

Effect of Prophylactic Knee Brace on Knee Joint Stability in Football Players

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Abstract

Background: Prophylactic knee braces were largely used in the prevention of ligament injuries, but their effectiveness on performance were still controversial. Knee supports were commonly worn by people with anterior cruciate ligament reconstructions (ACLRs) during athletic activity. How knee orthoses affect muscle activation in people with ACLRs was unclear. **Purpose:** to investigate the effect of prophylactic knee brace on knee stability in football players. **Subjects:** thirty football players selected from Bahtim Club, Shoubra El-Khema their mean ages were 18-22 years. **Materials:** Biodex system III and prophylactic knee brace with bilateral bars, hinges and adhesive straps. **Methods:** Knee proprioception at three selected target angles and maximum voluntary isotonic quadriceps torque were evaluated without and with prophylactic knee brace. **Results:** ANOVA test revealed that there was insignificant increase in knee proprioception at angles 15, 30, and 75 degrees of knee extension by 2.6%, 9.6% and 6.4% respectively ($p= 0.37, 0.13$ and 0.16 respectively and $F= 2.42$). t-test revealed that there was insignificant increase in maximum voluntary isotonic quadriceps torque by 2.7% ($p= 6.63$ and $t= 0.15$). **Conclusion:** Prophylactic knee brace insignificantly improved knee proprioception at three selected target angles (15, 30 and 75 of knee extension) and maximum voluntary isotonic quadriceps torque in football players.

Key wards: Prophylactic Knee Brace- Isokinetic- Knee proprioception- Maximum voluntary isotonic quadriceps torque.

Introduction

Prophylactic knee props were utilized as a part of ligament injuries prevention; however their effectiveness on performance was still disputable [1 and 2]. Knee neoprene sleeves were worn by individuals with anterior cruciate tendon reconstructions (ACLRs) during athletic activity [3 and 4]. How knee supports influenced muscle activation in individuals was

not clear [5 and 6]. Many types of knee orthoses had been recommended to help individuals with ACLRs, keep up joint stability and anticipate additionally joint harm during practice [7 and 8]. Inflexible props were regularly worn during athletic practice [9, 10 and 11] for many reasons; although, a little was thought about how they impact neuromuscular

adjustments during exercise. Quadriceps muscle work had been appeared to fall apart after an institutionalized treadmill aerobic exercise protocol activity with knee neoprene sleeves [12].

Epidemiological reviews had mentioned that knee joint injuries were the most widely recognized incapacitating injuries in games. To counteract and limit the negative impacts of injuries, various orthotic devices, for example, prophylactic knee supports had been created [10 and 11]. Few researches had been conducted to decide the adequacy of prophylactic knee propping on avoidance of knee injury though, the viability of prophylactic knee supports is disputable [12 and 13]. A few reviews had decided that prophylactic braces decreased knee injuries [10 and 11], while others had demonstrated a rise in knee injuries [14, 15], and some others suggested no impact [16, 17 and 18]. Recently, various reviews focused around the impact of prophylactic knee orthoses on performance [19, 20 and 21].

There was little data about how props influence the muscle torque, balance and proprioception [14 and 22] and which braces were reasonable for the best performance. Proprioception and coordination were parameters that had an impressive consideration in sports medicine researches. A few late reports had surveyed the proprioceptive

benefits of neoprene sleeves [10 and 23] and elastic bandages [24 and 25].

The significance of braces on neuromuscular system corresponding its injury and reinjure pathology hadn't not been plainly caught on. There were very little reviews determined the impact of various types of knee supports on muscle strength and recommended the best proper orthoses for both patients and healthy individuals [27 and 28]. Although, the muscle performance parameters of speed, strength, and endurance had been studied [18 and 19], there was little data about how props influence the muscle torque and proprioception [22 and 28]. The hypothesis of this study was no effect of prophylactic knee brace on proprioception at 15, 30 or 75 degrees of knee extension in football players. Also it was hypothesized that no effect of knee brace on maximum voluntary isotonic contraction of quadriceps muscle torque in football players.

Design of the study: was pre-test post-test experimental design. This study was ethically approved from the ethical committee of Faculty of Physical Therapy, Cairo University.

The current research was conducted during the period from March to July 2012 in the isokinetic laboratory of the faculty.

Subjects, materials and methods

Thirty football players selected from Bahtim Club, Shoubra El-Khema their age was ranged from 18-22 years.

Instrumentations

1. Biodex system III isokinetic dynamometer (Biodex Medical, Inc., Shirley, NY): was used to measure knee proprioception at 15, 30 and 75 degrees of knee extension and maximum voluntary isometric quadriceps muscle torque without and with prophylactic knee brace. It provides an objective method for assessment of proprioception for different joints of the body. It could be operated in different modes: isokinetic, passive, isometric and isotonic mode.

2. Prophylactic Knee Brace: with bilateral bars, hinges and adhesive straps. The deformable metal of these brace could absorb some of the impact and decrease the force applied to the medial collateral ligament by 10%-30%. It had been intended to protect the medial collateral ligament during a valgus knee stress and to support the cruciate ligaments during a rotational stress.

Procedures

Evaluative Procedures:

1. Subjects participated in this study were given an explanatory session before the evaluation procedures to be aware of the different test steps and signed the consent form.
2. Body weight and height were measured for each subject.
3. Researcher determined the dominant lower extremity for each subject by ordering each subject to kick a ball..

B. Measurement Procedures:

I. Measurement of knee proprioception:

The subject seated on the bench of the dynamometer with his hips and knees were flexed at 90 degrees. The subject

was stabilized in the position by straps around the trunk, waist and thigh. Researcher was passively extending the subject's leg foreword to one of the three selected target angles (15, 30 or 75 degrees of knee extension) to stimulate different mechanoreceptors at beginning, midpoint and extreme range of motion.

Once the target angle was reached, the limb was maintained at that position for 10 seconds. The subject then returned his limb to the starting position. After one minute, the subject was asked to move his limb to the target angle actively. When the subject felt that he reached the target angle actively, he would tell the examiner to stop the apparatus using the hold/release button.

The error scores were determined by taking the difference between the actual and repositioned joint angles. Absolute values of the three joint angles error scores then summed together then using the average of these three scores. Knee proprioception was evaluated without and with prophylactic knee brace (figure1).



Figure (1): Measurement of knee proprioception

II. Measurement of maximum voluntary isotonic quadriceps muscle torque:

Maximum voluntary isotonic quadriceps torque was measured on the Biodex system. The volunteers sat upright with the axis of rotation of the dynamometer arm oriented with the axis of rotation of the dominant knee. Belts were used to secure the thigh, pelvis and trunk to the dynamometer chair to prevent additional body movement. The lateral femoral epicondyle was used as the bony landmark for matching the knee joint with the axis of rotation of the dynamometer. Gravity correction was obtained by measuring the torque exerted on the dynamometer resistance with the knee in a relaxed state.

Subjects were instructed to fully extend and flex the knee and to work maximally during test. Each subject was asked to hold into the sides of the chair with both hands during the test procedures. Then the subjects were asked to perform three consecutive maximum isotonic contractions of the quadriceps femoris muscle.

The greatest torque reading of the three trials would be accepted as maximum voluntary isotonic contraction. Isotonic peak torque was measured with and

without the prophylactic knee brace (figure 2).



Figure (2): Measurement of maximum voluntary isotonic quadriceps muscle torque

Results

I. General characteristics of the subjects:

Thirty football players were participated in this study; their mean age was 22.17 ± 1.98 years, weight 64.3 ± 10.47 kilograms and height 164.4 ± 4.631 centimeters.

II. Knee proprioception:

ANOVA test revealed that there was insignificant increase in knee proprioception in angles 15, 30, and 75 degrees of knee extension by 2.6%, 9.6% and 6.4% respectively ($P= 0.37$, 0.13 and 0.16 respectively and $F= 2.42$) (table 1 and figure 3).

Table 1: Knee proprioception (at angles 15, 30 and 75 degrees)

	Mean Without brace	Mean With brace	P	F
Knee proprioception in 15 degree knee extension	6.75 ± 1.73	6.93 ± 1.12	0.37	2.42
Knee proprioception in 30 degree knee extension	5.25 ± 1.24	5.81 ± 1.60	0.13	2.42
Knee proprioception in 75 degree knee extension	6.43 ± 1.67	6.87 ± 1.31	0.16	2.42

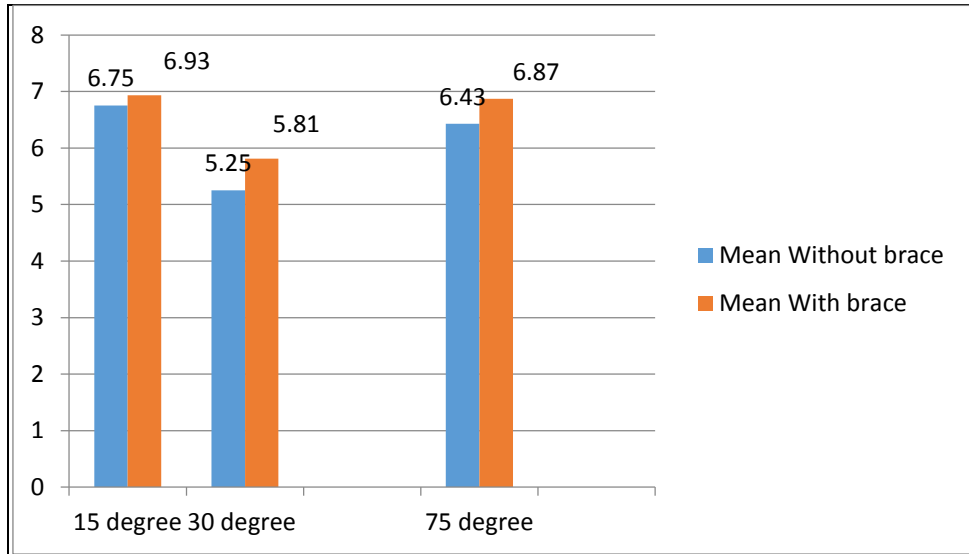


Figure 3: Knee proprioception (at angles 15, 30 and 75 degrees)

III. Maximum voluntary isotonic quadriceps torque:
t-test revealed that there was insignificant increase in

maximum voluntary isotonic quadriceps torque by 2.7% (p= 6.63 and t= 0.15) (table 2 and figure 4).

Table 2: Quadriceps maximum voluntary isotonic torque

	Mean Without brace	Mean With brace	P	t
Maximum voluntary isotonic quadriceps torque (N)	107.24 _± 25.13	110.12 _± 27.08	6.63	0.15

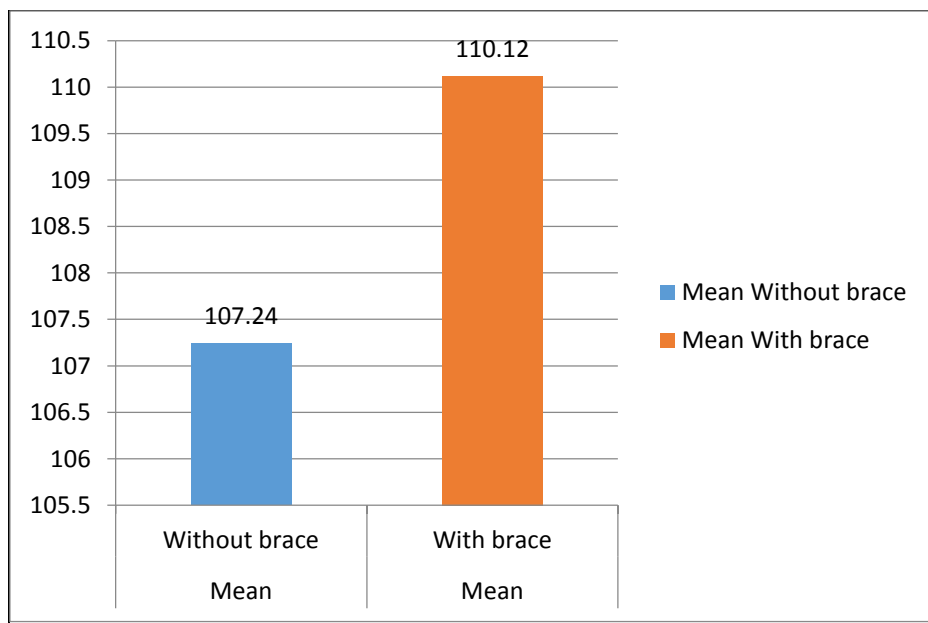


Figure 4: Quadriceps maximum voluntary isotonic torque

Discussion

Basing on the findings of the present study, ANOVA test revealed that there was insignificant increase in knee proprioception at angles 15, 30, and 75 degrees of knee extension by 2.6%, 9.6% and 6.4% respectively ($p=0.37, 0.13$ and 0.16 respectively and $F=2.42$). t-test revealed that there was insignificant increase in maximum voluntary isotonic quadriceps torque by 2.7% ($p=6.63$ and $t=0.15$). These findings suggested that the unloader knee brace insignificantly improved the perceived sense of knee joint position and maximum voluntary isotonic quadriceps torque. On the same side; researchers concluded that different types of knee orthoses had been reported to improve kinaesthesia in football player subjects [19, 22 and 28]. Although unloaders might provide subtle knee proprioceptive cues, this contribution might be minor compared with the somatosensory information already available during weight-bearing tasks. Similarly, since postural control involved the integration of visual and vestibular systems in addition to somatosensory input in those with knee pathology subjects [14 and 16]

It was possible that valgus propping for prolonged periods involved the combination of several underlying mechanisms, including changes in various neuromuscular factors, such as proprioception, muscular strength and atrophy, along with mechanical factors such as altered moments about the knee and compressive joint loads [4, 5 and 29]. As a result, future research should

attempt to investigate the relative clinical importance of these mechanisms. When orthoses worn during a closed kinetic chain task, it resisted flexion about the knee and therefore assisted the quadriceps in controlling knee flexion. On the same side, researchers had demonstrated that increasing resistance in the prop didn't decrease knee-flexion angle and knee-extension moment during the stance phase of stair descent. Furthermore, quadriceps activity was significantly decreased when wearing the brace with some level of resistance during a closed kinetic chain knee-flexion exercise and this might result in a decreased patella femoral joint reaction force. Thus, the brace didn't unload the quadriceps in healthy subjects [30]. So, the hypothesized said that no effect of knee brace on maximum voluntary isotonic contraction of quadriceps muscle torque in football players was rejected.

It was agreed that the immediate application of a knee brace or a neoprene sleeve before exercise did not affect proprioception; however, torque values insignificantly decreased, indicating that knee extensor strength was affected but central activation was not. One possible explanation was that cutaneous afferent feedback from sleeve application resulted in a proportional reduction in maximum voluntary isometric contraction torque (T_{MVIC})[28]. So, the hypothesis said that no effect of prophylactic knee brace on proprioception at 15, 30 or 75 degrees of knee extension in football players was rejected.

In addition, previous researcher demonstrated that orthoses were providing direct cutaneous stimulation, such as hot and cold, could change afferent responses to the central nervous system [31]. On the other hand, others observed larger effect in the braced conditions than in the control condition, which might reflect increased cutaneous mechanoreceptor stimulation from greater surface area contact with the skin surrounding the knee joint [32]. Research on the clinical effects of knee supports continued to show conflicting findings because numerous authors had indicated that a knee prop might decrease the amount of shear forces and anterior tibial translation at the knee [33 and 34].

It was argued that although enhanced knee proprioception might be partially responsible for the reported improvements in function and quality of life with the use of a brace, the present findings call into question the clinical importance of the minor changes in neuromuscular performance observed. The mechanisms underlying the use of a brace probably involved minor neuromuscular effects working in combination with more substantial mechanical effects. Since knee bracing appeared to involve several mechanisms [35 and 36].

Conclusions: Prophylactic knee brace insignificantly improved knee proprioception at three selected target angles (15, 30 and 75 of knee extension) and maximum voluntary isotonic quadriceps torque in football players.

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تأثير الجبيرة الوقائية للركبة على إستقرار مفصل الركبة للاعبى كرة القدم

الخلفية: إن جباير الركبة الوقائية تستخدم إلى حد كبير في الوقاية من إصابات الأربطة، ولكن فاعليتها على الأداء لا يزال مثير للجدل . إن إرتداء ساندات الركبة عادة ما يكثر شيوعا بواسطة الناس بعد إعادة بناء الرباط الصليبي الأمامي، أثناء ممارسة النشاط الرياضي .إن كيفية تأثير جباير الركبة على النشاط العضلى في الناس بعد إعادة بناء الرباط الصليبي الأمامي غير واضحة . **الغرض:** لدراسة تأثير جبيرة الركبة الوقائية على إستقرار مفصل الركبة في لاعبي كرة القدم .**الأشخاص:** ثلاثون من لاعبي كرة القدم تم إختيارهم من نادي بهتيم ، بشبرا الخيمة ، كان متوسط أعمارهم من ١٨-٢٢ عاما . **الأدوات:** نظام الأيزوكينيتك الثالث . و جبيرة الركبة الوقائية ثنائية القضبان وأشرطتها اللاصقة .**الطريقة:** تم تقييم استقبال الحس العميق للركبة في ثلاث زوايا محددة والحد الأقصى الطوعي لعزم إنقباض العضلة الرباعية مرة بدون و مرة أخرى بإرتداء جبيرة الركبة الوقائية .**النتائج :** كشف إختبار أنوفا أن هناك زيادة ليست ذات دلالة إحصائية في استقبال الحس العميق للركبة في زوايا ١٥ و ٣٠ و ٧٥ درجة من تمديد الركبة بنسبة ٢.٦% و ٩.٦% و ٦.٤% على التوالي (ب = ٠.٣٧ و ٠.١٣ و ٠.١٦ على التوالي و ف = ٢.٤٢) . وكشف اختبار (ت) أن هناك زيادة ليست ذات دلالة إحصائية في الحد الأقصى الطوعي لعزم إنقباض العضلة الرباعية بنسبة ٢.٧% (ب = ٦.٦٣ و ت = ٠.١٥) . **الاستنتاج:** الجبيرة الوقائية للركبة حسنت بدون دلالة إحصائية الحس العميق للركبة في ثلاث زوايا ١٥ و ٣٠ و ٧٥ درجة من تمديد الركبة و الحد الأقصى الطوعي لعزم إنقباض العضلة الرباعية فى لاعبي كرة القدم.

الكلمات الدالة: الجبيرة الوقائية للركبة ، الأيزوكينيتك ، الحس العميق للركبة ، الحد الأقصى الطوعي لعزم إنقباض العضلة الرباعية.