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NON-PHARMACOLOGICAL TREATMENT OF PAINFUL SHOULDER SYNDROME – COMPARATIVE RESEARCH

NEFARMAKOLOŠKO LIJEČENJE BOLNOG RAMENA – KOMPARATIVNO ISTRAŽIVANJE

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Abstract

Non-pharmacological treatment is undeniably a significant part of painful shoulder syndrome treatment. Medical exercises are its most important segment, according to the results of evidence-based medicine. Due to the fact that exercises are rarely used as monotherapy, we were particularly interested in the data regarding other non-pharmacological methods of treatment found in the Cochrane library and PEDro database (Physiotherapy Evidence Database). Simultaneously, we conducted a research study of painful shoulder syndrome treatment with conventional methods of physical therapy. The study included 157 patients, which allowed us to compare our preliminary results with data found in the previously mentioned databases.

The majority of quality studies that can be found in the literature database involve the use of modern technology, such as extracorporeal shock wave therapy and high-intensity laser therapy, because they have proven to be very effective in the reduction of pain intensity and the increase of functional capacity of the painful shoulder. These methods of treatment have shown to be effective even in patients with calcific tendinitis, a more severe form of the disease, as well as in patients who had no calcifications. Conventional methods of treatment, often referred to as standard physical therapy (low-level laser therapy, electrotherapy, therapeutic ultrasound) have proven to be effective, but less effective compared to the aforementioned methods. The results of our research also corroborate the previously mentioned fact, thus confirming that the use of conventional methods of physical medicine (therapeutic ultrasound, diclofenac sonophoresis, interferential current therapy, low-level laser therapy, cryotherapy) has been successful in reducing pain intensity and increasing the functional capacity of the painful shoulder. Among the conventional methods of treatment, electrotherapy (interferential current therapy) turned out to be the most efficient one.

Non-pharmacological treatment have to be an integral part of all painful shoulder syndrome treatment protocols, and in the future, the use of modern technology in addition to conventional methods of treatment should be encouraged.

Key words: Shoulder pain – etiology, therapy; Physical therapy modalities; Rotator cuff injuries – therapy; Electric stimulation therapy – methods; Extracorporeal shockwave therapy; Laser therapy – methods; Range of motion, articular; Treatment outcome

Sažetak

Nedvojbeno je da u procesu liječenja sindroma bolnog ramena važnu ulogu ima nefarmakološko liječenje (NFL). Pritom, sukladno rezultatima medicine utemeljene na dokazima (EBM), najveću ulogu imaju medicinske vježbe. One

se, pak, rijetko rabe samostalno, kao monoterapija, pa nas je zbog toga zanimalo kakve ćemo podatke pronaći u Cochraneovoj bazi i Fizioterapijskoj bazi podataka (engl. *Physiotherapy Evidence Database* – PEDro) za ostale oblike NFL-a. Istodobno, proveli smo istraživanje o liječenju sindroma bolnog ramena konvencionalnom terapijom, uključivši u istraživanje 157 bolesnika, kako bismo svoje preliminarne rezultate mogli usporediti s podatcima nađenima u rečenim bazama podataka.

Najveći broj kvalitetnih studija, pronađenih u literaturi, vezan je za primjenu modernih tehnologija, primjerice, udarnog vala i lasera visokog intenziteta, koji su pokazali znatan učinak na smanjenje boli i povećanje funkcionalnog kapaciteta bolnog ramena. Ove metode liječenja pokazale su se uspješnima i u bolesnika s kalcificirajućim tendinitisom, kao težim oblikom bolesti, ali i kod onih bez te otegotne činjenice. Konvencionalne metode liječenja, često nazivane klasičnom fizikalnom terapijom (elektroterapija, laser niskog intenziteta i ultrazvuk) pokazale su svoju učinkovitost, iako su uvijek bile inferiorne prije navedenim metodama. Rezultati našeg istraživanja bili su u skladu sa spomenutom činjenicom, tako da se primjena konvencionalne fizikalne terapije (ultrazvuk, sonoforeza, interferentne struje, laser niskog intenziteta, krioterapija) pokazala učinkovitom u smanjenju boli i povećanju funkcionalnog kapaciteta bolnog ramena, pri čemu je primjena interferentnih struja bila nešto uspješnija od drugih metoda.

NFL mora i nadalje ostati sastavni dio svih protokola liječenja sindroma bolnog ramena, pri čemu modernim tehnologijama treba ustupati sve više mjesta u odnosu prema konvencionalnim metodama liječenja.

Ključne riječi: Bolno rame – etiologija, liječenje; Fizioterapijske metode; Oštećenja rotatorne manšete – liječenje; Elektroterapija – metode; Liječenje udarnim valom; Liječenje laserom – metode, zglobna pokretljivost; Ishod liječenja

INTRODUCTION

Non-pharmacological treatment is extremely important in all protocols/algorithms for the treatment of extra-articular rheumatic diseases (1). By using numerous benefits resulting from advances in medicine, modern technology, as an integral part of standard physical therapy, has become an extremely important segment whose efficiency can be compared with that of the most effective non-pharmacological method – kinesiotherapy (2). Painful shoulder syndrome is one of the most prevalent extra-articular rheumatic disease, as well as one of the most frequent cause of pain when it comes to rheumatic diseases in general, and it significantly affects the quality of daily activities and the life of patients who suffer from it (3).

Therefore, it is important to note the main causes of painful shoulder syndrome as well as to analyze the literature data regarding the treatment effectiveness and compare them to the results from our research on conventional physical therapy effects on the functional capacity and pain intensity in patients treated in a tertiary care center. As the majority of our public health facilities including some clinical hospital centers still do not have access to modern technology for the treatment of painful shoulder syndrome, it would be interesting to explore the possibilities that standard (conventional) physical therapy modalities offer.

The main characteristic of extra-articular rheumatic diseases, as their very name implies, is the fact that the changes occur in the immediate vicinity of the joint (synovial bursa, tendon, tendon sheath), with degenerative and inflammatory changes etiologically overlapping in the affected areas (3, 4).

UVOD

U svim postupnicima/algoritmima liječenja izvanzglobnih reumatskih bolesti nefarmakološko liječenje (NFL) zauzima važno mjesto (1). Koristeći se prednostima napretka u medicini, moderna tehnologija, kao sastavni dio uobičajene fizikalne terapije, iznimno je bitna i stavlja se uz bok najučinkovitijoj metodi NFL-a – kinezioterapiji (2). Od svih izvanzglobnih bolesti u reumatološkoj se praksi najviše spominje sindrom bolnog ramena kao jedan od najčešćih uzroka bolnih stanja u reumatologiji uopće, koji znatno utječe na dnevne aktivnosti i kvalitetu života bolesnika (3).

Zbog toga bi bilo dobro podsjetiti se glavnih uzroka nastanka toga bolnog sindroma, provjeriti podatke iz literature o uspješnosti liječenja bolesnika i usporediti ih s nekim našim rezultatima iz istraživanja o učinku konvencionalne fizikalne terapije na funkcionalne mogućnosti i bol u bolesnika liječenih u jednome tercijarnom centru. Naime, velik dio naših državnih ustanova i dalje ne raspolaže modernim tehnologijama za liječenje ovoga bolnog sindroma, a među takvima su i neki klinički bolnički centri, pa bi bilo zanimljivo vidjeti kakve nam mogućnosti nude klasični (konvencionalni) fizikalnoterapijski modaliteti.

Glavna karakteristika izvanzglobnih reumatskih bolesti jest, kao što ime govori, da se promjene događaju u neposrednoj blizini zgloba (sluzne vreće, tetive, tetivne ovojnice), a da se pritom u zahvaćenim tkivima etiološki isprepleću degenerativne i upalne promjene (3, 4).

Sindrom bolnog ramena bolest je kod koje u kliničkoj slici dominiraju bol i smanjenje funkcionalnog kapaciteta ramenog zgloba. U medicinskoj se literaturi taj klinički entitet, koji se s jednakom učestalošću javlja

Painful shoulder syndrome is a disease whose clinical features include pain and a reduced functional capacity of the shoulder joint. In medical literature, this clinical entity, equally frequent in both males and females and most often unilateral, is referred to as "periarthritis humeroscapularis" (from the Greek word *peri* = about, around), and the cause of the disease is inflammation (Greek suffix -itis = inflammation) (5). As opposed to inflammatory rheumatic diseases, this disorder predominantly includes localized, aseptic inflammation and consequent degenerative changes which most often occur in the supraspinatus muscle tendons and the long head of the biceps brachii muscle, while the inflammatory changes, most cases caused by calcification, are present in the subacromial bursa (3, 5).

Mechanical causes found in the patient history, such as data on physical strain of the shoulder joint, repeated shoulder movements with clenched fist carrying a certain load, or movements with hands above the head, are an important determinant in the etiopathogenesis of painful shoulder syndrome. In performing these movements, the joint itself and the area around it are exposed to repeated daily microtraumas, which can lead to an accelerated occurrence of degenerative scarring on the soft tissue around the shoulder joint (3, 5). Calcifications of various sizes can develop in soft tissue, most often in tendons (3, 6). They are often an accidental finding in the tendon area and the joint capsule during an X-ray (7). Thus, they are often detected in patients without standard typical symptoms of painful shoulder. The pain often progresses and intensifies after exertion or falling on one's arm or shoulder, when calcific deposits move and the body starts perceiving them as foreign bodies, initiating an intense inflammatory response in order to defend itself (3, 5). Like any other inflammatory response, this reaction becomes more intense and pronounced (and therefore more painful) when the joint and nearby joint structures start warming up. This is exactly what happens during night-time: the typical nocturnal pain develops while the patient is resting and his/her shoulder starts warming up from the outside. This is a seemingly paradoxical situation: while the patient is resting, we expect the pain to subside, but instead it becomes most intense; this is a common case in inflammation, but not in degenerative musculoskeletal diseases.

In the case of painful shoulder syndrome we are dealing with localized aseptic inflammation, which has no repercussions on laboratory indicators of inflammation, as opposed to inflammatory rheumatic diseases, in which the painful shoulder syndrome is part of a complex clinical picture such as in ankylosing spondylitis or rheumatoid arthritis. Also, the patient shows no symptoms of general inflammation.

u oba spola i najčešće unilateralno, naziva i humeroskapularni periartritis (grč. *peri* = oko, prema), a uzrok bolnosti jest upalno zbivanje (grč. *itis* = upala) (5). Za razliku od upalnih reumatskih bolesti, ovdje se dominantno radi o lokaliziranoj, aseptičkoj upali te posljedičnim degenerativnim promjenama koje su najčešće locirane u tetivama supraspinatusa i duge glave bicepsa, dok su upalne promjene izazvane najčešće kalcifikatima prisutne u subakromijskoj sluznoj vreći (3, 5).

Mehanički momenti – kad u anamnezi bolesnika nalazimo podatke o fizičkim naprezanjima ramenog zgloba, ponavljanim pokretima u ramenu sa stisnutom šakom uz opterećenje ili rad s rukama iznad glave – čine važnu odrednicu u etiopatogenezi bolnog ramena. Pritom je područje zgloba i okolozglobnih struktura izloženo ponavljanim svakodnevnim mikrotraumama, što može dovesti do ubrzanog nastanka degenerativnih, ožiljnih promjena na mekim tkivima oko ramenog zgloba (3, 5). Katkad u mekim tkivima, a najčešće u tetivama, nastaju i kalcifikati različitih veličina (3, 6). Često se događa da se ti kalcifikati na tetivama i u zglobnoj čahuri nađu kao slučajan nalaz pri rendgenskom snimanju (7). Dakle, nerijetko ih imaju i osobe koje nemaju karakterističnu simptomatologiju, odnosno boli u ramenu. Boli se često razviju i intenziviraju nakon nekoga napornog rada, pada na ruku ili rame, kada dođe do pomaka tih nakupina vapnenca te ih organizam doživljava kao strano tijelo pa se od njih brani burnom upalnom reakcijom (3, 5, 6). Kao i sve druge upalne reakcije, i ova postaje to burnija i izraženija (a time i bolnija) pri zagrijavanju zgloba i okolozglobnih struktura. Upravo se to događa noću, kada se tipična noćna bol javlja pri mirovanju i utopljavanju ramena izvana. Dakle, riječ je o, naoko, paradoksalnoj situaciji: kod potpunog mirovanja, kad očekujemo da se bol smiri, ona postaje najjača, što je uobičajeno za upalu, ali ne i za degenerativne muskuloskeletne bolesti.

U ovom je slučaju riječ o lokalnoj aseptičkoj upali, koja nema reperkusija na laboratorijske pokazatelje upalnih zbivanja, za razliku od upalnih reumatskih bolesti, kad je sindrom bolnog ramena dio kompleksne kliničke slike, npr., ankilozantnog spondilitisa ili reumatoidnog artritisa. Pritom se kod bolesnika ne nalaze znakovi opće upale.

Iako nam klasične radiološke pretrage ne pomažu puno pri dijagnostici, znatan je doprinos uporabe dijagnostičkog ultrazvuka, kao i magnetske rezonancije, koji imaju dobru razlučivost pa se s pomoću njih uočavaju morfološke i strukturne promjene pri zahvaćenosti mekih tkiva (7). Dijagnoza sindroma bolnog ramena postavlja se na osnovi kliničke slike dopunjene rezultatima navedenih dijagnostičkih pretraga.

Liječenje je uglavnom konzervativno, pri čemu bitnu ulogu ima i rano medikamentno liječenje, koje što pri-

Although standard radiological examinations do not significantly contribute to the diagnostic process, diagnostic ultrasound as well as magnetic resonance imaging are able to contribute greatly, due to the fact that they can produce images of great resolution in which morphological and structural changes of soft tissues are clearly visible (7). The diagnosis of painful shoulder syndrome is based on the clinical picture in addition to the results of imaging modalities.

The treatment is mainly conservative and largely dependent on early pharmacological treatment, which must be supplemented as soon as possible with various non-pharmacological treatment methods (1, 6). Surgical treatment is extremely rare and used in the most severe cases of soft tissue disorders, such as a complete tendon rupture (6). These patients, especially the ones who suffer from isolated mechanically conditioned diseases, can often develop various complications, such as relapses, which have an adverse effect on the quality of their daily life. Therefore, patient education is important. Patient education can help in prevention of relapses, making it easier to identify the disease in its early stages and start treating it in a fast and efficient way (2, 6, 8).

AIM OF THE RESEARCH

The aim of this paper is to gain insight into the possibilities of an integrated approach to the non-pharmacological treatment of painful shoulder syndrome by analyzing literature data in accordance with the principles of evidence-based medicine (EBM). The other aim of this paper is to present an overview of research data on the effectiveness of painful shoulder syndrome treatment by the use of conventional methods of physical therapy. Our goal was to come to a conclusion regarding the effectiveness and consistency in the process of rehabilitation of this disease as well as to analyze the use of modern technology in the non-pharmacological treatment of painful shoulder syndrome. This could prove useful for the institutions which still do not have access to modern technology used in physical medicine and the rehabilitation of this disease.

METHODS AND SUBJECTS

Research methods

This prospective comparative study on the effectiveness of certain forms of conventional physical therapy, conducted at the Department of Physical Medicine, Rehabilitation, and Rheumatology of the Clinical Hospital Center Split, included 157 subjects suffering from painful shoulder syndrome whose relevant data were recorded before their introduction to physical therapy and after 10 therapy sessions. Conventional passive methods of physical therapy included: therapeutic ul-

je treba dopuniti primjenom različitih metoda NFL-a (1, 6). Kirurško je liječenje iznimno rijetko, a rabi se kod najtežih posljedica rečenih bolesti mekih tkiva kao što je, npr., potpuna ruptura tetiva (6). Ovi bolesnici, poglavito kod izoliranih mehamički uvjetovanih bolesti, mogu razviti komplikacije koje imaju nepovoljne učinka na kvalitetu života. Stoga je u ovih bolesnika iznimno važna edukacija. Njome se smanjuje broj recidiva, bolest se prepoznaje u ranoj fazi, te se može pristupiti brzom i učinkovitom liječenju (2, 6, 8).

CILJ ISTRAŽIVANJA

Cilj su ovog rada uvid u mogućnosti i sjedinjeni pristup NFL-a sindromu bolnog ramena analizom literaturnih navoda, a prema načelima medicine utemeljene na dokazima (EBM). Također, željeli smo prikazati podatke istraživanja o učinku liječenja sindroma bolnog ramena konvencionalnim metodama fizikalne terapije. Time bi se mogli donijeti zaključci o njihovoj učinkovitosti, usuglasiti postupci pri rehabilitaciji bolesti, analizirati primjene modernih tehnologija u NFL-u bolnog ramena te utvrditi što bi bilo korisno za sve one ustanove koje još ne raspolažu modernim tehnologijama fizikalne medicine i rehabilitacije pri ovoj bolesti.

METODE ISTRAŽIVANJA I ISPITANICI

Metode istraživanja

Komparativno istraživanje učinka pojedinih oblika konvencionalne fizikalne terapije, koje je provedeno u Zavodu za fizikalnu medicinu i rehabilitaciju s reumatologijom Kliničkoga bolničkog centra Split, prospektivna je studija provedena na 157 ispitanika sa sindromom bolnog ramena, kod kojih su relevantni podatci bilježeni prije početka fizikalne terapije te poslije 10 terapijskih procedura. Pasivne konvencionalne metode fizikalne terapije uključivale su: terapijski ultrazvuk, sonoforezu, interferentne struje, laser te krioterapiju. Prije terapije i nakon nje mjereni su ovi parametri: opseg pokreta u bolnom ramenu i u svim ravninama te intenzitet boli. Opseg pokreta u ramenu (abdukcija ramena, antefleksija ramena, retrofleksija ramena, unutarnja i vanjska rotacija, udaljenost *vertebrae prominentis* i stiloida palčane kosti – tzv. udaljenost VP – S) mjerio se goniometrom *Universal Inclinometer UI01B*, prema načelima kliničke kineziometrije, i centimetarskom vrpcom (tablica 1.) (8). Intenzitet boli mjerio se horizontalnom vizualno-analognom skalom (VAS) prema vrijednostima koje su upisivali bolesnici (4).

Svi podatci statistički su analizirani, pri čemu su upotrijebljeni neparametrijski testovi (χ^2-test i Mann-Whitneyjev U-test), uz prag prihvaćanja hipoteze $p < 0,05$.

Nakon toga smo, prema načelima medicine utemeljene na dokazima (EBM), pretražili dostupnu literatu-

Table 1. Range of motion measurement in the shoulder with a description of the patient's position and placement of the goniometer
Tablica 1. Mjerenje opsega pokreta u ramenu s opisom položaja bolesnika i postavljanja goniometra

Motion measured / Pokret koji se mjeri	Patient's position / Položaj bolesnika	Placement of the goniometer / Poostavljanje goniometra
Upper arm anteflexion / Antefleksija nadlaktice	Supine lying position, upper arm in adduction leaning to the thorax / Ležeći supinirani položaj, nadlaktica aducirana uz toraks	Lateral aspect of the upper arm (above the elbow) / Lateralna strana nadlaktice iznad lakta
Upper arm retroflexion / Retrofleksija nadlaktice	Prone lying position, upper arm in adduction leaning to the thorax, shoulder fixed / Ležeći pronirani položaj, nadlaktica aducirana uz toraks, a rame fiksirano	Lateral aspect of the upper arm (above the elbow) / Lateralna strana nadlaktice iznad lakta
Upper arm abduction / Abdukcija nadlaktice	Sitting position with upper arm in adduction / Sjedeći položaj, aducirane nadlaktice	Anterior aspect of the upper arm (above the elbow) / Prednja strana nadlaktice iznad lakta
Horizontal abduction of the upper arm / Horizontalna abdukcija nadlaktice	Prone position, upper arm abduction at 90 degrees, lower arm flexion across the surface, shoulder fixed / Pronirani položaj, nadlaktica u abdukciji od 90°, podlaktica flektirana preko podloge, rame fiksirano	Anterior or posterior aspect of the upper arm (above the elbow) / Prednja ili stražnja strana nadlaktice iznad lakta
Horizontal adduction of the upper arm / Horizontalna adukcija nadlaktice	Supine position, upper arm abduction at 90 degrees, lower arm flexion at 90 degrees / Supinirani položaj, nadlaktica u abdukciji od 90°, podlaktica u fleksiji od 90°	Anterior or posterior aspect of the upper arm (above the elbow) / Prednja ili stražnja strana nadlaktice iznad lakta
Internal upper arm rotation / Unutarnja rotacija nadlaktice	Supine position, upper arm abduction at 90 degrees, lower arm flexion at 90 degrees in the medial position, shoulder fixed / Supinirani položaj, nadlaktica u abdukciji od 90°, podlaktica flektirana pod 90° u srednjem položaju, a rame fiksirano	Dorsal aspect of the lower arm above the radiocarpal joint / Dorzalna strana podlaktice iznad radiokarpalnog zgloba
External upper arm rotation / Vanjska rotacija nadlaktice	Same as with internal rotation / Jednako kao pri unutarnjoj rotaciji	Same as with external rotation / Jednako kao pri unutarnjoj rotaciji

trasound, sonophoresis, interferential current therapy, laser therapy, and cryotherapy. The following parameters were measured before and after the treatment: range of motion in the painful shoulder in all directions and intensity of pain. The range of motion in the shoulder (shoulder abduction, shoulder anteflexion and retroflexion, internal and external rotation, and distance between vertebrae prominens and styloid radius (VP-S distance)) was measured with a universal inclinometer UI01B goniometer, in accordance with the principles of clinical kinesiometrics and with a centimeter scale measuring tape (Table 1) (8). Pain intensity was measured with a horizontal visual analogue scale (VAS), and the value was entered by the patient (4).

All data were statistically analyzed using nonparametric tests, χ^2 test, and Mann–Whitney U test, with an acceptance threshold hypothesis of $p < 0.05$.

Next, we researched the Cochrane Review Database, which is accessible via the Cochrane Collaboration official website, by analyzing the available medical literature and taking into account the standard principles of evidence-based medicine (EBM). We also used data from the PEDro database (Physiotherapy Evidence Database) with the purpose of comparing our research results with the results mentioned in the literature. Thus, we used the available data in order to come to a conclusion on the importance of modern technology

ru. Podatke smo tražili u Cochraneovoj bazi podataka, koja je slobodno dostupna na internetskim stranicama organizacije *The Cochrane Collaboration*, i u Fizioterapijskoj bazi podataka (engl. *Physiotherapy Evidence Database* – PEDro), a radi usporedbe rezultata dobivenih našim istraživanjem s rezultatima u literaturnim navodima. Pritom smo iz dostupnih podataka zaključivali i o važnosti modernih tehnologija u postupnicima liječenja sindroma bolnog ramena, istražili njihove prednosti u odnosu prema konvencionalnoj terapiji, kao i sličnosti u učincima tih dvaju pristupa NFL-a sindromu bolnog ramena.

Ispitanici

Ispitanici su bili konsekutivni bolesnici s klinički potvrđenom dijagnozom sindroma bolnog ramena postavljenom od specijalista fizijatra ili specijalista fizijatra / supspecijalista reumatologa. U istraživanje je uključeno 157 bolesnika, čije su tegobe trajale od 20 do 40 dana i bile karakterizirane znatno ograničenim kretnjama u ramenom zglobu uz vrlo naglašenu bolnu komponentu. Fizikalna se terapija provodila u ambulantnim uvjetima 10 puta (2 tjedna, bez terapije tijekom subote i nedjelje). Na tablici 2. prikazani su demografski podatci (broj, dob i spol) ispitanika. Raspon dobi bio je od 26 do 70 godina, a ujednačen je u svim

in the treatment protocols for painful shoulder syndrome. We also researched the benefits of the use of modern technology in comparison with conventional methods of treatment, as well as the similarities in the effectiveness of these two non-pharmacological approaches to the treatment of painful shoulder syndrome.

Subjects

This was a consecutive case series study which included all eligible patients with a clinical diagnosis of painful shoulder syndrome who were diagnosed by a specialist in physical medicine and rehabilitation or by a specialist in physical medicine with a subspecialization in rheumatology. The research included 157 patients with a disease duration of 20 to 40 days, with severely limited movement in the shoulder joint accompanied by a feeling of intense pain. Physical therapy was conducted in the clinical center in the course of 10 sessions (in a period of 2 weeks, with no therapy during weekends). Table 2 contains the patients' demographic data (number, age, and sex). The study included patients aged 26–70, divided into age-based therapy groups of individuals of similar ages.

The patients who underwent the therapeutic ultrasound procedure (using the Cosmogamma Ultrasonic Therapy M 32 device) were treated with a mobile application technique with an intensity of 1.0 W/cm^2. During this procedure the conductive agent used was an ultrasound gel which does not interfere with the accuracy of the test and causes no reactions on the skin. Each therapeutic procedure lasted approximately 5 minutes.

Voltaren Gel (Diclofenac Sodium Gel) was used as a conductive agent in the procedure of diclofenac sonophoresis and was applied to the painful shoulder of each patient who underwent the therapeutic ultrasound procedure (using the Cosmogamma Ultrasonic Therapy M 32 device). This was done by a mobile application technique with an intensity of 1.0 W/cm2, and each application procedure lasted approximately 5 minutes.

Interferential current therapy (IFC) was administered in ten 15-minute sessions by using a 4-pole application with a static interference generated within the Cosmogamma IFA-3 device, with an interferential frequency corresponding to the difference of both AC sinusoidal waveforms in the 1–100 Hz range.

The patients in the group treated with low-level laser therapy underwent 10 therapeutic procedures (in a period of 10 days) and each therapeutic session, during which they were exposed to a continuous-wave laser beam emitted from the Cosmogamma Sistema 9000 device (Laser twin He+Ne/IR), lasted for 10 minutes.

Table 2. Characteristics of the study groups
Tablica 2. Obilježja ispitivanih skupina

Procedure / Procedura	N	Men / Muškarci	Women / Žene	Age (years) / Dob (godine)
US / UZV	33	17	16	47,10
SONOPHORESIS SONOFOREZA	31	17	14	48,10
ICT / IFS	31	15	16	45,70
LASER	30	16	14	43,60
CRYO / KRIO	32	14	18	49,30
Total / Ukupno	157	79	78	46,76

Legend / Legenda:
US / UZV = therapeutic ultrasound / terapijski ultrazvuk
SONOPHORESIS / SONOFOREZA = diclofenac sonophoresis / sonoforeza diklofenakom
ICT / IFS = interferential current therapy / interferentne struje
LASER = low-level laser therapy / laser niskog intenziteta
CRYO / KRIO = cryotherapy / krioterapija
N = number of patients in the group / broj bolesnika u skupini

terapijskim skupinama, odnosno prosječna se dob nije znatno razlikovala.

Bolesnici u kojih je primijenjen terapijski ultrazvuk (uređaj *Cosmogamma Ultrasonic Therapy M 32*) tretirani su mobilnom tehnikom aplikacije, intenzitetom od 1,0 W/cm^2. Pritom se rabilo indiferentno kontaktno sredstvo – komercijalno dostupan gel. Svaka terapijska procedura trajala je po 5 minuta.

Svakom od bolesnika liječenih ultrazvukom (uređaj *Cosmogamma Ultrasonic Therapy M 32*) s diklofenakom kao kontaktnim sredstvom (sonoforeza) na bolno je rame apliciran gel Voltaren (diklofenak) kao kontaktno sredstvo. Bolesnici su tretirani mobilnom tehnikom aplikacije, intenziteta od 1,0 W/cm^2, uz trajanje aplikacije od 5 minuta.

Interferentne struje (IFS) primijenjene su po 15 minuta četveropolnom aplikacijom s njihovom statičkom interferencijom na uređaju *Cosmogamma IFA-3*, interferentnom frekvencijom koja odgovara razlici obiju sinusoidnih izmjeničnih strujnih komponenta od 1 do 100 Hz.

Bolesnici u skupini liječenoj laserom niskog intenziteta (LASER) tretirani su 10 puta (dana) po 10 minuta kontinuiranom laserskom zrakom uređaja *Cosmogamma Sistema 9000* (*Laser Twin He-Ne/IR*), valne duljine 623,8 nm i izlazne snage od 5 mW.

U skupini bolesnika tretiranih kriomasažom masaža se provodila kružnim pokretima ledom nastalim od zaleđenja 0,2 litre vode, a procedura je trajala 6 minuta.

Tijekom navedenih 10 dana primjene fizikalne terapije nitko od ispitanika nije uzimao nikakvu medikamentnu terapiju protiv boli i upale (analgetici, nesteroidni antireumatici), a nitko nije istodobno provodio ni kinezioterapiju. Podatci su prikupljani s pomoću

The wavelength of the laser beam was 623.8 nm, and the rated output was 5mW.

The group of patients treated by cryomassage underwent massage performed by softly rubbing ice (obtained by freezing 0.2 liters of water) onto the painful area using circular motions during a 6-minute session.

Throughout the whole physical therapy period in the duration of 10 days, none of the subjects were taking any pain-relieving and anti-inflammatory medications (analgesics, non-steroidal antirheumatics) and none of them were simultaneously exposed to kinesiotherapy. The data were collected through a series of carefully structured questionnaires. The subjects were given an informed consent form to read prior to the start of the procedure and they agreed to take part in this study by signing it.

RESULTS

Research results

By conducting a prospective study whose aim was to objectivize the effectiveness of conventional methods of physical therapy commonly used for the treatment of painful shoulder syndrome (therapeutic ultrasound, diclofenac sonophoresis, laser therapy, interferential current therapy, cryotherapy), we found a general improvement in the measured parameters of functional capacity and pain intensity.

The research yielded the following results, displayed in Tables 3–9:

- statistically significant improvement of shoulder abduction in all groups, excluding those treated by cryotherapy (Table 3);
- statistically significant improvement of shoulder anteflexion in all groups, with the most notable results in the groups treated by interferential current therapy (Table 4);
- statistically significant improvement of shoulder retroflexion in all groups, with the most notable results in the groups treated by interferential current therapy (Table 5);
- statistically significant improvement of internal shoulder rotation in all groups (Table 6);
- statistically significant improvement of external shoulder rotation in all groups, excluding those that underwent laser therapy, and with the most notable effect in the group treated by interferential current therapy (Table 7);
- statistically significant reduction of the VP-S distance in all groups, excluding the one that underwent laser therapy (Table 8);
- statistically significant reduction of pain intensity (measured with a visual analog scale (VAS)) in all groups, with the most notable results in patients who underwent diclofenac sonophoresis and laser therapy (Table 9).

Table 3. Changes in the shoulder range of motion: shoulder abduction (°)

Tablica 3. Promjene pokretljivosti ramena: abdukcija ramena (°)

Procedure / Procedura	N	0	10	P
US / UZV	33	79,03 (± 14,8)	93,22 (± 10,8)	< 0,05
SONOPHORESIS SONOFOREZA	31	81,40 (± 16,1)	94,20 (± 14,6)	< 0,05
ICT / IFS	31	75,8 (± 17,0)	87,9 (± 8,9)	< 0,05
LASER	30	69,5 (± 14,1)	80,83 (± 12,9)	< 0,05
CRYO / KRIO	32	77,09 (± 16,1)	88,54 (± 18,1)	> 0,05

Legend / Legenda:
US / UZV = therapeutic ultrasound / terapijski ultrazvuk
SONOPHORESIS / SONOFOREZA = diclofenac sonophoresis / sonoforeza diklofenakom
ICT / IFS = interferential current therapy / interferentne struje
LASER = low-level laser therapy / laser niskog intenziteta
CRYO / KRIO = cryotherapy / krioterapija
N = number of patients in the group / broj bolesnika u skupini
0 = value before the treatment / vrijednost prije liječenja
10 = value after 10 therapeutic procedures / vrijednost nakon 10 terapijskih procedura
P = statistical significance level / statistička razina značajnosti

posebno osmišljenih upitnika, a ispitanici su prethodno pročitali informacije i potpisali suglasnost za sudjelovanje u ispitivanju.

REZULTATI

Rezultati istraživanja

Provodeći prospektivno istraživanje radi objektiviziranja učinaka konvencionalnih oblika fizikalne terapije, koji se u našoj ustanovi najčešće primjenjuju za liječenje bolesnika sa sindromom bolnog ramena (terapijski ultrazvuk, sonoforeza diklofenakom, laser, interferentne struje, krioterapija), općenito smo našli poboljšanje u mjerenim parametrima funkcionalnog kapaciteta i stupnja boli.

Rezultati koje smo zabilježili, kako slijedi, prikazani su na tablicama 3. – 9.:

- statistički značajno povećanje abdukcije ramena u svim skupinama bolesnika, osim u onih koji su liječeni krioterapijom (tablica 3.)
- statistički značajno povećanje antefleksije ramena u svim skupinama bolesnika, a najizraženije u onih što su liječeni interferentnim strujama (tablica 4.)
- statistički značajno povećanje retrofleksije ramena u svim skupinama bolesnika, a najizraženije u onih koji su liječeni interferentnim strujama (tablica 5.)
- statistički značajno povećanje unutarnje rotacije ramena u svim skupinama bolesnika (tablica 6.)

Table 4. Changes in the shoulder range of motion: shoulder anteflexion (°)

Tablica 4. Promjene pokretljivosti ramena: antefleksija ramena (°)

Procedure / Procedura	N	0	10	P
US / UZV	33	129,19 (± 21,4)	145,80 (± 18,2)	< 0,05
SONOPHORESIS SONOFOREZA	31	128,14 (± 19,8)	146,91 (± 20,0)	< 0,05
ICT / IFS	31	127,30 (± 36,8)	165,9 (± 27,3)	< 0,001
LASER	30	130,62 (± 21,2)	143,12 (± 25,8)	< 0,05
CRYO / KRIO	32	134,67 (± 25,0)	153,70 (± 18,2)	< 0,05

Legend / Legenda:
US / UZV = therapeutic ultrasound / terapijski ultrazvuk
SONOPHORESIS / SONOFOREZA = diclofenac sonophoresis / sonoforeza diklofenakom
ICT / IFS = interferential current therapy / interferentne struje
LASER = low-level laser therapy / laser niskog intenziteta
CRYO / KRIO = cryotherapy / krioterapija
N = number of patients in the group / broj bolesnika u skupini
0 = value before the treatment / vrijednost prije liječenja
10 = value after 10 therapeutic procedures / vrijednost nakon 10 terapijskih procedura
P = statistical significance level / statistička razina značajnosti

Table 5. Changes in the shoulder range of motion: shoulder retroflexion (°)

Tablica 5. Promjene pokretljivosti ramena: retrofleksija ramena (°)

Procedure / Procedura	N	0	10	P
US / UZV	33	38,26 (± 13,2)	47,74 (± 10,1)	< 0,05
SONOPHORESIS SONOFOREZA	31	37,91 (± 8,8)	58,32 (± 9,1)	< 0,05
ICT / IFS	31	27,11 (± 12,9)	42,7 (± 8,4)	< 0,01
LASER	30	38,12 (± 11,7)	52,08 (± 12,8)	< 0,05
CRYO / KRIO	32	45,64 (± 14,1)	54,83 (± 13,8)	< 0,05

Legend / Legenda:
US / UZV = therapeutic ultrasound / terapijski ultrazvuk
SONOPHORESIS / SONOFOREZA = diclofenac sonophoresis / sonoforeza diklofenakom
ICT / IFS = interferential current therapy / interferentne struje
LASER = low-level laser therapy / laser niskog intenziteta
CRYO / KRIO = cryotherapy / krioterapija
N = number of patients in the group / broj bolesnika u skupini
0 = value before the treatment / vrijednost prije liječenja
10 = value after 10 therapeutic procedures / vrijednost nakon 10 terapijskih procedura
P = statistical significance level / statistička razina značajnosti

Table 6. Changes in the shoulder range of motion: internal shoulder rotation (°)

Tablica 6. Promjene pokretljivosti ramena: unutarnja rotacija ramena (°)

Procedure / Procedura	N	0	10	P
US / UZV	33	50,03 (± 9,8)	65,32 (± 12,3)	< 0,05
SONOPHORESIS SONOFOREZA	31	51,08 (± 10,9)	66,00 (± 10,0)	< 0,05
ICT / IFS	31	36,20 (± 7,6)	48,80 (± 10,6)	< 0,05
LASER	30	40,45 (± 12,9)	65,83 (± 14,2)	< 0,05
CRYO / KRIO	32	48,54 (± 8,8)	63,04 (± 12,4)	< 0,05

Legend / Legenda:
US / UZV = therapeutic ultrasound / terapijski ultrazvuk
SONOPHORESIS / SONOFOREZA = diclofenac sonophoresis / sonoforeza diklofenakom
ICT / IFS = interferential current therapy / interferentne struje
LASER = low-level laser therapy / laser niskog intenziteta
CRYO / KRIO = cryotherapy / krioterapija
N = number of patients in the group / broj bolesnika u skupini
0 = value before the treatment / vrijednost prije liječenja
10 = value after 10 therapeutic procedures / vrijednost nakon 10 terapijskih procedura
P = statistical significance level / statistička razina značajnosti

Table 7. Changes in the shoulder range of motion: external shoulder rotation (°)

Tablica 7. Promjene pokretljivosti ramena: vanjska rotacija ramena (°)

Procedure / Procedura	N	0	10	P
US / UZV	33	51,67 (± 14,2)	62,83 (± 10,4)	< 0,05
SONOPHORESIS SONOFOREZA	31	49,47 (± 15,8)	61,82 (± 11,9)	< 0,05
ICT / IFS	31	35,00 (± 12,7)	67,92 (± 13,5)	< 0,001
LASER	30	57,61 (± 20,1)	63,04 (± 9,2)	> 0,05
CRYO / KRIO	32	55,67 (± 17,2)	67,74 (± 10,4)	< 0,05

Legend / Legenda:
US / UZV = therapeutic ultrasound / terapijski ultrazvuk
SONOPHORESIS / SONOFOREZA = diclofenac sonophoresis / sonoforeza diklofenakom
ICT / IFS = interferential current therapy / interferentne struje
LASER = low-level laser therapy / laser niskog intenziteta
CRYO / KRIO = cryotherapy / krioterapija
N = number of patients in the group / broj bolesnika u skupini
0 = value before the treatment / vrijednost prije liječenja
10 = value after 10 therapeutic procedures / vrijednost nakon 10 terapijskih procedura
P = statistical significance level / statistička razina značajnosti

No adverse effects of physical therapy occurred during the research; no treatment withdrawals were recorded.

Overview of literature data

The data found in the Cochrane library and PEDro databases were important for enabling a comparison with our research results. The effectiveness of specific

- statistički značajno povećanje vanjske rotacije ramena u svim skupinama bolesnika, osim u onih što su liječeni laserom, a najizraženiji učinak postignut je u skupini liječenih interferentnim strujama (tablica 7.)
- statistički značajno kraća udaljenost VP – S u svim skupinama bolesnika, osim u onih liječenih laserom (tablica 8.)

Table 8. Changes in the shoulder range of motion: VP-S distance (cm)
Tablica 8. Promjene pokretljivosti ramena: udaljenost VP – S (cm)

Procedure / Procedura	N	0	10	P
US / UZV	33	40,27 (± 8,5)	35,38 (± 7,1)	< 0,05
SONOPHORESIS SONOFOREZA	31	41,11 (± 4,9)	37,01 (± 8,2)	< 0,05
ICT / IFS	31	50,70 (± 9,8)	40,2 (± 8,1)	< 0,05
LASER	30	43,04 (± 10,2)	37,87 (± 9,0)	> 0,05
CRYO / KRIO	32	38,03 (± 4,2)	34,96 (± 3,9)	< 0,05

Legend / Legenda:
US / UZV = therapeutic ultrasound / terapijski ultrazvuk
SONOPHORESIS / SONOFOREZA = diclofenac sonophoresis / sonoforeza diklofenakom
ICT / IFS = interferential current therapy / interferentne struje
LASER = low-level laser therapy / laser niskog intenziteta
CRYO / KRIO = cryotherapy / krioterapija
N = number of patients in the group / broj bolesnika u skupini
0 = value before the treatment / vrijednost prije liječenja
10 = value after 10 therapeutic procedures / vrijednost nakon 10 terapijskih procedura
P = statistical significance level / statistička razina značajnosti

Table 9. Change in intensity of pain (VAS)
Tablica 9. Promjena intenziteta bola (VAS)

Procedure / Procedura	N	0	10	P
US / UZV	33	8,7	4,6	< 0,05
SONOPHORESIS SONOFOREZA	31	8,8	3,4	< 0,001
ICT / IFS	31	8,7	4,7	< 0,05
LASER	30	8,9	3,2	< 0,001
CRYO / KRIO	32	8,8	4,5	< 0,05

Legend / Legenda:
US / UZV = therapeutic ultrasound / terapijski ultrazvuk
SONOPHORESIS / SONOFOREZA = diclofenac sonophoresis / sonoforeza diklofenakom
ICT / IFS = interferential current therapy / interferentne struje
LASER = low-level laser therapy / laser niskog intenziteta
CRYO / KRIO = cryotherapy / krioterapija
N = number of patients in the group / broj bolesnika u skupini
0 = value before the treatment / vrijednost prije liječenja
10 = value after 10 therapeutic procedures / vrijednost nakon 10 terapijskih procedura
P = statistical significance level / statistička razina značajnosti

exercises on the short-term treatment effect and recovery of the rotator cuff with long-term improvement of the shoulder function were determined in 26 controlled studies of mediocre methodological quality (2, 9, 10). Their results were expected and they were mentioned in the introductory part of this paper, but they were not considered in comparison with our research due to the fact that our research was focused on different methods of conventional physical therapy. In the treatment of supraspinatus muscle tendinitis, the results of laser therapy were not significantly better than the placebo treatment results, but they were significantly superior to the placebo results in the treatment of adhesive capsulitis of the shoulder (10). In the treatment of calcific tendinitis, pulsed electromagnetic field therapy (PEMFT) and ultrasound therapy had a far better analgesic effect than placebo. In the treatment of painful shoulder syndrome (different diagnoses) and adhesive capsulitis, therapeutic ultrasound as monotherapy had no significant analgesic effect. Moreover, no significant analgesic effect was obtained by the use of combination therapy consisting of ultrasound therapy and exercises compared to ultrasound monotherapy (10).

Regarding the effect of extracorporeal shock wave therapy (ESWT) on rotator cuff changes in painful shoulder syndrome with or without calcific deposits, in the overview of the Cochrane library database, which included 32 research studies (2281 subjects) conducted on patients with calcific deposits, 5 studies conducted on patients without calcific deposits, and 2 studies conducted on patients with and without calcific deposits,

– statistički značajno smanjenje intenziteta boli (mjereno VAS-om) u svim skupinama, a najviše kod bolesnika liječenih sonoforezom (diklofenak) i laserom (tablica 9.).

Tijekom istraživanja nisu prijavljeni nijedan neželjeni učinak provedene fizikalne terapije niti odustajanje od započetog tretmana.

Rezultati pretraživanja literature

Literaturni podatci iz Cochraneove baze i Fizioterapijske baze podataka (PEDro) bili su važni za usporedbu s našim istraživanjem. Iz 26 kontroliranih studija srednje ocijenjene metodološke kvalitete utvrđena je učinkovitost specifičnih vježba na kratkotrajan učinak liječenja i oporavak rotatorne manšete, uz dugotrajno poboljšanje funkcije ramena (2, 9, 10). Takvi su podatci bili i očekivani te su navedeni u uvodnom dijelu, ali nisu razmatrani u usporedbi s našim istraživanjem, jer se ono odnosilo na različite oblike konvencionalne fizikalne terapije. Terapija laserom nije bila bolja od placeba pri liječenju tendinitisa supraspinatusa, dok je kod adhezivnog kapsulitisa bila znatno bolja od placeba (10). Terapija pulsirajućim elektromagnetskim poljem ili ultrazvukom imala je bitno bolji analgetski učinak od placeba pri liječenju kalcificirajućeg tendinitisa (10). Terapijski ultrazvuk nije pokazao znatniji analgetski učinak ni kod bolnog ramena (različite dijagnoze) ni kod adhezivnog kapsulitisa, ni pri samostalnoj primjeni niti u kombinaciji ultrazvuka i vježba, a u odnosu prema samo ultrazvuku (10).

Sustavnim pregledom literature o utjecaju udarnog vala (engl. *Extracorporeal shockwave therapy* – ESWT)

the effects of ESWT (≥0.2 – 0.4 mJ/mm^2) were researched. ESWT was compared to the placebo, a small dose of the ESWT, a local glucocorticoid infiltration and the application of the transcutaneous electrical nerve stimulation (TENS) method (11). The results showed that the majority of patients experienced a reduction of pain intensity (by 50% and more) and an increase of functional capacity when compared to the control subjects, with adverse effects of the therapy recorded in 3–19% of cases, regarding the dose (11). An improved therapeutic effect was related to the application of larger therapeutic doses of ESWT. Wu et al noted that the application of larger doses of the ESWT had a significantly better long-term effect on the treatment of calcific tendinitis of the shoulder (12). The use of the ESWT was also proven to be very effective in combination therapies, for instance, in addition to electromagnetic transduction therapy (EMTT) (13).

In the following systematic overview of the Cochrane library database, the effect of electrotherapy on rotator cuff diseases was researched by investigating its effect on the reduction of pain and the increase of functional capacity in painful shoulder syndrome as well as by focusing on the effect of therapeutic ultrasound and low-level laser therapy (LLLT). This study included the results of 47 research studies conducted on 2388 subjects. The majority of patients in those research studies had no calcific deposits in the rotator cuff (14). Even though the quality of results in this study was evaluated as low, it was shown that ultrasound has a short-term beneficial effect in the treatment of symptoms which appear in patients who suffer from painful shoulder syndrome, and especially in those who have calcific deposits. LLLT proved to be more effective than placebo, as opposed to pulsed electromagnetic field therapy (PEMFT). TENS proved to be superior to placebo, and it was recommended that future similar research studies should be designed to obtain more reliable results, even though noted positive effect of LLLT and TENS in the reduction of pain intensity and the increase of functional capacities was undeniable. It must be noted that no side-effects were reported and that the issue of more frequent use of combination therapy as opposed to monotherapy with this method of non-pharmacological treatment was presented.

Individual, smaller research studies of high-intensity laser therapy (HILT) conducted on a smaller number of subjects (42 patients) have proven this therapy to be effective – even after a short-term session resulted in undeniable, such as a reduction of pain intensity and functional disability of patients suffering from subacromial impingement syndrome (SAIS) (15). Moreover, in some cases it was proven that HILT used in

kod sindroma bolnog ramena na promjene rotatorne manšete s kalcifikatom u njoj ili bez njega, u Cochraneovoj su bazi nađena 32 istraživanja na 2281 bolesniku s kalcifikatom, njih 5 na bolesnicima bez kalcifikata i 2 istraživanja na miješanoj populaciji bolesnika s kalcifikatom i bez njega. Tim su istraživanjima praćeni učinci ESWT-a (0,2 – 0,4 mJ/mm^2 pa naviše) u odnosu prema placebnoj skupini, prema niskoj dozi jednake terapije, zatim u odnosu prema infiltraciji glukokortikoida te s obzirom na aplikaciju transkutane električne živčane stimulacije (engl. *Transcutaneous Electrical Nerve Stimulation* – TENS) (11). Rezultati su pokazali da je u najvećeg broja ispitanika došlo do znatnog smanjenja boli (50% i više) te povećanja funkcionalnih sposobnosti u odnosu prema kontrolnim skupinama. Pritom je neželjene učinke terapije prijavilo 3 – 19% bolesnika, s tim da je problematizirana doza udarnog vala kao standarda terapije (11). Bolji terapijski učinak veže se uz primjenu viših terapijskih doza ESWT-a. Tako prema istraživanju Wua i suradnika, znatno bolji i dugotrajniji učinak na kalcificirajući tendinitis ramena ima primjena viših terapijskih doza (12), a ESWT se pokazao vrlo učinkovit i u kombiniranim terapijama, npr., uz elektromagnetsku transdukcijsku terapiju (13).

Sljedećim sustavnim pregledom literature iz Cochraneove baze pratio se učinak elektroterapije na bolesti rotatorne manšete s obzirom na smanjenje boli i povećanje funkcionalnih mogućnosti kod sindroma bolnog ramena, a s naglaskom na učinke terapijskog ultrazvuka, lasera male izlazne snage (LLLT), TENS-a i pulsirajućega magnetskog polja. Obuhvaćeni su rezultati 47 istraživanja, provedena na 2388 bolesnika, od kojih najveći broj nije imao kalcifikate u rotatornoj manšeti (14). Iako je kvaliteta dokaza u toj studiji ocijenjena slabom, pokazalo se da ultrazvuk kratkotrajno učinkovito djeluje na simptome u bolesnika s bolnim ramenom, osobito kod onih koji imaju kalcifikate. LLLT je bio učinkovitiji od placeba, za razliku od pulsirajućega magnetskog polja. TENS se pokazao boljim od placeba, pri čemu je preporučeno da buduća slična istraživanja budu koncipirana tako da postignu znatno veću snagu dokaza. Ipak, pozitivan učinak tih dviju metoda na smanjenje boli i povećanje funkcionalnih mogućnosti neprijeporan je. Valja napomenuti da nuspojave nisu prijavljene, a postavljeno je pitanje češće primjene kombinirane terapije ovim načinom NFL-a u odnosu prema monoterapiji.

Pojedinačna istraživanja o utjecaju lasera visokog intenziteta (HILT), provedena na manjem broju ispitanika (42 bolesnika), pokazala su znatnu učinkovitost ove terapije: već je kratkotrajan tretman bitno utjecao na smanjenje boli i onesposobljenosti bolesnika sa sindromom subakromijskog sraza (15), a u nekih se bolesnika pokazalo da dobrim rezultatima liječenja HILT-om pridonosi i kombinacija s drugim terapijskim opcija-

combination with other non-pharmacological treatment methods, such as the kinesio taping method, was even more efficient.

We had a short-term option of working on borrowed devices (manufactured by the **kinesis company BLT**) and in that time we were able to experience the effects of extracorporeal shock wave therapy (ESWT) and high-intensity laser therapy (HILT) at first hand. We came to the conclusion that both of these methods are efficient.

In our department the short-term experimental use of ESWT and HILT resulted in a significant reduction of pain intensity in patients suffering from painful shoulder syndrome. More precisely, a total of 16 patients underwent extracorporeal shock wave therapy (ESWT) (VAS difference after application was $p < 0.01$) (18) and a total of 20 patients underwent high-intensity laser therapy (HILT) (VAS difference after application was $p < 0.0001$) (19). The objective disadvantage of these research studies was the small number of subjects. Nonetheless, the results are in line with the aforementioned studies, which were also conducted on small cohorts of subjects.

DISCUSSION

Due to the fact that our institution, like numerous other institutions in Croatia, does not have access to modern technology in the field of physical medicine and rehabilitation, we have tried to present an overview of our research results in order to objectivize the actual treatment options for patients suffering from painful shoulder syndrome through the use of conventional methods of physical therapy and rehabilitation which yielded positive results. In addition to that, by researching databases and trying to draw conclusions on the basis of EBM, we obtained results which point to the fact that the treatment protocols used in such patients should be based on non-pharmacological treatment. It has been recorded, both in large randomized controlled trials as well as in our research, that these treatment methods have very few reported adverse effects. Through the use of modern technology, it is possible to get more impressive treatment results in comparison with conventional therapy methods, and ESWT and HILT were highlighted as the most efficient treatment methods in that regard (11–13). It should be noted that, according to large research studies (10) and data from the literature, medical exercises generally produce the best treatment results (1, 2, 20). However, it can be said that this may be quite controversial when it comes to drawing conclusions, because the type of exercises, their intensity, frequency of exercise cycles, modification according to various age groups, and other elements are rarely explicitly stated, which makes it more difficult to draw proper conclusions about their

ma NFL-a, npr., s kineziološkim vrpcama (engl. *Kinesio Taping*) (16, 17).

Kratkotrajan rad u našem Zavodu na posuđenim uređajima (proizvođača BTL) omogućio nam je stjecanje osobnih iskustava o učinku monoterapije udarnim valom (ESWT) i laserom visokog intenziteta (HILT) te pokazao da su obje ove metode učinkovite. Naime, kod bolesnika sa sindromom bolnog ramena postignuta je znatna redukcija boli, i to s pomoću ESWT-a kod 16 bolesnika (razlika na VAS-u poslije aplikacije $p < 0,01$) (18) te kod 20 bolesnika liječenih HILT-om (razlika na VAS-u poslije aplikacije $p < 0,0001$) (19). Objektivni nedostatak ovih istraživanja bio je malen broj ispitanika, ali se rezultati uklapaju u prije navedene referencije koje, međutim, također nisu imale velike kohorte ispitanika.

RASPRAVA

U našoj se ustanovi, kao ni u brojnim drugim ustanovama u Hrvatskoj, zasad ne mogu rabiti moderne tehnologije iz područja fizikalne medicine i rehabilitacije. Stoga smo, prikazujući rezultate svojeg istraživanja, pokušali objektivizirati stvarne mogućnosti liječenja bolesnika sa sindromom bolnog ramena primjenom konvencionalnih metoda fizikalne medicine i rehabilitacije te smo našli pozitivne rezultate. Osim toga, pretraživanjem baza podataka i izvođenjem zaključaka na temelju EBM-a našli smo dokaze da kod tih bolesnika u protokolima liječenja treba primjenjivati NFL. Zabilježeno je da ta metoda liječenja ima vrlo malo prijavljenih neželjenih učinaka i u velikim kontroliranim randomiziranim studijama i u našem istraživanju. Moderne tehnologije pokazuju impresivnije rezultate liječenja u odnosu prema konvencionalnoj terapiji pa su ESWT i HILT istaknuti kao najkvalitetnije metode (11 – 13). Potrebno je naglasiti da u velikim studijama (10), a i prema stručnoj literaturi, najbolji učinak pri liječenju imaju medicinske vježbe (1, 2, 20). Međutim, tu se uvijek nađemo na „skliskom terenu“ pri izvođenju zaključaka, jer se rijetko gdje izrijekom navodi vrsta vježba, njihov intenzitet, učestalost vježbovnih ciklusa, prilagodba dobnim skupinama i dr. pa nam to znatno otežava izvođenje pravilnih zaključaka o njihovoj učinkovitosti i međusobnoj usporedivosti. Upravo zbog toga u svojem smo se radu usredotočili na druge oblike NFL-a, pokušavajući iskoristiti bolju klasificiranost rezultata koji su međusobno lakše usporedivi. Činjenica jest da ni takvih studija nema previše pa velik broj nađenih istraživanja, navedenih na početku Cochraneovih sustavnih pregleda, na kraju otpadne zbog neujednačenosti i neusporedivosti podataka, kao što je to i inače slučaj kod radova koji su evaluirali NFL. Svakako treba istaknuti još jedan problem u vezi s modernim tehnologijama: zasad još nema dovoljno podataka za sve tehnološki

effectiveness and comparability. Due to this fact, in this paper we have focused our attention on other methods of non-pharmacological treatment by trying to use a better classification of results to make them more comparable. It is a well-known fact that there is a small number of such studies; thus the majority of research studies referred to at the beginning of the Cochrane systematic reviews were eventually dropped due to inconsistencies and incomparability of data, as was the case with most papers which were focused on the evaluation of non-pharmacological treatment methods. It is also important to note another problem regarding modern technology, namely the fact that there is a serious lack of data related to all technologically advanced treatment modalities (such as radiofrequency (RF) or super inductive systems (SIS)), which are only mentioned in individual studies with a relatively small number of subjects (21).

Conventional methods of physical therapy are still widely used, which is extremely important for us due to the fact that the majority of our public health facilities still lack experience in the use of modern and more expensive technology or do not have access to it. These conventional modalities, whose effects were evaluated by EBM methods, proved to be efficient and harmless (14–16). The results of our research also corroborate this conclusion: the evaluated methods in our research proved to be effective as well as harmless. It should also be stated that the most effective method related to the increase of functional capacity of the painful shoulder proved to be interferential current therapy, because its application had the statistically most significant effect on the increase of anteflexion and retroflexion as well as external rotation of the painful shoulder. This comes as no surprise when we consider the action mechanism of these medium-frequency (Nemec) currents, which are generated by two sinusoidal alternating currents that overlap in intensity, phase, and frequency, and whose interference occurs deep within the tissue; thus they have better depth efficiency than other methods.

In accordance with the common and expected analgesic effects of various physical therapy methods (22), the best analgesic effects were noted in the use of sonophoresis, due to the direct activity of its pharmacologically active substance (diclofenac), which has analgesic as well as anti-inflammatory properties, as well as with the use of low-level laser therapy.

In accordance with the aforementioned, our research has shown that our results are in line with those published in the Cochrane systematic review (14, 22). Therefore, conventional therapy methods can be regarded effective in the treatment of painful shoulder syndrome in environments without access to modern technology such as ESWT and HILT.

napredne modalitete liječenja (npr., radiofrekvencija, superinduktivni sustavi) pa nailazimo tek na pojedinačne studije s relativno malenim brojem ispitanika (21).

Konvencionalne metode fizikalne terapije i nadalje su sveprisutne, a za nas je to osobito važno jer u najvećem broju državnih institucija još nemamo previše iskustava ni mogućnosti uporabe modernih i skupljih tehnologija. Ti konvencionalni modaliteti, čiji su učinci evaluirani metodama EBM-a, pokazali su se učinkovitima i neštetnima (14 – 16). I rezultati našeg istraživanja podupiru takav zaključak, odnosno evaluirane metode bile su na kraju i učinkovite i neštetne. Možda bi trebalo izdvojiti činjenicu da su se kao najučinkovitija metoda, s obzirom na povećanje funkcionalnog kapaciteta bolnog ramena, pokazale interferentne struje, jer je njihova primjena imala statistički najznačajniji učinak na povećanje i antefleksije i retrofleksije, kao i vanjske rotacije bolnog ramena, To ne iznenađuje kada znamo mehanizam djelovanja tih srednje frekventnih struja: one nastaju iz dviju sinusoidnih izmjeničnih struja koje se preklapaju u intenzitetu, fazi i frekvenciji, a interferencija se događa u dubinskim tkivima pa te tzv. Nemecove struje imaju jače dubinsko djelovanje od ostalih upotrijebljenih metoda.

Sukladno uobičajenim i očekivanim analgetskim učincima različitih oblika fizikalne terapije (22) najbolje analgetsko djelovanje postigle su sonoforeza, zbog njezina izravnog djelovanja farmakološki aktivne supstancije koja ima i analgetsko i protuupalno djelovanje (diklofenak), te laser niskog intenziteta.

Dakle, naše istraživanje daje nam pravo da kažemo kako su naši rezultati u skladu s onima objavljenima u Cochraneovu sustavnom pregledu (14, 22). Stoga konvencionalnu terapiju i nadalje možemo pozicionirati kao učinkovitu za liječenje sindroma bolnog ramena u situacijama kada nemamo na raspolaganju moderne tehnologije poput ESWT-a i HILT-a.

ZAKLJUČAK

Svojim istraživanjem na uzorku bolesnika sa sindromom bolnog ramena potvrdili smo pozitivne učinke NFL-a primjenom konvencionalnih metoda fizikalne medicine u tih bolesnika pa ih treba ostaviti u protokolima liječenja ove izvanzglobne reumatske bolesti. Pritom valja znati da moderne tehnologije nude brže i učinkovitije rezultate, a osobito u sinergiji s medicinskim vježbama bolesnicima omogućavaju brzu i znatnu redukciju boli te povećanje funkcionalnog kapaciteta ramena. Međutim, u slučajevima kad još nije dostupna primjena modernih tehnologija pri NFL-u bolnog ramena, učinkovitima su se pokazale i metode konvencionalne fizikalne terapije, a tomu pridonose i rezultati pretraživanja dostupne literature. Dobra

CONCLUSION

Our research, conducted on a sample of patients who suffer from painful shoulder syndrome, has confirmed the positive effects of conventional methods of physical therapy as part of non-pharmacological treatment of this disorder, and which should be incorporated in the protocols for the treatment of this extra-articular rheumatic disease. It was concluded that the use of modern technology offers faster and more efficient results, and that this technology, in addition to medical exercises, enables the patients to experience a fast and a significant reduction of pain intensity and an increase in the functional capacity of the shoulder. However, in the settings of non-pharmacological treatment of painful shoulder syndrome in which access to modern technology is still not widely available, the methods of conventional physical therapy have proven to be effective. The results of our literature data research confirm this conclusion. Non-pharmacological treatment methods and all of their modalities are well-tolerated, which gives them additional value.

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podnošljivost zajedničko je obilježje svih modaliteta NFL-a, što im daje dodatnu važnost i vrijednost.

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