

Treatment of tennis elbow with a forearm support brace (Epi Forsa Plus)

DR. MED. ANDREAS KANNENBERG, Director Medical Affairs, Otto Bock HealthCare GmbH, Duderstadt

Epicondylitis lateralis humeri, or tennis elbow, is characterised by pain at the lateral epicondyle of the humerus and pain on resisted dorsiflexion of the wrist. Tennis elbow is a frequently reported condition. The incidence in general practice is approximately 4-7 per 1000 patients per year (1, 2). The annual incidence of the condition is 1-3% in the general population (3, 4).

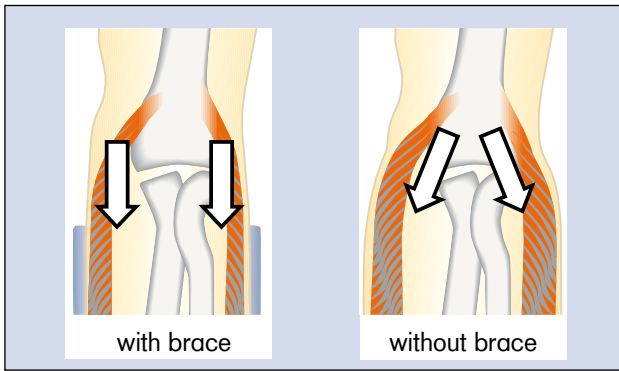
Over 40 treatment options have been described in the literature (17). In Dutch primary care about 21% of the patients are prescribed an orthotic device as a treatment measure (5).

Classic lateral epicondylitis has been described as an overuse or misuse injury resulting in a tendinitis. The extensor carpi radialis brevis and extensor digitorum communis muscles have been implicated as primary culprits in this pathology (6). This view is supported by electromyographical studies showing significantly higher EMG activities of these muscles in tennis elbow patients than in healthy controls (7, 8, 9), indicating higher activation and mechanical strain to accomplish the same physical task. This results in the wrist extensors being more vulnerable to injury (8) and detrimental to the healing process (9).

Furthermore, a study investigating wrist joint weight lifting suggested that in epicondylitis the dorsal extension of the hand is exerted by a smaller number of fibers, what might explain enthesiopathy (7).

Theoretically, binding the muscles with a forearm brace like the Epi Forsa Plus may limit expansion of muscle fibers and decrease the contribution to force production made by muscle fibres proximal to the brace. The effect of a constrictive brace can be demonstrated by analysis of EMG activity of the extensor carpi radialis brevis (ECRB) and extensor digitorum communis (EDC) muscles proximal to the brace. EMG data were recorded at 80% of maximum voluntary isometric contraction (MVIC) with and without the brace. An analysis of integrated EMG (IEMG) showed that the forearm support brace caused a significant reduction in IEMG, thus indicating a significant reduction of activation and mechanical stress to the two muscles usually affected in epicondylitis (6).

The electromyographical findings are backed by results of mechanical investigations in cadaveric and clinical models. The cadaver model measured forces at the ECRB origin as various pressures were



applied to a forearm support brace and while the ECRB tendon was loaded distally. Results revealed an increased forearm support brace effect in terms of force reduction at the ECRB origin with increased brace pressure. Measurements in healthy volunteers suggest that the forearm support brace may be most effective when applied to 30 to 50 mm Hg at rest, resulting in up to 120 mm Hg pressure during activity. This would result in a force reduction at the ECRB origin of 13% to 15% throughout a range of activity levels (10, 11). Another study in healthy subjects found that a forearm brace produced a significantly higher pain threshold ($p=0.001$) in passive stretching of the forearm muscles than could be detected without a brace (12).

Another study investigated acceleration amplitudes and integrals of the forearm and the elbow under different types of braces while the subjects were playing tennis. Braces with pads placed at the forearm showed the highest reduction of acceleration amplitudes (-46%) and acceleration integrals (-42%). Overload of the wrist extensors, which is considered to be a major pathogenic factor in lateral epicondylitis, can thus be reduced by braces putting pressure to the proximal forearm muscles (18).

Clinical Studies

Twenty-seven patients who presented with tennis elbow had their grip strengths measured with and without a forearm brace. 81% of these patients displayed a significantly increased pain-free grip strength with the brace ($p < 0.001$) (Table 1 and

figure 1) (13).

A randomised, prospective trial compared the

Effect of brace	Number of patients	Proportion of patients
Increase of painfree grip strength	22	81 %
No change of grip strength	4	15 %
Decrease of painfree grip strength	1	4 %

Tab. 1: Effects of forearm brace on painfree grip strength in 27 epicondylitis patients

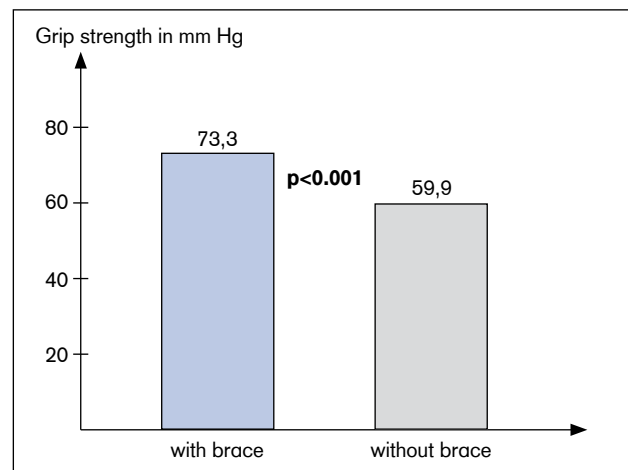


Fig. 1: Average painfree grip strength of patients with and without wearing a forearm brace

application of an elbow support brace with a physical treatment program over 6 weeks. Concerning pain and a subjective outcome measure on global improvement the brace was as effective as the physical treatment program (14).

Another randomised, prospective study used stretching or upper forearm braces in the treatment of radial epicondylalgia in 185 patients. 94 patients were treated with home stretching exercises and 91 patients were told to use a prescribed proximal forearm brace in daily activities as much as possible. Both treatments were successful with a continuous symptom reduction with the outcome being in favour of stretching (15). Taking into account that a forearm brace reduces pain threshold in stretching (12), the combination of both treatment modalities might be even more effective.

Sixty-one patients were consecutively assigned at random to a treatment with either an elbow-brace to be worn daily during activity for 3 months or an

injection of bupivacaine hydrochloride (Marcaine) 0.3 ml and triamcinolone acetonide, 10 mg/ml (Kenacort) 0.2 ml into the area of maximal tenderness at the lateral epicondyle. Follow-up, including subjective and objective outcome, was done at the clinic after 2 weeks, 3, 6, and 12 months. In subjective as well as objective outcome a significant difference between the groups, favouring the steroid injections, was observed only after 2 weeks: $P < 0.001$ and $P < 0.05$, respectively. After 3 months there was no significant difference between the treatment groups. In conclusion, in the long-term treatment of lateral epicondylitis an elbow support brace is as effective as local steroid injections (16).



Fig. 2: Epi Forsa Plus Brace

36 patients with a mean duration of complaints of 17.7 weeks (3-156 weeks) were randomly splitted into four groups receiving NSAID acemetacin or local triamcinolone injection in addition to epicondylitis brace or epicondylitis brace and local injection alone. Pain at rest and during resistive wrist extension was investigated with Visual Analogue Scale (VAS), grip strength in terms of kilograms was measured with a hand dynamometer while tenderness over the lateral epicondyle was graded between 0-3 before and after 3 weeks of treatment. No statistical difference between the four treatment groups could be found, supporting the result of (16) that a forearm support brace is as effective as local steroid injections and oral NSAID therapy or a combination of both (17).

Summary

From the pathophysiological and biomechanical point of view a forearm brace as the Epi Forsa Plus can reduce activation of and mechanical stress to the muscles commonly affected in lateral

epicondylitis (6, 10, 11, 18). It is able to increase pain threshold in stretching of the forearm muscles (12). From the clinical perspective a forearm brace is as effective as local steroid injections (16, 17), oral NSAID therapy (17), and physical therapy (14) except stretching (15). Combination of stretching and forearm brace might render even better results (12). Patients who are likely to benefit from the forearm brace can be identified by the help of the "Extensor-Grip-Test": Clasp the forearm with your hand several centimeters distal of the wrist extensor origin (where the brace would be positioned) with strong pressure (Fig 3). Let the patient carry out a dorsiflexion of his wrist against resistance (Fig 4). If the pain is substantially diminished the patient would be a good candidate for treatment with Epi Forsa Plus.



Fig. 3 and 4: Extensor-Grip-Test

References

- HAMILTON, P.G.**
The prevalence of humeral epicondylitis: a survey in general practice.
J. Royal Coll. General Pract. 1986, 36: 464-465
- KIVI, P.**
The etiology and conservative treatment of humeral epicondylitis.
Sc. J. Rehab. Med. 1983, 15 (1): 37-41
- VERHAAR, J.A.**
Tennis elbow.
Int. Orthopedics 1994, 18: 263-267
- CHARD, M.D.**
Tennis elbow – a reappraisal.
Br. J. Rheumatol. 1989, 28: 186-190
- VERHAAR, J.A.**
Tennis elbow. (Dissertation)
Maastricht, University Press, 1992
- SNYDER-MACKLER, L.; EPLER, M.**
Effect of standard and Aircast tennis elbow bands on integrated electromyography of forearm musculature to the bands.
Am. J. Sports Med. 1989, 17(2): 278-281
- WEH, L.; BAUMANN, A.**
Polymyographische Ableitungen bei der Epicondylopathia humeri radialis.
[Polymyographic recording in epicondylopathia humeri radialis]
Z. Orthop. Grenzgeb. 1989, 127(1): 72-76
- KELLEY, J.D.; LOMBARDO, S.J.; PINK, M.; PERRY, J.; GAINGARRA, C.E.**
Electromyographic and cinematographic analysis of elbow function in tennis players with lateral epicondylitis.
Am. J. Sports Med. 1994, 22(3): 359-363
- BAUER, J.A.; MURRAY, R.D.**
Electromyographic patterns of individuals suffering from lateral tennis elbow.
J. Electromyogr. Kinesiol 1999, 9(4): 245-252
- MEYER, N.J.; PENNINGTON, W.; HAINES, B.; DALEY, R.**
The effect of the forearm support band on forces at the origin of the extensor carpi radialis brevis: a cadaveric study and review of the literature.
J. Hand Ther. 2002, 15(2): 179-184
- MEYER, N.J.; WALTER, F.; HAINES, B.; ORTON, D.; DALEY, R.A.**
Modeled evidence of force reduction at the extensor carpi radialis brevis origin with the forearm support band.
J. Hand Surg. 2003, 28(2): 279-287
- CHAN, H.L.; NG, G.Y.**
Effect of counterforce forearm bracing on wrist extensor muscles performance.
Am. J. Phys. Med. Rehab. 2003, 82(4): 290-295
- BURTON, A.K.**
Grip strength and forearm straps in tennis elbow.
Br. J. Sports Med. 1985, 19(1): 37-38
- DWARS, B.J.; DE FEITER, P.; PATKA, P.; HAARMAN, H.J.Th.M.**
Functional treatment of tennis elbow. A comparative study between an elbow support and physical therapy.
Sports, Medicine and Health 1990: 237-241
- SOLVEBORN, S.A.**
Radial epicondylalgia ('tennis elbow'): treatment with stretching or forearm band. A prospective study with long-term follow-up including range-of-motion measurements.
Scand J Med Sci Sports. 1997 Aug;7(4):229-37
- HAKER, E.; LUNDBERG, T.**
Elbow-band, splintage and steroids in lateral epicondylalgia (tennis elbow).
Pain Clinic 1993, 6(2): 103-112
- ERTURK, H.; CELIKER, R.; SIVRI, A.; CETIN, A. CINDAS, A.**
The efficacy of different treatment regimens that are commonly used in tennis elbow.
J. Rheum. Med. Rehab. 1997, 8(4): 298-301
- WALTHER, M.; KIRSCHNER, S.; KÖNIG, A.; BARTHEL, T.; GOHLKE, F.**
Biomechanical evaluation of braces used for treatment of epicondylitis.
J. Shoulder Elbow Surg. 2002, 11(3): 265-270

With compliments

Otto Bock HealthCare GmbH

Max-Näder-Str. 15 · 37115 Duderstadt

Tel.: +49 551 8480 · Fax: +49 551 72330

healthcare@ottobock.de · www.ottobock.com