



Long-term efficiency of extracorporeal shockwave therapy on lateral epicondylitis

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Lateral epicondylitis is a frequent cause of elbow pain in the adult age population. The purpose of this study was to determine the effects of extracorporeal shock wave therapy (ESWT) effective on long term clinical and functional results in the treatment on patients with lateral epicondylitis. Forty-six patients suffering from lateral epicondylitis for at least 3 months were treated in this study. Clinical evaluation scoring system tests were used before and done year after the treatment for each patients. The VAS improved from 9,3 to 1,8, and the Nirschl values improved from 6,4 to 4,3. In the control group, VAS improved from 8,4 to 7, and the Nirschl values improved from 6,8 to 6,1. ESWT application to LE patients those are resistant to the therapy, carries beneficial effects to the long term which was previously stated for the short term, both clinically and functionally.

Keywords : Epicondylitis ; ESWT ; long-term.

INTRODUCTION

Lateral epicondylitis is a frequent cause of elbow pain in the adult age population (4,6,26,29). However pathoanatomy of this disease, called “tennis elbow” remains unclear (18,19). Aging, local trauma, hormonal, vascular and chemical factors were considered in the etiology of lateral epicondylitis and injury of the origin of the extensor tendon due to recurrent excessive utility

is accepted as predisposing factor (20,24,26,29,30). Histopathological examination studies of surgically treated cases revealed that the disease course is mainly degenerative, rather than an inflammatory process (4,6,15,19,20,22,26).

The treatment of lateral epicondylitis is usually conservative (18,21,24,26,29). Treatment strategies generally include antiinflammatory agents, reduction of physical activity, splints, physical therapy sessions and local corticosteroids (1,3,6, 15,27,30). Alternative treatment modalities like; extracorporeal shock wave therapy (ESWT), laser application, botulinum injection, acupuncture, autologous blood injection and platelet rich plasma injection, are under researched to be utilized in lateral epicondylitis cases those can not benefit from

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conservative approach (6,11,30). Patients, resistant to conservative treatment modalities are treated by debridement via arthroscopic technique or open surgery (4,7,15,18,27,30).

Lateral epicondylitis does not have a universally accepted and standardized treatment. On the other hand, it is an important cause of morbidity since it is prevalent in the society and leads to a considerable workforce loss (6). Fundamental approach to the disease is conservative. It includes limiting physical activity and physical therapy sessions, but they have the disadvantage of prohibiting the patients from returning to their daily life and occupation. Injections are invasive options those are proven efficient, but have a side effect of changing the histopathological structure of the tissues (7,18).

There are short term studies showing ESWT has a beneficial effect over pain and functions in this condition (15,24,26). It has an advantage of being a non invasive option which doesn't interfere with the daily or professional life of the patients. However,

there is not enough study about its long term effects on lateral epicondylitis (12,18,23,30).

ESWT is a painless procedure and treatment last 30 minutes for once a week. Patients rapidly turn back to their work even just after the session.

METHODS

Patients those are under follow up at least for a year after receiving treatment for lateral epicondylitis during 2013-2014 were enrolled in the study. 34 conservatively treated (at least one of the following; non steroid anti inflammatory drugs, splints, physical treatment) patients and 94 patients given ESWT for the treatment of lateral epicondylitis during the determined period, were called and invited for the study. Patients' acceptance or decline for the study was planned according to the previously set criteria (Table I). 27 of the ESWT received patients and 19 controls from the conservative treatment group were meeting the inclusion criteria.

Lateral epicondylitis was diagnosed if there was pain with palpation of the lateral epicondyle; or painful dorsal flexion of the wrist or forearm extensor muscle group's passive stretch; and pain with the force against the third finger extensor motion, during the examination.

ESWT application was performed while the patient was sitting on the bed, his elbow was bended 90 degrees and forearm lies neutral. Head of the ESWT device was placed 90 degrees tangential position over the painful area. Protective earmuffs were used by both the patient and the operator to avoid the discomfort of the loud noise of the device. Application area was cleaned by the iodine solution and gel material was used to enhance the conduction (coupling gel). Local anesthesia was not used in any case. Previous studies suggest to make the application just over the painful area (12,18,21,23,30). However, due to the extreme amount of pain in LE patients, application is performed in a circular manner around the 1 cm² of the painful area in the first session. Then, in the following sessions, application was right over the painful area as previously suggested. We assume that the patients have a higher compatibility to the treatment with this gradual style.



Fig. 1. — ESWT application

Table I.

Inclusion Criteria	Exclusion Criteria
Diagnosed lateral epicondylitis	Cervical spine problems, upper extremity other pathologies (e.g. entrapment neuropathies, operation history)
VAS above 6	Generalized polyarthritis or other romatological diseases
At least 3 month of pain on lateral epicondyle	Neurological abnormalities
Treatment to the affected area within the previous 3 month	Pregnancy
Followed and treated in our hospital	Malignancy, vasculitis
	Local dermatological problem
	Anticoagulant therapy
	< 18 year of age
	Previus injection treatment in last three month (corticosteroid, autolog blood, platelet rich plasma, mesotherapy, peppering)
	Connective tissue or infections disease

ESWT was performed by the same operator using the same device (ElettronicaRoland 2, Pagani, Italy). Procedure consists of two stages. In the first one, energy density is 0,348 mj/ cm², frequency 5 hz, 300 pulses. In the second stage 0,372 mj/ cm², 3,5 hz and 1200 pulses. A total of 4 sessions were carried out once a week.

10 minutes of ice applied after ESWT treatment. Besides, patients were advised to apply ice for 20 minutes once a day during the treatment. Patients were not given any physical activity limitation. Each patients were given the same exercise plan in the second session. Ball and towel squeeze (wrist power and movement range), rolling pencil (forearm supination and pronation) and rubber stretch exercises provided the evaluation of the pain, that emerges with movement. Patients were restricted using any NSAIDs. 10 of the patients experienced a slight rash which faded away in 2 or 3 days. Five of the patients felt pain durin application but the following sessions were painless.

VAS, Nirshcl, Venhaar clinical evaluation scoring system tests were used before an done year after the treatment for each patients. Also jamar measurements were performed in the first year control visit. Patients did not need any surgical or any alternative treatment for one year after the treatment.

Statistical Package for the Social Sciences (SPSS) 17 program was used for the statistical evaluation of the study. Demographic data was compred using

Fischer's chi square and Mann Whitney-U tests. MannWhitney -U, Pearson chi square and wilcoxon tests were used to compare evaluation scores.

RESULTS

27 ESWT treated patients and 19 control patients receiving conservative treatment met the inclusion criteria and enrolled in the study. ESWT group consisted of 20 females and 7 males (mean age 42,9 ± 10,2 years). Right/left ratio was 22/5. Mean follow up period was 10,5±6,0 months. Control group was consisted of 14 females and 5 males (mean age 47,5 ± 9,1 years). Right/left ratio was 11 / 8. They were followed up for 18,6±7,9 months. (Table II)

VAS score of the ESWT treated patients were 9,3±0,7 at the onset and 1,8±1,2 after one year. The reduction was statistically significant (p = 0,000,4). Nirschl values of the same group was 6,4±0,7 and 4,3 ± 1,9 consecutively for the onset and the first year visit with a statistically significant (p = 0,000) reduction. In the control group, VAS values were reduced from 8,4±1,1 to 7±1,5 in one year (p = 0,000) and Nirschl values reduced from 6,8±0,4 to 6,1± 0,9 in one year follow up which was also statistically significant (p = 0,003). In the last control of the cases, Venhaar scores of the ESWT group were 3,3±0,8 and showed statistical significance (p = 0,002) when compared to control group score of 2,4±0,7 (Table III).

Table II. — Baseline characteristics of subjects in each group

Demographic details	ESWT group N=27	Control group N =19	p
Age (years)	47,5 ± 9,1	42,9 ± 10,2	0,2*
Gender (Male/Female)	7/20	5/14	
Cigarette	22 (%81,5)	12 (%63,0)	0,1**
Dominant and Right/left*	27/0	18/1	0,4**
Side of involvement Right/left	22/5	11/8	0,1**

Statistical significance was set at $p < 0.05$

** Mann Whitney –U

* Fischer's ki-kare

Table III. — Pre-treatment and Post-treatment results of the study

	ESWT group n=27	Control group n=19	p
Pre treatment VAS	9,3±0,7	8,4±1,1	0,01*
Post-treatment VAS (Twelve Month)	1,8±1,2	7±1,5	0,0*
Pre-treatment Nirschl	6,4±0,7	6,8±0,4	0,01 *
Post-treatment Nirschl (Twelve Month)	4,3 ± 1,9	6,1± 0,9	0,0*
Venhaar	3,3±0,8	2,4±0,7	0,0*

ESWT: extra-corporeal shock wave therapy VAS: visual analogue scale. * Mann Whitney-U

Grasp powers of the ESWT group were $30,6 \pm 11,2$ on the right and $30,9 \pm 11,1$ on the left. Same parameter was measured for the control group was $31,2 \pm 11,7$ on the right and $30,9 \pm 13,1$ on the left. The difference showed no significance. Returning back to work was also better in ESWT group and 16 (%59,2) patients returned back to their occupation immediately after the treatment. In summary, we observed that ESWT treated patients were pain free and functional after one year.

There was no difference between two groups regarding age ($p = 0,2$), gender ($p = 1,0$) and affected side ($p = 0,4$, $p = 0,1$). Smokers were higher in ESWT group but the difference was not significant. ESWT group consisted of 11 housewives, 9 blue collar workers (earns life by physical work), 6 white collars (earns life by desk work) and 1 student. On the other hand, control group consisted of 8 housewives, 5 blue collar workers (earns life by physical work), 5 white collars (earns life by desk work) and 1 student.

DISCUSSION

Lateral epicondylitis or in another widely used term tennis elbow is a frequent cause of elbow

pain which leads to a disruption in the daily life and interrupts work life. There is not a consensus on its treatment (6,15). ESWT is used in orthopedic conditions like plantar fasciitis, calcific tendinitis of the shoulder and non union, since 1980s (2,6,25,31,32). Its field of utility rapidly widens. Today, using ESWT in the treatment of lateral epicondylitis and plantar fasciitis is approved by FDA (2). ESWT is assumed to provide benefits by blocking nociceptors and accelerating healing by amplifying the permeability of tenocytes (6). Past studies show that it may be beneficial for the cases those are resistant to the other modalities (5,8,18,21,23,30).

In our study, we treated LE patients with ESWT, who did not benefit from conservative treatment procedures such as medication, splint, injection. Same day returning to occupation rate was quite high (%60). This gives a huge advantage to the patients according to the other treatment options. Besides, comparison of venhaar, vas and nirschl scores with control group was significant.

In our study we found that ESWT application to LE patients those are resistant to the therapy, carries beneficial effects to the long term which was previously stated for the short term, both clinically and functionally.

Furthermore, studies using ESWT indicates that recovery after ESWT may prolong up to 24 weeks and patients may need ESWT treatment again. (15,18,20) However our patients did not need the treatment again.

The major limitation of our study was its retrospective design. Our control group was not uniform. Our effort to make our study and control groups uniform, led us to set a wide inclusion and exclusion criteria set and this limited our study and control patients' number.

One year long term results of ESWT treatment resulted a significant improvement in VAS, Nirschl and venhaar scores according to control group. All of our patients had a good compliance to the treatment and ESWT had no major complications in our patients. Some minor complications were encountered but they quickly resolved. Complications regarding the application mentioned in the literature till today are, local swelling, pain during application, petechiae and small sized hematomas (13). According to previous reports, those complications are usually resolved in 1 or 2 days. Long term result of ESWT is a subject on which there is a limited number of studies present (12,18,21,23,30). In 2002, in a study of 272 patients of LE, Haake et al showed that ESWT has no additional benefit over placebo (12). This study is important because it is the first one which clearly describes inclusion and exclusion criteria and includes a placebo group. On the other hand, in the placebo group, head of ESWT was covered with air filled polyethylene foil and was not contacted to skin via gel. We think that this compromises placebo concept in this study. Because even little, some side effects were noted in the placebo group of abovementioned study. This was caused by the active function of the device during application. Our placebo application suggestion is to apply non functional head of the ESWT device while the other head is still active. Besides, applying local anesthesia to the ESWT site interferes with the results of the treatment. Thus, we did not use local anesthesia in any of our patients. Melikyan et al also conducted a placebo controlled study with 86 patients in 2003 and did not use local anesthesia (18). They did not find a significant difference between two groups after a

year. Using a similar patient population, Rompe et al studied 78 tennis players and in this valuable study they revealed that ESWT is superior to placebo (23). Pettrone et al, using ESWT in LE is safe and effective (21). They stated that even the similar conditions and design of their study to Haake et al's (12), different results might be the consequence of local anesthesia. Limited number of randomized controlled long term studies push ESWT forward as an effective and safe procedure.

Different injection therapies are used in LE treatment, but there is a lack of wide, double blind, uniform trials regarding the superiority of any of those (14,18). Generally, steroid injections are efficient in short term, within 6 weeks period (3,15,27,28). There are various sized and quality studies showing the superiority of botulinum toxin, autologous blood, PRP, hyaluronic acid and prolotherapy on placebo (14,16). On the other hand, injection therapies have infection risk because of its invasive nature. In a meta analysis of 744 cases who were given steroid injections for shoulder or elbow tendinitis, a temporary pain in the injection site %10.7, skin atrophy or depigmentation %4 were reported as side effects (10). Studies also report work force loss after the treatment.

In our study, we differently performed the treatment not directly to the most painful area, but around it in a circular manner. This is a novel technique which provides much better patient compliance. Due to the high noise of the device, both the operator and the patient used earmuffs.

Lateral epicondylitis is an important cause of work force loss (9). It is an important advantage for the ESWT treated patients to continue working without any work force loss. Patients continue their daily life activities and have a shorter recovery period. Other advantages are less occupational loss and lower cost of treatment than surgical procedures.

On the contrary, the major disadvantage is the lack of clear protocols. However there are some causes those obstacles to achieve an agreement on a common treatment protocol. Technical variations during application (device design, number of sessions), differences in patient population, variation of the severity of the disease and differences of study designs may lead to this (2).

CONCLUSIONS

Lateral epicondylitis is hard to treat and has recursive nature. If untreated, it leads to a painful period of 6 months to 2 years when the patients can not contribute to work life. There is not a common opinion for its treatment. ESWT is a non invasive procedure with no or minimal complications. We believe that, studies conducted on a wide patient series are needed, which has placebo control as we defined, to establish the effectiveness of ESWT treatment.

REFERENCES

1. **Altay T, Gunal I, Ozturk H.** Local injection treatment for lateral epicondylitis. *Clin Orthop Relat Res.* 2002 ; 398 : 127-130.
2. **Andres BM, Murrel GAC, Dphill.** Treatment of tendinopathy what Works, what does not, and what is on the horizon. *Clin Orthop Relat Res.* 2008 ; 466 : 1539-1554.
3. **Assendelft WJ, Hay EM, Adshead R, Bouter LM.** Corticosteroid injections for lateral epicondylitis : A systemic overview. *Br J Gen Pract.* 1996 ; 46 :209-216.
4. **Barrington J, Hage W.** Lateral epicondylitis : non-operative, open, or arthroscopic treatment? *Curr Opin Orthop.* 2003 ; 14 : 291-295.
5. **Buchbinder R, Green SE, Youd JM, Asfendelft WJ, Barnsley L, Smidt N.** Shockwave therapy for lateral elbow pain. *Cochrane Database SystRev.* 2005 ; 19 : CD003524.
6. **Calfee RP, Patel A, DaSilva MF, Akelman E.** Management of Lateral Epicondylitis : Current Concepts. *J Am Acad Orthop Surg.* 2008 ; 16 : 19-29.
7. **Coonrad RW, Hooper WR.** Tenniselbow : itscourse, naturalhistory, conservative and surgical management. *J Bone Joint Surg Am.* 1973 ; 55 : 1177-1182.
8. **Crowther MA, Bannister GC, Huma H, Rooker D.** A prospective, randomised study to compare extracorporeal shock-wavetherapy and injection of steroid for thetreatment of tennis elbow. *J Bone Joint Surg Br.* 2002 ; 84 : 678-679.
9. **Furia JP.** Safety and efficacy of extracorporeal shockwave therapy for chronic lateral epicondylitis. *Am J Orthop (Belle Mead JN).* 2005 ; 34 : 13-19.
10. **Gaujoux-Viala C, Dougados M, Gossec L.** Efficacy and safety of steroid injections for shoulder and elbow tendonitis : a meta-analysis of randomised controlled trials. *Ann Rheum Dis.* 2009 ; 68 : 1843-1849.
11. **Gunduz R, Malas FU, Borman P, Kocao lu S, Ozcakar L.** Physicaltherapy, corticosteroid injection, and extracorporeal shockwave treatment in lateral epicondylitis clinical and ultrasonographical comparison. *Clin Rheumatol.* 2012 ; 31 :807-812.
12. **Haake M, König IR, DeckerT, Riedel C, Buch M, Muller HH ;** Extracorporeal ShockWave Therapy Clinical Trial Group. Extracorporeal shockwave therapy in thetreatment of lateral epicondylitis : A randomized multicentertrial. *J Bone Joint Surg Am.* 2002 ; 84 : 1982-1991.
13. **Haake M, Böddeker IR, Decker T, Buch M et al.** Side-effects of extracorporeal shockwave therapy (ESWT) in thetreatment of tennis elbow. *Arch Orthop Trauma Surg.* 2002 ; 122 : 222-228.
14. **Judson CH, Wolf JM.** Lateral epicondylitis review of injection therapies. *Orthop Clin N Am.* 2013 ; 44 :615-623
15. **Ko JY, Chen HS, Chen LM.** Treatment of lateral epicondylitis of the elbow with shockwaves. *Clin Ortop.* 2001 ; 387 : 60-67.
16. **Krogh TP, Bartels EM, Ellingsen T, Stengard-Petersen K, Buchinder R, Fredberg U, Bliddal H, Christensen R.** Comparative effectiveness of injection therapies in lateral epicondylitis : a systematic review and network meta-analysis of randomized controlled trials. *Am J Sports Med.* 2012 ; 41 : 1435-1446.
17. **Kudo P, Dainty K, Clarfield M, Coughlin L, Lavoie P, LebrunC.** Randomized, placebo-controlled, double-blind clinical trial evaluating the treatment of plantar fasciit is with an extracorporeal shock wave therapy (ESWT) device : a North American confirmatory study. *J Orthop Res* 2006 ; 24 : 115-123.
18. **Melikyan EY, Shahin E, Miles J, Bainbridge LC.** Extracorporeal shock-wave treatment for tennis elbow : a randomised double-blind study. *J Bone Joint Surg Br.* 2003 ; 85 : 852-855.
19. **Nirschl RP.** Elbow tendinosis/tennis elbow. *Clin Sports Med.* 1992 ; 11 : 851-870.
20. **Nirschl RP, Pettrone FA.** Tenniselbow : the surgical treatment of lateral epicondylitis. *J Bone Joint Surg Am.* 1979 ; 61 : 832-839.
21. **Pettrone RJ, Cogliano A, Decaria J, Mohamed N, Lee R.** Extracorporeal shockwave therapy without local anesthesia for chronic lateral epicondylitis. *J Bone Joint Surg Am.* 2005 :87 : 1297-1304.
22. **Regan W, Wold LE, Coonrad R.** Microscopic histopathology of chronic refractory lateral epicondylitis. *Am J Sports Med.*1992 ; 20 : 746-749.
23. **Rompe JD, Decking J, Schoellner C, Theis C.** Repetitive low-energy shock wave treatment for chronic lateral epicondylitis in tennis players. *Am J Sports Med.*2004 ; 32 : 734-743.
24. **Rompe JD, Hopf C, Kullmer K.** Low-energy extracorporeal shockwave therapy on chronic tennis elbow. *Int Orthop.* 1996 ; 20 : 23-27.
25. **Rompe JD, Schoellner C, Nafe B.** Evaluation of low energy extracorporeal shockwave treatment for treatment of chronic plantar fasciitis. *J Bone Joint Surg Am.* 2002 ; 84 : 335-341.
26. **Sayegh ET, Strauch RJ.** Does nonsurgical treatment improve longitudinal outcomes of lateral epicondylitis

- over no treatment A meta-analysis. *Clin Orthop Relat Res.* 2014 ; 29 (Epubahead of print).
27. **Sems A, Dimeff R, Ianotti JP.** Extracorporeal shockwave therapy in the treatment of chronic tendinopathies. *J Am Acad Orthop Surg.* 2006 ; 14 : 195-204.
28. **Smidt N, van der Windt DA, Assendelft WJ, Deville WL, Korthals-de Bos IB, Bouter LM.** Corticosteroid injections, physiotherapy, or a wait-and-see policy for lateral epicondylitis : a randomised controlled trial. *Lancet.* 2002 ; 359 : 657-662.
29. **Spacca G, Necozone S, Cacchio A.** Radial shock wave therapy for lateral epicondylitis : a prospective randomised controlled single-blind study. *Eura Medicophys.* 2005 ; 41 : 17-25.
30. **Wang CJ, Chen HS.** Shockwave therapy for patients with lateral epicondylitis of the elbow : a one-to two-year follow-up study. *Am J Sport Med.* 2002 ; 30 : 422-425.
31. **Wang CJ, Yang KD, Wang FS.** Shockwave therapy for calcific tendonitis of the shoulder. *Am J Sports Med.* 2003 ; 31 : 425-30.
32. **Valchanou VD, Michailov P.** High energy shockwave is the treatment of delayed and nonunion of fractures. *Int Orthop.* 1991 ; 15 : 181-84.
33. **Wild C, Khene M, Wanke S.** Extracorporeal shockwave therapy in orthopedics. Assessment of an emerging health technology. *Int J Technol Assess Health Care.* 2000, 16 : 199-209.