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Rehabilitation protocol after radial head arthroplasty – a single centre experience and narrative review of the literature

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Abstract

Radial head fractures are relatively common injuries – they represent about 1.5–4% of all fractures and approximately 1/3 of fractures of the elbow. Nevertheless, treatment algorithms and rehabilitation plans in such injuries still remain controversial. One of the treatment methods is arthroplasty of the radial head. It is suitable for patients classified as II or III Mason type with concomitant instability and limited mobility of the elbow joint. Arthroplasty of the radial head aims at restoring joint stability, as well as early mobilization and rehabilitation. Currently in Poland, 200–250 alloplastic implantations of the radial head are performed per year (according to the Central Database of Arthroplasties) and this number is increasing annually. Consequently, physicians and physiotherapists may face that problem more frequently than only several years ago in their everyday clinical practice. For patients who underwent this type of surgery, there exists no unified, widely accepted rehabilitation protocol, neither in Poland nor worldwide. It has been proven that rehabilitation plays an important role in restoring the functioning of patients after arthroplasty of the radial head; however, it is difficult to find scientific reports and studies with therapeutic schemes that would provide guidelines for physiotherapy, active exercises, manual therapy, and muscle strength improving exercises. The aim of this review is to analyse and compare information about rehabilitation process after surgery of proximal radius that is available in the literature. The authors also present their own experience and results.
Key words: radial head fracture, radial head arthroplasty, rehabilitation protocol, elbow injury

Introduction

Both physicians and physiotherapists observe an increasing number of patients with fractures within the head of the radial bone in their clinical practice. According to statistics, these cover about 1.5–4% of all fractures and 1/3 of fractures in the area of the elbow [1]. Currently, there are many methods for fixing fractures of the proximal epiphysis of the radius. They include both non-surgical methods, consisting of periodic immobilization of the broken limb, and surgical methods, such as partial or complete resection of the radial head, open reposition with internal fixation with the use of metal connectors, and radial head arthroplasty [2–4]. The qualification for a specific treatment method depends on many factors, including the nature of the fracture, the level of the elbow joint instability, or the age of the patient.

The elbow joint is a two-axial joint of the rotary-hinge type. Therefore, it requires intensive rehabilitation to prevent contractures that occur quickly in the postoperative period [3]. That is why it is very important to implement an adequate and effective mobility improvement process in the postoperative period. Along with the increasing trend in the number of radial head arthroplasty procedures, the question arises how to correctly conduct the protocol of rehabilitation in patients who undergo such surgery to improve the short- and long-term efficiency of the procedure.

In the paper, we presented rehabilitation protocols applied after radial head arthroplasty that are described in the literature. The aim of this narrative article was to review the rehabilitative options for patients after radial head arthroplasty in the light of the current recommendations, safety issues, and our clinical experience.

Search strategy

We analysed reports and materials available in Polish and English language literature regarding methods of rehabilitation, recommendations, and accessible rehabilitation protocols after radial head arthroplasty. In the search, we used the Medline, ClinicalKey, and Academic Search Complete databases. The scope of our research included articles published between 2000 and 2017. The following keywords were used: radial head fracture, radial head arthroplasty, rehabilitation protocol, elbow injury, radial head surgery. In this narrative review, we included review papers and original articles with the preference for randomized trials with long-term follow-up.

Results

The current literature lacks unified recommendations for the rehabilitation protocol in patients after radial head arthroplasty. There is no universally recognized standardized rehabilitation program for Polish patients, either. In the current literature, there are only 2 detailed reports on the rehabilitation protocols for patients after radial head arthroplasty [5, 6]. Those protocols are presented in Table 1.

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Table 1. Rehabilitation protocols for patients after radial head arthroplasty

Bhinderwala and Wani [5]	Pho et al. [6]	Ashwood et al. [7]	Program from authors' institution
	Pre-rehabilitation Instructions about application of ice, home exercise program; discussion about basic progression of rehabilitation and patient expectations	**Pre-rehabilitation** Injury protection with immobilization; instructions about postoperative rehabilitation goals and plans	
Week 1 Active assisted shoulder flexion, extension, abduction, and rotations; elbow flexion extension, forearm pronation, wrist flexion extension, radial and ulna deviation, stretching exercises, mobilization of distal radioulnar and radiocarpal joint	**Inpatient (days 0–4)** Arm elevated in a sling on a pole to prevent oedema and hematoma; full flexion and extension; cryotherapy in between sessions	**Immobilization (days 3–5)** Pain and oedema control; fracture site protection with posterior splint or compression bandage; minimizing cardiovascular deconditioning; maintenance of range in joints around the affected region; contractures prevention	**Period I (weeks 0–1)** Immobilization of the upper limb in the orthosis or plaster splint in the neutral position; anti-oedematous exercises – 20 repetitions every hour, active wrist and shoulder exercises for 4–5 minutes 3–4 times a day, local cryotherapy 3–4 times a day every 4 hours for 3 minutes
Weeks 2–4 Scar tissue mobilization and myofascial release, flexion; extension, pronation, and supination against an unyielding resistance imparted by the therapist; static and isometric stretching given to the elbow flexors, extensors, pronators, and supinators; strengthening of shoulder and wrist muscles	**Outpatient phase 1 (to week 4)** Active elbow and wrist flexion, pronation, and supination and active assisted elbow flexion; shoulder flexibility exercises	**Phase I – maximum protection phase (weeks 1–3)** Active assistive flexion/extension and pronation/supination with sticks or pulleys; cardiovascular conditioning; increase in mobility to tolerance; prevention of stiffness; CPM	**Period II (weeks 1–3)** No rigid immobilization, minimization of strain on the operated upper limb with the use of a sling; active and passive exercises with the assistance of a therapist; flexion, extension of the elbow joint, pronation and supination of the forearm to the border of pain 4–5 times a day; scar and fascial mobilization 4–5 times a day; isometric exercises 3 × 30 seconds with 1-minute breaks; local cryotherapy 3–4 times a day every 4 hours for 3 minutes
Weeks 4–8 In addition to exercises from weeks 2–4: resistance exercises; strengthening biceps and triceps muscles; resisted exercises (flexion, scaption, abduction) for the shoulders, elbow flexion and extension; forearm supination and pronation	**Outpatient phase 2 (weeks 5–8)** Shoulder elbow and wrist ROM; at 6 weeks can add active extension; gentle isometric and isotonic wrist flexion/extension and elbow flexion strengthening; biceps strengthening with supported elbow; no elbow extension strengthening	**Phase II – moderate protection phase (weeks 4–6)** Active flexion/extension and pronation/supination of the elbow; active flexion, extension, pronation, supination with a wand or pulleys; pulleys with eccentric control during flexion/extension; isometrics – flexion, extension, pronation, supination; gentle stretching with inhibition/elongation techniques or joint mobilization to increase ROM	**Period III (weeks 3–6)** Immobilization with a sling; active-passive exercises with the assistance of a therapist; flexion, extension of the elbow joint; pronation and supination of the forearm to the border of pain 6–7 times a day, at least 20 minutes; increasing ROM and muscle strength; isometric exercises – 20–30 repetitions every hour; active exercises and with resistance dosed with the therapist's hand aiming for 10 repetitions of a given movement 3–4 times a day; functional exercises, manual, PNF method elements – at least 2–3 times a day for 20 minutes; mobilization of the scar; gentle stretching exercises and post-isometric relaxation after each series of exercises, local cryotherapy after each series of exercises for 4–5 minutes
	Outpatient phase 3 (weeks 9–16) Maintenance flexibility program; progressive isotonic resistance including elbow extension; progress to functional use	**Phase III – minimum protection phase (weeks 6–12)** Resistive exercises: standing with weights, theraband resisted exercises (flexion, extension, pronation, supination); self-stretching: flexion/extension, pronation/supination, shoulder and wrist flexion/extension, ulnar and radial deviation; elbow extension with radial deviation; elbow flexion with ulnar deviation; intensive isotonic flexion/extension, pronation/supination while standing or performing ADLs; open and closed-chain exercises	**Period IV (weeks 6–8)** Upper limb without immobilization with a sling; increasing ROM, striving for a full range of movement – exercises series 4–5 times a day for 30 minutes; increasing muscle strength; exercises with counterweights, tapes, pumps next to the wall 4–5 times a day for 10 minutes; functional therapy, PNF 4–5 times a day for 10–15 minutes, local cryotherapy after each series of exercises for 4–5 minutes; returning to daily functioning
Home exercise program Started at week 2	**Home exercise program** Started at week 2		**Home exercise program** Started at week 2

ROM – range of motion, CPM – continous passive motion, ADL – activities of daily living, PNF – proprioceptive neuromuscular facilitation

In the available reports, the topic of the mobility improvement process is often discussed superficially, without details which could be used in clinical practice. Despite claims concerning the importance of the post-surgery rehabilitation for the healing process in patients after radial head arthroplasty, the available papers lack specific recommendations or indications. Many authors [5, 6, 8, 9] suggest that the rehabilitation protocol for patients undergoing surgery may be similar to that advocated after conservative treatment.

The review of the literature allows to create general recommendations for rehabilitation in patients after radial head arthroplasty:

1. Early start of rehabilitation – preferably on the 2nd day after the surgery [5, 7, 10].
2. Maintaining the immobilization of the elbow joint for a maximum of 2–3 weeks after surgery [5, 7].
3. At least 6–8 weeks of rehabilitation, but there is a lack of strict indications for the usage of physical therapy (except for cryotherapy) [5, 7, 10].
4. During the initial period of convalescence (up to 3–4 weeks after surgery), forced passive and resistance exercises are not recommended. Intensive supination should be avoided during the first 2 postoperative weeks, as this further contributed to the decreased stability of the elbow joint.

In our institution, we developed a protocol for patients who had undergone radial head arthroplasty on the basis of the data from the literature and our clinical experience. The protocol consists of 4 periods of mobility improvement, presented in Table 1, in comparison with protocols from the literature, and accompanied by home exercises performed independently.

Patients are advised to perform the following exercises at home:

– from week 2 after the operation: active-passive flexion, straightening of the elbow joint (20 repetitions at least 4–5 times a day), exercises of pronation and supination of the forearm (20 repetitions 4–5 times a day) after prior instruction from a physiotherapist, and also gentle stretching exercises after each series;

– after 4 weeks from the moment of operation: as above, and also: exercises increasing muscle strength with the use of a 0.5-litre bottle of water, 3 times a day, 5–10 repetitions at the beginning, with gradual increase with the increasing muscle force; exercises performed in front of a mirror with feedback – flexion, extension, supination, and pronation (40 repetitions 3 times a day) and with cold compresses for 5 minutes after each sequence of exercises.

Discussion

Despite the fact that radial bone fractures cover 1/3 of injuries within the elbow joint [5, 11], proper treatment of fractures in this region is still a field of many disputes and controversies. These mainly concern operating orthopaedic treatment. The lack of standards in the above-mentioned area also leads to difficulties in establishing guidelines regarding rehabilitation protocols.

The planning of the correct process of surgical and rehabilitation treatment is dictated by the knowledge of the mechanism of injury and the role of damaged anatomical structures in the biomechanics of the elbow joint [4, 12, 13]. The fractures in the area of the radial bone head occur most often as a result of falling on a bent elbow joint during the abduction of the shoulder or during injuries of the 'crooked mechanism' of the elbow joint [11, 14]. Less often, fractures are caused by direct injuries in this area. Bone trauma is most often accompanied by soft tissue injuries, which include structures such as annular ligament, medial and lateral collateral ligaments, and the joint capsule [3, 11, 12, 15]. In the case of such multi-traumatic injuries, the radial head takes the main stabilizing role in the elbow [11]. It is a factor that encourages orthopaedists to attempt to connect the broken head of the radial bone or replace it with a prosthesis. There is a definite departure from resection of broken bone fragments [11, 13, 15, 16].

While determining the method of surgical treatment, the Mason's classification is used. Type I fractures account for about 82% of injuries and are treated conservatively. The indications for surgical treatment are fractures of II–IV type with the displacement of fragments, limitation of mobility, and elbow instability [1, 12, 17, 18]. Factors that influence the decision to implant a radial head prosthesis include a large number of fractured fragments (more than 3 fragments), the risk of osteonecrosis after osteosynthesis, fracture of the head associated with dislocation within the radial-ulnar joint, and the patient's age (in younger patients, osteosynthesis of the broken head is preferred) [1, 8, 12, 14].

The main assumptions of radial head arthroplasty include the recovery of the physiological trajectory in the brachial-radial part of the elbow joint, recovery of the biomechanical function of the natural radial head, recovery of joint stability and the ability to transmit forces acting on the elbow joint [3, 14, 19]. The selection of the correct diameter of the head implant, its height, and its correct axial alignment is important for the end result of the treatment [17, 20].

Radial head bone arthroplasty allows for a rapid start of rehabilitation [5]. Owing to a high risk of contracture formation in the elbow joint during immobilization, attention is paid to an immediate start of rehabilitation after surgery in the majority of studies. However, Pho et al. [6] recommend to avoid active supination, pronation, weight lifting, and pushing movements during the first 2 weeks after surgery because this may disturb the stability of the elbow joint [10, 19]. Therefore, postoperative management requires maintaining a balance between the protection of the reconstructed connective tissue structures and achieving proper joint mobility [5, 7, 9]. For the immediate postoperative period, the majority of available literature recommends immobilization of the operated limb in a 90-degree flexion of the elbow and regular active exercises with the assist of a therapist [2, 9].

The presence of an experienced therapist, who properly conducts the rehabilitation protocol, has a significant impact on the regain of mobility, strength, and functionality in the area of the elbow [3, 7, 20–22]. However, documented manual therapy techniques for patients who had undergone radial head arthroplasty are scarce. Reports available in the literature indicate only methods of fascial mobilization and the proprioceptive neuromuscular facilitation method.

The patient's rehabilitation process should be carefully monitored by a physiotherapist. It is best to use standardized and objective functional tests. In the analysed literature, the reference was most frequently made to the Mayo Elbow Performance Score (MEPS) or the Disabilities of the Arm, Shoulder and Hand Score (QuickDASH) [1, 2, 5, 13, 23, 24]. These allow to evaluate the mobility improvement on an ongoing basis and modify it on the basis of the obtained results.

The dependence of the treatment effects on the implemented rehabilitation process in patients who had undergone radial head arthroplasty is unquestionable [5, 12, 14]. However, the inconsistency of available rehabilitation protocols allows to presume that conducting randomized trials on the mobility improvement scheme would provide even better

knowledge about mobility and functionality regain in the operated joints.

Limitations

The main limitation of our analysis is the small amount of available literature regarding rehabilitation after radial head arthroplasty. The short observation period in some reports additionally reduced the possibility to include available protocols in our research. There were also rehabilitation schemes in which the authors did not provide any effects of the mobility improvement.

Conclusions

1. Rehabilitation of patients who had undergone radial head arthroplasty requires more attention and further study.
2. Most reports from the literature focus on the early initiation of rehabilitation, avoidance of long-term immobilization, and treatment within the first 2–3 weeks in the post-operative period as a protective period, without overcharging the operated joint; however, the minimum period of the rehabilitation protocol should last 6–8 weeks.
3. The literature also draws attention to the significant role of a therapist in the process of mobility improvement.
4. Because of the increasing number of patients who undergo postoperative rehabilitation due to radial head arthroplasty, there is a need to extend the research in this area to evaluate the rehabilitation process in accordance with the evidence-based medicine recommendations.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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