

# Evaluation of the effectivity of physiotherapy and regime management of patients on functioning of shoulder joint after implantation of total reverse endoprosthesis

## Procjena djelatnosti fizioterapije i upravljanja režima pacijenata na funkcioniranje ramenog zgloba nakon implantacije ukupne reverzibilne endoproteze

Jakub Čuj<sup>1,2\*</sup>, Miloslav Gajdoš<sup>1,2</sup>, Pavol Nechvátal<sup>1</sup>, Lucia Kendrová<sup>1</sup>, Soňa Jandová<sup>3</sup>, Bronislav Kračmar<sup>2</sup>

<sup>1</sup> University of Prešov, Faculty of Health Care, Department of Physiotherapy, Slovak Republic

<sup>2</sup> Charles University in Prague, Faculty of Physical Education and Sport, Department of Outdoor Sports, Czech Republic

<sup>3</sup> Palacký University Olomouc, Faculty of Physical Culture, Department of Natural Sciences in Kinanthropology, Czech Republic

**Abstract. Aim:** The aim of our study was to evaluate the effect of established regime and physiotherapy treatment described by Brems on patients after reverse arthroplasty of shoulder joint, their ability to perform activities of daily living, functional status of the shoulder girdle, and a range of motion. **Methods:** The research sample consisted of 60 patients, 57±2.9 years, with implanted total reverse endoprosthesis of shoulder joint. To assess the ability of performing the activities of daily living, we used the Simple Shoulder Test. Functional status of shoulder joint was evaluated through a "Constant Score" questionnaire. The range of movement was evaluated through the "Constant Score – Range of Motion" questionnaire. The examined parameters were evaluated before surgery and a month after the surgery. During the one-month post-surgery period, all participants undergone the set of targeted physiotherapy treatment and kept the established regime. After one month of targeted physiotherapeutical treatment and correct regime management we observed significant differences in all examined parameters ( $p < 0.001$ ). **Results:** After one month of post-surgery physiotherapy, significant differences in the ability to perform certain activities of daily living, functioning of the operated shoulder joint and in the range of movement, have been reported. **Conclusion:** The results of our study confirmed that if patients follow this specific rehabilitation protocol and cooperate during various stages of recovery, there is a high probability that after one month, they can perform activities of daily living.

**Key words:** physiotherapy; shoulder joint; shoulder rehabilitation protocol; shoulder reverse prosthesis

**Sažetak. Cilj:** Cilj studije bio je procijeniti učinak uspostavljenog režima i fizioterapeutskog tretmana koji je opisao Brems na pacijentima nakon reverzne artroplastike ramenog zgloba, njihove sposobnosti za obavljanje svakodnevnih aktivnosti, funkcionalno stanje ramena i raspon pokreta. **Metode:** Uzorak istraživanja sastojao se od 60 pacijenata, 57 ± 2,9 godina, s implantiranom ukupnom reverzibilnom endoprotezom ramenog zgloba. Da bismo procijenili sposobnost pacijenata za obavljanje svakodnevnih aktivnosti koristili smo test *Simple shoulder*. Funkcionalno stanje ramenog zgloba ocijenjeno je upitnikom "Constant score". Raspon pokreta ocijenjen je upitnikom "Constant score – range of motion". Razmatrani parametri procijenjeni su prije operacije i mjesec dana nakon operacije. Tijekom jednomjesečnog postoperativnog razdoblja svi su sudionici prošli skup ciljanog fizioterapeutskog tretmana i pridržavali se uspostavljenog režima. Nakon mjesec dana ciljanog fizioterapeutskog tretmana i ispravnog

**\*Corresponding author:**

Mgr. Jakub Čuj

Faculty of Health Care, University of Prešov  
Partizánska 1, 080 01 Prešov,  
Slovak Republic

e-mail: jakub.cuj@unipo.sk

<http://hrcak.srce.hr/medicina>

upravljanja režimom zabilježili smo značajne razlike u svim razmatranim parametrima ( $p \leq 0.001$ ). **Rezultati:** Nakon mjesec dana postoperativne fizioterapije zabilježene su bitne razlike u sposobnosti za obavljanje određenih aktivnosti svakodnevnog života, u funkcioniranju operiranog ramenog zgloba i u rasponu pokreta. **Zaključak:** Rezultati naše studije potvrdili su da, ako se pacijenti pridržavaju ovog specifičnog rehabilitacijskog protokola i surađuju tijekom različitih faza oporavka, postoji velika vjerojatnost da će nakon mjesec dana moći obavljati svakodnevne aktivnosti.

**Gljučne riječi:** fizioterapija; protokol rehabilitacije ramena; rameni zglob; reverzibilna endoproteza ramena

## INTRODUCTION

Endoprosthetic replacement of shoulder joint is a less common surgery than hip or knee replacement. The purpose of the endoprosthetic surgery is to ease the pain, restore the range of movement and stability improvement. All these have positive effect on the quality of life of the patient<sup>1</sup>.

Important part of the post-operative care is properly guided physiotherapy, which is the basis for the restoration of optimal operating range of motion of the upper arm. Improper or neglected physiotherapy may cause complications and overall poor condition of the operated joint. The first physiotherapeutical program for patients with an artificial replacement of the shoulder joint was described in 1975 and with minor adjustments it is used till today<sup>2</sup>. It consists of a system of exercises that restore optimum mobility, muscle strength and stability of the shoulder girdle<sup>2</sup>.

Nowadays, there are many types of implants and surgical methods for dealing with any conditions or anatomical abnormalities in the damaged shoulder joint<sup>3</sup>. Final choice of the endoprosthesis type must match with the anatomy of a given patient. The basic types of artificial substitutes are: anatomical implants, reverse implants, bipolar implants and implants for cancer solving situations. The most common indicative criteria for the implantation of total endoprosthesis are omarthrosis, rheumatoid arthritis, aseptic necrosis of the humeral head, oncological diseases and severe traumatic injuries<sup>4</sup>.

Shoulder girdle is in its vertical character designed for the function of handling and grip-

ping<sup>5,6</sup>. However, during sports and recreational activities (cross-country skiing, Nordic walking, wall climbing, paddling, swimming, crawling, climbing, ladder climbing, climbing up a very steep hill, helping when getting up from a lying or sitting position, etc.) the locomotor functions of a shoulder girdle are used. Unlike the vertical bipedal walking, which has its origins more than six million years ago, the shoulder girdle locomotion is dated 375 million years ago from the time of the later Devonian when the land had been colonized by vertebrates<sup>7</sup>.

The rehabilitation protocol described by Brems is very effective, based on our results, one month after operation the patients can perform everyday activities. Therefore, it is recommended to apply this procedure in post-operative care after implantation of reversed endoprosthesis of the shoulder joint.

In ordinary life, locomotor function of the shoulder girdle is suppressed by a humanizing function of vertical stature which are handling and a grip. It is not the nature of locomotor muscles work (for example, when there is a contraction of functional antagonists – long heads shoulder muscles), but the phasic function. Functional disorders of the shoulder joint have their etiology mostly in degenerative changes. These often tend to be caused by long-term functional deceleration of the shoulder joint, when the articulating joint surfaces are decreasing and thus increasing the mensural pressure<sup>7</sup>.

## PHYSIOTHERAPY

Immediately after surgery, the shoulder is fixed with a brace and the arm is supported by shims. That ensures an easy abduction of the operated limb<sup>4,8</sup>. The aim of the correct positioning is to prevent contractures, improve peripheral circulation, reduce risk of damage to the peripheral nervous system. If the post-surgery patient condition allows it, the patient is verticalized and the undergoes the vascular gymnastics on the first post-surgery day to prevent the venous thrombosis<sup>9</sup>. The limb is in the sling or a brace also during sleep. These arrangements are designed to ease

the pain and assist in the optimal healing condition of the soft tissues which have been damaged by the surgery. The next day, physical therapist performs passive moves with the operated arms. They are performed in a painless motion range. Rotations in the shoulder joint are contraindicated during the first post-surgery days. If necessary, before exercise, the patient can be administered analgesics or local cryotherapy to reduce swelling and pains. To increase the range of motion continuous passive motion is used.

The focus of regime treatment and education of the patient is to emphasize the fact that the patient cannot weight down on the elbow joint of the operated upper arm as well as doing any rotational movements which are practiced after 3-4 weeks. If the patient fails to obey these basic instructions, there is a risk of luxation<sup>10</sup>. Therefore, it is essential to educate patient about the regime and activities that cannot be done with the operated joint.

The aim of the research was to assess the effectiveness of Brems<sup>10</sup> physiotherapy protocol and regime guidance of participants with an implant of total shoulder joint reverse replacement (Table 1). The research has been done one month after the surgery. We focused on evaluating the ability to perform activities of daily living, functional sta-

tus of upper arm girdle and the shoulder joint range of motion.

## PATIENTS AND METHODS

The research was process at the University Hospital J.A. Reimanina Prešov, Slovakia with a representative sample of 60 patients aged 50 to 60 years. The average age was  $57 \pm 2.9$  years old, 38 females and 22 males who undergone implantation of total reverse endoprosthesis of shoulder joint were chosen deliberately. The criteria for inclusion of the patient in the research sample were age, type of implant, patients did not suffer from other diseases of the locomotor system and psychiatric diseases. One of the basic criteria was the diagnosis that indicated the operation – omarthrosis. The surgeon has chosen a deltoid-pectoral surgical approach<sup>11</sup>. In the process of physiotherapeutic postoperative care, we have chosen rehabilitation protocol described by Brems<sup>10</sup>. During the postoperative period, all patients undergone a month-long physiotherapy treatment in outpatient's departments and they were required to adhere to the set exercise regimen. Participants undergone an initial examination the day before the surgery and exit examination after one month physiotherapy.

**Table 1.** Brems rehabilitation protocol

<b>Early post-operative phase</b>	
Pendulum movements	30-60 seconds
Passive elevation	15-30 seconds, 2-3 times a day
Passive abduction	15-30 seconds, 2-3 times a day
Passive extrarotation	30-45 seconds, 2-3 times a day
<b>The phase of the activation of the joint and active exercise</b>	
Assisted elevation with the help of pulley	1-2 minutes, 2-3 times a day
Assisted extension with the help of pulley	1-2 minutes, 2-3 times a day
Assisted intarotation	1-2 minutes, 2-3 times a day
Assisted extrarotation	3-4 minutes, 2-3 times a day
Assisted adduction	3-5 minutes, 2-3 times a day
<b>The phase of strengthening</b>	
Isometric exercises	6-7 seconds hold, relaxation 12-14 seconds
Strengthening of deltoid muscle	2 set of 10 repetition
Strengthening of intrarotation muscles	2 set of 10 repetition
Strengthening of extrarotation muscles	2 set of 10 repetition
Strengthening of extension muscles	2 set of 10 repetition

**Table 2.** Demographic data

Participants	(n=60)
Age	57 ± 2.9 years
Sex	38 females
	22 males

**Table 3.** The evaluation of Tests and Measuring (average, standard deviation, minimum, maximum)

	Preoperative results (n=60)	One month postoperative results (n=60)	<i>p</i>
Activities of daily living	25.2±14.69 (0-50)	66.7±11.04 (50-83)	<b>0.001</b>
Functional status	17.8±4.63 (10-27)	47.9±5.45 (40-62)	<b>0.001</b>
Range of motion	7.00±4.78 (2-18)	15.7±4.73 (6-24)	<b>0.001</b>
Flexion	1.4±1.14 (0-4)	4.4±0.99 (2-6)	<b>0.001</b>
Abduction	1.4±1.28 (0-4)	4.26±1.23 (2-6)	<b>0.001</b>
Intrarotation	2.73±0.96 (2-4)	4.33±1.16 (2-6)	<b>0.001</b>
Extrarotation	1.20±1.42 (0-4)	2.86±1.60 (0-6)	<b>0.001</b>

Through the Simple Shoulder Test (SST)<sup>12</sup>, the patients were tested while performing daily activities (activities of daily living, ADL). The test consists of twelve questions and the final score is expressed as a percentage<sup>13</sup>. Functional status of the shoulder joint is evaluated by a Constant Score questionnaire (CS)<sup>4</sup>. The questions are focused on rating the pain, the ability to fully perform the various activities and ranges of motion in flexion, abduction, external and internal rotation, and the approximate evaluation of muscle strength. The answers are scored. The total score is between 0 and 100 points. Total score of 0 points expresses the lowest functionality of the shoulder girdle, total score of 100 points the highest.

The range of motion was measured goniometrically. The CS- Range of Motion questionnaire was evaluated, which consists of four measurements (flexion, abduction, internal and external rotation). Each result is scored according to the range of movement. The total score of all four measurements is evaluated. The results of our tests and measurements were statistically processed and evaluated through The Wilcoxon Two Sample Test. The unobserved variables were: exact daily schedule and physiotherapeutical schedule, nourishment, further health complications and pain. For statistical computations we used the statistical program R (Statistic for Windows and

MacOS, release 3.2.2., The R Foundation for Statistical Computing, Vienna).

## RESULTS

After one month of post-surgery physiotherapy, significant differences in the ability to perform certain activities of daily living, functioning of the operated shoulder joint and in the range of movement, have been reported. As is shown in the Table 3, for all tested parameters, including the range of individual movements, there is a statistically significant difference on significance level of 0.001 ( $p < 0.001$ ).

## DISCUSSION

Many authors who deal with the problems of total shoulder replacement, in their studies describe a classical rehabilitation program, moving from passive movements to active movements with the inclusion of exercises to strengthen weakened muscles<sup>3,8,10,14-19</sup>. However, the opinions of some authors differ. Mulieri this gradual program applied only to one group of patients<sup>20</sup>. The second group performed exercises by Holcomb, which is a program that is aimed at intentional movements during activities of daily living<sup>21</sup>. These authors initiate rehabilitation processes 24 to 48 hours after surgery. After positive experience of our research team with the initiali-

zation of rehabilitation within 48 hours after surgery, we could argue with authors Labriola et al., who recommend the start of postsurgery rehabilitation after 4 weeks of brace immobilized of the shoulder joint<sup>11</sup>. Romano et al. applied a personalized rehabilitation protocol to three groups of responders with different intentions of postoperative physiotherapy. The study confirms that the protocol used can effectively improve the function of the operated shoulder joint, which was confirmed by the evaluation of the Constant score with the significance level  $p \leq 0.005$ <sup>22</sup>.

The indication for surgery in our study was omarthrosis, it is questionable how the rehabilitation program used to be effective in other indications such as: rheumatoid arthritis, rotator cuff damage or others.

For the positive effect of the chosen rehabilitation protocol, the right choice of joint replacement is also important, as confirmed by Giardella et al. which compared the RTSA (reverse total shoulder arthroplasty) with other types of substitution. It is clear from the results that RTSA is the best choice for the replacement of the shoulder joint. RTSA implantation and a properly chosen rehabilitation protocol guarantee a high return to non-contact sport and leisure activities at 75% -85% of patients<sup>23-25</sup>.

The most discussed issue among the authors is the period of fixation of the operated shoulder joint. Brown recommend the brace patients are advised to remove the brace while exercising and personal hygiene<sup>16</sup>. However, they do not specify how long the operated limb should be fixed.

Taller and Pokorný et al., recommend immobilizing the limb only when walking and sleeping<sup>4,19</sup>. They do not comment on the time, after which the patient permanently deposits the brace. Group of authors, Wilcox, Boudreau and Amirfezy et al., recommend a brace for 3-4 weeks after surgery<sup>2,26,27</sup>. Immobilization of the operated limb for 6 weeks is recommended by Mulieri, Sanchez-Sotelo and Holcomb et al.<sup>18,20,21</sup>. They allow to remove the brace for physiotherapy and for personal hygiene. Most of the authors, agree that the start of and a time of immobilization

must always be based on the current health of the patient and accessed strictly individually.

In certain situations, is necessary the use of continual passive movement. For patients suffering from bilateral shoulder joint damage, the continual passive motion is beneficial if exercise is difficult or impossible. In shoulder replacements, cuff repairs he found that continual passive motion resulted in earlier recovery of motion, diminished pain, and a shorter hospital stay<sup>6</sup>.

From our experience and based on the results of the study we can say that rehabilitation protocol described by Brems is effective and it is well-tolerated by patients<sup>10</sup>. Patients are able to perform activities of daily living such as personal hygiene, dressing, cooking and more after a one postoperative month. To improve the function of the joint, we recommend activities that activate muscle groups of the entire upper limb at the same time, for example, Nordic walking, running, etc. During work with patients, there were a few cases with complications, such as loosening of the implant or damage to the surrounding soft tissue and subsequent reoperation. They were caused by not following the regime but also due to incorrect therapeutical treatment. Most authors agree that the prevention of postsurgery complications is a highly professional physiotherapeutical treatment, with an emphasis on accurately performing each exercise and following the established regime.

## CONCLUSION

After evaluating and analyzing the results of the questionnaire, we concluded that the length of physiotherapy treatment after implantation of reverse endoprosthesis of shoulder joint and following the established regimen may be one month. Brems has described a protocol that is very effective, and we recommend using it in practice, based on the results. In some complicated cases the rehabilitation can take one year or more. It depends on general state of the upper limb girdle after surgery, as well as on the physical and mental state of the patient. Through targeted therapies, we try to restore an optimal range of motion and muscle strength in the damaged joint, so that the patient can return back to his work and hobbies as soon as possible.

**Conflicts of interest statement:** The authors report no conflicts of interest.

## REFERENCES

1. Nechvátal P. Physiotherapy and nursing care in patients after implantation of total knee joint endoprosthesis. *In: Proceedings of papers from V. Slovak Surgical Day in Prešov; 2012 Apr 20; Prešov, Slovakia. Prešov: University of Prešov, Faculty of Healthcare Departments, 2013;92-9.*
2. Wilcox R, Arslanian L, Millett P. Rehabilitation following total shoulder arthroplasty. *J Orthop Sports Phys Ther* 2005;35:821-36.
3. Žandová L. Using BOSU in the treatment of damaged rotator cuff. *Rehabilitácia* 2014;51:23-8.
4. Pokorný D, Sosna A. Alopasty of the shoulder joint. 1<sup>st</sup> Edition. Prague: Triton, 2007;1-161.
5. Véle F. Kinesiology – Overview of Clinical Kinesiology and Patho-Kinesiology for Diagnosis and Therapy of Musculoskeletal System Disorders. Prague: Triton, 2015;265-82.
6. Vančata V. Evolutionary anthropology. *In: Cichá M, Auferhart J, Boberová K, Dorková Z, Gazdová V, Gejdoš M et al. Integral anthropology Prague: Triton, 2014;90-6.*
7. Kračmar B, Bačáková R, Chrástková M, Jindra M, Novotný P, Zbořilová M et al. Human locomotor phylogenesis. Prague: Karolinum, 2016;40-197.
8. Pokorný D. Rehabilitation after alloplasty of the shoulder joint. *Acta Chir Orthop Traumatol Cech* 2000;67:280-90.
9. Mikuláková W. Vascular gymnastics and vascular training, prevention of thromboembolic disease. *In: Kociová K, Homzová P, Ištoňová M, Labunová E. Basics of physiotherapy. 1<sup>st</sup> Edition. Martin: Osveta, 2014;121-4.*
10. Brems J. Rehabilitation after total shoulder arthroplasty. *Semin Arthroplasty* 2007;18:55-6.
11. Labriola J, Edwards T. Reverse Total Shoulder Arthroplasty in the Senior Athlete. *Oper Tech Sports Med* 2008;16:43-9.
12. Matsen F. SST. AAOS [Internet]. 2010. [cited 2018 Mar 20] Available from: <http://www.orthodoc.aaos.org>.
13. Čuj J, Gajdoš M, Urbanová K. Physiotherapy and its influence on quality of life of patients after shoulder total endoprosthesis implantation. *Rehabilitácia* 2015;52:19-27.
14. Boardman N, Cofield R, Bengtson K, Little R, Jones M, Rowland Ch et al. Rehabilitation after total shoulder arthroplasty. *J arthroplasty* 2001;16:483-6.
15. Brems J. Rehabilitation following total shoulder arthroplasty. *Clin Orthop Relat Res* 1994;70-85.
16. Brown D, Friedman R. Postoperative rehabilitation following total shoulder arthroplasty. *Orthop clin N Am* 1998;29:535-47.
17. Matsen F, Wirth M, Rockwood Ch, Lippitt S, Fehringer E, Sperling J. The shoulder. 4<sup>th</sup> Edition. Philadelphia, PA: Saunders, 2009;332-404.
18. Sanchez- Sotelo J. Shoulder arthroplasty for osteoarthritis and rheumatoid arthritis. *Curr Orthop* 2007;21: 405-14.
19. Taller S. Hemiarthroplasty in the treatment of proximal humerus fractures. *Acta Chir Orthop Traumatol Cech* 2007;74 :262-7.
20. Mulieri P, Holcomb J, Dunning P, Pliner M, Bogle R, Pupe- llo D et al. Is a formal physical therapy program necessary after total shoulder arthroplasty for osteoarthritis? *J Shoulder Elbow Surg / American Shoulder and Elbow Surgeons* 2010;19:570-9.
21. Holcomb J, Cuff D, Petersen S. Revision reverse shoulder arthroplasty for glenoid baseplate failure after primary reverse shoulder arthroplasty. *J Shoulder Elbow Surg / American Shoulder and Elbow Surgeons* 2009;5:717-23.
22. Romano A, Oliva F, Nastrucci G, Casillo P, Giunta A, Sussanna M et al. Reverse shoulder arthroplasty patient personalized rehabilitation protocol. Preliminary results according to prognostic groups. *Muscles Ligaments Tendons J* 2017;7:263-70.
23. Giardella A, Ascione F, Mocchi M, Berlusconi M, Romano A, Oliva F et al. Reverse total shoulder versus angular stable plate treatment for proximal humeral fractures in over 65 years old patients. *Muscles Ligaments Tendons J* 2017;7:271-8.
24. Johnson C, Johnson D, Liu J, Dines J, Dines D, Gulotta L et al. Return to sports after shoulder arthroplasty. *World J Orthop* 2016;7:519-26.
25. Johnson D, Johnson C, Gulotta L. Return to Play After Shoulder Replacement Surgery: What Is Realistic and What Does the Evidence Tell Us. *Clin Sports Med* 2018;37:585-92
26. Boudreau S, Boudreau E, Higgins L, Wilcox R. Rehabilitation following reverse total shoulder arthroplasty. *J Orthop Sports Phys Ther* 2007;37:734-43.
27. Amirfeyz R, Sarangi P. Shoulder hemiarthroplasty for fracture with a conservative rehabilitation regime. *Arch orthop trauma sur* 2008;9:985-7.