SURGICAL TREATMENT OF SHOULDER ROTATOR CUFF INJURIES

HIRURŠKO LEČENJE POVREDA ROTATORNE MANŽETNE RAMENA

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Introduction

A shoulder pain is often caused by a rotator cuff injury. The structure of the rotator cuff is very solid. During normal daily activities 140 to 200 N of force is transmitted through these tendons. The maximum force that an undamaged rotator cuff tendon in elderly people can withstand is 600 N to 800 N [1].

According to the epidemiological data, these injuries account for 9% to even 39% of soft tissue lesions in population over 40 [2, 3], and they most frequently occur due to repeated microtrauma and poor nutrition of the tendon. Non-operative treatment in patients with a chronic rotator cuff injury is recommended when the pain is pronounced but the weakness of the arm is not dramatic and progressive. If there is no significant improvement in the following three to six months, the operative treatment is recommended [4].

Bassett and Cofield [5] have concluded that the most optimal time for operative reparation of a complete tear of the rotator cuff tendon is within the first three weeks after an acute injury. In cases when the weakness is pronounced or progressive, it is necessary to perform the operating procedure as soon as possible because it should be done before retraction of the tendon.

Summary

Introduction. The rotator cuff is the most important functional structure of the shoulder. The aim of this study was to determine which factors contribute to a rotator cuff injury and to evaluate the results of the surgical treatment at the Department of Orthopedic Surgery and Traumatology in Novi Sad since December 2009 until May 2012. Material and Methods. The study sample consisted of 20 patients who had been operated for a shoulder rotator cuff injury. Their mean age was 56.8 ± 9.1. Results. According to the Constant Shoulder Score, 75% of the patients had excellent and good results. A statistically significant difference (p<0.05) was found between Constant Shoulder Score of the operated should and the opposite shoulder as well as between the range of external and internal rotation and abduction. After the surgical treatment, 95% of the patients have no limitations in the activities of daily living and they are satisfied with the results of treatment. Conclusion. Surgical treatment of a shoulder rotator cuff injury is reliable, time-tested and provides good clinical results especially in patients who were operated within the first three weeks after the injury.

Key words: Shoulder; Surgical Procedures, Operative; Rotator Cuff; Risk Factors; Middle Aged; Range of Motion, Articular; Treatment Outcome; Patient Satisfaction

Sažetak


Ključne reči: Rame; Operativne hirurške procedure; Rotatorna manžetna; Faktori rizika; Odrasli, srednjih godina; Obim pokreta; Ishod lečenja; Zadovoljstvo pacijenta
don, loss of its tissue and muscle volume decrease. Codman was the first to describe the technique of rotator cuff reparation in 1911 [6]. Neer perfected the existing open technique in 1972 and established the principals of modern treatment of the rotator cuff injuries [7]. Since then the number of patients satisfied with the results of surgical treatment has ranged from 70% to 95% according to Murray et al. [8]. The next step in treatment was made by applying the shoulder arthroscopy which enabled better overview of the procedure and fewer complications. Today there are different opinions about which technique provides better results but the fact is that the rotator cuff surgery has been yielding ever better results.

The aim of this study was to establish which etiological factors contribute to the rotator cuff injury as well as to assess the results of the performed surgical procedures.

**Material and Methods**

The study sample consisted of twenty patients, 12 male and eight female patients who had been operated at the Department of Orthopedic Surgery and Traumatology, Clinical Center of Vojvodina in Novi Sad. The data about the treatment were obtained from the medical history forms of the patients treated from 2009 to 2012. The data and measurements were taken during the regular check-ups at the Polyclinic of Clinical Center of Vojvodina. The mean age of the participants was 56.8 ± 9.1. Eleven of the patients had been engaged in recreational sports before the injury and four of them continued their recreation after the injury. The causes of injury reported by the patients were as follows: slipping and falling while walking in six cases; an injury while doing sport activities in four cases; while performing a task at work and at home in three cases, each; in a traffic accident in one case and three patients did not report any data regarding their trauma. The most common mechanism of trauma was fall onto the shoulder in 60%, while lifting a heavy load in 15%, during a quick abduction and flexion movement of the shoulder in 10% and 15% of the patients did not know the exact cause and mechanism of the injury. After the injury, 75% of the patients went to a general practitioner, 10% went to a sports medicine physician and 15% visited a physiatrist.

The same operative technique was applied in all patients. The patient was in the half-sitting position. The upper anterior approach was used by applying the shoulder arthroscopy which enabled better overview of the procedure and fewer complications. Today there are different opinions about which technique provides better results but the fact is that the rotator cuff surgery has been yielding ever better results.

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the ends of the damaged rotator cuff. Then the threads were put through the bone tunnels and the lateral part of the cuff was sutured. After that, two mattress sutures were placed by means of the threads fixated by previously placed metal screws in order to reconstruct the medial part of the footprint, thus providing the tendon strength along with the optimal contact between the tendon and the bone. After the procedure, the deltoid muscle was reconstructed by transosseous sutures through the acromion.

After the surgery, the patients wore immobilization in a position of 45 degrees abduction of the shoulder and 90 degrees flexion of the elbow in neutral position. The immobilization was removed after six weeks. The patients were given a prophylactic antibiotic dose (first generation cephalosporin 1 g/12 h and Garamycin 240 mg/24 h) preoperatively and during the first two postoperative days to prevent infections. In cooperation with a hemostatologist, those patients who were at risk of thromboembolism received anticoagulation therapy.

After the immobilization had been removed, a nine-month rehabilitation program was performed at the Outpatient Department for Sports Medicine in Novi Sad. The rehabilitation consisted of passive, active-assisted and active exercises in order to get the full range of motion. The full range of passive motion was achieved in less than six weeks after the immobilization had been removed. Then the period of regaining the range of active motion began and lasted for six months after surgery when the exercises were introduced in order to improve the strength of the shoulder with the full range of motion and to boost the general physical condition. The latter exercises were performed until the ninth month after surgery. After that, the patients returned to their sport and recreational activities.

The results were evaluated by the Constant shoulder score [10].

**Results**

The average time from being injured to being diagnosed was 10.9 (1 to 36) months. Magnetic resonance imaging (MRI) position of 45 degrees abduction of the shoulder was done in all patients after 11.5 (one to 42) months on average after the injury. The average time from the injury to the operation was 14.1 (3 to 45) months. The patients were operated 2.6 months (2 days to 8 months) after MRI. All injuries were unilateral. Twelve patients had the rotator cuff injury on the right side and eight of them had it on the left side. Three of them had a partial tear and 17 had a complete tendon tear. The tear of one tendon was in 14 patients and the tear of two tendons occurred in six cases. The dominant arm was affected in 75% of the patients. A complete tear of supraspinatus muscle occurred in 55% of the cases, a partial tear of supraspinatus muscle happened in 15%, a complete tear of the tendon of supraspinatus and subscapularis muscles was in 20%, and a complete tear of supraspinatus and infraspinatus muscles occurred in 10% of the cases. Postoperative complications occurred in three cases – a partial tear of the sutured deltoid muscle at the acromion, venous stasis and a consecutive phlebitis as well as a deep wound infection in one case each. Twenty percent of the patients did not attend rehabilitation program regularly.

According to the Constant shoulder score, 75% of the patients had excellent and good results, 15% of them had fair results and 10% of the patients had poor results (Graph 1). The sum of the Constant shoulder score, range of motion of external and internal rotation of the operated and the opposite healthy shoulder showed a statistically significant difference (p<0.05). By comparing the upper arm abduction, we found a statistically significant difference (p<0.05). The average sum of the Constant score for the operated shoulder was 67±16 and for the opposite healthy shoulder it was 83±7. The sum of the Constant score for the operated shoulder was by 19% less than for the opposite healthy shoulder. The range of external rotation was 73% compared to the healthy side. The range of internal rotation, abduction and flexion was 79%, 88% and 94%, respectively compared to the opposite shoulder (Tables 1 and 2).

After the operation, 19 patients are able to perform all activities of daily living, one patient has a permanent restriction in activities of daily living. Ninety five percent of the patients were satisfied with the results of the surgery.

**Discussion**

The rotator cuff is the most important structure of the shoulder. In the United States of America, 75000 repairs of the rotator cuff are performed annually. By analyzing the age structure, it can be concluded that 85% of patients are between 50 and 65 years of age. These data match the data from other studies where the injury is the most frequent...
in the age group from 40 to 60 with a tendency to increase with each following decade [2, 10–13].

Traumatic injuries of the rotator cuff often remain unrecognized at the first medical examination due to mild symptoms in most cases. When the x-ray imaging excludes fracture or luxation, the patients are often prescribed physical therapy without further diagnostics. The study performed by Sorensen [14] et al. at Denmark’s Emergency rooms was aimed at answering the question whether the doctors failed to diagnose the rotator cuff injury. The patients who had sought medical aid for a shoulder injury were clinically examined and the shoulder x-ray was done.

The authors of this study wanted to find out whether the patients were about to be discharged from hospital only based on these diagnostic procedures. After the clinical and x-ray examination, ultrasound of the shoulder was done for the purpose of the research (ultrasound was not a standard diagnostic method). It was found that most of the patients would have been discharged from the hospital and prescribed physical therapy although the additional diagnostics showed a rotator cuff injury. According to this research, special attention should be paid to the patients without clear clinical signs of tendon rupture and, therefore, early diagnostics must be improved. In our research, 75% of the patients visited the general practitioner after the injury, 10% of them went to a sport medicine physician and 15% visited a physiatrist. The average time from being injured to being diagnosed was 10.9 months, that being a very long period. The explanation of the reason why it took so long to set the diagnosis should be a topic of further research. A late diagnosis delays the treatment and affects the outcome of the treatment [5]. On average the patients were operated three months after having been diagnosed, that being in accordance with the published recommendations for chronic injuries [5].

Yamamoto et al. [15] conducted a research in which they identified risk factors for rotator cuff injuries in general population. The history of shoulder injury of the dominant arm and age were correlated with the frequency of injury. The participants younger than 49 years of age had an injury resulting from a strong force. The results showed that the trauma and degenerative changes contributed to the tendon tear but the trauma had a greater degree of correlation with the tendon tear in younger people. Sorensen et al. [14] reported that 66% of the patients were injured because of the fall onto the shoulder, 19% of them injured the shoulder during...
a sudden stretch and 15% of the patients were not aware of the mechanism of injury. The data from their research are not very different from the results of our study, in which two participants younger than 50 said they had been injured while lifting a heavy load and in a traffic accident, which implies that the force which caused the injury was strong. This is in correlation with the observation of Yamamoto and Hattrup [15, 16].

Supraspinatus muscle was affected in 70% of the cases. Namdari and Green [17] got similar results in their research of motion ranges in 345 surgically treated injuries and they reported 62% of isolated injuries of the supraspinatus muscle. Other studies have also confirmed that this muscle is most frequently injured [18–20].

Postoperative complications developed in 15% of the cases. Namdari and Green [17] got similar results in their research of motion ranges in 345 surgically treated injuries and they reported 62% of isolated injuries of the supraspinatus muscle. Other studies have also confirmed that this muscle is most frequently injured [18–20].

Table 2. Values of the sum of the Constant scale and range of motion of the patients

<table>
<thead>
<tr>
<th>Number of participants</th>
<th>Operated shoulder</th>
<th>Opposite shoulder</th>
<th>Flexion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redni broj ispitanika</td>
<td>Abduction</td>
<td>Suprotno rame</td>
<td>Abdukacija</td>
</tr>
<tr>
<td>1. 165˚ 170˚ 170˚ 170˚</td>
<td>170˚</td>
<td>170˚</td>
<td>170˚</td>
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<td>2. 165˚ 170˚ 170˚ 170˚</td>
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<td>3. 170˚ 175˚ 165˚ 170˚</td>
<td>165˚</td>
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<td>170˚</td>
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<td>4. 90˚ 150˚ 160˚ 165˚</td>
<td>150˚</td>
<td>160˚</td>
<td>165˚</td>
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<td>5. 165˚ 175˚ 170˚ 170˚</td>
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<td>6. 110˚ 145˚ 165˚ 160˚</td>
<td>145˚</td>
<td>165˚</td>
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<td>7. 150˚ 160˚ 120˚ 155˚</td>
<td>160˚</td>
<td>120˚</td>
<td>155˚</td>
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<td>8. 80˚ 140˚ 95˚ 135˚</td>
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<td>95˚</td>
<td>135˚</td>
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<td>9. 130˚ 150˚ 170˚ 165˚</td>
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<td>10. 150˚ 160˚ 165˚ 160˚</td>
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<td>11. 160˚ 165˚ 175˚ 175˚</td>
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<td>12. 165˚ 165˚ 165˚ 170˚</td>
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<td>13. 120˚ 130˚ 150˚ 155˚</td>
<td>130˚</td>
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<td>14. 120˚ 135˚ 110˚ 140˚</td>
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<td>15. 145˚ 160˚ 150˚ 155˚</td>
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<td>16. 165˚ 160˚ 160˚ 165˚</td>
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<td>18. 175˚ 170˚ 180˚ 170˚</td>
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<td>19. 65˚ 140˚ 75˚ 135˚</td>
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<td>20. 120˚ 150˚ 125˚ 145˚</td>
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</table>

After surgical treatment, it is necessary to undergo physical treatment in order to increase the muscle strength. According to the results of Grondel’s study [22], 87% of the participants had excellent and good results measured by the Constant score, and all of them received physical therapy regularly during the 12 months after the operation. In our study, 75% of the participants had excellent and good results according to the Constant score and 20% of the participants did not undergo physical treatment regularly.

A statistically significant difference (p<0.05) was found between the Constant score of the operated shoulder and the opposite healthy shoulder as well as between the range of external and internal rotation and abduction (p<0.05). The period time (10.9 months) between the injury and the diagnosis is one of the negative factors which reduces the ability to regain the pre-injury range of motions. Retraction of the tendon towards the muscle belly increases over time thus preventing successful reparation. In the study performed in 2012, Mayer et al. [23] showed that first the size of muscle decreased and then the length of the injured tendon got shorter. This pathogenetic mechanism causes the decrease in the shoulder motion range and strength after the surgical treatment.
and Green [17] confirmed that in chronic injuries the affection of the subscapularis muscle led to a decrease in the external rotation, whereas the injury of supraspinatus and infraspinatus muscle led to a decrease in the abduction and the internal rotation.

A year after the surgical treatment, Namdari and Green [17] recorded that the range of flexion was 95% and the range of external rotation was 85% compared to the opposite shoulder. The range of passive internal rotation was 88%. This greater range of internal rotation can be explained by the fact that Namdari and Green [17] measured the passive rotation in their study. In our study, the range of external rotation is smaller because of the higher incidence of injury of both the subscapularis and the supraspinatus muscle.

The study of Kronberg et al. [24] included 37 participants and 80% of them had either none or some occasional limitations in activities of daily living. Romeo et al. [25] followed 72 patients in their study and this percentage was 96. These results do not deviate from the ones obtained in our study.

Several studies have revealed that the function of the shoulder is significantly improved after the rotator cuff repair although a slight reduction of motion range and strength does remain in comparison to the opposite healthy shoulder [17, 24–26]. Our study showed that the range of motion of the operated shoulder compared to the opposite healthy shoulder was 73% to 94%. Despite this, the fact that 95% of the patients can perform all activities of daily living and that 95% of the patients are satisfied with the results of the operative treatment suggests that the results are very good.

In addition to the small sample size, the shortcoming of this study is that the range of motion of the injured shoulder was not measured prior to surgery, which would have provided a better insight in the outcome of the operative treatment. Another possible flaw of this study was our failure to perform postoperative magnetic resonance imaging to assess the condition of the tendon upon the completion of treatment. A control MRI scan would have made it easier to find and interpret the causes of weaker postoperative results. The problem of making a control MRI scan is described in other studies as well. The application of MRI is limited due to a long waiting list and high cost [17, 27].

**Conclusion**

The rotator cuff injury is most frequent in people between 50 and 65 years of age. Trauma of the shoulder is the most common mechanism of injury, the fall onto the shoulder being the most common cause. The dominant arm is more often affected. The diagnosis is usually made very late, thus affecting the results of treatment. The basic requirement for the positive outcome of the treatment is timely diagnosis and early surgical repair of the torn tendon. Tear of the supraspinatus muscle is the most frequent injury; the second most frequent is the injury of the supraspinatus and subscapularis muscles at the same time. Ninety five percent of the patients are able to perform all activities of daily living and they are satisfied with the results of operative treatment.

Surgical repair of the rotator cuff injury is a reliable, time-tested method, which provides good clinical results particularly in patients without associated bone lesions operated during the first three weeks after the injury.

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