THE USE OF PARTIAL PROSTHESIS IN SHOULDER SURGERY
PRIMENA PARCIJALNIH PROTEZA U HIRURGIJI RAMENA

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Summary

Introduction. Indications for the use of partial shoulder prosthesis are dislocated four-part fractures and multi-part and four-part fractures-dislocations,pressive fractures of the humeral head (including involvement of more than 40% of the articular surface) and “head splitting” fractures of humerus. The aim of this study was to present the results of the application of partial shoulder prosthesis at the Department of Orthopedic Surgery and Traumatology, Clinical Center of Vojvodina in Novi Sad and identify risk groups among the participants. Material and Methods. The study, which was retrospective, included 22 patients who had undergone the partial shoulder arthroplasty in the period from 2005 to 2015 at the Department of Orthopedic Surgery and Traumatology, Clinical Center of Vojvodina. The functional results were evaluated on the basis of the Constant Shoulder Score. Results. The study sample consisted of 15 women and 7 men, whose mean age was 64.9 ± 9.1 years. The average time from the injury to surgery was 13.3 days. According to the Constant scoring scale, the result was excellent in 6 (27%) patients, good in 3 (14%), fair in 7 (32%), and poor in 6 (27%) participants. 75% of participants said they were satisfied with the results of the operation. Conclusion. Partial shoulder prosthesis gives good functional results and allows resumption of activities of daily living. Better results were obtained within the subjective segments (pain, daily activities, vitality), which points out a greater subjective patient’s satisfaction in relation to the measured functional outcome. Key words: Shoulder Joint; Dislocations; Arthroplasty, Replacement; Prostheses and Implants; Range of Motion, Articular; Treatment Outcome; Recovery of Function; Patient Satisfaction; Pain Measurement

Sažetak

Uvod. Indikacije za primenu parcijalnih proteza ramena su četverodelni dislokovani prelomi i četverodelni i višedelni prelomi – iščašenja, impresivni prelomi glave nadlaktice (sa zahvaćenošću više od 40% zglobnje površinje) i head splitting prelomi gornjeg okrajka nadlaktice. Cilj rada bio je da se prikažu rezultati primene parcijalnih proteza ramena na Klinici za ortopedsku hiruriju i traumatologiju Kliničkog centra Vojvodine u Novom Sadu. Materijal i metode. Studija je bila retrospektivna. Ispitane su 22 pacijenta kojima je primenjena parcijalna proteza ramena u periodu 2005–2015. godine na Klinici za ortopedsku hiruriju i traumatologiju Kliničkog centra Vojvodine. Funkcionalni rezultati su procenjeni na osnovu Konstantovog skora. Rezultati. Među ispitanimast se nalazilo 15 žena i sedam muškaraca. Prosečna starost ispitanika bila je 64,9 ± 9,1 godina. Prosečno vreme od povrede do operacije je 13,3 dana. Prema Konstantovoj bodovnoj skali šest (27%) ispitanika imalo je odličan rezultat, dobar rezultat tri (14%), zadovoljavajući sedam (32%), a loš rezultat Konstantove skale imalo je šest (27%) ispitanika. Da je zadovoljno rezultatima operacije izjavilo je 75% ispitanika. Zaključak. Parcijalne proteze ramenog zgloba daju dobre funkcionalne rezultate i omogućavaju vraćanje aktivnostima dnevnog života. Bolji rezultati dobijeni su u okviru subjektivnih segmenata (bol, svakodnevne aktivnosti, vitalnost) što govori o većem subjektivnom zadovoljstvu pacijenata u odnosu na izmereni funkcionalni rezultat. Ključne reči: rameni zglog; dislokacije; arthroplastika; proteze i implantii; opseg pokreta zgloba; ishod lečenja; zadovoljstvo pacijenata; merenje bola

Introduction

Prosthesis is an artificial shoulder joint which partially or completely replaces the diseased or injured joint. The first written data on the application of prosthesis in the human population dates back to 1893, when Jules Émile Péan [1] used an implant of platinum and rubber by a Parisian dentist Porter Michaelis design [2]. The largest contribution to the development of shoulder prosthesis was given by Neer [3]. He designed the partial Neer prosthesis in 1973, which is still applied but with certain modifications [3]. Indications for the use of partial shoulder prosthesis are dislocated four-part fractures and multi-part and four-part fractures-dislocations,pressive fractures of the humeral head (including involvement of more than 40% of the articular surface) and “head splitting” fractures of humerus [3].

Results of partial shoulder prosthesis depend on the precise surgical technique, condition of the rotator cuff musculature, adequate soft tissue tension, rehabilitation and motivation of patients [4]. Delaying surgery for more than 14 days leads to the initial occurrence of scar, contracture of muscles, osteoporosis and increased risk of infection.
This study was aimed at identifying the risk groups among the participants and functional assessment of results of partial prosthesis in shoulder surgery.

**Material and Methods**

The study was approved by the Ethics Committee of the Faculty of Medicine, University of Novi Sad and the Ethics Committee of the Clinical Center of Vojvodina in Novi Sad. The study participants gave their consent to participate in the study after the detailed explanation of the planned procedure.

Out of 26 patients who had the partial shoulder prosthesis implanted at the Department of Orthopedic Surgery and Traumatology, Clinical Center of Vojvodina in the period from 2005 to 2015, 22 agreed to be included in the study sample. Average follow-up time was 38.8 months. Fracture of the proximal humerus was the indication for the use of partial prosthesis in all cases, of which 19 were “head splitting” and 3 were four-part fractures-luxation (Figures 1 and 2). The diagnosis was based on clinical examination, a series of x-rays and computed tomography (CT). The deltoid pectoral approach was used in all patients and the partial prosthesis was implanted to all of them (Lima Corporate, SMR system). After surgery, the patients were immobilized in a neutral position, placing the upper arm in the 45° abduction and 90° flexion during 6 weeks. Antibiotic prophylaxis was applied for a period of 48 hours by parenteral administration of the first generation cefalosporins. Control radiograph (Figure 3) recordings were made 10 days, 3 weeks, 6 weeks, 3 months and 6 months after surgery. Rehabilitation program, which was individual for each patient, was initiated immediately after surgical treatment.

The Constant shoulder score was used to assess the results of operations. The range of motion was measured by means of goniometer, while the force of withdrawal was measured according to the criteria based on the number of kilograms that the participant may hold in the position with the upper arm at 90° abduction (the shoulder of a 25-year old healthy man can withstand 12.5 kilograms without major difficulties; this value is taken as the highest and carries 25 points). The Constant shoulder score consists of four parts: the presence and intensity of pain, activity level, range of motion and power of abduction. The maximum score for the presence and intensity of pain is 15 points, 20 points for the activity level, 40 points for the range of motion and 25 points for the strength of abduction. The difference in the Constant shoulder score between the healthy and operated limb represents a Constant’s result which can be excellent (<11), good (12-20), fair (21-30) and poor (>31).

The obtained data were analyzed by means of statistical program SPSS for Windows ver. 20. The average values and standard deviation were calculated, and χ² and t tests were used to determine the statistical significance.

**Results**

The study sample consisted of 15 (68.2%) women and 7 (31.8%) men, whose mean age was 64.9 ± 9.1 years. The oldest and the youngest participant were 75 and 40 years old, respectively. The participants between the ages 50 and 70 years made up 63.6% of the sample. Body mass index (BMI) was 28.3 ± 5.1, placing the sample in the group of overweight.

The injury resulted from a fall in 16 (72.7%) cases, traffic accidents in 5 (22.7%) cases, and in...
one patient it was a result of electric shock (4.6%).

(Graph 1).

The time period between the injury and surgery was less than 7 days in 6 (27.3%) patients, 7 to 14 days in 4 (18.2%) patients, 15 to 21 days in 4 (18.2%) patients, 22 to 30 days in 5 (22.7%), and over 30 days in 3 (13.6%) patients (Graph 2).

The dominant hand was affected in 60% of patients. Eight participants said that they felt no pain in the operated shoulder, 7 and 5 participants had mild pain and medium strength pain, respectively while 2 participants said that they felt strong pain. (Graph 3) 77.3% of participants said that there was no pain in healthy shoulder, while 22.7% of them felt mild pain.

After surgery 9 patients could perform all activities of daily living, 6 participants occasionally had limitations, and 7 had a permanent restriction in their daily activities. According to the Constant scoring scale, the result was excellent in 6 (27%) patients, good in 3 (14%), fair in 7 (32%), and poor in 6 (27%).

We compared the sum of Constant’s scoring scale of the operated shoulder with the results of the opposite healthy shoulder, and the range of motion of the external and internal rotation of the operated and healthy shoulder. There was a statistically significant difference (p <0.05) in all compared parameters. By comparing the range of abduction between the operated and the opposite healthy shoulder, a statistically significant difference (p <0.05) was found. The range of flexion between the operated and the healthy shoulder showed a statistically significant difference (p <0.05). Medium Constant’s score was 65.3 ± 18.8 and 88.2 ± 9.5 for the operated shoulder and the opposite healthy shoulder, respectively. The average value of the range of motion in external rotation was 54.25˚ ± 21.61˚ and 85.25˚ ± 4.72˚ for the operated shoulder, and the opposite shoulder, respectively. In internal rotation, the average value of the range of motion for the operated shoulder was 58˚ ± 15.84˚ and 78˚ ± 6.56˚ for opposite healthy shoulder.

75% of participants said they were satisfied with the results of the operation.

Discussion

The design of shoulder prosthesis has undergone numerous changes during its development. A partial type of prosthesis was first created, which was intended for the treatment of fractures of the proximal humerus. Nowadays, there is a considerably expanded range of indications, resulting in an annual increase in the application of shoulder arthroplasty [5].

There were more female than male patients in our study sample. Such a difference in gender representation is due to the decreased bone density in women over the age of 50 years, with a consequent increase in the incidence of fractures of the proximal humerus [6, 7].

In the age structure of the participants of our study, we noticed that 63.6% of them were between the ages of 50 and 70 years. These data coincide with the literature, where the fracture of the proximal humerus usually affects the age group of 50 to 70 years, and goes up with each successive decade [8, 9]. The average age of the patients in our study was 65 years. Diklić et al. [10] reported that the average age of the patients in their two-year study was 69 years. The similarity in the age structure can be explained by the partial shoulder prosthesis applied in both cases for the treatment of multi-fragmental...
fractures of the proximal humerus. Chu et al. [11] have identified gender, age, obesity, osteoporosis, epilepsy, diabetes, depression, left-handed people, bad eyesight, use of alcohol and psychoactive substances as risk factors for fracture of the proximal humerus. The risk factors present in our study were gender, age and increased BMI, while other factors were excluded by anamnesis.

Since the measured body mass index (BMI) of patients was 28.3 ± 5.1 in our study, they were classified as being overweight. No data were found in research that directly compared the measured BMI in both genders with the incidence of fractures of the proximal humerus. Prieto–Alhambra et al. [12] reported in their study that overweight and obese women in menopause were 30% more prone to fractures of the proximal humerus compared to normal weight women. The mechanisms by which preobese stage and obesity lead to the development of musculoskeletal symptoms are increasing work demands and damage to blood vessels which reduces the ability to regenerate cartilage and consequent further damage [13].

In our study, the dominant hand was affected more frequently (60%). These data coincide with the observations of Diklić et al. [10] whose research showed that the dominant hand was affected in 62% of 29 patients, as well as with other literature data where a fracture of the proximal humerus frequently occurs in the dominant hand [9,14]. LeBlanc et al. [15] in their work wondered whether there was a difference in the treatment outcome of fractures of the proximal humeral treated with hemiarthroplasty in relation to whether the dominant or non-dominant arm was affected. Their study included 61 patients with a multifragmented fracture of the proximal humerus. Based on the results, the group of patients with the injured dominant arm had significantly lower objective and subjective outcomes of treatment.

The most common cause of injury in our study was fall on the shoulders. Lind et al. [16] have shown that the mechanism of injury in most cases is the result of indirect effects of force on the shoulder, which occurs as a result of the fall in 79% of cases, traffic accidents in 14% or in the course of various sports and recreational activities in 7% of cases.

One of our patients suffered a fracture of the proximal humerus as a result of electric shock. Zbudčeva [17] in his case report mentions the same example. Although they are often described as the result of electroconvulsive therapy, skeletal injuries as a result of accidental electrocution are very rare. Fractures as a result of electrocution occur in places with significant and powerful muscles, such as the spine, hip and shoulder. Fracture occurs as a result of tetanic muscle contraction [17].

The patients were operated 13.3 days after the injury on average, which is consistent with data from the literature, according to which it is necessary to perform hemiarthroplasty of proximal humeral fractures within the first 14 days after injury in order to achieve the best results.

In our study, the average value of the Constant’s scoring scale was 65.3. Robinson et al. [18] in their study included 138 patients who had undergone hemiarthroplasty. They calculated that the average value of Constant’s scoring scale for the operated shoulder was 64, which is worse than the result of our research. Esen et al. [6] in their retrospective study involving 42 patients who had undergone hemiarthroplasty found that average value of external rotation of the treated shoulder was 73.59° ± 17.95°, while the average value of flexion was 121.30° ± 42.99°. In our study, the average flexion was 122.5° which is consistent with the results obtained by Esen et al. [19], while the average value of external rotation was 54.25° which is worse than in their research.

75% of participants said they were satisfied with the results of the operation. The difference between objective and subjective evaluations of the results of shoulder hemiarthroplasty is explained by the fact that the resulting range of motion after surgery is sufficient for normal activities of daily living because the majority of the activities are carried out at the level of scapula with the abduction of 80 to 90° and external rotation, while the smallest number of activities is performed at maximum abduction and flexion (180°) [20].

The ability to perform everyday activities combined with the loss of pain makes the patient satisfied with the results of treatment.

References

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