle instability, sometimes associated with multiple ankle sprains, can lead to difficulty with walking, running, jumping, and cutting. Although functional instability can lead to impaired performance, the literature shows that proprioceptive exercise may help with overall balance. The combination of rehabilitative and proprioceptive exercises has been shown to decrease the chance of recurrent ankle sprains as well as reduce the chance of reinjury in a functionally stable ankle. The most common methods of training include single leg stance and the ankle disk. Individually or in combination these exercises and devices help improve ankle stability. This suggests that proprioceptive deficiencies can be improved through a variety of balance exercises that help to increase muscle reaction time and the contraction patterns that favor the correction of excessive inversion.¹⁰

Future research

The literature suggests that proprioceptive exercise is beneficial for increasing functional ankle stability. However, a few articles dispute the effectiveness of proprioceptive exercise.^{3,9} They suggest that the training period in some studies may not have been long enough to show the effectiveness of proprioceptive exercise. Also, further research needs to be conducted under different parameters. The difficulty with this approach is compliance and accuracy. Stasinopoulos, the author of a study on professional women volleyball players in Greece, suggested that more research was needed to look more closely at male volleyball players.¹² Studies looking at young soccer players might need to look further at older players.¹³ These studies have helped to demonstrate the effectiveness of proprioceptive exercise, but more needs to be done in a variety of settings to show overall effectiveness.

Research is an ongoing endeavor resulting in new methods of rehabilitation that are being tried every day. Proprioceptive exercise is one of the newer benefits available in rehabilitation. With every new study that is completed, physical therapists and athletic trainers are able to provide better care to their patients. In the future, it is likely more studies will indicate that proprioceptive exercise, along with rehabilitation and strengthening, will help a patient return to activity with a stronger, more functionally stable ankle.

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