POSITION

By **Assoc. Prof. Dr. Kalin Kolev Mihov, Ph. D.**

With reference to: Dissertation paper **"Operative treatment of proximal humeral fractures by locking plate with and without augmentation- comparative analysis"**

For awarding the educational and scientific Doctorate degree / Ph.D./

By Order Nr. RD-26-523/ 14.02.2022 by the Director of UMHATEM N.I.Pirogov EAD I have been appointed as a member of Scientific Jury and assigned to provide a position about the procedure for awarding educational and scientific Doctorate degree /Ph.D. to the candidate Dr. Stoyan Hristov, doctorate candidate on individual doctorate program in scientific specialty "Orthopedics and Traumatology".

Proximal humeral fractures ` epidemiology has been showing a tendency for increasing the number of such fractures within elderly population. Author`s observation for the period of 30 years in Finland indicates a 4 quadruple growth of fractures within women over 80 years. Besides we observe a significant rise in patient`s demands regarding treatment and life quality. Locking plate (LP) use in last 30 years broadened the indications for treatment for such fractures. However, results display significant frequency of complications reaching up to 49% - such as improper bone healing (mal-union), AVN, screw penetration and sub-acromial impingement. This comes only to show that stable fixation in cases of proximal humeral fractures (PHFx) with bone deficiency and complicated morphology is hardly achievable. In such situations the augmentation of the osteosynthesis by LP in PHFx is a reasonable option for ensuring stability of the construction.

The dissertation paper of Dr. Stoyan Hristov is focused on the analysis of fixation methods of PHFx by LP with or without augmentation.

Within the frame of the conducted research the author manages to optimize his approach in PHFx cases analyzing mistakes in treatment and intraoperative strategy` choice, improving the algorithm in order to avoid possible complications. The author pays attention to the difficulties in anatomical restoration, resulting from additional comminution in high – energy fractures or poor bone quality and expressed osteoporosis. Above circumstances increase the demands for osteosynthesis stability and focus our attention on the augmentation potentials, giving the author the option to compare techniques, recovery, functional outcome and complication in the three subgroups of patients with PHFx.

The author represents the opinion that reducing the stress on the medial wall of the proximal humerus enhances the primary stability of the fixation since the augmentation additionally recoups the poor bone quality and evenly distributes the load over the entire screw length- a thesis, which is justified by achieved functional results and analyses of postoperative complications` distribution.

Interpreting the middle – term results the author manages to formulate several scientific conclusions regarding the complete approach in PHFx cases and to draw the final conclusion that PMMA augmentation in PHFx with bone deficit ensures better results compared to treatment by LP only and comparable or better than treatment by LP and bone autograft (BA) augmentation.

The dissertation paper is structured in compliance with the requirements, demonstrates a logical consistency, and enclosed is a comprehensive list of literature sources, related to the problems with diagnostic, operative treatment of PHFx and results of its implementation.

Literature review includes 43 pages and is separated in six chapters. Based on first five chapters the author delivers a detailed analysis of surgical anatomy and biomechanics of shoulder joint, diagnostics and classification of humeral fractures, which is absolutely necessary for the analysis of problems related to treatment of PHFx. The last chapter's topic lies on non- operative and operative treatment, the main focus is on the type of fracture fixation and the necessity for augmentation in such treatment cases.

The dissertation author analyses in details the available surgical techniques for treatment of PHFx – their respective advantages and disadvantages. In my opinion this is the very first scientific research, which purposefully observes PHFx cases, treated by LP and PMMA augmentation in the metaphyseal zone.

The dissertation goal is clearly formulated and four achievable tasks have been assigned.

In chapter **Patients and methods** the author separates patients according several characteristics and excluding criteria as well, including patients with 3- and 4- fragment fractures, treated by LP. General number of patients includes 112 cases with 114 fractures of proximal humerus for the period of four years, all of them fresh fracture cases. Observed number of patients is entirely sufficient for formation of studied groups and for statistical analysis of the results. Dr. Stoyan Hristov himself has been personally involved in the treatment of all patients included in this dissertation work. Criteria used for comparative analysis and patient groups in this research are clearly and precisely formulated, which proves the study statistically and scientifically feasible.

Complications in the observed group have been accurately recorded and carefully analyzed- within whole cohort 41 (36%) patients are with complications and the biggest percentage with complications (14%) are caused by cutting, screw penetration and loosening. Other significant complication frequency (8%) is related to secondary dislocation in varus. Author's research states that PMMA augmentation in PHFx cases with bone deficit ensures better treatment results compared to treatment by LP only and comparable or better than treatment by LP and BA augmentation.

The Discussion chapter includes 23 pages and is actually a critical analysis of author's results compared to results of proven authors.

Conclusions, drawn by the author, are clearly formulated and logically justified based on in – depth analysis on the problematic issue.

1. Stability of the construction via PMMA augmentation is better and reduces the risk of penetration and secondary varus dislocation of the fracture.
2. Patients with augmentation achieve faster and better functional outcome.

3. PMMA augmentation could replace BA as treatment method based on short operating time ($p<0.01$) and decreased percentage of complications. In the 3rd and 6th postoperative period a better CMS & DASH compared to BA augmentation is statistically significant ($p<0.05$).
4. A correlation dependency and positive correlation coefficient between indexes of postoperative neck-shaft angle (NSA) and functional outcome, expressed by CMS, $p=0.0292$, $a< 0.05$ has been recorded.
5. The author has developed an action algorithm in treatment of PHFx aiming to optimize and facilitate the approach to patients in order to minimize treatment complications.

Literature bibliography is in alphabetical order and includes 251 scientific sources, no presence of Bulgarian authors is noticeable.

Following contributions in the dissertation paper, presented by Dr. Stoyan Hristov are clearly to be considered:

1. The author has conducted a detailed analysis of indications for augmentation in treatment of PHFx and clinical and biomechanical aspects of both methods of osteosynthesis augmentation by LP.
2. For the first time in Bulgaria a research is presented, which purposely follows PHFx cases, treated by LP and PMMA augmentation in metaphyseal void.
3. Based on middle – term results the PMMA augmentation is justified to be used in bone-preserving operations of PHFx.
4. Recorded data display better functional and X- ray results in PHFx, operated by LP and augmentation.

In conclusion I would like to point out that the dissertation paper fulfills all criteria, required for obtaining the scientific- educational Doctorate degree / Ph. D.

I give a positive assessment on the presented paper and encourage the members of the Scientific Jury to award Dr. Stoyan Hristov the educational and scientific Doctorate degree / Ph. D.

23.03.2022

Assoc. Prof. Kalin Mihov, Ph. D.