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Balance Exercises and its Role in the Treatment of Chronic Ankle Instability

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Abstract: Chronic ankle instability is a condition characterized by a recurring "giving way" of the outer (lateral) side of the ankle. This condition often develops after repeated ankle sprains. Usually the "giving way" occurs while walking or doing other activities, but it can also happen when you're just standing. Many athletes, as well as others, suffer from chronic ankle instability Ankle sprains are one of the most common injuries in sport. Symptoms may last for months and recurrence rates are very high. The stability of the ankle, as with all joints, comes from the shape of the bone, the length of the ligaments and the strength of the muscles. The objective of the study is using balance exercises for the treatment of chronic ankle instability study used the experimental method on a sample of patients with chronic ankle instability number six patients and has designed a program of exercises balance for the treatment of chronic ankle instability significant results improved sample from a chronic ankle instability and the disappearance of the pain of repeated recommendations, the study recommends using balance exercises for the treatment of chronic ankle instability.

Key words: Chronic ankle sprain % Ankle instability % Static balance exercises % Ankle injury

INTRODUCTION

The ankle joint is the second most common injured body site in sport with lateral ankle sprains being the most common type of ankle injury [1]. Thus, ankle sprains are one of the most frequently encountered musculoskeletal injuries. Ankle sprains, account for between 3% and 5% of all Emergency Department attendances in the UK, with about 5,600 incidences per day [2]. It is probable that many more attend primary care facilities, such as General Practitioners and sports clinics and thus the true incidence may well be underestimated. In the acute phase, ankle sprains are associated with pain and loss of function and one quarter of all injured people are unable to attend school or work for more than seven days [3].

Unfortunately, the current misconception is that ankle sprains are simple innocuous injuries. This misconception is ill placed and up to 30% of people who incur a "simple" ankle sprain will report persistent symptoms such as pain, swelling, decreased function, feelings of ankle joint instability and recurrent sprains. The generic term for these persistent symptoms is chronic ankle instability (CAI).

CAI has recently been defined as an encompassing term used to classify a subject with both mechanical and functional instability of the ankle joint [4]. Furthermore according to the definition put forth by Chen [5], to be classified as having CAI, residual symptoms such as episodes of ankle joint "giving way" and feelings of ankle joint instability should be present for a minimum of 1 year post-initial sprain. Mechanical instability (MI) of the ankle joint is characterized by excessive inversion laxity of the rear foot or excessive anterior laxity of the talocrural joint. As a result, joint range of motion is beyond the normal expected physiological or accessory range of motion for that joint [4]. Functional instability (FI) of the ankle joint refers to a situation whereby a subject reports experiencing frequent episodes of ankle joint "giving way" and feelings of ankle joint instability [4].

The well accepted paradigm put forth by Hertel [6] suggests that the development of CAI is dependent upon the interaction of various mechanical and sensorimotor insufficiencies. Mechanical insufficiencies include excessive joint laxity, restricted accessory joint gliding and micro-subluxations. Sensorimotor insufficiencies include alterations in muscle activation patterns, impaired postural stability and altered movement patterns during gait and other functional activities.

The high rate of ankle sprains sustained during activities of daily living, occupational endeavor and across all sports, as well as the severity and subsequent negative consequences associated with the development

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of CAI motivates attention for preventive measures against this type of injury. Exercises to improve neuromuscular control in subjects with CAI are advocated throughout the literature [7-14], yet there remains little unequivocal evidence regarding their effectiveness.

Inversion ankle sprains are among the most common injuries in sports. Often, recurrent injury ensues and functional instability (1517) becomes evident in as many as 33 to 42% of the patients suf-fering from an acute ankle injury. Contributing factors to functional ankle instability are decreased range of motion decreased strength of ankle evertors [15] and a decrease in joint proprioception [4, 15-20]. Some authors reported symptoms of functional instability in the absence of mechanical in-stability [19, 21]. The ability to detect motion in the foot and make postural adjustments in response to these detected motions is crucial in the prevention of ankle injury. Similarly, the ability of an individual to sense the position of the foot prior to heel strike is of the utmost importance. Studies have shown that functional ankle instability results in a decreased ability to maintain balance [22] and a decrease in joint position sense [23]. Ankle injury may cause disruption of joint afferents located in the supporting ligaments and capsule, leading to an impairment of the postural control system. Using a modified Rom- berg's test, they found a decrease in the ability to maintain static balance on the injured limb when compared to the uninjured limb of patients with unilateral ankle injury. From their finding of decreased postural control, they proposed a partial differentiation of joint mechanoreceptors in the functionally unstable ankle, which contributed to symptoms of functional instability [22].

Numerous mechanoreceptors are present in joint capsule, ligament, muscle and skin. Mechanoreceptors are sensitive to joint pressure and tension caused by both dynamic movement and static position. These afferent nerve fibers provide a sense of movement and position as well as contributing to a complex reflex system that acts to control posture and coordination.

Control of posture entails reflex mechanisms involving coordinated activity of three balance senses: visual, vestibular and somatosensory systems [8]. In order to maintain balance, a body is in a constant state of automatic movement [8, 17] attempting to keep the center of gravity over the base of support. Balance is preserved by movements at the ankle, knee and hip and may be disturbed when the center of balance cannot be properly sensed or when corrective movements are not executed in a smooth coordinated fashion.

These three balance senses work in combination and are all critical to the execution of coordinated postural corrections. Impairment of one component is compensated for by the other two. Often, one of the systems provides faulty information or sensory conflict. In this case, it is crucial that the other two senses provide accurate information so that sensory organization can take place. Sensory organization is a process by which all three senses receive input and a determination is made whether any of the input is misleading [8].

The vestibular system plays only a minor role in the maintenance of balance when visual and somatosensory systems are functioning [8, 10]. The primary role of the vestibular system is to signal sensation of acceleration of the head in relation to the body and to the environment [8, 24]. It allows independent control of head and eye positions.

Vision is an important sense for the control of balance. When somatosensory conflict is present, such as a moving platform or a compliant foam surface, balance is significantly decreased with eyes closed compared to eyes open. On a stable surface, closing the eyes should cause only minimal increases in postural sway in nor-mal subjects. However, if somatosensory input is disrupted due to injury, closing the eyes will increase sway significantly [8, 16, 25].

Mechanoreceptors provide information to the three movement systems, which aid in the regulation of balance. The mitotic stretch reflex is the first mechanism to react at approximately 40 msec. An externally imposed rotation or increased load to the joint triggers muscle spindles to increase activity in the muscle and improve muscle stiffness properties. Muscle stiffness is described as the muscle's resistance to stretch and is dependent upon the level of activation of the muscle [8]. Stretch reflexes may at times be inappropriate or insufficient and act to destabilize balance [8]. Therefore, other movement systems which rely on alternate input are required to maintain balance.

The second system, which is the first effective response to control balance, comes from the automatic systems. They too are triggered by external perturbations. The response is somewhat slower than the mitotic stretch reflex at 90-100 msec. Somatosensory input results in automatic responses which are governed by the degree of intensity of the stimulus in combination with the individual's past experiences [9].

The third system involved in balance control is the voluntary system. It is the slowest responding system at approximately 150 msec. Voluntary and automatic responses are often used in conjunction with each other, with automatic responses occurring first followed by voluntary purposeful behaviors [9].

Several authors [12, 19, 20] suggested that inversion ankle sprains may occur due to an improper positioning of the foot just prior to and at, heel strike. Improper positioning may be due to the loss of proprioceptive input from mechanoreceptors. Joint position sense is a component of proprioception and is often measured to assess proprioception. Results of joint position sense studies in the functionally unstable ankle have demonstrated varying results. Glen- cross and Thornton [23] and Cox *et al.* [26] reported a decrease in active joint position sense of the functionally unstable ankle over that of the uninjured ankle. Gross [27] as well as Gam and Newton [28] however, failed to reveal any significant differences between injured and uninjured limbs in either active or passive joint position sense of the ankle.

Joint position sense at the ankle is typically measured in a non-weight bearing position but usually involves uniplanar measurement. Glencross and Thornton [23] and Lentell *et al*. [29] measured joint position sense in a dorsiflexion/plantar flexion pattern. Gross [27] measured inversion/eversion joint position sense and did not report the position of the ankle in the sagittal plane. Since ankle and foot motion rarely involve uniplanar motion, these tests may not be accurate indicators of position sense during functional activity. No attempts have been made to evaluate joint position sense in a no weight-bearing position with combined motions about the subtalar and talocrural joints. Further, the effects of training on joint position sense are not known.

Exercises to improve joint proprioception and coordination of the ankle are advocated for individuals with functional ankle instability throughout the literature [5, 11, 13, 17, 22, 30-36]. Little attention, however, has been given to the efficacy of these rehabilitation protocols.

Two studies [32, 37] revealed that static postural sway can be improved with 6 weeks and 8 weeks of ankle disk training, respectively. Additionally, Tropp *et al*. [20] reported a decrease in symptoms of functional instability and repeated episode of injury following a training regimen of balance-type exercises. It has not been shown, however, if dynamic postural sway can be improved. Additionally, the visual system can compensate for defects in the central pathways or of the vestibular system [38]. A ratio of balance measures with eyes open to that of eyes closed is an indicator of somatosensory input [8, 10, 39]. Visual cues were not removed in the testing procedures of previous studies [15, 20, 37].

The purpose of this study was to determine if ankle joint proprioception in subjects with functional instability of the ankle could be improved with 6 weeks of training. The parameters of interest were sway index and a modified equilibrium score assessed in a weight-bearing position under both static and dynamic conditions with and without visual cues. Additionally, degrees of en-or for active and passive position sense were assessed in a non-weight-bearing position.

MATERIALS AND METHODS

The study used the experimental method using the experimental group and its relevance to the nature of the study, the experimental group used the balance exercises for 6 weeks on a sample of 6 players injured chronic ankle instability Goniometer researcher used to measure the range of the ankle and Dynamometer to measure the muscle strength of the ankle and the pain scale to measure the degree of pain, The researcher used several forms of exercise balance with wood panels and cylinders and balls and medical balance beam and different intensity and time of performance depending on the degree of pain using a scale of pain and evaluate the level of performance by measuring the level of muscle strength using Dynamometer and measure the level of long motor using Goniometer.

Data Analysis: SPSS for Windows [Version 19], Mean, Median, Std. Deviation, Std. Error of Mean, Skewness, Std. Error of Skewness, Mean Rank, Sum of Ranks and Z Score. Wilcoxon Signed Ranks Test were used for statistical analysis.

RESULTS AND DISCUSSION

Table 1 shows the mean and standard deviation, median age, height, weight and age of the training sample. Table 2 shows the mean, standard deviation, minimum and maximum for the research variables. Table 3 shows the Mean Rank and Sum of Ranks for the research variables. Table 4 shows z score and Asymp. Sig. (2-tailed) for the research variables.

Table 1: Statistics of the training sample

	N								
	Valid	Missing	Mean	Std. Error of Mean	Median	Std. Deviation	Skewness	Std. Error of Skewness
Age	6	0	20.3333	.61464	20.0000	1.50555	1.270	.845
Length	6	0	186.3333	2.23109	185.5000	5.46504	.666	.845
Weight	6	0	79.5000	2.36291	79.0000	5.78792	.042	.845
Age training	6	0	5.6667	.33333	5.5000	.81650	.857	.845

All values are confined between ±3 indicating the homogeneity of the research sample in age, height, weight and age

Table 2: Descriptive Statistics of the research variables

	N	Mean	Std. Deviation	Minimum	Maximum
Range of flexor muscles the ankle	6	30.5000	2.50998	28.00	34.00
Range of extensor muscles of the ankle	6	13.6667	2.25093	11.00	16.00
Range of rider s muscles of the ankle	6	18.8333	1.47196	17.00	21.00
Range of Abductor muscle of the ankle	6	20.8333	2.48328	18.00	25.00
Muscle strength flexor the ankle	6	43.5000	2.50998	40.00	46.00
Muscle strength extensor of the ankle	6	36.3333	3.14113	32.00	40.00
Rider s muscles strength of the ankle	6	27.5000	1.87083	25.00	30.00
Abductor muscle strength of the ankle	6	26.5000	1.87083	24.00	29.00
Degree of pain	6	8.3333	.81650	7.00	9.00

It is clear from Tables 3 and 4 that improvement was statistically significant for all variables of the search.

Researcher attributed improving muscle strength measurements to the balance exercises. Researcher attributed improved dynamic range of the ankle to balance exercises that have helped in increasing the level of flexibility to the ligaments of the ankle. They also helped in the removal of the pain of the ankle increase the level of muscle strength to the muscles of the ankle.

The researcher used several forms of exercise balance with wood panels and cylinders and balls and medical balance beam and different intensity and time of performance depending on the degree of pain using a scale of pain and evaluate the level of performance by measuring the level of muscle strength using Dynamometer and measure the level of long motor using Goniometer.

The major finding of this study was that 6 weeks of balance training had a significant effect on the modified equilibrium scores of balance in both the anterior/posterior and medial/lateral direction. There was, however, no effect observed on joint position sense of the ankle.

Nashner and Peters [10] reported that when somatosensory input is intact, removing visual input should only increase sway minimally. Therefore, in the injured individual, if somatosensory input is improved through training, the eyes closed condition should be the condition that would reveal improvements. The results of the modified equilibrium score in our study indicated that this somatosensory input can be improved in the functionally unstable ankle.

Based on the reports from a previous study [19], ankle joint injury may be due to an improper positioning of the foot at heel strike, it is clear that nonweight-bearing pro-prioception remains an integral sense that must be of concern. Although it is unclear whether, joint position sense can be improved, it is suggested that nonweight-bearing coordination exercises also be included in the retraining of functionally unstable ankles and that future studies assess the efficacy of such programs on joint position sense.

The overall results of an improvement in postural sway and no improvement in joint position sense can be discussed by looking at central motor control and peripheral motor control. Gaufin [14] refuted the theory of. In the study by Gaufin *et al.* [32], subjects trained for 8 weeks on an ankle disc. They measured postural sway while simultaneously recording body movements with two cameras. Not only did they report a decrease in postural sway, but also an improved pattern of balance control. This was evident in the injured limb as well as in the uninjured, untrained limb. They proposed that this improvement implicated central motor control rather than peripheral proprioceptive control. If this theory holds true, it would be expected that the balance and coordination training in our study would improve measures of balance.

Table 3: Ranks of the research variables

		N	Mean Rank	Sum of Ranks
Range of flexor muscles	Negative Ranks	0[a]	.00	.00
	Positive Ranks	6[b]	3.50	21.00
	Ties	0[c]		
	Total	6		
Range of extensor muscles of the ankle	Negative Ranks	0[d]	.00	.00
	Positive Ranks	6[e]	3.50	21.00
	Ties	0[f]		
	Total	6		
Range of rider s muscles of the ankle	Negative Ranks	0[g]	.00	.00
	Positive Ranks	6[h]	3.50	21.00
	Ties	0[i]		
	Total	6		
Range of Abductor muscle of the ankle	Negative Ranks	0[j]	.00	.00
	Positive Ranks	6[k]	3.50	21.00
	Ties	0[l]		
	Total	6		
Muscle strength flexor the ankle	Negative Ranks	0[m]	.00	.00
	Positive Ranks	6[n]	3.50	21.00
	Ties	0[o]		
	Total	6		
Muscle strength extensor of the ankle	Negative Ranks	0[p]	.00	.00
	Positive Ranks	6[q]	3.50	21.00
	Ties	0[r]		
	Total	6		
Rider s muscles strength of the ankle	Negative Ranks	0[s]	.00	.00
	Positive Ranks	6[t]	3.50	21.00
	Ties	0[u]		
	Total	6		
Abductor muscle strength of the ankle	Negative Ranks	0[v]	.00	.00
	Positive Ranks	6[w]	3.50	21.00
	Ties	0[x]		
	Total	6		
Degree of pain	Negative Ranks	6[y]	3.50	21.00
	Positive Ranks	0[z]	.00	.00
	Ties	0[aa]		
	Total	6		

Table 4: Statistics test (Wilcoxon Signed Ranks Test)

	Z	Asymp. Sig. (2-tailed)
Range of flexor muscles the ankle	-2.207-[a]	.027
Range of extensor muscles of the ankle	-2.232-[a]	.026
Range of rider s muscles of the ankle	-2.201-[a]	.028
Range of Abductor muscle of the ankle	-2.214-[a]	.027
Muscle strength flexor the ankle	-2.207-[a]	.027
Muscle strength extensor of the ankle	-2.207-[a]	.027
Rider s muscles strength of the ankle	-2.207-[a]	.027
Abductor muscle strength of the ankle	-2.207-[a]	.027
Degree of pain	-2.333-[b]	.020

CONCLUSION

- Balance exercises worked to strengthen the muscles of the ankle.
- Balance exercises worked to restore the dynamic range of the ankle.
- The functional efficiency of the ankle was improved after the use of balance exercises.

- Balance exercises help to remove the pain of the ankle.

Recommendation:

- Balance exercises have a positive role in improving the functional efficiency of the ankle.
- Balance exercises work to strengthen the muscles of the ankle.
- Balance exercises improve dynamic range of the ankle.
- The researcher recommends more programs, balance exercises to improve functional efficiency of the joints of the legs.

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