

ORIGINAL STUDIES

The role of isokinetic exercises in the rehabilitation of patients with impingement syndrome of the shoulder

Rolul izokinetismului în reabilitarea pacienților cu sindrom de conflict subacromio-deltoidian

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Abstract

Background. Scapulohumeral periarthritis is a medical condition consisting of the inflammation of tendinomuscular structures of the shoulder, causing pain, limited mobility, functional impotence and reduced quality of life.

Aims. The study aimed to demonstrate the effectiveness of active kinesiotherapy programs combined with isokinetic exercises in improving the symptoms of patients presenting with scapulohumeral periarthritis.

Methods. The study was conducted on a number of 30 patients diagnosed with simple shoulder pain, mixed shoulder pain or subacromial-deltoid impingement syndrome. The subjects were divided into two groups. The reference group, consisting of 15 patients, was subjected to an active kinesiotherapy program, as well as an active endurance one. The study group, also comprising 15 patients, was subjected to the same kinesiotherapy program, combined with isokinetic exercises. In order to objectify the results, assessment tests were performed on days 1 and 10 of treatment. These included the VAS (visual analog scale) for pain intensity, the flexion-abduction-external rotation articular test, and the Constant-Murley shoulder test.

Results. On day 1 of treatment, the symptoms and levels of pathology observed among the two groups were similar. The study was performed on groups of homogeneous sex and age, ranging between 60 and 70 years. As per the VAS, the average pain intensity was measured at 5.8 among patients in the reference group and 5.7 among patients in the study group. On day 10 of treatment, the test indicated a reduction in the pain levels of both groups, the average pain intensity being measured at 2.2 and 1.6, respectively. In terms of the Constant-Murley scores, they were similar on day 1 of treatment and registered as 57.6 and 63.1, respectively, on day 10 of treatment. The articular test revealed an improvement in the range of motion of patients in the study group by 4% on flexion, 5% on abduction and 4% on external rotation as compared to patients in the reference group. The T-test results were statistically significant as regards the VAS ($p < 0.006$), the Constant-Murley test ($p < 0.02$), abduction ($p < 0.03$), external rotation ($p < 0.005$), and at the limit in terms of flexion ($0 < 0.05$).

Conclusions. The active kinesiotherapy program combined with kinetic exercises ensures better outcomes in terms of pain relief, improved joint mobility, muscle rebalancing and, implicitly, improved quality of life among patients.

Keywords: scapulohumeral periarthritis, kinesiotherapy, isokinetic

Rezumat

Premize. Periartrita scapulo-humerală este o afecțiune medicală care constă din inflamația structurilor tendino-musculare ale umărului, ceea ce duce la durere, limitare de mobilitate, impotență funcțională și afectare a calității vieții.

Obiective. Obiectivul studiului a fost demonstrarea eficienței superioare a unui program de kinetoterapie activă, combinat cu exerciții izokinetice, în ameliorarea simptomatologiei pacientului cu periartrită scapulo-humerală.

Metode. Studiul a fost efectuat pe 30 de pacienți, cu diagnostic de umăr dureros simplu, umăr mixt și sindrom de conflict subacromio-deltoidian, împărțiți în două loturi. Lotul martor cu 15 pacienți a beneficiat de un program de kinetoterapie activă și activă cu rezistență; lotul de studiu tot cu 15 pacienți a beneficiat tot de același program de kinetoterapie, la care s-a mai adăugat un program de exerciții izokinetice. Pentru obiectivarea rezultatelor, în prima zi de tratament (ziua 1) și ultima zi de tratament (ziua 10) am aplicat teste de evaluare, respectiv scala analog vizuală a durerii - VAS, testing-ul articular pentru mișcarea de flexie, abducție și rotație externă și Testul Constant-Murley pentru umăr.

Received: 2017, November 22; Accepted for publication: 2017, December 15

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<https://doi.org/10.26659/pm3.2018.19.1.8>

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Rezultate. În prima zi de tratament, ambele loturi au fost asemănătoare din punct de vedere al simptomatologiei și gradului de afectiune. Componența loturilor a fost omogenă din punctul de vedere al sexului, cât și al vârstei pacienților, vârsta medie fiind cuprinsă între 60-70 de ani. Pe scara analog vizuală a durerii VAS, pentru lotul martor am obținut o medie de 5,8, iar pentru cel de studiu 5,7. În ziua 10, durerea a scăzut la ambele loturi, pentru cel martor la 2,2, iar la cel de studiu la 1,6. Pentru scorul CONSTANT, loturile au avut rezultate asemănătoare în prima zi, iar în ziua 10 lotul martor a obținut un scor de 57,6, iar cel de studiu 63,1. În urma testing-ului efectuat, lotul de studiu a obținut o creștere a amplitudinii de mișcare cu 4% pe flexie, 5% abducție și 4% rotație externă în ziua 10, față de lotul martor. Rezultatele T-test-ului au fost semnificative statistic pentru VAS ($p<0,006$), CONSTANT ($p<0,02$), abducție ($p<0,03$), rotație externă ($p<0,005$), iar pentru flexie ($p<0,05$) au fost la limită.

Concluzii. Programul de kinetoterapie activă în combinație cu exercițiile izokineticice are rezultate mai bune în ameliorarea durerii, creșterea mobilității articulare, reechilibrare musculară și implicit îmbunătățirea calității vieții pacienților.

Cuvinte cheie: periartrită scapulo-humerală, kinetoterapie, izokineticism

Introduction

Scapulohumeral periarthritis, or impingement syndrome, represents a frequently encountered cause of shoulder pain, disability, limited ADL (activities of daily living) performance (Sigh et al., 2017). Also, it affects the patients' sleeping habits and quality of sleep. According to one study, there is a close connection between the quality, duration and continuity of sleep in patients suffering from shoulder pain, a vicious circle which causes constant fatigue, weakness and muscle imbalance, and affects the shoulder in particular (Tekeoglu et al., 2013).

In terms of incidence rates, scapulohumeral periarthritis is the third most common cause of musculoskeletal disability, after lower and upper back pain. However, it is one of the main musculoskeletal areas where physical kinesiotherapy plays a major role (Borda et al., 2015).

Sixteen percent of patients presenting with musculoskeletal pathologies suffer from shoulder pain, the annual incidence rate being 15 new cases in 1000 patients (Burbank et al., 2008).

The human shoulder is the most mobile joint in the body. It is also one of the most complex joints. Its range of motion includes flexion/extension, abduction/adduction, internal rotation/external rotation. Its complexity lies in the increased number of tendon, ligament, muscle and bursae insertions. All these complex structures ensure an improved mobility of the shoulder, as well as its stabilization during the execution of movements and activities. Indispensable in ADL performance, the shoulder joint is subjected to highly increased wear. The most demanding movements include flexion, abduction and external rotation in particular (Irsay et al., 2015).

During flexion and abduction, the humeral head is subjected to movements of translation and rotation within the glenoid socket. Flexion is associated with an anterior translation of the humeral head. Similarly, abduction is associated with a superior translation (Chen et al., 1999). The superior translation is 1-2 mm, whereas the distance between the humeral head, muscular ligaments and acromion is approximately 1 cm. Thus, a greater translation causes an exaggerated compression and wear on the tendons, resulting in inflammation, pain, functional impotence and, in severe cases, tendon tears. According to one study, the translation of the humeral head occurs during the execution of both active and passive movements (Kedgley et al., 2008). However, this is reduced during loaded movement. As a result, compression of the adjacent structures is also reduced. Another study (Li et al., 2017)

focused on the relationship between scapulohumeral periarthritis and patients presenting with morphological variations of the acromion, associating such modifications of the acromion with shoulder pain.

Hypothesis

The maximization of results obtained during rehabilitation sessions requires the application of a complete and complex rehabilitation program, adapted to patients and their pathology.

The current study aims to demonstrate the higher effectiveness of active kinesiotherapy programs combined with isokinetic exercises as a means to improve the symptoms of patients presenting with scapulohumeral periarthritis.

Materials and methods

Declaration

The study was approved by the Research Ethics Committee of UMF Cluj-Napoca. Also, all the patients who participated in the study gave their consent to the use and publication of the results obtained during their assessment for research purposes.

Research protocol

a) Duration and location

The study was conducted on inpatients in the Department of Balneology of the Rehabilitation Clinic Cluj-Napoca, who presented with simple shoulder pain, mixed shoulder pain and chronic subacromial-deltoid impingement syndrome between January 2017 and June 2017.

b) Subjects and groups

The study was conducted on a number of 30 subjects. The patients were divided into two groups consisting of 15 patients each. The first group, identified as "the reference group", consisted of 11 female patients and 4 male patients. The second group, identified as "the study group", consisted of 12 female patients and 3 male patients. In both cases, the predominant age range of the studied population was 60-70 years.

The inclusion criteria were the following: shoulder pain, particularly upon mobilization, limited range of motion, discomfort, limited ADL performance, poor quality of life.

The exclusion criteria were set as follows: acute phase of the disease, exaggerated pain intensity, limited range of motion due to capsular ligament causes, recent surgery in the shoulder, lack of cooperation.

c) Assessment methods

The patients included in the study were assessed on days 1 (first day) and 10 (last day) of treatment.

The assessment methods used were the following: the VAS, which measures the pain intensity experienced by patients on a scale between 0 and 10, where 0 indicates the absence of pain and 10 indicates the highest level of pain experienced by them at any point; the Constant-Murley test (Ban et al., 2013), which measures pain intensity, pain interference with daily activities (e.g. lifting the arm to the back of the head, lifting the arm over the vertex etc., simulating normal daily activities), and muscle strength, adding up the three individual scores into one final score - the evolution of the final scores between days 1 and 10 of treatment was monitored; the articular test using manual goniometry, which monitors the range of motion on flexion, abduction and external rotation, which is the most affected in patients suffering from scapulohumeral periarthritis - once more, the assessment was performed on days 1 and 10 of treatment to compare the evolution of the range of motion.

d) Statistical processing

Upon conducting the initial and final assessments, we calculated the average scores obtained by the patients. The results were processed using Microsoft Excel 2017. A T-test was performed in the two groups in order to compare the effectiveness of the two rehabilitation protocols. The reference value obtained was $p < 0.05$. The results were introduced into a table.

Rehabilitation protocol

Kinesiotherapy

The rehabilitation protocol applied to the reference group consisted of a program based on exercises specially designed for patients presenting with simple shoulder pain, mixed shoulder pain and subacromial-deltoid impingement syndrome. The treatment program consisted of active-passive exercises, active exercises, active endurance open chain exercises, stretching exercises and shoulder stabilization exercises.

Joint warm-up

1. Flexion and extension of the upper limb using the Bobath ball
2. Combined abduction and external rotation exercises using the Bobath ball
3. Wheel exercises using a pronated grip followed by wheel exercises using a pronated-supinated grip
4. Cane exercises using a supinated grip with both hands, arms down by the side, elbows flexed at a 90° angle, cane on each side, and internal/external rotation shoulder movements
5. Skipping rope exercises over the higher footstep of the trellis, using flexion-extension, active-passive, horizontal abduction-adduction movements
6. Cane lifted along the spine using a pronated back grip and extension, abduction and internal rotation movements
7. Codman's pendulum exercises, introduced after every second exercise

Stretching

1. Arms down by the side, elbows flexed, pronated-supinated forearms, palms resting on the trellis, rotation of the body in the opposite direction
2. Orthostatic position, adduction of the arms at a 90°

angle, palms resting on the trellis, rotation of the body in the opposite direction

Toning

1. Flexion of the arms – active flexion, arms and elbows in extension, sandbag/dumbbell in hands, alternating limbs
2. Abduction – sandbag/dumbbell in hands, abduction movement at a 90° angle, external rotation of the arms with completion of the movement
3. Extension – sitting position, arms down by the side, elbows flexed, weights in hands, arms behind the body plane
4. Rotations – arms down by the side, elbows flexed, supinated forearms, holding a resistance band with both hands, external rotation of the shoulder - forearms apart to produce tension in the resistance band – or internal rotation of the shoulder - resistance band attached to the trellis, lateral position, arms down by the side, elbows flexed at a 90° angle, hands removed from the trellis to produce tension in the resistance band

Stability

1. Orthostatic position, arms flexed at a 90° angle, palms pushing a ball against the wall, ball pressed, rotation in both directions, alternating; followed by the same exercise with arms abducted at a 90° angle
2. Dorsal decubitus position, flexion at a 90° angle, sandbag hanging by the wrists, against the therapist's attempts at destabilization from all angles

The exercises were performed in 3 sets, each consisting of 10-15 repetitions, with 30-45-second breaks between the sets to prevent muscular overload.

Isokinetic therapy

Isokinetic exercises are active exercises performed against resistance. Basically, they are modified isotonic contractions against resistance. Isokinetic training provides a range of advantages that cannot be obtained using traditional methods. The level of resistance can be "adjusted" depending on the range of motion, while maintaining a constant velocity. Also, it can be associated with concentric contractions, eccentric contractions or both. The speed of execution can also be adjusted. The risk of muscle lesions can be excluded as the resistance applied cannot exceed the strength developed by the muscle (Irsay et al., 2009).

Patients in the study group were subjected to the kinesiotherapy program described above, as well as to isokinetic training (Table I). The latter consisted of 4 sets of exercises. Velocity was constant over sets 1 and 2, increased in set 3, thus facilitating the execution of the exercises, and reduced to the initial value in set 4. Forty-five-second breaks were imposed between sets to prevent muscular overload.

Table I

The isokinetic program applied to patients in the study group

| Indicator | Sets 1 and 2 | Set 3 | Set 4 |
|-------------|--------------|-------------|----------|
| IR velocity | 240°/sec | 270°/sec | 240°/sec |
| ER velocity | 240°/sec | RE:270°/sec | 240°/sec |
| Repetition | 2x10 | 2x10 | 1x10 |
| Break | 45 sec | 45 sec | – |

Results

The results are presented in diagrams from Figs. 1 to 5

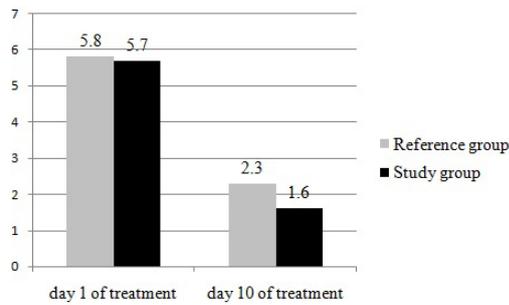


Fig. 1 – The evolution of the VAS scores in the two groups

On day 1 of treatment, the VAS scores of the two groups were similar, the pain intensity levels being average. After treatment, both groups experienced a reduced level of pain. However, the reduction was more significant in the study group, the pain intensity values being very low, almost minimum.

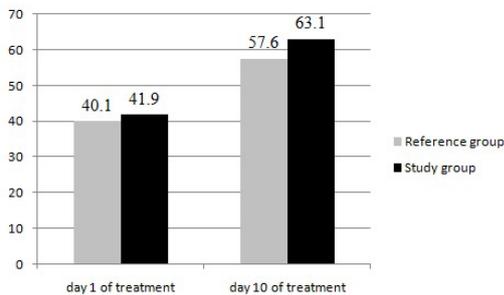


Fig. 2 – The evolution of the Constant-Murley scores in the two groups

As regards the Constant-Murley score, which reflects shoulder mobility, functionality, pain and strength, the scores obtained by the two groups after the initial assessment were similar. After treatment, the score obtained by the study group was higher compared to the reference group.

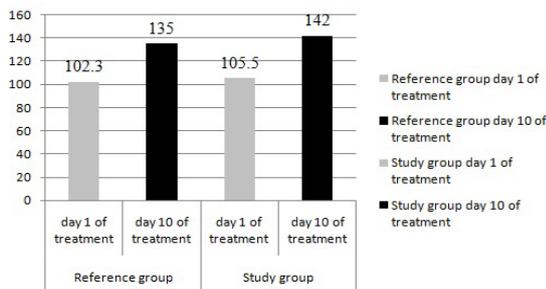


Fig. 3 – The evolution of the flexion movement in the two groups

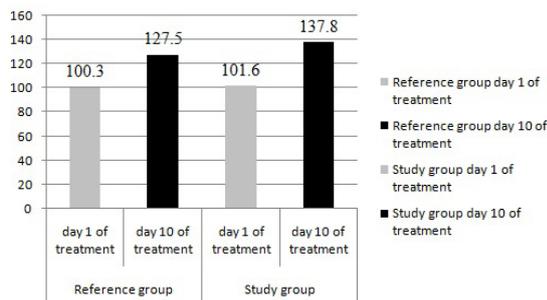


Fig. 4 – The evolution of the abduction movement in the two groups

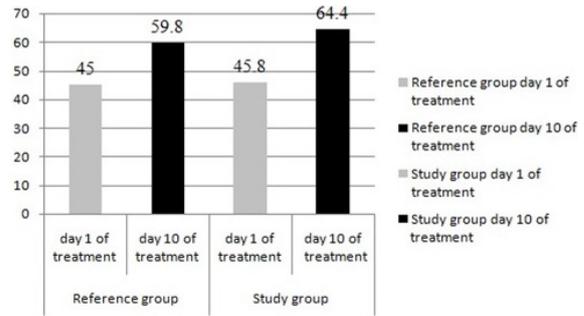


Fig. 5 – The evolution of the external rotation movement in the two groups

The initial assessment of flexion, abduction and external rotation movements in the two groups revealed similar average scores. The patients were reassessed after treatment. The reassessment revealed an extended range of motion within all targeted angles, with better results obtained among patients in the study group.

Table II

A comparison between the results obtained after treatment (%)

| Indicator | Reference group (%) | Study group (%) | Comparison (%) |
|-------------------|---------------------|-----------------|----------------|
| VAS | 61 | 72 | 11 |
| Constant-Murley | 30 | 34 | 4 |
| Flexion | 24 | 28 | 4 |
| Abduction | 21 | 26 | 5 |
| External rotation | 25 | 29 | 4 |

After treatment, we compared the differences between the average scores obtained by the patients in their assessment. As shown in Table II, the study group obtained improved results by 4-5% in joint mobility and the areas assessed using the Constant-Murley test, and up to 11% in the area of pain intensity experienced.

Table III

The results of the T-test

| VAS | Constant-Murley | Flexion | Abduction | External rotation | Reference value |
|-------|-----------------|---------|-----------|-------------------|-----------------|
| 0.006 | 0.02 | 0.05 | 0.03 | 0.005 | p>0.05 |

The statistical relevance of the results obtained was assessed using the T-test function in Microsoft Excel 2017. The T-test function was applied to all results, generating a reference value of p<0.05. As indicated in Table III, all results were statistically significant, apart from those corresponding to the flexion movement.

Discussions

The study was conducted on a number of 30 patients. Therefore, it does not reveal the large-scale effectiveness of the proposed therapy method in patients presenting with scapulohumeral periarthrits. Also, in the context of it being carried out over a period of 10 days, it does not provide information about the effectiveness of the proposed therapy over longer periods of time. Therefore, we cannot know what results would have been obtained in the context of an extended period of treatment.

Also unknown remains the further evolution of patients as the research was ceased upon the completion of the

study. Therefore, there is no information regarding the evolution of symptoms over time, relapse rates or ways of maintaining the therapeutic results and determining the period of time over which they were maintained.

The rehabilitation program implemented for the aims of the study was specially designed for patients presenting with subacromial-deltoid impingement syndrome, for shoulder stretching, toning, rebalancing and stabilization purposes. According to one study, the higher effectiveness of a selected type of exercises can only be demonstrated provided that sufficient evidence is available (Shire et al., 2017).

Proprioception plays a key role in the functionality of the human shoulder. The present study did not look at proprioception, the ways in which it is affected or its absence causing major biomechanical impairments. However, research conducted has revealed that changes in proprioception occur not only in the affected shoulder, but also on the apparently asymptomatic contralateral side, which can also become pathological (Sahin et al., 2017).

Therefore, prevention of the disease requires a proprioceptive approach on both sides of the body.

The nature of the exercises (i.e. open chain, closed chain, etc.) impacts the rehabilitation process directly. A study conducted in 120 patients over a period of 6 weeks (Heron et al., 2017) indicated that open chain, closed chain and mobility exercises have similar beneficial short-term effects in improving the symptoms of patients presenting with inflammatory shoulder pain.

A study carried out in 18 patients over a period of 6 weeks (Turgut et al., 2017) focused on the impact of stretching exercises on shoulder mobility, pain and disability. The results were positive.

The rehabilitation program also included physiotherapy treatment consisting of electrotherapy and thermotherapy (heat therapy). However, in the context of each patient having their own individual indications, the outcomes might have been influenced by the additional treatment methods applied. A study performed on 181 patients presenting with shoulder pain (Gomora-Garcia et al., 2016) revealed that a treatment plan consisting of 9 physiotherapy sessions which included the application of hot packs, diadynamic current therapy and ultrasound therapy had beneficial effects in their rehabilitation, causing a 90% improvement in functionality.

Conclusions

1. The current study indicates a higher incidence of scapulohumeral periarthritis in female patients, despite literature data reporting an equal distribution of the condition between male and female patients.

2. The highest incidence of scapulohumeral periarthritis in a subacute/chronic phase is in patients within the 60-70 age range.

3. The most affected movements in patients suffering from scapulohumeral periarthritis are flexion, abduction and external rotation.

4. The rehabilitation program combining kinesiotherapy and isokinetic exercises, which was applied to the study group, provided better results in terms of pain relief, improved joint mobility, functionality and, implicitly, improved quality of life among patients.

5. The results obtained are statistically significant. Therefore, treatment protocols combining physiotherapy and isokinetic exercises are more beneficial in improving the symptoms of patients with scapulohumeral periarthritis.

Conflicts of interest

There were no conflicts of interest during the research period.

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