

EFEKTI PETO- I DESETONEDELJNE PRIMENE MEHANIČKIH UDARNIH TALASA NA SMANJENJE BOLA UZROKOVANOG HRONIČNIM LATERALNIM EPIKONDILITISOM

ORIGINALNI RAD

ORIGINAL ARTICLE

THE EFFECTS OF FIVE-WEEK AND TEN-WEEK APPLICATION OF SHOCK WAVE THERAPY ON THE REDUCTION OF PAIN CAUSED BY CHRONIC LATERAL EPICONDYLITIS

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SAŽETAK

Uvod: Terapija mehaničkim udarnim talasima (engl. *shock wave*) predstavlja novu metodu u lečenju lateralnog epikondilitisa - teniskog lakta, koja daje dobre rezultate.

Cilj: Cilj ovog rada bio je da se ispita efekat peto- i desetonedeljne terapije udarnim talasima na smanjenje intenziteta bola kod muškaraca sa lateralnim epikondilitisom koji su se rekreativno bavili tenisom.

Materijal i metode: U istraživanje je bio uključen 21 muškarac, starosti 22 – 65 godina ($\bar{x} \pm sd$, 41,7 $\pm$ 10,5 godina), sa dijagnozom hroničnog lateralnog epikondilitisa, bez kalcifikata, koja je bila postavljena na osnovu kliničkog i ultrazvučnog pregleda. Ispitanici su podeljeni u dve grupe prema starosti: na mlađe ($\leq$ 40 godina) i starije ($>$ 40 godina). Jednom u sedam dana, svi pacijenti bili su podvrgnuti terapiji mehaničkim udarnim talasima, fokusiranom sondom (frekvencija od 10 Hz; 1.600 udara; pritisak od 1,6 bara). Pacijenti su imali ukupno deset terapija. Intenzitet bola određivan je korišćenjem vizuelne analogne skale (VAS) za bol. Procena intenziteta bola VAS skalom je vršena pre početka terapije, kao i posle pet i deset *shock wave* terapija, tj. posle pet i deset nedelja primene terapije.

Rezultati: Kod muškaraca sa hroničnim lateralnim epikondilitisom došlo je do statistički značajnog pada intenziteta bola na VAS skali ($p < 0,001$) tokom ispitivanog perioda od deset nedelja. Statistički značajan pad intenziteta bola na VAS skali tokom ispitivanog perioda postojao je i kod pacijenata do 40 godina starosti ($p < 0,001$) i kod pacijenata preko 40 godina starosti ($p = 0,001$). Između mlađih i starijih muškaraca nije bilo značajne razlike u intenzitetu bola, ni na početku terapije, kao ni posle pet i deset primenjenih *shock wave* terapija.

Zaključak: U zaključku, naši rezultati ukazuju da primena deset tretmana *shock wave* terapije kod muškaraca sa hroničnim lateralnim epikondilitisom značajno smanjuje intenzitet bola.

Ključne reči: hronični lateralni epikondilitis, bol, *shock wave* terapija

ABSTRACT

Introduction: Shock wave therapy represents a new method in the treatment of lateral epicondylitis – tennis elbow, which achieves good results.

Aim: The aim of this paper was to test and analyze the effect of five-week and ten-week shock wave therapy on the reduction of pain intensity in men with lateral epicondylitis, who played tennis recreationally.

Materials and methods: The study included 21 male patients, aged 22 – 65 years ($\bar{x} \pm sd$, 41.7 $\pm$ 10.5 years), with the diagnosis of chronic lateral epicondylitis, without calcifications, which had been established with a clinical and ultrasound examination. The subjects were divided into two groups, according to age: the younger group ($\leq$ 40 years) and the older group ($>$ 40 years). Once in seven days, all the patients were treated with shock wave therapy, which was applied with a focused probe (frequency of 10 Hz; 1,600 shocks; pressure at 1.6 bars). The patients had a total of ten therapies. The intensity of pain was determined with the visual analog scale (VAS) for pain. The assessment of pain intensity with the visual analog scale (VAS) was performed before the start of therapy, as well as after five and after ten applications of shock wave therapy, i.e. after five and ten weeks of therapy application.

Results: In men with chronic lateral epicondylitis, a statistically significant decrease in pain intensity occurred on the VAS scale ($p < 0.001$), during the observation period of ten weeks. A statistically significant decrease of pain intensity on the VAS scale during the observation period occurred both in patients aged under 40 years ($p < 0.001$) and in those aged over 40 years ($p = 0.001$). There was no significant difference in pain intensity between the younger and older men, neither at the beginning of therapy, nor after five and ten shock wave therapy sessions.

Conclusion: To conclude, our results indicate that the application of ten shock wave treatments in men with chronic lateral epicondylitis significantly reduces pain.

Keywords: chronic lateral epicondylitis, pain, shock wave therapy

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UVOD

Teniski lakat ili lateralni epikondilitis je tendinopatija mišića ekstenzora prstiju šake. Ova tendinopatija se najčešće javlja kod tenisera. Prvi put je opisao Runge 1873. godine, a sam termin „teniski lakat” u medicinsku terminologiju uveo je Major 1883. godine [1,2]. On je doveo u vezu lateralni epikondilitis sa preteranom upotrebom zajedničkog ekstenzora prstiju šake, što dovodi do bola pri pokretu u laktu. Osim bola, javlja se i otok na mestu pripoja mišića na lateralni epikondilus. Još 1936. godine, Trudel i saradnici detaljno su opisali kliničku sliku i patologiju teniskog lakta i taj opis je i danas potpuno aktuelan [3].

Postoji više mogućnosti lečenja teniskog lakta. Ako je terapijski izbor lokalna primena kombinovane fizikalne terapije, onda je protokol za lečenje lateralnog epikondilitisa ili teniskog lakta sledeći: magnetoterapija, elektroforeza lekova, laseroterapija, transkutana električna nervna stimulacija (TENS) na telo *m. extensor digitorum communis*-a [2]. Ako se lekar odluči za konzervativno lečenje, onda to podrazumeva mirovanje ruke, primenu ortoze ili gipsa i uzimanje *per os* nesteroidnih antireumatika. Treća, ali ne i poslednja opcija, je primena operativnog zahvata ili lokalna aplikacija kortikosteroidnih preparata radi smanjenja bola. Nijedan od navedenih načina lečenja ne daje uvek dobre rezultate [4].

Pored navedenih, još jedna od mogućnosti za lečenje teniskog lakta je terapija mehaničkim udarnim talasima, tzv. *shock wave* terapija, koja daje dobre rezultate u lečenju, posebno kod hroničnih formi ove bolesti [4, 5]. Primena *shock wave* terapije može da bude putem fokusiranih talasa, kada govorimo o ekstrakorporalnoj *shock wave* terapiji (*extracorporeal shock wave therapy* - ESWT), ili putem radijalnih udarnih talasa (*radial shock wave therapy*). Razlika između fokusiranih i radijalnih talasa je pre svega u njihovoj fizičkoj osnovi. Fokusirani udarni talasi se razlikuju u pogledu terapijske dubine prodiranja u tkivo od radijalnih udarnih talasa [4]. Ova dva oblika se u praksi razlikuju po tehnikama korišćenim za njihovo generisanje i po redu veličine uobičajno korišćenih parametara u terapiji. Primena *shock wave* terapije kod epikondilitisa je isključivo fokusiranim talasima, jer je potrebno da se direktno deluje na pripoj mišića ekstenzora prstiju na spoljni epikondilus lakta [5].

Svega nekoliko studija je ispitivalo efekte ove terapije na bolni sindrom kod pacijenata sa teniskim laktom. Neke studije su pokazale da je ovo vrlo korisna metoda za smanjenje bola i ima pozitivan terapijski efekat, dok su druge studije pokazale da nema potvrđenog pozitivnog efekta kod ovih pacijenata [6, 7]. Zato je cilj ovog rada bio je da se ispita efekat terapije mehaničkim udarnim talasima na smanjenje bola kod muškaraca koji se rekreativno bave tenisom.

INTRODUCTION

Tennis elbow, or lateral epicondylitis, is tendinopathy of the finger extensor muscles. This tendinopathy is most frequently found in tennis players. It was first described by Runge in 1873, and the term *tennis elbow* was first introduced into terminology by Major in 1883 [1,2]. He established a link between lateral epicondylitis and the overuse of the *extensor digitorum communis* muscle, which causes pain when movement is made in the elbow joint. In addition to pain, swelling also occurs at the site where the muscle attaches to the lateral epicondyle. As early as 1936, Trudel et al. gave a detailed description of the clinical picture and pathology of tennis elbow, and this description remains valid to date [3].

There are several options for tennis elbow treatment. If the therapy of choice is local application of combined physical therapy, then the protocol for treating lateral epicondylitis, i.e. tennis elbow is the following: magnetotherapy, medication electrophoresis, laser therapy, transcutaneous electrical nerve stimulation (TENS) applied to the body of the *m. extensor digitorum communis* [2]. If the physician opts for conservative treatment, this entails resting the arm, application of an orthosis or cast, and taking nonsteroidal antirheumatics, orally. The third, but not necessarily the last option, is surgery or local application of corticosteroid medication, for pain alleviation. None of the described methods of treatment are always effective [4].

In addition to the ones described, another option for treating tennis elbow is shock wave therapy, which achieves good results, especially in the chronic forms of the condition [4, 5]. Shock wave therapy can be applied with the use of focused waves; this is extracorporeal shock wave therapy (ESWT), or with the use of radial shock waves; this is radial shock wave therapy. The difference between focused and radial waves is primarily in their physical basis. Focused shock waves differ from radial shock waves with respect to the therapeutic depth of penetration into the tissue [4]. These two forms of waves differ, in practice, regarding the techniques used to generate them and the value ranges of parameters normally used in therapy. The application of shock wave therapy in epicondylitis is exclusively with focused waves, since it is necessary to directly act on the attachment of the extensor digitorum muscle to the lateral epicondyle [5].

Only a few studies have analyzed the effects of this therapy on the pain syndrome in patients with tennis elbow. Some studies have shown that this is a very useful method for reducing pain and that it has a positive therapeutic effect, while other studies have shown that there is no confirmed positive effect on tennis elbow patients [6, 7]. Therefore, the aim of this paper was to

MATERIJAL I METODE

U okviru ove panel studije bio je uključen 21 muškarac, starosti 22 - 65 godina ($\bar{x} \pm sd$, $41,7 \pm 10,5$ godina), sa dijagnozom hroničnog lateralnog epikondilitisa. Istraživanje je sprovedeno od juna 2019. do marta 2020. godine, u privatnoj ordinaciji *Physical*, u Beogradu. Kriterijumi za uključivanje ispitanika u studiju bili su: potvrđena dijagnoza hroničnog lateralnog epikondilitisa, dužina trajanja tegoba 3 do 5 meseci pre započinjanja lečenja, prvi put postavljena data dijagnoza bolesti, kao i rekreativno bavljenje tenisom. Kriterijumi za isključenje ispitanika iz studije bili su: korišćenje bilo koje terapije, prethodne hirurške intervencije, kao i odbijanje da budu uključeni u istraživanje. Svi pacijenti su bili desnoruki, tako da su imali lateralni epikondilitis desnog lakta. Na dijagnozu lateralnog epikondilitisa posumnjalo se na osnovu bola koji se javlja na palpaciju, na mestu pripoja mišića ekstenzora prstiju na lateralni epikondilus, sa spazmom istog mišića, uz njegovu bolnu ekstenziju. Dijagnostička metoda kojom je utvrđeno da se radi o letaralnom epikondilitisu je bila ultrazvučna metoda. Nijedan pacijent nije imao dijagnostikovan kalcifikat. Pre početka lečenja svaki pacijent pojedinačno je bio upoznat sa tehnikom primene mehaničkog udarnog talasa i dao je pisanu saglasnost za uključivanje u istraživanje. Ispitanici su podeljeni u dve grupe prema starosti: na mlađe (≤ 40 godina) i starije (> 40 godina).

Svi pacijenti bili su podvrgnuti terapiji mehaničkim udarnim talasom (*shock wave*) korišćenjem aparata *Masterpuls MP -200* serijski broj BS 2058, godina proizvodnje 2011 (*Storz Medical*, Švajcarska), sa fokusiranom sondom i definisanim sledećim parametrima: frekvencijom od 10 Hz, brojem udaraca 1.600 i pritiskom od 1,6 bara. Primenjena terapija je rađena jednom u sedam dana pri čemu su pacijenti ukupno imali deset terapija.

Kod svih pacijenata intezitet bola određen je korišćenjem vizuelne analogne skale (VAS) za bol. VAS skala za merenje intenziteta bola podeljena je na podeoke od po 1cm, od 0 do 10. Bolesnik na skali pokazuje svoj intenzitet bola, gde 0 označava stanje bez bola, a 10 maksimalni bol. Pacijenti su određivali intezitet bola na VAS skali po dolasku u ordinaciju (tj. na početku istraživanja), kao i posle pet i deset aplikacija *shock wave* terapije.

U zavisnosti od tipa varijabli i normalnosti raspodele, deskripcija podataka je prikazana kao %, $\bar{x} \pm sd$ ili medijana (minimalna - maksimalna vrednost). Za procenu promene VAS skora u vremenu primenjen je Fridmanov test, a za *post hoc* testiranje korišćen je Vilkoksonov test. Za procenu razlike VAS skorova u odnosu na kategorije starosti primenjen je Man-Vitnijev test. Nivo statističke značajnosti postavljen je na $p \leq 0,05$.

investigate the effects of shock wave therapy on pain reduction in men who play tennis recreationally.

MATERIALS AND METHODS

This panel study included 21 men, aged 22 – 65 years ($\bar{x} \pm sd$, 41.7 ± 10.5 years), with the diagnosis of chronic lateral epicondylitis. The study was carried out from June 2019 to March 2020 at the private clinic *Physical*, in Belgrade, Serbia. The criteria for including subjects in the study were: confirmed diagnosis of chronic lateral epicondylitis, discomfort lasting 3 to 5 months prior to therapy, first-time diagnosis of the said condition, as well as playing tennis recreationally. The criteria for excluding subjects from the study were: use of any therapy, prior surgical procedures, as well as declining to participate in the study. All the patients were right-handed, which is why they had lateral epicondylitis of the right elbow. Lateral epicondylitis was suspected due to pain caused by palpation of the site of attachment of the extensor digitorum muscle to the lateral epicondyle, with the spasm of this muscle and its painful extension. Lateral epicondylitis was diagnosed with ultrasound. None of the patients were diagnosed with calcification. Before the therapy began, each patient had been individually informed about the technique of shock wave therapy and had signed a written consent form.

All patients underwent shock wave therapy applied with the *Masterpuls MP -200* device, serial No. BS 2058, manufactured in 2011 (*Storz Medical*, Switzerland), with a focused probe and the following defined parameters: frequency of 10 Hz, 1,600 shocks, pressure at 1.6 bars. The therapy was applied once a week, and the patients had a total of 10 therapy sessions.

Pain intensity in all patients was determined by means of the visual analog scale (VAS) for pain. The VAS scale for measuring pain intensity is divided into one-centimeter marks, from 0 to 10. The patient indicates, on the scale, the intensity of their pain, whereby 0 signifies the state without pain, while 10 signifies maximum pain. The patients defined the intensity of their pain on the VAS scale at their first visit to the clinic (i.e. at the beginning of the study), as well as after five and ten applications of shock wave therapy.

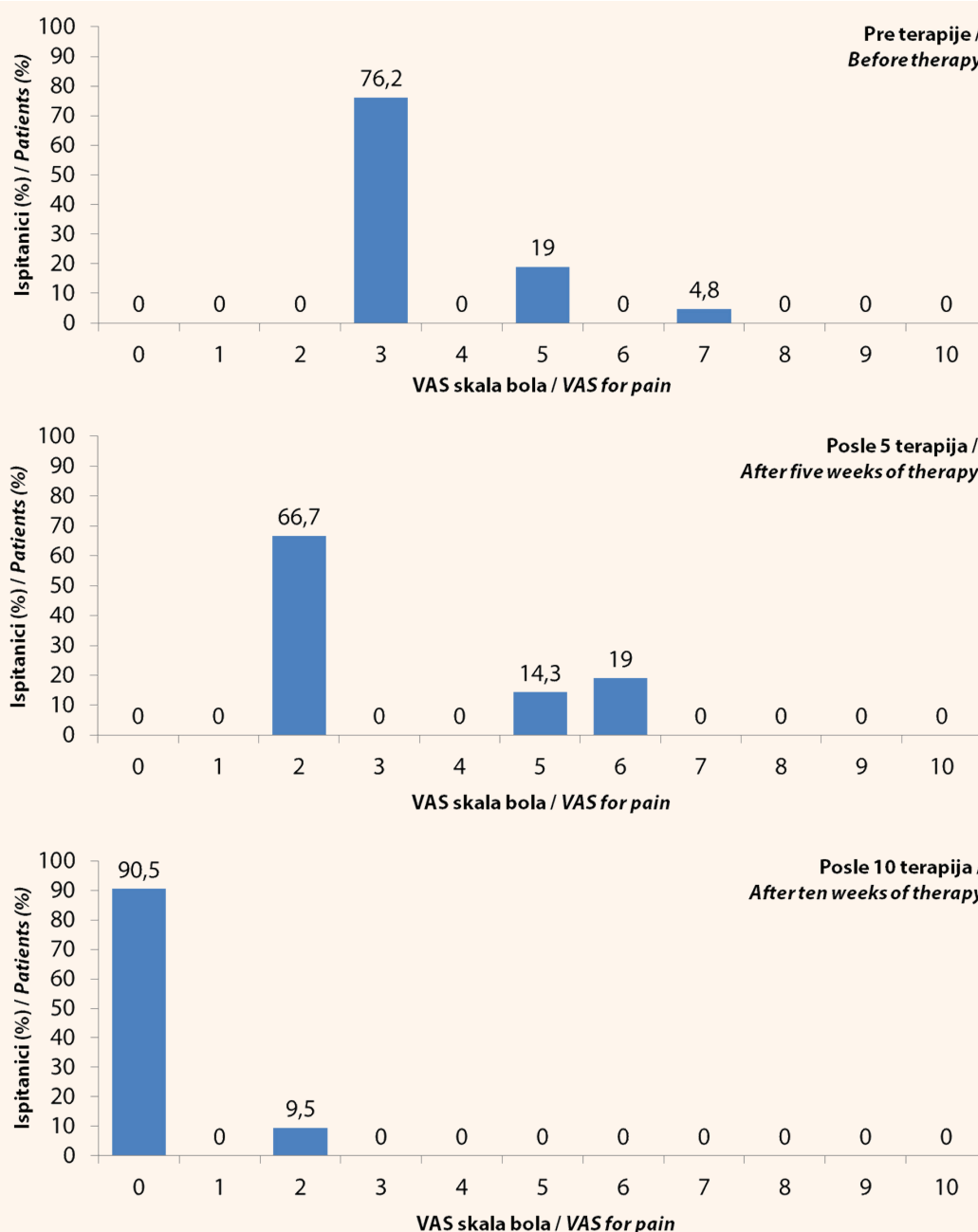
Depending on the type of variables and the normality of distribution, data description was presented as %, $\bar{x} \pm sd$, or the median value (minimum – maximum value). The Friedman test was used for assessing the change of the VAS score over time, while the Wilcoxon test was used for post hoc testing. The Mann-Whitney test was used for assessing the differences between VAS scores in relation to the age categories. The level of statistical significance was set at $p \leq 0.05$.

REZULTATI

Pre početka terapije najveći broj pacijenata (76,2%) je intenzitet svog bola ocenio sa 3 na VAS skali, 19,0% sa 5, a 4,8% sa 7 (Grafikon 1). Posle pet aplikacija *shock wave* terapije, tj. posle pet nedelja terapije, kod 66,7% pacijenata intezitet bola na VAS skali je ocenjen sa 2, kod 14,3% sa 5, a kod 19,0% ocenom 6. Nakon deset aplikacija mehaničkim udarnim talasima, tj. posle deset nedelja terapije, većina pacijenata (90,5%) nije imala bol, a kod 9,5% intezitet bola je ocenjen sa 2 (Grafikon 1).

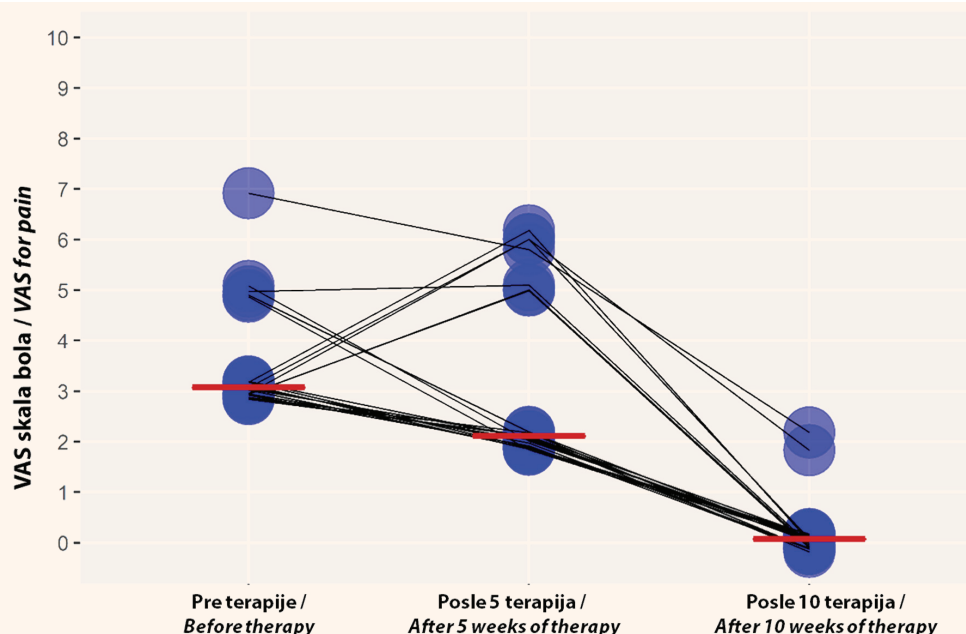
RESULTS

Prior to the commencement of therapy, a majority of the patients (76.2%) assessed the intensity of their pain with the rating 3, on the VAS scale, 19.0% assessed the pain with the rating 5, while 4.8% assessed it with 7 (Figure 1). Upon five applications of shock wave therapy, i.e. after five weeks of therapy, in 66.7% of the patients the intensity of pain was rated with 2, on the VAS scale, in 14.3% it was rated with 5, and in 19.0% with 6. After ten applications of shock wave therapy, i.e. after ten weeks of therapy, most patients (90.5%)



Grafikon 1. Procenat muškaraca sa hroničnim lateralnim epikondilitisom, prema intezitetu bola, procenjenog vizuelnom analagnom skalom (VAS), pre početka terapije, kao i posle pet i posle deset *shock wave* terapija

Figure 1. Percentage of men with chronic lateral epicondylitis, by pain intensity, rated on the visual analog scale (VAS), prior to therapy, as well as after five and after ten shock wave treatments.



Grafikon 2. Medijane i individualne vrednosti ocene intenziteta bola prema vizuelnoj analognoj skali (VAS), pre terapije, kao i posle pet i deset nedelja *shock wave* terapije, kod muškaraca sa hroničnim lateralnim epikondilitisom

Figure 2. Median and individual values of the pain intensity ratings on the visual analog scale (VAS), prior to therapy, as well as after five and after ten weeks of shock wave therapy, in men with chronic lateral epicondylitis

Medijana i opseg ocene intenziteta bola (minimum - maksimum) na VAS skali, za sve muškarce, pre uvođenja terapije, iznosili su 3 (3 - 7); nakon pet terapija, iznosili su 2 (2 - 6); a nakon deset terapija, iznosili su 0 (0 - 2). Došlo je do statistički značajnog pada ocene intenziteta bola na VAS skali ($p < 0,001$) tokom ispitivnog perioda (**Grafikon 2**). Kod ispitanika uključenih u istraživanje, došlo je do značajnog pada ocene intenziteta bola posle desete terapije ($p < 0,001$), ali ne i posle pete terapije ($p = 0,327$).

Statistički značajan pad ocene intenziteta bola na VAS skali tokom ispitivanog perioda od deset nedelja postoji i kod muškaraca do 40 godina starosti ($p < 0,001$) i kod onih preko 40 godina starosti ($p = 0,001$). Između mlađih i starijih muškaraca nije bilo značajne razlike pre terapije, nakon pet, kao ni nakon deset aplikacija *shock wave* terapije (**Tabela 1**).

DISKUSIJA

U ovoj studiji, ispitivali smo, po prvi put u Srbiji, uticaj terapije mehaničkim udarnim talasima (*shock wave* terapija) na smanjenje bola kod muškaraca koji se rekreativno bave tenisom, i dobili rezultate koji ukazuju na značajno smanjenje intenziteta bola nakon deset terapija, odnosno deset nedelja terapije, kod svih muškaraca, starijih i mlađih, uključenih u studiju.

experienced no pain, while in 9.5% of the patients the intensity of pain was rated with 2 (**Figure 1**).

The median value and the range of the pain intensity rating (minimum - maximum) on the VAS scale, for all the men, prior to therapy, amounted to 3 (3 - 7); after five treatments they amounted to 2 (2 - 6); and after ten therapy sessions, they were 0 (0 - 2). During the observation period, a statistically significant drop of pain intensity rating on the VAS scale ($p < 0.001$) occurred (**Figure 2**). In subjects involved in the study, a significant drop in the rating of pain intensity occurred after the tenth therapy session ($p < 0.001$), but not after the fifth one ($p = 0,327$).

A statistically significant drop in the pain intensity ratings on the VAS scale occurred during the observation period of ten weeks, both in men under 40 years of age ($p < 0.001$) and in men over 40 years of age ($p = 0.001$). There was no statistically significant difference between the younger and the older group of men before therapy, after five, and after ten applications of shock wave therapy (**Table 1**).

DISCUSSION

In this study, for the first time in Serbia, we investigated the effect of shock wave therapy on the reduction of pain in men who play tennis recreationally, and we obtained results which indicate a significant reduction in the intensity of pain after ten treatments, i.e. after ten weeks of therapy, in all men, both younger and older, which were included in the study.

Tabela 1. Medijana i opseg ocene inteziteta bola, procenjenog vizuelnom analognom skalom (VAS), kod mlađih i starijih muškaraca sa hroničnim lateralnim epikondilitisom, pre početka terapije, kao i posle pet i posle deset shock wave terapija, odnosno posle pet i posle deset nedelja terapije

	Muškarci / Men		*p-vrednost
	Mlađi (≤ 40 godina) (n=12) Medijana (min – max)	Stariji (> 40 godina) (n=9) Medijana (min – max)	
	Younger group (≤ 40 years) (n=12) Median value (min – max)	Older group (> 40 years) (n=9) Median value (min – max)	*p-value
VAS pre tretmana / VAS before therapy	3 (3 – 7)	3 (3 – 5)	0.811
VAS posle 5 nedelja terapije / VAS after five weeks of therapy	2 (2 – 6)	2 (2 – 6)	0.418
VAS posle 10 nedelja terapije / VAS after ten weeks of therapy	0 (0 – 2)	0 (0 – 2)	0.834
#p-vrednost / #p-value	< 0.001	0.001	

min – minimum; max – maksimum;
*Man-Vitnjev test; #Fridmanov test

Table 1. The median value and the range of the pain intensity rating, assessed on the visual analog scale (VAS), in younger and older men with chronic lateral epicondylitis, before therapy, as well as after five and after ten applications of shock wave therapy, i.e. after five and after ten weeks of therapy

min – minimal; max – maximal;
*Mann-Whitney test; # Friedman test

U literaturi je dobro poznato da ekstrakorporalna *shock wave* terapija ima sledeće dokazane efekte na tkivo: hondoprotektivni efekat, poboljšanje vaskularizacije, smanjenje upale, i regeneraciju tkiva i mišića [6-10]. Ekstrakorporalna *shock wave* terapija svojim mehaničkim dejstvom na mestu lečenja dovodi do lokalnog toplotnog efekta koji omogućava navedene biološke efekte na mestu primene [11]. Brojni su mehanizmi putem kojih ovaj vid terapije ostvaruje svoje efekte. Haupt i saradnici su 1997. godine pokazali da udarni talas dovodi do pozitivnog pritiska u ćelijama što dalje dovodi do apsorpcije, refleksije, refrakcije i do prenosa energije do tkiva i ćelija [7]. Crupnik i saradnici su dokazali da ekstrakorporalna *shock wave* terapija izaziva kavitaciju i povećava propustljivost ćelijskih membrana usled čega dolazi do promene potencijala samih membrana. Istovremeno dolazi do oslobađanja molekula adenozin trifosfata (ATP) [8]. Procesi koji slede dovode do promene funkcije ćelijske membrane koji kao rezultat imaju povećanje kalcijuma u ćeliji. Ovu fazu su autori označili kao hemijska faza. Sledeća faza je označena kao biološka faza. Nju karakterišu proliferacija ćelija, povećana sinteza endotelnog faktora rasta i stimulacija angiogeneze. Primena ove terapije povećava proliferaciju T ćelija i poboljšava prokrvljenost mišića [10]. Kao rezultat navedenih procesa dolazi do zarastanja rana [8-10].

It is well documented in literature that extracorporeal shock wave therapy has the following proven effects on tissue: chondroprotective effect, improvement in vascularization, inflammation reduction, and tissue and muscle regeneration [6-10]. Extracorporeal shock wave therapy acts mechanically at the site of treatment, generating a local thermal effect, which enables the aforementioned biological effects at the site of application [11]. There are numerous mechanisms through which this form of therapy achieves its effects. Haupt et al. demonstrated in 1997 that shock waves bring about positive pressure in the cells, which further leads to absorption, reflection, refraction, and distribution of energy to tissues and cells [7]. Crupnik et al. proved that extracorporeal shock wave therapy causes cavitation and increases the permeability of cell membranes, which brings about the change in the electric potential of the membranes themselves. At the same time, molecules of adenosine triphosphate (ATP) are released [8]. After this, processes that follow cause a change in cell membrane function, which, as a result, bring about the elevation of the calcium level in the cell. The authors have named this phase – the chemical phase. The next phase is the biological phase. It is characterized by cell proliferation, increased synthesis of the endothelial growth factor, and angiogenesis stimulation. Application of this therapy increases the proliferation of T cells and improves the vascularization of muscles [10]. The described processes

U većini studija je dokazana efikasnost ove metode u lečenju različitih sportskih povreda i bolnih sindroma [12,13].

Mnogi autori su ispitivali uticaj ove terapije na bolnost teniskog lakta (lateralnog epikondilitisa) [14-17]. Analizom dostupnih publikovanih rezultata lečenja lateralnog epikondilitisa, dobijenih primenom *shock wave* terapije, a prema smernicama Međunarodnog društva za lečenje udarnim talasima (*International Society of Medical Shockwave Treatment - (ISMST)*) i Međunarodnog društva za ekstrakorporalnu *shock wave* terapiju nemačkog govornog područja (*German-speaking International Association for Extracorporeal Shock Wave Therapy – DIGEST*), zaključeno je da se radi o primenljivoj i efikasnoj metodi [14]. Naime, Bisset i saradnici utvrdili su meta-analizom dostupnih podataka da ekstrakorporalni udarni talasi efikasno ublažavaju bolove kod lateralnog epikondilitisa, već posle prvog tretmana [4]. Kirschke i saradnici pokazali su, primenom fokusiranih udarnih talasa u terapiji teniskog lakta, da u akutnim slučajevima bolesti imaju pozitivne rezultate već do pet aplikacija [5]. Takođe, utvrđeno je da je veći učinak primene fokusiranih *ESWT* od radijalnih talasa. Ovi rezultati su doveli do zaključka da je *ESWT* superiorna terapija u lečenju teniskog lakta [8]. Naši rezultati su u skladu sa ovom velikom studijom, s obzirom da je kod naših pacijenata koji su lečeni mehaničkim udarnim talasom, a imali su hronični oblik lateralnog epikondilitisa, pokazano da već posle pet aplikacija dolazi do jasnog smanjenja bola kod pacijenata.

Veliki broj studija ukazuje na značajan uticaj učestalosti tretmana *shock wave* terapije na njenu uspešnost kod pacijenata sa teniskim laktom [16,18-20]. Rezultati u ovoj studiji pokazali su da je po završetku lečenja kod 94.4 % pacijenata došlo do kompletnog obezboljavanja. Ovi rezultati su u skladu sa većinom studija analiziranih u sistematskom pregledu Tanga i saradnika [19]. Međutim, Rompe i saradnici pokazali su, na populaciji od 78 pacijenata sa teniskim laktom dijagnostikovanog magnetnom rezonancijom, da tek nakon tri meseca pacijenti imaju značajno poboljšanje simptoma [18].

ZAKLJUČAK

Naši rezultati ukazuju da primena deset tretmana *shock wave* terapije kod pacijenata muškog pola sa hroničnim lateralnim epikondilitisom smanjuje intenzitet bola, bez obzira na njihov uzrast, i ukazuje da se ova metoda može preporučiti kao terapija u lečenju hroničnog lateralnog epikondilitisa kod tenisera. To je neinvazivna, bezbedna metoda, i praktično bez kontraindikacija.

Sukob interesa: Nije prijavljen.

bring about the healing of wounds [8-10]. Most studies have proven the effectiveness of this method in treating different sports injuries and pain syndromes [12,13].

Many authors investigated the effect of this therapy on tennis elbow pain (lateral epicondylitis) [14-17]. Analysis of available published results in treating lateral epicondylitis with shock wave therapy, applied in keeping with the recommendations of the International Society of Medical Shockwave Treatment (ISMST) and the German-speaking International Association for Extracorporeal Shock Wave Therapy (DIGEST), concluded that this is an applicable and effective method [14]. Namely, Bisset et al. determined through a meta-analysis of available data, that extracorporeal shock waves effectively alleviate pain in lateral epicondylitis, immediately after the first treatment [4]. Kirschke et al. demonstrated, applying focused shock waves in tennis elbow treatment, that in acute cases of the condition, positive results can be achieved by the fifth application [5]. Also, a better effect was determined when applying focused *ESWT* than when radial waves were used. These results have led to the conclusion that *ESWT* is a superior therapy option in tennis elbow treatment [8]. Our results are in accordance with this large study, since we showed that, in our patients suffering from chronic lateral epicondylitis and treated with mechanical shock waves, a clear reduction of pain occurred after only five applications.

It is indicated, in a large number of studies, that, in patients suffering from tennis elbow, the frequency of shock wave treatment affects the success of the therapy [16,18-20]. The result of our study showed that, upon therapy completion, total disappearance of pain occurred in 94.4 % of the patients. These results are consistent with the results of most studies analyzed in the systematic review by Tang et al [19]. However, Rompe et al. showed, on a population of 78 patients suffering from tennis elbow, which was diagnosed with magnetic resonance imaging, that it was only after three months of treatment that patients demonstrated a significant improvement in symptoms [18].

CONCLUSION

Our results show that the application of ten shock wave treatments in male patients with chronic lateral epicondylitis reduces the intensity of pain, irrespective of their age, and they also indicate that this method can be recommended as a therapy of choice in treating chronic lateral epicondylitis in tennis players. This is a noninvasive and safe method, with practically no contraindications.

Conflict of interest: None declared.

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