

POSITION

By: Prof. Dr. Diyan Enchev, DM

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UMHATSM "N.I. Pirogov"

Regarding: The dissertation of Dr. Maria Andreeva Hadzhinikolova titled "**Shoulder Arthroplasty – Analysis of Outcomes and Complications**" for obtaining the educational and scientific degree "Doctor" in the field of higher education 7. Healthcare and Sports, professional direction 7.1. Medicine, and specialty "Orthopedics and Traumatology."

This statement complies with the requirements of the *Law on the Development of the Academic Staff* in the Republic of Bulgaria, the Rules for its Implementation, and the Regulations for the Development of the Academic Staff at UMHATEM "N.I. Pirogov" EAD – Sofia. Based on the proposal from the primary scientific unit, the approval of the Scientific Council of UMHATEM "N.I. Pirogov" EAD, and Order No. RD 26-1162/14.06.2023, the candidate was officially discharged with the right to defend her dissertation in the scientific specialty of Orthopedics and Traumatology.

Pursuant to Article 32, paragraph 3 of the Regulations for the Development of the Academic Staff at UMHATEM "N.I. Pirogov" EAD, and in accordance with the decision of the Scientific Council (Protocol No. RD 01-02-3/12.09.2023) and the order of the Director of UMHATEM "N.I. Pirogov" EAD (Order No. RD 26-1933/04.10.2023), I was appointed as a member of the Scientific Jury with the responsibility of preparing a scientific statement for this procedure.

Shoulder Arthroplasty has evolved significantly over the past decades. Unipolar shoulder arthroplasty, widely used for irreparable fractures and fracture dislocations, was once applied as the only possible solution in such cases. However, numerous publications have proven that functional recovery in these patients is unlikely, despite the development of new-generation modular unipolar prostheses and various surgical techniques for tuberosity repair. The challenges of avascular necrosis of the tuberosities, degeneration of the rotator cuff, and subsequent functional loss over time have proven difficult to overcome. Additionally, glenoid erosion and wear have emerged as other factors contributing to poor clinical outcomes. In practice, it became evident that the exceptional results of Charles Neer, the founder of modern shoulder arthroplasty, were nearly impossible to replicate. Despite these limitations, shoulder hemiarthroplasty is still employed today under specific indications, especially with modern modular prostheses that allow easy conversion to reverse shoulder prostheses in younger patients. For this cohort of patients with omarthrosis and an intact rotator cuff, another option is surface replacement shoulder prostheses with cementless fixation. Total shoulder arthroplasty also has its indications, particularly in advanced arthritis with a functioning rotator cuff.

The concept of reverse shoulder arthroplasty was developed in the 1970s, where the convex head of the prosthesis is positioned towards the glenoid, and the concave insert faces the humerus. This design aims to achieve joint stability and improve the range of motion while addressing the challenges posed by rotator cuff dysfunction. In 1985, Paul Grammont

established four key principles for successful reverse shoulder arthroplasty. The design he introduced is widely regarded as the foundation of modern reverse shoulder arthroplasty.

The primary indications for this method include elderly patients with irreparable proximal humeral fractures and/or rotator cuff tears, severe cuff tear arthropathy, pseudoparalysis, and conditions requiring revision arthroplasty. The main contraindications are damage to the axillary nerve, lack of adequate bone stock in the glenoid, and, controversially, younger patient age.

In contemporary literature, complications vary significantly, with infection being a common issue, along with joint instability, scapular notching, stress fractures of the acromion, loosening of the glenoid component, deltoid muscle dysfunction, etc. In addition to the correct positioning of the implant, the surgical technique also includes the restoration of the tubercles, which reduces the risk of instability and improves the final functional outcome. Design improvements are focused on lateralization of the joint, surface glenoid prosthetics, cementless short stems, and other modifications to address some of these complications.

Reverse shoulder arthroplasty is an encouraging method with less pain and better function. In recent years, reverse shoulder arthroplasty has become widely practiced both in Bulgaria and worldwide.

Monitoring these patients with clear criteria and evaluation scales is of great importance. Timely identification of existing problems provides an opportunity for quick and rational solutions. Surgical risks are lower, and consequently, the patient's prognosis is better. Comparing the two methods, hemiarthroplasty and reverse shoulder arthroplasty, will further clarify the disadvantages, indications, and expected outcomes for the patient.

The topic of Dr. Maria Hadzhinikolova's dissertation, "Shoulder Arthroplasty – Analysis of Results and Complications," addresses the current issues in shoulder arthroplasty with a focus on the monitoring criteria for these patients, allowing for early assessment of their condition, complications, and their timely resolution.

The dissertation is developed on 170 pages with 33 pages of bibliography. It is illustrated with 18 tables and 65 figures, graphs, and X-ray images. The structure follows the classic format: Literature review, objectives and tasks, materials and methods, results and complications, discussion, conclusions, and contributions.

The goal of the work is clearly formulated – to perform a retrospective analysis of the results and complications in patients treated with unipolar and reverse shoulder arthroplasty.

The tasks are logically structured into 5 objectives: to analyze the results in the literature, to track a sufficient number of patients treated with unipolar and reverse shoulder arthroplasty, to assess the possibilities of the two methods based on the clinical results, to test B-mode ultrasonography for the evaluation of rotator cuff lesions in patients after unipolar shoulder arthroplasty, to use elastography to evaluate the mechanical properties of the deltoid muscle in patients with reverse shoulder arthroplasty, and to create

a standardized follow-up protocol to optimize the early detection of potential complications using clinical and instrumental methods.

The study involves 58 patients who meet the author's established criteria. 33 patients underwent hemiarthroplasty, and 26 underwent reverse shoulder arthroplasty. In the hemiarthroplasty group, there are 7 men and 25 women, with a mean age of 66.55 years (range 45-85). The mean follow-up period is 26.16 months (range 7-68 months). In the reverse shoulder arthroplasty group, there are 5 men and 21 women, with a mean age of 64.88 years (range 29-80), and the mean follow-up period is 19.62 months (range 6-48 months).

The patients with hemiarthroplasty were assessed for non-union of the tubercles, integrity of the rotator cuff, prosthesis migration, and glenoid erosion. In the reverse arthroplasty group, the complications assessed were instability, resorption of the tubercles, and deltoid muscle dysfunction.

For this purpose, the author used conventional X-ray control with criteria for non-union and resorption of the tubercles, measurement of the acromioclavicular distance (migration), changes in the center of the humeral head in relation to the center of the glenoid, the Favard scale for assessing glenoid erosion and congruency of the reverse shoulder joint. The rotator cuff in the hemiarthroplasty patients was evaluated using ultrasonographic examination. The deltoid muscle was assessed through conventional ultrasonography, and its functional qualities were evaluated with strain and shear-wave elastography. Modern statistical methods were applied to analyze the results.

The "Discussion" chapter is developed over 64 pages. The problems identified in the literature and the author's own results are thoroughly analyzed and discussed. A critical comparison of unipolar and reverse shoulder arthroplasty is presented. The design of different prostheses and their associated advantages and disadvantages are discussed. Special attention is given to tubercle fixation as a major surgical issue. The need for a follow-up algorithm is comprehensively justified, logically explained with the stages of recovery and rehabilitation of the prosthetic shoulder. In the "Results and Complications" section, radiological and ultrasonographic results are reviewed and analyzed in detail. A comparison with clinical outcomes is made. In the "Complications" section, problems with the tubercles, non-union, resorption, rotator cuff issues, and subsequent migration of the implant are analyzed. Special attention is given to the ultrasonography of the rotator cuff. The causes of shoulder instability, scapular notching, and ways to prevent these complications are discussed. The modern method of ultrasonographic elastography of the deltoid muscle to assess its functional qualities is thoroughly covered. Two algorithms for patient follow-up after hemiarthroplasty and reverse shoulder arthroplasty are presented.

I agree with the conclusions drawn, which correspond to the stated goal and tasks. The contributions presented are correct, and I fully share them with the author.

In conclusion, the topic is modern and of clear scientific and practical value. Based on everything written above, I believe that Dr. Maria Hadjinikolova's dissertation has all the necessary qualities and meets the requirements for acquiring the scientific and educational degree of "Doctor."

With respect,
Prof. Dr. Diyan Enchev, DM

November 15, 2024
Sofia