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The immediate sensorimotor effects of elbow orthoses in patients with lateral elbow tendinopathy: a prospective crossover study

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Background: Counterforce orthoses are used to manage lateral elbow tendinopathy, and their effectiveness in improving motor function has been documented. Little is known about the impact of bracing on sensory function. The objective of this study was to investigate the immediate effectiveness of 2 counterforce orthoses in improving the sensorimotor abilities of the hand in patients with lateral elbow tendinopathy.
Methods: In this crossover, randomized controlled trial, elbow proprioception, pain severity, pain-free grip strength, and finger dexterity were measured in 50 participants with a diagnosis of lateral elbow tendinopathy. Outcomes were measured in 3 randomized conditions (no brace, forearm band, or elbow sleeve). Data were analyzed using 1-way repeated-measures analysis of variance for each outcome measure.
Results: Better scores were observed with the forearm band, as compared with no orthosis, for multiple outcomes including joint position reproduction score at 70° of elbow flexion ($P = .006$), pain ($P < .001$), grip strength ($P = .01$), and dexterity ($P < .001$). The elbow sleeve yielded better scores than no orthosis for the following outcomes: joint position reproduction score at 110° ($P < .001$), pain ($P < .001$), and grip strength ($P = .012$). No statistically significant difference was found between the orthoses' effects on pain reduction and grip strength ($P > .05$). The forearm band showed better scores on joint position reproduction at 70° compared with the elbow sleeve ($P = .006$), whereas the elbow sleeve showed better scores at 110° ($P < .001$).
Conclusion: Our results support the mechanisms occurring with the use of either of the described orthotic interventions. Future randomized trials with longer-term outcomes that include sensorimotor mechanisms might enhance our understanding of the comparative effectiveness.
Level of evidence: Level II; Prospective Crossover Design; Treatment Study

Keywords: Lateral elbow tendinopathy; tennis elbow; orthotic devices; brace; grip; proprioception

Ethical approval was obtained from the Isfahan University of Medical Sciences Ethics Committee (registration No. IR.MUI-REC-1396.3.216) before recruitments of participants.

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Lateral elbow tendinopathy (LET) is a condition that affects the common origin of the wrist extensor muscles at the lateral aspect of the elbow.[2] Between 1% and 3% of adults aged 35 to 55 years are affected by this lesion in their lifetime.[24] Pain below the lateral epicondyle is a common presentation on clinical examination that is exacerbated by applying resistance to wrist extension.[2,8] The extensor carpi radialis brevis (ECRB) is the most commonly affected extensor muscle, and resisted extension of the middle finger is one clinical test to confirm the diagnosis of ECRB tendinopathy.[18] A change in terminology included moving from "tendinitis" to "tendinosis," with recognition that at the cellular level, the condition exists as a degenerative condition rather than an inflammatory process, at least in chronic cases.[18] More recent discussions of pathology have emphasized that reactive and degenerative mechanisms can occur together, even in chronic cases; therefore, the term "tendinopathy" has tended to be used.[1] Despite its traditional name ("tennis elbow"), this lesion often is a work-related injury for persons other than athletes.[9] LET has developed from a variety of activities of daily living that increase tension on the injured common extensor tendon.[2]

In recent research, there has been an extended focus, beyond a sole focus on motor function, to consider sensory function and sensorimotor integration.[29] "Sensory function" refers to the perception of body segments.[6] Sensory afferents are supplied by specialized nerve endings (mechanoreceptors) converting the mechanical stimuli to action potentials for transmission to the nerves. Mechanoreceptors are localized in the articular capsule, ligaments, muscles, tendons, fascia, and skin.[27] Numerous clinical studies have reported that periarticular lesions can negatively influence the perception of the body segments at the ankle, knee, shoulder, back, and neck.[27] Sensory information is necessary to activate the skeletal muscles for proper movement of body segments at the joints.[12] Control of the elbow joint can also be particularly important for the fine and coordinated movements of the upper limb during activities of daily living. It has been shown that complications of LET include both sensory and motor aspects.[6] The affected arm often has a proprioception deficit[17] and presents with a weakened grip.[7]

Nonsurgical management yields successful treatment in a majority of patients with LET.[37] Use of an orthosis is a noninvasive method that is widely applied as an initial therapy for LET because it has shown superior effectiveness and acceptability compared with other modalities such as steroids, exercise, massage, and laser therapy.[25,34] Orthotic therapy has shown immediate pain relief and improved hand function.[16] A neoprene strap (band) and sleeve are the most common counterforce orthoses used at the elbow for the management of LET.[4,28] Pain relief was shown to be a clinically significant advantage of using counterforce orthoses in previous studies[4,28]; however, other sensory effects of counterforce orthoses may also be important to improve hand control. The assessment of sensory function therefore can be clinically important for practitioners to tailor effective treatment strategies for improvement in motor control in LET.[6,17]

Patients with LET have decreased joint position sense (JPS) at the affected elbow.[17] A proprioceptive deficit in LET is one of the factors contributing to reduced motor control in arm-hand movements.[6] Evidence of neuromuscular dysfunction has been documented in LET[6] and includes but is not limited to reduced muscle force generation,[35] reduced endurance,[3] difficulties in multisegmented coordination, and poor endpoint (finger) control.[11] We hypothesized that patients with LET could benefit from the use of counterforce orthoses to improve JPS at the elbow because the use of a counterforce band has shown improvements in the sensorimotor performance of patients with similar musculoskeletal conditions, such as knee pain.[32] The superior sensory ability at the elbow can help the control of muscles acting on the upper limb to obtain synergetic contractions required for various manual tasks performed with the hand.[13,22] Hence, the hand grip and finger dexterity parameters would also be improved. The objective of this study was to investigate the sensorimotor effects of 2 frequently used counterforce elbow orthoses in patients with LET.

Methods

Design

This was a randomized controlled crossover study, during which participants acted as their own controls (no orthosis) and 2 counterforce orthoses (a forearm band and an elbow sleeve) were compared in a single session. The order of intervention and testing conditions was randomized and determined by drawing a concealed envelop from a bag. The testing protocol was started after fitting of orthoses and a 5-minute acclimatization period. Participants were given about 5 minutes of rest and then crossed over to the second orthosis. For all measurements, the test was explained and demonstrated to the participant. All participants were informed about the details of research and provided signed informed consent before participation, in accordance with the standards of the Declaration of Helsinki.

Participants

The participants had LET symptoms lasting for more than 6 weeks, and the diagnosis was made by an orthopedic specialist at Alzahra Hospital, Isfahan, Iran. LET was diagnosed using the 3 following criteria: (1) pain on palpation of the lateral epicondyle, (2) elbow pain aggravated with resisted wrist extension, and (3) pain on resisted middle finger extension. Participants with positive findings for all 3 criteria were included. Patients with a history of surgery, fracture, dislocation, or injection in the elbow less than 6 weeks earlier were excluded.

Orthoses

Two counterforce orthoses frequently used in LET patients were compared with the "no orthosis" condition: forearm band and elbow sleeve (Fig. 1). All orthoses were purchased from the same manufacturer (Teknotan, Tehran, Iran). The forearm band was an 8-cm-wide neoprene band fitted 2.5 cm below the elbow. A double-layered neoprene

Figure 1 Counterforce orthoses: forearm band **(A)** and elbow sleeve **(B)**.

pad was incorporated in the forearm band to apply direct pressure to the origin of the extensor muscles. The elbow strap had a 5-cm-wide non-elastic strap to adjust the pressure on the pad. The elbow sleeve was a neoprene support that circumferentially contained the arm approximately 15 cm above and below the elbow. This sleeve was fitted on the arm using two 5-cm-wide non-elastic straps above and below the elbow. Both types of counterforce orthoses had a range of available sizes to accommodate different participants' sizes. The appropriate size was selected based on arm circumference measurements. Each participant made a fist with the orthosis, and the strap or straps were tightened. The orthotic size was considered suitable if the pressure in the orthosis was comfortable after the fist was released.

Outcome measures

Pain severity, elbow proprioception, hand grip strength, and finger dexterity were measured to determine the sensorimotor effects of counterforce orthoses in LET.

Pain severity

Pain severity was measured using a 10-cm visual analog scale (VAS) in which 0 represented no pain and 10 indicated the most severe pain.[26] Each participant sat on a chair with the elbow in 90° of flexion and the forearm supported on an armrest. He or she was asked to make a fist, extend the wrist, and then concentrate on the elbow pain before reporting the pain level by drawing a line within 0 to 10 on the scale.[28]

Elbow proprioception

Elbow proprioception was evaluated by measuring JPS. For this purpose, the ability to perform active angle reproduction was measured in the involved elbow. The participant sat on a chair and the arm was kept undisturbed and parallel to the floor using an adjustable arm support attached to the chair's handle. The participant's eyes were closed during proprioception testing. The examiner held the participant's forearm and started slowly moving the elbow from 90° toward extension until the elbow reached 70° of flexion. The elbow was kept at 70° for 20 seconds, and the participant was asked to memorize this position. The elbow was returned to 90°, and the participant was asked to reproduce the target angle (70° of flexion). The active angle reproduction test was also used when moving the elbow toward the flexion direction. The participant was asked to move the elbow from 90° toward further flexion until reaching a target angle set at 110° of flexion. Each test was repeated 3 times, and the angle error was calculated as the mean absolute error in degrees and was used as the primary outcome. The joint angle was measured with an electrical digital goniometer (TREDAR200; Trend Direct UK, Swansea, UK) with an accuracy of 0.1°. The goniometer arms were placed on the lateral longitudinal axes of the humerus and ulna.

Hand grip strength

Pain-free grip on the involved side was measured using a digital handgrip dynamometer (YDM-110; Yagami, Tokyo, Japan). Each participant stood with the shoulder in the neutral position, the elbow in extension, and the forearm in the neutral position of supination-pronation and then slowly squeezed the dynamometer handle until he or she felt pain at the elbow.[16] The force generated was recorded, and the average value of 3 repeated assessments was used for data analysis.

Finger dexterity

Finger dexterity was evaluated using the 9-hole peg test.[14] The testing instrument consisted of a wooden board with 9 holes and a counterpart consisting of a shallow round dish that contained 9 pegs. The board with the holes was centered in front of the participant, and the shallow dish was placed on the involved side. The participant took the pegs one by one and put them in the holes as quickly as possible. He or she then removed the pegs one by one and replaced them in the shallow round dish. The time was recorded, using a stopwatch, from the moment the participant touched the first peg until the last peg was put back in the dish.[14]

Data analysis

One-way repeated-measures analysis of variance (ANOVA) was used to compare the outcomes measured across testing conditions. If the ANOVA test indicated a statistically significant difference, the Bonferroni test was used for post hoc analysis. This was performed to explore pair-wise differences between testing conditions. The statistical calculations were carried out using SPSS software (version 18; IBM, Armonk, NY, USA), and the level of significance was set at .05.

Results

Demographic characteristics

Fifty patients with LET (21 men and 29 women) participated in this study. All completed the testing. The demographic characteristics of the participants are presented in Table I. The mean, standard deviation, and range for VAS score, elbow

Table I Demographic characteristics of participants

Characteristic	Data
Female, n (%)	29 (58)
Age, mean (SD), yr	45.3 (6.3)
Body mass index, mean (SD)	23.1 (2.7)
Job status, n (%)	
Manual laborer	12 (24)
Normal laborer	14 (28)
Unemployed or homemaker	24 (48)
Right side dominant, n (%)	35 (70)
Dominant side affected, n (%)	44 (88)
Duration of symptoms, mean (SD), weeks	17.5 (3.2)
Recurrent condition, n (%)	44 (88)

SD, standard deviation.

JPS, pain-free grip strength, and recorded time for the 9-hole peg test are reported in Table II.

Outcome measures

One-way repeated-measures ANOVA showed significant main effects for the orthoses in all outcome measures ($P < .05$). The mean and standard deviation for outcome measures across the testing conditions are presented in Table II.

Post hoc pair-wise comparisons indicated a significant difference in the error of joint position reproduction (JPR) at 70° of elbow flexion with the counterforce elbow band ($P = .006$; 95% confidence interval [CI], 0.42-2.4). Furthermore, the Cohen effect size value ($d = 0.4$) indicated relatively moderate clinical significance. The error of JPR at 110° of flexion was significantly reduced using an elbow sleeve ($P < .001$; 95% CI, 0.74-2.4; Cohen $d = 0.47$), showing moderate clinical significance. Post hoc pair-wise comparisons also revealed that both the forearm band and elbow sleeve significantly reduced the perceived pain at the elbow ($P < .05$ with Cohen effect sizes of 0.79 and 0.65, respectively), showing moderate to large clinical significance, and improved pain-free hand grip ($P = .01$ with Cohen effect sizes of 0.36 and 0.4, respectively), showing relatively moderate clinical significance. No significant differences between the effects of the 2 orthoses were found for VAS score and hand grip strength (as detailed in Table II). The forearm band significantly improved finger dexterity with a reduction in the recorded time for the 9-hole peg test ($P < .001$; 95% CI, 0.44-1.54; Cohen $d = 0.31$), showing low to moderate clinical significance. The results of the post hoc pair-wise comparisons are presented in Table III.

Discussion

The main finding of the study was that counterforce orthoses (either band or sleeve) improved the sensorimotor performance in patients with LET immediately after application. Both orthoses showed moderate to large improvements

Table II Changes in outcome measures across study conditions

Outcome measure	Condition			1-Way repeated-measures ANOVA
	No orthosis	Forearm band	Elbow sleeve	
JPR, °				
At 70°	5.6 ± 3.9 (1.1-16.4)	4.2 ± 3 (0.9-14.2)	5.6 ± 3.7 (1.4-14.4)	Wilks Λ = 0.82, $F = 5.1$, $P = .01$,* partial $\eta^2 = 0.17$
At 110°	6.6 ± 3.6 (1.6-16.2)	7.1 ± 3.9 (1.3-17)	5 ± 3.2 (1-15.9)	Wilks Λ = 0.64, $F = 13.6$, $P < .001$,* partial $\eta^2 = 0.36$
VAS score (0-10)	5.8 ± 2.2 (2-10)	4.1 ± 1.9 (1-9)	4.5 ± 1.8 (1-8)	Wilks Λ = 0.43, $F = 31.9$, $P < .001$,* partial $\eta^2 = 0.57$
Hand grip, N	157.63 ± 73.58 (28-370)	189.14 ± 99.63 (73.3-392)	186.9 ± 96.06 (27.3-381.3)	Wilks Λ = 0.83, $F = 4.86$, $P = .012$,* partial $\eta^2 = 0.17$
NHPT, s	16.57 ± 3.7 (11.65-26.69)	15.5 ± 3.1 (9.93-24.98)	16.02 ± 3.09 (11.03-27.38)	Wilks Λ = 0.42, $F = 10.2$, $P < .001$,* partial $\eta^2 = 0.3$

ANOVA, analysis of variance; *JPR*, joint position reproduction; *VAS*, visual analog scale; *NHPT*, 9-hole peg test.
Descriptive values for study conditions are presented as mean ± standard deviation (minimum-maximum).
* Statistically significant difference between groups ($P < .05$).

Table III Results of pair-wise comparisons between study conditions

Pair-wise comparison	JPR, °		VAS score	Hand grip, N	NHPT, s
	At 70°	At 110°			
No orthosis vs forearm band					
P value (95% CI)	.006* (0.42-2.4)	.5 (−0.45 to 1.5)	<.001* (1.1-2.2)	.01* (5.9-57.1)	<.001* (0.44-1.54)
MD (SE)	1.43 (0.5)	0.55 (0.4)	1.7 (0.23)	31.5 (10.3)	0.99 (0.22)
No orthosis vs elbow sleeve					
P value (95% CI)	.96 (−0.91 to 0.96)	<.001* (0.74-2.4)	<.001* (0.81-1.8)	.012* (5.2-53.3)	.15 (−0.13 to 1.2)
MD (SE)	0.02 (0.46)	1.6 (0.33)	1.3 (0.2)	29.3 (9.7)	0.56 (0.27)
Forearm band vs elbow sleeve					
P value (95% CI)	.006* (−2.4 to −0.4)	<.001* (0.96 to 3.3)	.28 (−0.88 to 0.16)	>.999 (−11 to 15.5)	.17 (−0.99 to 0.12)
MD (SE)	−1.41 (0.5)	2.12 (0.47)	−0.36 (0.21)	2.24 (5.34)	−0.44 (0.22)

JPR, joint position reproduction; *VAS*, visual analog scale; *NHPT*, 9-hole peg test; *CI*, confidence interval; *MD*, mean difference; *SE*, standard error.
* Statistically significant difference between groups ($P < .05$).

in the pain level and grip strength. The forearm band demonstrated a small to moderate increase in finger dexterity, whereas the elbow sleeve did not. The effectiveness of the orthoses on the error in joint position was relatively moderate and dependent on the target angle set for testing. The forearm band significantly reduced the reproduction error when testing was carried out at 70° of flexion, whereas the elbow sleeve was significant at 110° of elbow flexion. However, these findings cannot be interpreted as showing the superiority of one orthosis over the other because there were no significant differences between the orthoses for most of the outcome measures. Furthermore, this study was performed to evaluate the immediate impact, not to determine the effectiveness, because no follow-up monitoring was performed.

Regardless of orthosis type, improvements in pain-free grip strength and pain severity were shown in this study. These findings are in accordance with previous studies that have reported the effectiveness of orthoses on grip and pain parameters.[4,10,16,28,30] Despite heterogeneity in protocols, orthotic designs, or comparator interventions, previous studies have indicated that orthoses improve pain and hand grip in patients with LET. It is thought that counterforce orthoses have 2 interrelated therapeutic mechanisms: mechanical and neuromuscular effects. “Mechanical effects” refer to the reduction of tension on the tendons because the counterforce orthosis acts like a secondary attachment for the tendons of the wrist extensor muscles and reduces forces acting on the lateral epicondyle.[35] Neuromuscular effects include all the changes that happen in the motor control of patients with LET.

A counterforce orthosis prevents excessive tension from being transmitted to the muscle enthesis.[19] The sensory nerve endings for elbow proprioception may be influenced by this force redistribution.[17] If this mechanism of action is accepted, the concurrent improvement in elbow proprioception and hand function with orthoses is implied that elbow proprioception could be especially important for neuromuscular control of the upper limb in power and precision tasks. The exact mechanism underlying the reduction of JPR error with counterforce orthoses in this study is unknown. However, the only previous studies on this topic indicated that pain relief[41] and local sensory feedback from the skin[20] improve the position awareness at the elbow in patients with LET. It has been substantiated that a gentle pressure applied over the skin using tape stimulates mechanoreceptors and increases sensory afferents to the central nervous system.[5] Providing more sensory inputs to the central nervous system was reported to reduce the motor unit threshold and promote the contribution of the inactive muscle fibers, thus increasing hand function.[5,23]

We knew from previous research that LET causes a local proprioceptive deficit at the elbow.[17] Poor elbow proprioception may be due to local musculotendinous pathology near the lateral epicondyle and/or perceived pain.[31] The working mechanisms of counterforce orthoses therefore are expected to improve elbow proprioception through mechanical and neuromuscular effects, as has been explained. JPS was measured because it is a commonly used method for quantifying the proprioception of the elbow in both surgical and conservative treatments.[11,21] This testing was a noninvasive, simple method that did not require any sophisticated equipment and hence could easily be used in the clinical setting in this study. Two main clinical methods for testing JPS of the elbow have been described in previous studies: passive movement detection and JPR.[11,14] In the passive movement, the contribution of the muscle spindle to the afferent signal is reportedly low,[15] whereas in large articulations such as the elbow, proprioception mainly relies on the mechanoreceptors located in the muscles and tendons.[21] As such, we decided an active JPR test would be an appropriate testing tool in this study. An armrest system was used to provide a stable frame for the elbow during motion. This was used to prevent substituted movements that could activate the shoulder muscles and interfere with the testing results.[36] The target joint angle was an important factor that could inherently influence the matching error in the tests. It has been shown that further target angles result in a greater matching error at the elbow.[11] In our study, the participants were asked to match target angles that were 20° from the starting joint position in both the flexion and extension directions. Previous research justified that these target angles (70° and 110° of elbow flexion) have an acceptable sensitivity to measure the proprioceptive changes at the elbow.[17,21] The average error in healthy adults aged 30-50 years was reported to be 3.3°,[11] which is greater than the average error in the control condition in our study. This difference indicates that our study participants had some degree of proprioception impairment at the elbow due to LET. In this study, the average error in 110° of elbow flexion (6.6°) was greater than that in 70° (5.6°). This was likely due to increased tension on the origin of the ECRB at the lateral epicondyle while the elbow moved toward full extension.[7]

The elbow sleeve and elbow band both successfully improved elbow proprioception but in 2 opposite directions from the reference joint position. The elbow band was shown to be effective when the target angle was set at 70°, whereas the sleeve was not. The required motion in this condition was elbow extension, and the difference in the effectiveness of the 2 orthoses was likely due to the forearm pressure pad that existed only in the elbow band. A double-layered pad was placed below the lateral epicondyle to augment the local pressure under the lesion area and increase the mechanical effectiveness of the counterforce orthosis; the sleeve did not have such a pad. In 110° of flexion, the sleeve was effective at reducing the matching error whereas the elbow band was not. At this target angle, the elbow flexor muscles that originate from above the elbow are encompassed by the sleeve and become more active. Gentle pressure on the active musculature acting on a large articulation possibly could improve overall joint proprioception, as shown in the knee.[40]

Grip strength was measured as an outcome in this study because it is a predictor of the upper limb function and is involved in many daily activities.[38] Pain-free grip was used in this study because it was reported to be more sensitive than forceful grip strength to show the changes caused by therapeutic interventions.[33] Another reason for selecting pain-free over maximal hand grip strength was to prevent possible harm to participants. Testing participants with maximal grip could boost the local pressure under the forearm strap, which could obstruct blood flow during prolonged testing. This obstructive condition could then affect the precision of JPR and pain reports. The results of this study showed that both orthoses were effective at improving the pain-free grip immediately after application. No differences in improving pain-free grip strength were found between the use of the forearm band and use of the elbow sleeve. No power analysis was carried out to check the optimal sample size required for detection of any possible significant difference between the effects of 2 orthoses on pain-free grip strength. The mean difference was very small, the CIs were very wide, and the *P* value for the comparison was very high, supporting that the lack of difference was not because of an inadequate sample size.

A large part of the movement in the upper limb is dedicated to the fine coordinated motions involved in precision tasks using the fingers. Finger dexterity was measured in this study to assess how sensory-induced effects could influence the neuromuscular control of the fine movements in the hand. Finger dexterity showed an improvement with the elbow band but not with the sleeve. The nonsignificant change with the sleeve could possibly be due to a physical limitation in elbow movement caused by the sleeve and a resulting disturbance in the pattern of fine movements within the multisegmented upper limb chain. The improvement in finger dexterity with the elbow band can be attributed to either the efficacy in providing extra sensory feedback for motor control, improving processing (through pain reduction), or integration of afferent and efferent signals. According to this methodology, the underlying cause of improved fine motor control remains unclear and warrants further research. Future longitudinal studies are recommended to clarify whether the proprioceptive effectiveness of counterforce orthoses could prevent the development and recurrence of LET, as the progression of degenerative changes and the large recurrence rate are the primary concerns in the treatment of LET.[3]

There are limitations to this study that must be considered. First, using a repeated measure from a single arm during 1 session in this study means that we must consider the potential for carryover or learning effects. However, randomization should have partitioned the learning effect because the order of the 3 intervention conditions was randomized. The selection of a crossover design for this early-phase study was based on an assumption that was substantiated in previous research that implied that the mechanical effects of counterforce orthoses were not long-lasting and were reversible once they were removed.[16] It has been demonstrated that a 1-minute acclimation time is sufficient for inter-testing consistency while measuring grip strength[39]; a 5-minute period was set in this study for more confidence. Second, the participants and examiner could not be blinded in this study because they could see which orthosis was being used. The lack of blinding of the examiner was mitigated by use of patient-rated scales and automated equipment to reduce assessor judgment bias. Third, the investigator applied the orthoses in accordance with recommendations in clinical practice, ensuring that they were snugly fitted but comfortable. Although an attempt was made to consistently fit the counterforce straps, it is possible that the level of tension varied between the tests because this was not quantified.

The clinical consequence of this study is that counterforce orthoses can enhance afferent inputs from tissues surrounding the elbow joint in patients with LET. Although orthoses are commonly used in clinical practice to improve pain and hand function, there is limited evidence regarding the effects on sensory function. These results indicate a dual mechanism (sensorimotor effect) by which orthoses may lead to therapeutic benefit. The clinical implication of these results is limited because only the immediate effects of 2 orthoses on elbow proprioception and hand function were assessed; the impact of orthoses on the general upper limb function during sporting, occupational, and daily living activities was not tested in this study. The counterforce orthoses were made from fabric-faced closed-cell neoprene rubber that can show a degree of skin irritation in a few patients particularly with prolonged use. No skin reaction to this material was seen in this study. Most of the participants preferred the forearm band over the elbow sleeve, suggesting that although these results could not support the use of one orthosis over the other, the patient's preference should be used in making the final decision to warrant higher compliance with management.

Conclusion

Two types of elbow orthoses, a counterforce band and an elbow sleeve, showed an immediate improvement in the sensory and motor performance of the affected arm in patients with LET. Both orthoses improved elbow proprioception, pain severity, and force production in the hand. Better finger dexterity was achieved with the application of the forearm band but not with the sleeve.

Disclaimer

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