# The Effect of Various Pressure by Elbow Supporting Band on pain in Tinnes Elbow

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## ABSTRACT

*This study was conducted to investigate the effect of the pneumatic forearm support band on elbow pain. It also investigated the effect of varying the pressure of the forearm support band on the common extensor origin.* ***Methods****: Thirty subjects (14 males, and 16 females) participated in this study. They were diagnosed by an orthopedist as grade II lateral epicondylitis. Subjects were seated in the test chair and the tests were done without the using of the forearm support band and with the band at varying pressures. Pain was measured using a 10 cm visual analogue scale. By using the Biodex system 3 isokinetic dynamometer, patient was asked to hold the handle firmly and move it from full flexion to full extension exerting his maximum effort. The test was performed in two speeds 90°/sec and 240°/sec. Five minutes of rest were allowed, then the band was applied without fitting it snugly, then the cuff was inflated to the desired pressure (20, 30, or 40 mm Hg). The whole test procedure was repeated for each pressure. The order of testing (without band, with pressure 20, 30, and 40 mmHg) was randomized.* ***Results****: Results of this study showed that the band caused a significant decrease in pain at wrist extensors origin. Varying the pressure of the band on the forearm by means of modifying the pressure inside the air cell of the pneumatic band did not have a significant effect on pain at wrist extensors origin.* ***Conclusion****: According to the results of the current study, the band was efficient in decreasing pain of the common extensor origin with test speed 90°/sec at pressure 20 and 30 mmHg. and with test speed 240°/sec at all of the three tested pressures. Within the limits of the pressures used in the current study, varying the pressure of the band had no significant effect on pain scores.*
***Key wards:*** *Tennis elbow, supporting band, pain.*

## INTRODUCTION

Lateral epicondylitis (tennis elbow) is one of the most common causes of elbow pain. It is characterized by pain and tenderness at the lateral epicondyle of the heumrus that aggravated by resisted extension of the wrist (Boyd and Mcleod, 1973). One of the most common causes of tennis elbow is the repeated forced activities of the wrist. These resulted in micro-tear and inflammation in the tendon (Nicholas, 1990). This trauma could also happen in sports or in occupation and might be confused with other pathological conditions as reported by (Ciccotti, 1999). Almost 50% of the tennis players, and 1-3% of normal population might sufferes from tennis elbow during their life. Tennis elbow can be clinicaly diagnosed by pain and tenderness at the lateral epicondyle of the heumrus, and radial pain on resisted extension of the wrist with elbow extension

(Solveborn, 1999). **Lateral epicondylitis has a** good prognosis **but, even with optimum** management, **require** a **minimum of 3-5** months to resolve (Gabel, 1999).

Current clinical treatment of lateral epicondylitis encompasses a broad spectrum of physical therapy modalities, pharmacological treatment, and surgical intervention. None of these clinical treatments, either singularly or in combination, has a documented superior reduction in patient symptoms (Halle et al., 1986). Treatment with forearm support band revealed satisfactory results in reducing pain of the common extensor origin (Solveborn SA, 1997; Wadsworth et al., 1989; Groppel and Nirschl, 1986; Froimson, 1971). Unfortunately, studies that investigate the effect of the band on patients are lacking. The pressure of the band on pain at the common extensor origin was not measured except in one study (Stonecipher and Catlin, 1984), although this factor showed to be biomechanically important (Schaub et al., 2000). No previous studies investigated the effect of varying the pressure on the performance of the wrist extensors. The Purpose of this study was to investigate the effect of the forearm support band on pain at the elbow in patients with tennis elbow and determine the influence of using different band pressures.

## MATERIALS AND METHODS

This study was conducted to investigate the effect of the pneumatic forearm support band on pain scores at the common extensor origin during wrist extension.

### Subjects

Thirty subjects (14 males, and 16 females) participated in this study. They were diagnosed by an orthopedist as grade II lateral epicondylitis. **Their ages ranged** between 30 **and 45 years (mean = 41)**. The duration of **symptoms ranged between one** and 24 months (mean= 5.27 ± 5.6 months). Twenty six% were manual workers, 20% were office workers, and 13% were housewives. All the patients were right-handed, the dominant hand was affected in 30%.

### Inclusion criteria

All patients participated in the study had the following criteria: Referral from an orthopedist diagnosed as grade II lateral epicondylitis, Positive resisted wrist extension test, Age between 30 and 45and there were localized tenderness over the lateral epicondyle.

### Exclusion criteria

Patient with any of the following were excluded from the study: treated surgically or by local corticosteroid injection since less than one month, Patients with other diseases, traumas, or surgeries in the elbow, wrist or shoulder of the examined side or the cervical spine or Patients with other systemic diseases that might interfere with the results of the study (diabetes, rheumatoid arthritis, etc).

### Instruments

#### *Pain measurements*

Pain was measured using a 10 cm visual analogue scale (VAS). One end scores 0 (no pain) and the other end scores 10 (worst possible pain).

#### *Isokinetic measurement*

Using Biodex system 3 isokinetic dynamometer*. Testing procedure took place in the Agozza Center of Physical Medicine, Rheumatism, And Rehabilitation.

Biodex isokinetic dynamometer consists of a dynamometer, a chair and a control panel that is controlled by a computer (fig. 1). It provides an objective method for testing and rehabilitation for joints of the upper limb, lower limb and the trunk. It can be operated in different modes; isokinetic, passive, isometric, isotonic, and reactive eccentric.

The position of the dynamometer can be controlled. It can be rotated horizontally, tilted, and its height can be adjusted according to the test or rehabilitation procedure as dictated by the manufacturer's guide. Similarly the chair position and height can be controlled. Biodex system is supplied with different attachments to fit to the different joints of the body (hip, knee, ankle, shoulder, elbow, wrist, and back) as well as work simulation accessories. The dynamometer can be controlled through the panel control or the computer software program. Using panel control, the operator should set the mode (isokinetic, passive, isotonic concentric or eccentric), and range of motion. Using the computer program, patient's data are entered, the testing or rehabilitation protocol is chosen, and finally a report can be obtained and printed if desired.

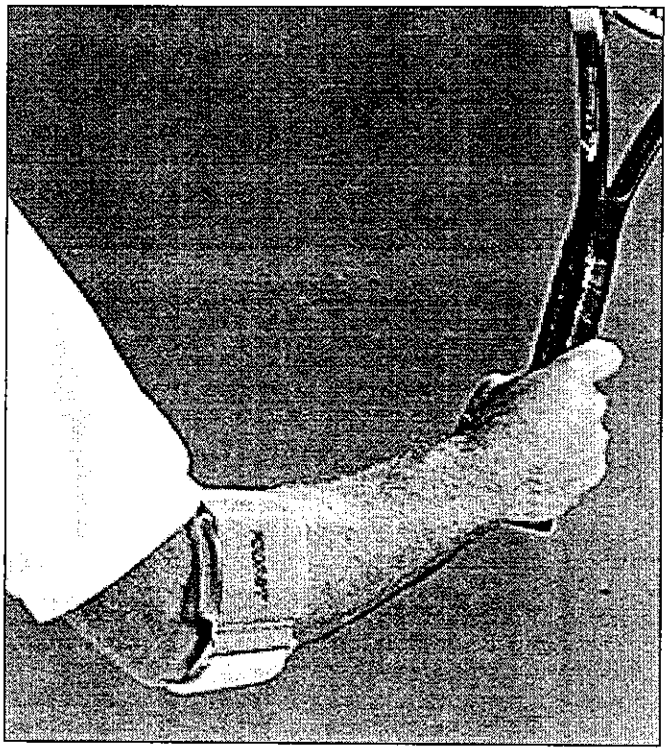

*Fig. (1): The pneumatic forearm support band*

***Modified forearm support band***

A modified Aircast tennis elbow forearm support band was used (Fig. 1). The traditional Aircast support band* consists of a non-elastic band that is lined with foam rubber to prevent slippage and is fixed by velcro. A pocket is found near one end of the band that contains an aircell. This aircell is supposed to impose more pressure on the common extensor origin. The aircell of the traditional Aircast band was removed. The rubbery interior airbag of a pediatric blood pressure cuff was used to replace and simulate the Aircast band's air-cell. Thus measuring the pressure inside the air-filled cell is possible (fig. 2). The whole system was calibrated prior to the experiment.

## Procedures

### *Screening test*

Initial evaluation included history taking, screening of the ROM of the shoulder, elbow, forearm, and wrist of the affected side, conducting tennis elbow tests (resisted wrist extension, resisted finger extension, and passive stretching of the wrist extensors), and recording pain score with resisted wrist extension.

### *Test procedures*

After fulfilling the inclusion criteria, the steps of the test were explained to the patient. Then personal data entered to the computer database.

### *Preparing the apparatus*

The chair rotation was adjusted to zero degree and the dynamometer rotation to zero degree (as indictated by the manufacturer). The limb support was set in place and the wrist attachment was attached to the dynamometer so that the fulcrum of the dynamometer was corresponding to the axis of rotation of the patient's wrist. The chair, the dynamometer, and the forearm rest heights were adjusted according to the height of each patient. The patient sat on the test chair with shoulder extended and abducted few degrees, elbow flexed 90°, forearm pronated and rested on the arm-rest and stabilized using the Velcro strap (fig. 1). The patient data were entered to the computer program database. Test protocol was set from the software program; isokinetic unilateral protocol was chosen, type of contraction was set as concentric with two speeds 240°/sec, and 90°/sec with 5 repetitions each. Range of motion was set using the control panel according to the patient's ability. After checking that the patient is ready, test procedure was started.

### *Testing wrist extension/ flexion*

The patient was asked to hold the handle firmly and move it from full flexion to full extension exerting his maximum effort. Verbal reinforcement was provided all over the test. No warm-up trials were allowed to avoid early fatigue and pain. The test was performed in two speeds 90°/sec and 240°/sec, starting with the higher speed (producing less torque) to avoid fatigue. For each speed, 5 repetitions were done with few seconds' rest between the two speeds. After completing the test the patient was asked to mark his pain score on VAS. Five minutes of rest were allowed, then the band was applied without fitting it snugly. The patient was asked to extend his wrist against resistance then the cuff was inflated to the desired pressure (20, 30, or 40 mm Hg). The whole test procedure was repeated for each pressure, and pain was recorded at each time. The order of testing (without band, with pressure 20, 30, and 40 mmHg) was randomized. These pressures were chosen according to a pilot study conducted prior to the experiment.

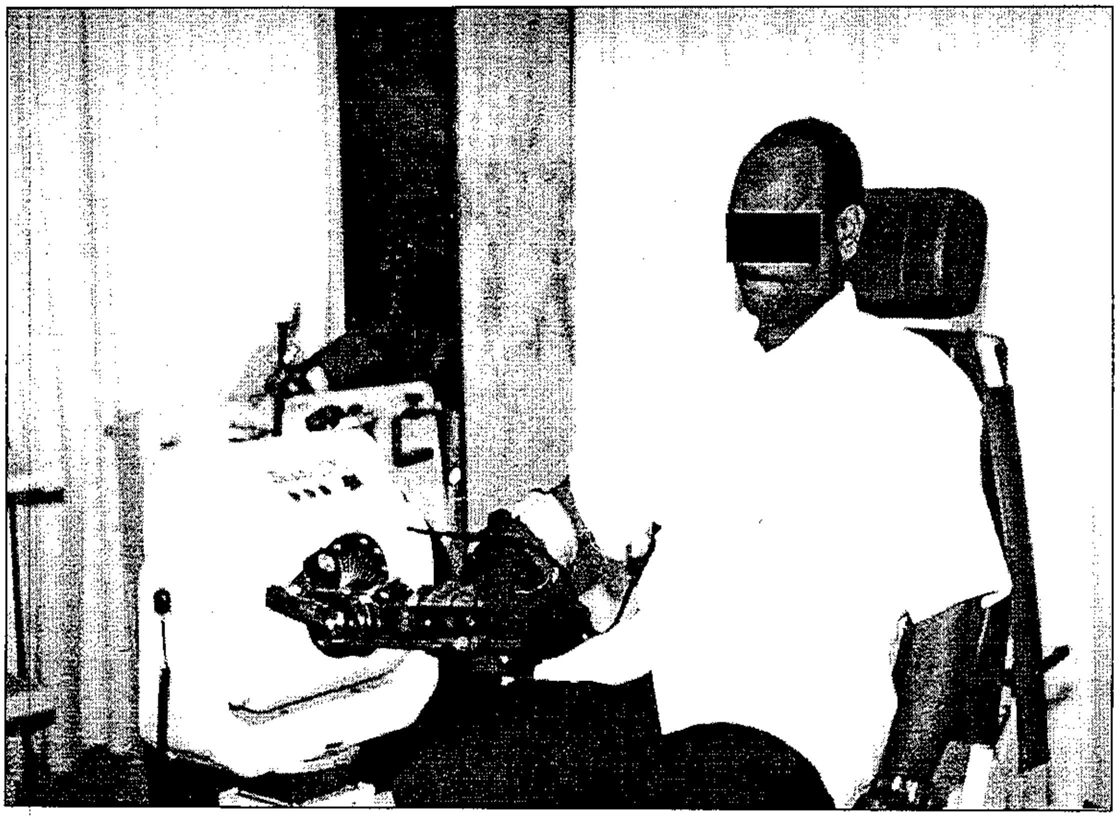

*Fig. (2): The patient is performing the test with the forearm support band applied.*

**Statistical analysis**

Descriptive statistics including the mean, maximum, minimum, and standard deviation of pain was calculated and analyzed using analysis of variance (ANOVA) test.

## RESULTS

Thirty unilateral tennis elbow patients participated in this study. Patients underwent the test procedures. Four patients (13%) were not able to perform the test at speed 90°/sec., so they performed only the tests at pressure 240°/sec., four patients (13%) performed the tests at only two of the three pressures. Pain scores were taken in four conditions; without band (PW), with band at pressure 20 mmHg (P20), with band at pressure 30 mmHg (P30), and with band at pressure 40 mmHg (P40). Summary of pain scores on VAS are shown in table (1) and (2).

***Table (1): Descriptive statistics of pain scores at test speed 90°/sec.***

| Variable | N | Mean | StDev | Max | Min |
|---|---|---|---|---|---|
| PW | 26 | 5.06 | 1.98 | 7.90 | 2.00 |
| P20 | 24 | 4.54 | 2.66 | 8.60 | 0.00 |
| P30 | 24 | 3.30 | 2.53 | 8.40 | 0.00 |
| P40 | 26 | 3.40 | 2.32 | 7.80 | 0.00 |

*Table (2): descriptive statistics of pain scores at test speed 240o/sec.*

| Variable | N | Mean | StDev | Max | Min |
|---|---|---|---|---|---|
| PW | 30 | 4.06 | 2.77 | 10.00 | 0.00 |
| P20 | 28 | 2.52 | 2.13 | 6.60 | 0.00 |
| P30 | 28 | 1.70 | 1.84 | 5.90 | 0.00 |
| P40 | 30 | 2.00 | 2.02 | 7.90 | 0.00 |

Pain scores were analyzed using one-way analysis of variance (ANOVA). At test speed 90°/sec, mean of pain scores on VAS without using the band was 5.06 ± 1.98. With using the band at pressure 20 mmHg, mean pain score was 4.54 ± 2.66, at pressure 30 was 3.3 ± 2.53 and at pressure 40 was 3.4 ± 2.32. ANOVA revealed significant difference between pain scores without band and with band at different pressures (P=0.02, F=3.32) (Table 3).

*Table (3): ANOVA for pain scores at speed 90o/sec.*

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Pain score | 3 | 56.52 | 18.84 | 3.32 | 0.023 |
| Error | 96 | 544.02 | 5.67 | | |
| Total | 99 | 600.53 | | | |

Tukey's pairwise comparison showed that using the band produced significant decrease in pain scores at pressure 30 and 40mmHg, while the decrease in pain scores at pressure 20 mmHg was not significant. There was no significant difference between pain scores with using the band at the three different pressures.

At test speed 240°/sec, mean of pain scores on VAS without using the band was 4.06 ± 2.77. With using the band at pressure 20 mmHg, mean pain score was 2.52 ± 3.13, at pressure 30 was 1.7 ± 1.84 and at pressure 40 was 2 ± 2.02. ANOVA revealed that using the band caused significant decrease in pain scores at the three pressures (20, 30, 40 mmHg), while there was no significant difference pain scores with using the band at different pressures (P= 0.001, F= 6.13) (Table 4). Fig. (3) shows means of pain scores with and without band at speed 90 °/sec and 240°/sec respectively.

*Table (4): ANOVA for pain scores at speed 240o/sec.*

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Pain score | 3 | 89.10 | 29.7 | 6.13 | 0.001 |
| Error | 108 | 523.12 | 4.84 | | |
| Total | 111 | 612.22 | | | |

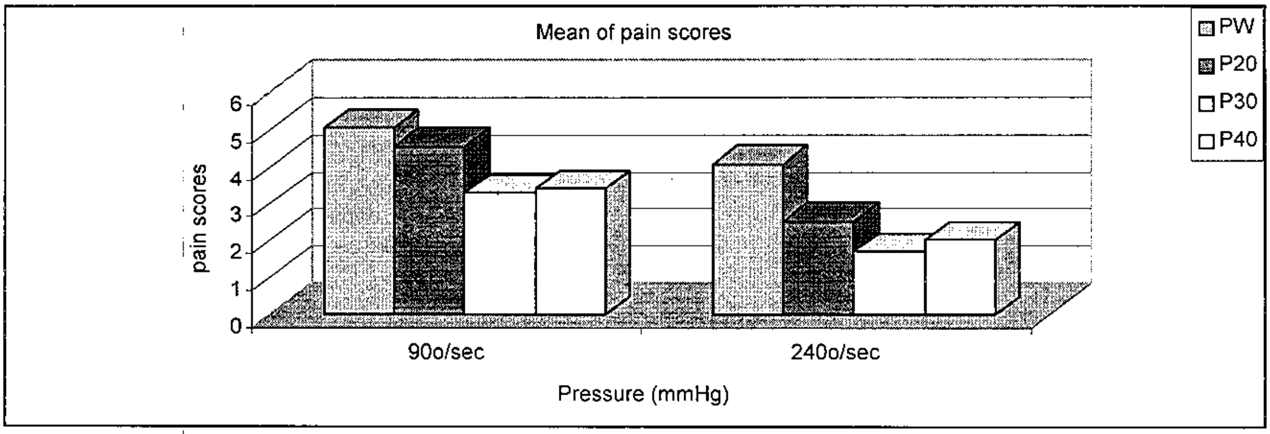


*Fig (3): Means of pain scores with and without band.*

## DISCUSSION

This study was conducted to investigate the effect of the pneumatic forearm support band on pain scores at the common extensor origin during wrist extension. It also investigated the effect of varying the pressure of the forearm support band on the common extensor origin.

The findings of the current study showed that there is significant decrease of pain scores with using the band. This effect on pain can be explained as suggested by Groppel and Nirschl (1986) that the band disperses stresses caused by muscle contraction away from the painful point to less vulnerable areas, and /or to the band itself. Reduction in pain can be explained physiologically on the basis of the pain gate theory. The theory states that stimulation of the large sensory fibers from the mechanoreceptors greatly depresses the transmission of pain signals either from the same area or from pain signals located several segments away (Guyton, 1991). As the pressure caused by the band probably stimulates mechanoreceptors in the common extensor origin, this may affect transmission of pain and thus pain is decreased. Several studies reported decrease in pain at the lateral epicondyle with using the forearm support band. Burton (1985) and Solveborn (1997) reported significant decrease in pain of tennis elbow patients with using the band. Wadsworth et al. (1989) also reported decrease in pain that did not reach the significance level. They suggested that this lack of significant decrease in pain is due to the small sample size or to the way of data collection, that depended on a verbal questionnaire rather than a numerical scale. Only the study by Wuori et al. (1998) that reported no decrease of pain with using the band. Furthermore, subjects reported increase in pain during contraction with using the band. This may be due to the type of bands that were used in this study; (a placebo band, an elastic counterforce brace, and an elbow support). As Nirschle (1977) and Reid (1992) recommended the use of a non-elastic band so that it applies pressure on the common extensor origin, the elastic band is not likely to do so. Regarding the elbow support, immobilization of the elbow wasn't recommended in literature as a treatment for tennis elbow.

In the current study, varying the pressure did not produce a significant effect on pain. The results were not consistent concerning the pressure that caused the least pain. This variable may be controlled by other factors, for example, the baseline strength of the subject, the forearm girth, or the degree of pain. It's recommended that these factors are to be controlled in future studies. Another cause of this finding may be the short period of rest between tests (5 minutes) which may not be enough for the recovery from pain of the previous test and elimination of its inhibitory effect and thus the differences between pressures were not pronounced The effect of the band on pain scores was more pronounced with the higher test speed (240o/sec.). Wrist extensors and particularly the ECRB muscle are rich in type II (fast glycolytic) muscle fibres (Ljung et al., 1999), which is primarily responsible for the high-speed movement (Low and Reed, 1996), such as that required with high isokinetic test speeds. So the effect of the band on this particular muscle was more pronounced in the mode of contraction suitable for it.

The pressures used in the current study were chosen according to a pilot study conducted prior to the main study. Subjects reported that increasing the pressure of the band above 40 mmHg produced manifestations of impaired circulation in the forearm and hand, such as swelling, pain, and tingling sensation. Stonecipher and Catlin (1984) set the pressure of the band through using a pediatric blood pressure cuff to simulate the band. They set the pressure at 40 mmHg according to their pilot study. At this pressure, subjects reported maximum comfort.

## CONCLUSTION

We investigated the effect of various pressures of the pneumatic forearm support band on the wrist extensors of patients with unilateral tennis elbow. Isokinetic testing was performed in two test speeds (90 and 240°/sec.). Three band pressures were tested (20, 30, 40 mmHg). According to the results of the current study, the band was efficient in decreasing pain of the common extensor origin with test speed 90 °/sec at pressure 20 and 30 mmHg. and with test speed 240 °/sec at all of the three tested pressures. Within the limits of the pressures used in the current study, varying the pressure of the band had no significant effect on pain scores.

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## الملخص العربي

### تأثير الضغوط متباينة للرباط المساند للساعد على آلام مفصل الكوع في حالات مرفق التنس

يعـد مرفق التنس أو التهاب اللقمية العضدية البرانية من أكثر المشاكل المسببة لآلام المرفق انتشاراً . ويتم علاج مرفق التنس إما بالعلاج التحفظي أو بالعلاج الجراحي . ومن وسائل العلاج التحفظي استخدام الرباط المساند للساعد ، الذي أثبت نجاحه في تخفيف الآلام المصاحبة لمرفق التنس .

وقـد كان الهدف من هذه الرسالة تقييم تأثير استخدام ضغوط مختلفة للرباط المساند للساعد على آلام المرفق . وقد استخدم مقياس الألم المرئي لقياس درجة الألم ، كما استخدام جهاز بيوديكس الأيزوكينيتكي لقياس أقصى عزم أيزوكيمينيكي للعضلات الباسطة للرسغ . وقـد اشـترك في الدراسة ٣٠ مريضاً يعنونا من مرفق التنس المزمن ، تتراوح أعمارهم بين ٣٠ -٤٥ . وتم قياس الألم والعزم الأقصى أثـناء قـيام المريض بثني وبسط الرسغ على جهاز بيوديكس باستخدام سرعتين ٩٠ ، ٢٤٠ درجة / ثانية . وكرر هذا القياس في أربعة أحوال : بدون رباط ، باستخدام الرباط بقوة ضغط ٢٠ ، ٣٠ ، ٤٠ ملم زئبق .

وقـد أسفرت الدراسة أن الرباط المساند للساعد قد أحدث تناقصاً ذا دلالة إحصائية في الألم ، بينما لم يحدث تغيير ضغوط الرباط على ساعد المريض على تأثير ذي دلالة إحصائية في الألم .

[a]Biodex Medical Systems, Inc., New York.
* Aircast Inc. Summit, NJ