ORIGINAL ARTICLE

Effects of Prefabricated Ankle Orthoses on Postural Stability in Basketball Players with Chronic Ankle Instability

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Abstract

Purpose: **Ankle sprain is one of the most common injuries among athletes and instability and injury to this joint is responsible for long time loss of physical and recreational activity. Also, it can impose high costs to sport teams. Prevention of this injury is an important concern of practice and rehabilitation. One way of reducing the possibility of ankle joint injury is using an ankle orthosis. The present study aimed at inspecting the effects of two ankle orthoses on dynamic and semi-dynamic postural stability in athletes with chronic ankle instability (CAI).**

***Methods*:** **Twenty basketball players with CAI and fifteen non-injured athletes volunteered to participate in this study. Biodex Balance System was used to assess the participants' postural stability in bilateral position at level 8 and level 2. Repeated measures analysis of variance (ANOVA) was performed in order to examine the effects of ankle orthoses. Statistical significance level was determined at P< 0.05.**

***Results*:** **Statistical analyses revealed the significant effect of ankle supports on dynamic and semi-dynamic postural stability in the two groups and results indicated there wasn't significant difference between groups.**

***Conclusions*:** **According to our results the orthoses improved both dynamic and semi-dynamic postural stability. Therefore, orthoses can prevent injury and its reoccurrence.**

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INTRODUCTION

Ankle sprain is one of the most common injuries among athletes, especially in sports with frequent jumps, landing on one foot and sharp cutting maneuvers for instance basketball [1]. About 10% to 28% of all injuries in sports are ankle sprains [2]. After the initial injury 40% to 75% of individuals develop chronic ankle instability (CAI). Incidence of lateral ankle sprain is 38% and 45% of all basketball injuries for men and women, respectively [3]. About 80% of basketball players suffer from repeated ankle injuries following the primary sprain[4]. Traditionally, there are two theories explaining the cause of CAI: mechanical instability and functional instability. Mechanical instability of the ankle is described as a cause of CAI due to pathologic laxity after ankle ligament injury. Freeman, Dean and Hanham first described the concept of functional instability as a condition in which a patient experiences recurrent sprains or a feeling of "giving way" of the ankle. They attributed CAI to the proprioceptive deficits resulted from damages to the articular mechanoreceptors in the lateral ankle ligaments [5]. A published meta-analysis showed that participants with CAI exhibit postural stability deficits in both static and

dynamic situations [6].

Prevention of injury and its reoccurrence are among the important concerns of practice and rehabilitation especially in relation to the ankle joint. One way of reducing the possibility of ankle joint injury is using external ankle supports e.g. ankle orthoses. Evidence shows that the use of ankle orthoses in individuals with chronic ankle instability can reduce ankle sprains in high-risk sports such as basketball [7]. Furthermore, the relationship between postural stability, CAI and external ankle supports such as braces has been an interesting research area. Baier and Hopf showed that both rigid and semi-rigid ankle braces significantly improved static balance in athletes with ankle joint instability, but had no influence on a healthy group [8]. Gribble, Taylor and Shinohara concluded that the application of Swede-o Universal brace didn't improve dynamic balance in participants with chronic ankle instability [9]. On the other hand, Hadadi, Mazaheri, Mousavi et al found that soft and semi-rigid ankle orthoses improve balance in people with functional ankle instability. Their results showed that the effect of soft brace was greater than that of the semi-rigid one. This study also demonstrated that in the healthy group, postural sway increased from, without orthoses conditions to soft and to semi-rigid orthosis conditions [10]. As previous researchers examined either static or dynamic postural control, the aim of the present investigation is to examine the effect of two kinds of ankle orthoses on dynamic and semi-dynamic postural stability in athletes with chronic ankle instability and healthy athletes.

METHODS AND SUBJECTS

Twenty basketball players with CAI (male, 11; female, 9 with age: 20±4.5 years, height: 182 ±10.5 cm, weight: 75.9± 12.7 kg) and fifteen non-injured basketball players (male, 7;female, 8with age: 18±2.9 years, height: 171.7 ±10.6 cm, weight: 62.9± 9.7 kg) volunteered to participate in the present study. The inclusion criteria for the CAI group included having a history of at least 1 acute ankle sprain that resulted in swelling, pain, and temporary loss of function (but none in the previous 3 months); and a history of multiple episodes of the ankle ''giving way'' in the past 6 months. For the healthy group, all participants were healthy with no ankle or knee injuries in the past 12 months and no history of lower extremity surgery or fracture. Additionally, participants did not have chronic lower extremity disorders (i.e. chronic ankle instability or patello femoral pain syndrome) [9,10].

This study was approved by the ethics committee at University of Ferdowsi and prior to participation all participants were informed about the procedures and signed an informed consent form. To assess postural stability, this study used the Biodex Balance System (Biodex. Inc, Shirley, NY, USA). It has a movable balance platform that provides up to 20 surface tilts in a 360 range of motion. The BBS device measures the athletes' balance on a circumferential platform by evaluating their neuromuscular potential. One of indices assessed by this device is the overall stability score, the best indicator of the ability to maintain postural stability. The participants' postural stability was assessed in bilateral position at level 8 and level 2 (level 12 being the most stable and level 1 the most unstable). Participants were asked to step on the BBS platform with their knees in slight flexion (15º), look straight ahead and assume holding a ball similar to a throw in basketball. Individuals stepped on the platform without footwear and while they wore ankle orthoses. We eliminated influence of different shoes this way. Therefore, each subject performed there tests. Tests included three trials and each trial took 20 seconds with 10 seconds rest between them. Two commercially available ankle supports, one soft and one semi-rigid orthosis, were used for all the participants. The soft orthosis was a neoprene ankle support and the semi-rigid one was a neoprene ankle support with flexible spiral springs. The orthoses' condition was randomized for athletes.

For each of these two dependant variables (dynamic and semi-dynamic), a separate 1-within (Condition), 1-between (Group) repeated measures ANOVA was performed. For multiple comparisons the Bonferroni adjustment method was used. Statistical significance was set a priori at $P<0.05$. All statistical analysis was performed using SPSS 17.0 (SPSS, Inc. Chicago, IL.).

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RESULTS

For semi-dynamic, the between groups test indicated that the variable group was not significant (F=0.56; *P*=0.5). Subjects in the CAI group (1.35±0.6) didn't have a significant postural stability score difference from those in the healthy group (1.06±0.5) .The within subject test indicated that there was a significant orthoses effect, in other words, the groups changed and improved postural stability with the orthoses (F=6.2; *P*<0.001). There were significant differences observed between the types of orthosis subjects had a lower score in postural stability in the soft orthosis condition (0.97±0.42) and semi-rigid orthosis condition (0.97±0.38) compared to without orthoses condition (1.21±0.59) (Table 1). Postural stability score decreased from without orthoses condition, to semi-rigid, to soft conditions. Pairwise comparisons showed significant differences between semi-rigid and without conditions (*P*=0.4) and between soft and without conditions (p=0.03) but didn't show significant differences between soft and semi-rigid condition (*P*=1.0). The group by orthoses interaction was not statistically significant (F=2.73; *P*=0.08).

For dynamic, the main effect for group was not statistically significant (F=0.78; *P*=0.4). Postural stability scores of subjects in the CAI group (2.25±1.7) wer not significantly more than those in the healthy group (1.64±0.72). The within subject test indicated that there was a significant orthoses effect(F=5.1; *P*=0.01). There was significantly different, subjects took lower score to postural stability in the soft orthosis condition (1.57±0.8) and semi-rigid orthosis condition (1.48±0.63) compared to without orthoses condition (1.82±0.91) (Table 1). Dynamic postural stability score decreased from without orthoses condition, to soft, to semi-rigid conditions. Pairwise comparisons showed significant differences between soft and without conditions (*P*=0.01) and between semi-rigid and without conditions (*P*<0.001) but didn't show significant differences between soft and semi-rigid condition (*P*=0.2). The group by orthoses interaction was not statistically significant (F=0.38; *P*=0.66).

DISCUSSION

The results of this investigation indicate that the ankle orthoses used affected postural stability of the participants. It is in accordance with Guskiewicz and Perin who measured the excursion of center of gravity using Chattex Balance System, during single-leg standing on a platform that moved medial lateral and inversion –eversion planes. They showed that orthoses reduced postural sway only in individuals with acute ankle sprain [11]. Our findings indicate that semi-rigid and soft orthoses influenced dynamic and semi-dynamic postural stability in injured and healthy athletes. It is in agreement with Hadadi, Mazaheri, Mousavi et al either soft or semi-rigid orthosis reduces postural sway. Their results showed that the effect of soft brace was greater than that of the semi-rigid one in subject with functional ankle instability. This study also demonstrated that in the healthy group, postural sway increased from, without orthoses conditions to soft and to semi-rigid orthosis conditions [10]. Whereas, our results indicate increased balance with using the orthoses in both groups. These studies investigated the effect ankle orthoses on static balance while in this study dynamic balance was assessed because of its importance in sport.

Our findings do not confirm the results of Wikstrom, Arrigenna, Tillman et al and the findings of Gribble, Taylor and Shinohara [9,12]. The former utilized a semi- rigid and a soft orthosis and evaluated stabilization of ground reaction forces while landing

Table 1: Mean (Standard Deviation) for postural stability in dynamic and semi-dynamic and the results of repeated measure analyses of variance in different condition

	Without orthosis	Soft orthosis	Semi-rigid orthosis	F	P
Dynamic	1. 82 (0.91)	1.57 (0.8)	1.48 (0.63)	5.1	0.01
Semi-dynamic	1.21 (0.59)	0.97 (0.42)	0.97 (0.38)	6.2	<0.001

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from a jump. They found no significant difference between not using and using orthosis positions in individuals with functionally unstable ankles. However, Gribble,Taylor and Shinohara showed that the Swede-O universal brace does not improve resultant vector an index of dynamic stability evaluation Time to Stabilization(TTS) in individuals with chronic ankle instability. Similarly, Catoni studied participants with CAI, and did not observe any difference in TTS with or without the application of Swede-O universal brace [13]. The differences between our results and those of the previous studies could be due to application of different balance assessment devices and stability indices. TTS is a measure of dynamic stability after a single-leg landing from a jump that does not put ankle into inversion – eversion mechanism. Platform of Biodex Balance System provides up to 20 º of surface tilt in 360º range of motion. In attention to, Catoni stated probably TTS measurement may not be the best way to measure the effectiveness of applying an ankle brace on preventing ankle sprain.

Regarding the healthy group, the results of the present study confirm that of Bennell and Goldie who demonstrated that application of a Swede-O laced-up brace reduced one-legged stability in healthy individuals [13]. But our results were not in agreement with those of Percy and Menz, who found no significant changes in postural stability of healthy professional soccer players, in with and without orthosis conditions [15]. Our results are not also in line with those of Baier and Hopf, who showed the ineffectiveness of semi-rigid orthosis on healthy individuals [8]. The findings of the present study also do not confirm the findings of Orteza, Vogelbach and Denegar who showed that unmolded orthotic devices did not improve balance scores of non-injured participants [16]. As material and design are important factors in the efficiency of orthoses, using different orthoses with various materials and designs may be another reason for the diversity of the results. Lack of similar results among different studies may also be due to applying different tests. Since, evaluation of static balance is not efficient for basketball players and according to previous studies; time to stabilization palpably is not an appropriate way to explore the influence of orthoses on balance. Therefore, in this study we used a different device. It will be good point if researchers evaluate the other ways and devices for example the star excursion balance tests and compare them.

CONCLUSION

According to our results the orthoses used in this study affect both healthy and injured athletes. The orthoses improved both dynamic and semi-dynamic postural stability.

The orthoses may enhance ligament mechano-receptor function and cause the stimulation of a greater number of peroneal motoneurons and then increase balance. , Orthoses can improve balance, prevent injury and its reoccurrence. Therefore use of orthoses will be beneficial for athletes.

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Conflict of interests: None

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