

## POSITION

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With reference to: dissertation defense of Dr. Lyubomir Simenonov Rusimov on the topic :  
**„Intramedullary allograft augmentation in unstable proximal humerus fractures fixed with locking plate”** for the acquisition of the educational and scientific degree "Doctor" (Ph.D.)

By order № RD 26-524 / 14.02.2022 from the executive director of UMHATEM "N.I.PIROGOV" Prof. Ivan Poromanski I was appointed as an external member of the Scientific jury and with its decision (Protocol № 1) I was determined to present a position about the dissertation work of Dr. Lyubomir Simeonov Rusimov, who is a doctoral student in the Scientific council of UMHATEM "N.I. PIROGOV", in higher education area 7. "Health and Sports" in professional section 7.1 "Medicine" and scientific specialty "Orthopedics and traumatology "

**Actuality of the topic.** Based on a biomechanical experiment and retrospective clinical study, a method of treatment for unstable, highly prone to ischemia proximal humerus fractures was analyzed. The method is based on the principles of biologic augmentation and locking plate fixation. The actuality of the dissertation is significant by the fact that for the first time in Bulgaria the problem is evaluated in such a scientific manner. The dissertation represents the author's perspectives for the indications, limitations and contraindications of the method and the choice between the latter as an organ-preserving surgery instead of joint replacement procedures. The medico-social significance of the dissertation is defined by the severity of the pathology, which as a rule is more common in elderly patients with osteoporosis, leading to high risk of avascular necrosis of the humeral head, nonunion and secondary dislocation. Last but not least the financial costs with the presented surgical method are lower.

**According to Clause 29.(1)(2) of the Regulations for development of the academic committee of UMHATEM "N.I.PIROGOV" – Sofia, 2018 – „Requirements of the dissertation work for the acquisition of the educational and scientific degree "doctor".**

The dissertation is presented according to the usual structure for this type of works. It is written on 174 pages and contains 49 figures (including graphics) and 34 tables. The dissertation has introduction (2 pages), literature review (61 pages), bibliography (21 pages with 386 titles in latin and 3 titles in cyrillic). In the remaining part of the dissertation Dr. Rusimov formulates the aim and the resulting six goals, the contingent of the study, experimental and clinical methods of the study, the used operative technique, author's own results, author's analysis and conclusions. The dissertation includes an abstract (as the same used in scientific papers), contributions and lists of author's publications about the topic. I consider the latter as a diversion from the requirements for dissertation. Its place is in the Autoreferat. As a mistake in the structure I consider the placement of deductions after the conclusion and the placement of the aim and tasks before the literature review. The lack of bulgarian authors in the dissertation is a omission. At least a dissertations relative to the topic could be cited, as the older of Kalapov (1980), Bonev (1989) and also newer ones as Totev (2016), Kaikchian (2017), Mitkovski (2020). The bulgarian scientific literature contains a set of articles by authors like Baltov, Rashkov, Dobrilov and others, whom I did not recognise in the bibliography.

In the commonly accepted succession, in the literature review the doctorant represents the anatomy and biomechanics of the shoulder, epidemiology and mechanism of the trauma, classification systems, clinical and radiological diagnostic methods. The detaily described specific x-ray views are highly valuable for every traumatologist on every level of trauma support in Bulgaria. The literature review also presents the familiar methods of treatment, their results and possible complications. I fully support the author's conclusion: „... the most common complication of locking plate fixation for proximal humerus fractures are limited to one vicious circle – osteoporotic bone, medial bone support deficiency and malreduction.“ A separate subchapter reviews the augmentation methods in locking plate osteosynthesis. The length of the literature review exceeds the permissible 30% of the dissertation's volume. In my opinion, some of the propaedeutic data could be presented in tables and the analysis of the other authors' results could be placed in the discussion chapter. As a criticism referring to the literature review, I would point to the absence at its end of a short analytical summary of the proved, unsolved and theoretically probable facts about the topic. With the above mentioned

exceptions, the literature review is concretely specified to the topic and it is a synthesized representation of Dr. Rusimov's extensive knowledge about the problem. We can accept this chapter as a short contemporary course for refreshment of our knowledge in the treatment, prognostic factors for ischemia, variable methods of osteosynthesis and principles of augmentation of proximal humerus fractures.

The aim is clearly formulated – „To evaluate the construction of locking plate and intramedullary allograft in the treatment of unstable and prone to ischemia fractures of the proximal humerus” The six tasks are concrete, clear, correctly defined and fully correspond to the pointed aim.

Chapter II (Materials, patients and methods) presents the experimental model and the clinical contingent.

The scientific foundation of the study is built with the use of 30 polyurethane synthetic humeral bones with low bone density, distributed in 3 experimental groups. They simulate different pathological substrates of the fracture, mechanically tested after reduction and fixation with 12-hole PHILOS plate alone or augmented with a hollow cylindrical intramedullary graft. The experiment was conducted in the department of Biomechanics in the AO Research Institute, Davos, Switzerland.

Working in the country's leading trauma center (UMHATEM "N.I.PIROGOV") gives the doctorant an opportunity to collect enough clinical data for reliable statistical results. His study includes 47 alive, clinically followed-up patients of 114 patients treated with reduction, fixation with locking plate and intramedullary graft for the period from 01. 2015 to 10. 2020 year. All cases are with displaced and unstable proximal humerus fracture and strictly selected according to the including and excluding criterias. The middle age of the cohort is 63,2 years (33 – 84). The following are predominant: female gender - 79%; domestic incident (falling from a standing height) – 61%; 4-part Neer fractures (3 with supplement dislocation) – 52,3% and 3-part Neer fractures (2 with supplement dislocation) – 29,8%. According to the strictly selected criterias for instability, fractures with medial calcar comminution – 76,6%, primarily varus displacement – 57,5% and deltoid tuberosity index  $\leq 1,4$  – 61,7% are predominant. The statistical analysis of the reported parameters are correctly presented in clearly defined graphics.

In the same chapter, the applied surgical treatment is presented in great detail with scientific application. Deltopectoral approach is used in 25 of the cases and anterolateral or direct transdeltoid minimally invasive approaches are used in 22 of the cases. The methods of fragments reposition and intramedullary graft implementation in the cases, in which the medial column can not be precisely restored due to medial comminution are described. Deep fresh frozen fibular graft is used in 31 of the cases and lyophilized tibial graft in the remaining 16. In 9 patients Locking Proximal Humerus Plate is used for fracture fixation and Proximal Humerus Internal Locking System in 38 of the patients. Essential moment in fixation is at least one plate screw passing through the allograft. The mean duration of the surgery is 127 min (30 – 330).

In all patients the diagnosis is based on orthopedic clinical examination and two x-ray views (AP Greshy view and lateral Y – view). In 24 of the patients a preoperative CT is performed.

For the dissertation's aim, an objective angular and linear x-ray measurements are performed – intraoperative and final follow-up neck-shaft angle and humeral head height. For functional evaluation the Constant-Murley and DASH scores are used.

In the results processing, the doctor applies reliable and contemporary statistical methods, used in the biomedical sciences. They are presented in the following chapter.

Chapter III (Results and complications) represents the data of the clinical mean follow-up of 28 months (12 – 79) and experimental part. They are completely author's and according to me – objective. I can generally synthesize them as:

- There is statistically, but not clinically significant difference in the mean intraoperative and final follow-up neck-shaft angle ( $131,91^{\circ}$  -  $123,93^{\circ}$ )
- There is statistically, but not clinically significant difference in the mean intraoperative and final follow-up humeral head height (14,11 mm - 13,15 mm)
- The final mean absolute Constant-Murley score is satisfactory.
- The final mean relative Constant-Murley score is good.
- The final mean individual Constant-Murley score is good.
- The subjective evaluation of the DASH score is good.
- The hypothetical risk of 97% for humeral head avascular necrosis is reduced to 32%

- The clinical results confirm the experimental results, which are detaily presented in the beginning of the chapter.

The doctorant correctly represents the occurred complications. They are clinically significant in 12 patients (26%). In the latter, a secondary surgical intervention is performed, predominantly implant removal and only one conversion to arthroplasty. AVN is diagnosed in 13 cases (27,7%). There is statistically significant dependence between fracture reposition and development of AVN. As a remark, I would point out the absence of summary representation of the complications, for example in table. It would facilitate the reader, because often there are more than one complication in the same patient.

In reference to the pointed aim, the doctorant performs a number of investigations regarding the influence of age, surgical exposure, the used allograft, bone quality and the achieved intraoperative fracture reposition on final functional results and complications. The obtained data information is not just for „adding volume” to the dissertation. It completely corresponds to the aim and objectively proves the reliability of the results. It has a very high professional level of statistical analysis

Chapter IV (Discussion) is 35 pages long and represents an extensive comparative analysis between the author’s perspectives, dissertation’s results and the other authors’ studies on the topic. This chapter is the most creative part of the dissertation. It confidently demonstrates the erudition of Dr. Lyubomir Rusimov on the presented problem.

Important deductions from a practical perspective, the author put in the chapter of the same name (Deductions). I fully agree with their reliability and based on this I accept that the aim of the dissertation is accomplished. Unexplainable for me is their placement after the Conclusion chapter.

The Conclusion is a synthesized analysis of the dissertation work and it confirms “ ... that intramedullary graft augmentation in the locking plate fixation for proximal humerus fractures prone to ischemia is grounded on a solid biomechanical basis. From a clinical perspective the technique is predictable, safe and effective.”

The bibliography is presented separately in an alphabetic order. The cyrilic citations are incorrectly ordered. They should be exported before tha citations in latin.

In general, the dissertation is written in the correct literal language, with the exception of one note. All units of measure in the Si system must be written in latin (for example mm, not MM.). The presented graphics and pictures have high quality and information, fully corresponding to the text. My notes concerning the structure of the dissertation don't reject the scientific value of it and mostly manifest insufficient methodology help for the doctorant in the final shaping of the dissertation.

Regarding the presented for review scientific work of Dr. Lyubomir Rusimov I can point out the following more important contributions. They contain theoretical and applicable scientific affirmative character:

1. This is one of few dissertations in the native orthopedic science using experimental models. The created biomechanical 4-part fracture model gives a scientifically based conclusion on the favourable biomechanical conditions for fracture healing, without complications using locking plate fixation and intramedullary allograft in unstable, prone to avascular necrosis proximal humerus fractures.
2. An optimal surgical technique with an algorithm for achieving anatomical reduction in unstable and prone to ischemia proximal humerus fracture is evaluated and established.
3. Hertel's criterias are confirmed as most informative with high prognostic value for development of posttraumatic avascular necrosis of the humeral head.

Regarding dissertation's subject the doctorant presents ten publications and presentations, **eligible for the minimal national criteria from Application 1 of Regulations for development of the academic committee in the Republic of Bulgaria.** They contain separate parts of the developed material. The presented Autoreferat of the dissertation has a volume of 79 pages and is structured according to the universally accepted criterias.

In conclusion, the presented for review dissertation represents the ability of the doctorant in setting a scientific thesis and methodology for its resolution, his ability of selecting and processing material and also in making statistically reliable conclusions in one debatable for the native bone surgery theme – highly-productive, organ-preserving surgeries in unstable proximal humerus fractures. This is an excellent developed dissertation. It corresponds to the qualitative and quantitative criterias set out in the Legal requirements of dissertation for the acquisition of educational and scientific degree "Doctor" in Regulations for development of the academic committee of UMHATEM "N.I.PIROGOV" and the law for development of the academic committee of Republic of Bulgaria.

Therefore I give a **positive valuation** of the dissertation and I call on the members of the Scientific jury to award Dr. Lyubomir Simeonov Rusimov with the educational and scientific degree "DOCTOR" in the scientific specialty "Orthopedics and traumatology "

21.03.2022

prof. Georgiev