

Review

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of the dissertation of Dr. Dimitar Stefanov Todorov on the topic "***Analysis of the results after minimally invasive fixation with angularly stable plates in distal femur fractures AO 33A / 33C***" for awarding the educational and scientific degree "Doctor" (Ph.D.).

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The issues with distal femur fractures continue to be the focus of orthopedic traumatology. The ubiquitous introduction of the AO doctrine has largely cleared the initial fluctuations related to classification, indications for surgery, surgical access, the need for anatomic placement of the joint component, and the specific difficulties typical for condylar fractures in the frontal plane.

Moreover, the fracture surgery of "segment 33" provided the material on the basis of which the pioneers of MIPO were able to implant metal osteosynthesis with a biological plate and thus changed the face of modern traumatology.

However, the routine application of one technique - MIPO fixation with lateral periarticular plate, in patients with different bone quality, motor needs, and especially in fractures with different morphology, has led to a number of disappointments. In several series, the frequency of implant reliability issues (debricolage) and bone healing reach up to 20%.

In this regard, the modern fractures surgeon asks oneself the following questions:

- To what extent does the lateral locking plate create optimal conditions for callus-formation of the meta-diaphyseal transition?
- Which cases of metaphysical comminution or bone insufficiency are applicable for augmentation?

It is this very topical issue that the scientific work presented by Dr. Dimitar Todorov, entitled "***Analysis of the results after minimally invasive fixation with angularly stable plates in distal femur fractures AO 33A / 33C***", is devoted.

The scientific work consists of 134 pages and is presented in a typical structure, namely - a literature review, material and method, results and complications, discussion, summary and conclusions. This undoubtedly allows a logical follow-up of the various components of the problem and introduces the reader to the author's experience.

The aimed goal is clearly stated. In order to achieve it, the author sets 4 scientific tasks for discussion and decision. They are logically justified, stem from the purpose and are practically feasible.

The paper begins with a brief introductory chapter reflecting Dr. Todorov's motives to dwell on this topic, as well as the relevance of the scientific issue under consideration.

Chapter 1 Literature Review covers the author's classic and contemporary publications on the topic of the treatment of distal femur fractures. The analysis of the sources is correct and critical.

Chapter 2 presents the clinical series of patients treated according to a specific treatment algorithm. The criteria for patient selection as well as the indications given by the author for the administration of the LISS plate are quite satisfactory. The operating technique is also described in detail.

The author examined 97 patients with 100 fractures of the distal femur over a period of 5 years (January 2013 - December 2017). All of them, who meet the criteria, have passed through the Clinics of Orthopedic Traumatology of UMHATEM "N. I. Pirogov". 54 patients (57 fractures) were followed up to consolidation throughout the end of the recovery period, when the consequences of the fracture and treatment were considered definitive.

The experimental study conducted by the author at AO Research Institute – Davos is presented in the same section. The crux of the experiment is non-destructive testing of simulated fractured distal femur models that have a lateral locking plate fixation. The models are divided into three groups - fixed only with lateral plate, lateral plate + augmentation with medial plate, lateral plate + augmentation with intramedullary graft.

Without directly relating to the recruitment of clinical material, the experimental work provides an extremely rich material for reflection, which is evident in the processing of clinical results and in the Discussion chapter.

The same section (Material and Methods) describes the documentation used and the statistical methods applied that create the conditions for the correctness and reliability of this scientific work.

In Chapter 3, the author presents the results and complications.

The section begins by defining the terms used, which may have happened in the preceding parts of the exposition, but in any case, brings the necessary clarity on the strict criteria adopted by Dr. Todorov.

Following an analysis of the trauma mechanism, accompanying injuries, and treatment time, the author analyses the radiographic and clinical results of MIPO fixation with a laterally inserted locking plate. The fact that implants with similar characteristics from 11 manufacturers, placed by 23 surgeons, are used as osteosynthetic means, gives a realistic idea of the current practice and does not reduce the weight of the presented results and conclusions.

The author finds a statistically significant relationship between the frequency of issue fixation and delayed healing, on the one hand, and the energy of trauma and the frequency of accompanying injuries, on the other. The distribution of results on the objective Schatzker score scale is as follows: excellent results in 12 (21%) patients, good 15 (26%), satisfactory 8 (14%) and poor 22 (39%). This data is to a large extent confirmed by the application of the subjective scale for the evaluation of the function of the knee joint - Lysholm score.

In this regard, the author's ability to accurately and critically analyze both the unsuccessful results and the complications that occur is evident.

The data collected from the biomechanical laboratory experiment is also presented in Chapter 3. It seems to me that of all the abundant information, the most significant is the fact that the longitudinal dislocation of fragments under axial loading differs significantly between the three fixing techniques for the two working lengths. The greatest deformation is found during fixation with LCP, followed by LCP + IM graft and fixation with 2 LCP.

This can bring significant practical benefits.

The last **Chapter 4** - Discussion is the essence of this dissertation. All aspects of modern treatment of distal femur fractures are discussed in detail. It describes and analyzes the healing philosophy on which the author's behavior is based, the advantages and disadvantages of the existing approaches and ways of fixation. The conclusions made are particularly valuable as they are based not only on the long-term clinical results achieved at a major trauma center (UMHATEM "Pirogov"), but are also based on a precisely performed biomechanical experiment in a reputable laboratory.

The questions raised about the biological response to bone (callus formation) in conditions of varying degrees of rigidity, address the most current or perhaps, eternally relevant topic of balance between biology and mechanics, which is the basis of solving any clinical problem in fracture surgery.

Dr. Todorov's work wraps up with 3 conclusions, in which the essence of the above-described scientific work is sparingly, but critically and accurately presented.

I fully agree with these conclusions.

In reading of this dissertation thesis, I have some small, mostly technical, comments that change the overall impression of the work in no way. The presented work has obvious theoretical and practical value. I allow myself to summarize the following significant contributions from the author:

1. The method of minimally invasive fixation with angularly stable plates for distal femur fractures has been applied to a sufficiently large contingent of patients.
2. Method-specific opportunities and disadvantages have been sought and proven.
3. A detailed statistical analysis was conducted to differentiate the various factors leading to poor treatment outcomes as well as problems with fracture consolidation.
4. The advantages of the technique for augmentation of fracture fixation of the distal femur have been experimentally demonstrated.
5. Current indications for the modification of osteosynthesis with angular-stable plates for distal femur fractures have been refined.

CONCLUSION. The dissertation deals with a present-day topic, it is structured properly, contains a number of innovative elements, covers a sufficient contingent, objectively presents the results and completes with useful conclusions. With these qualities, the work meets the criteria for obtaining a Ph.D. degree.

Based on the above, I propose that the scientific jury award Dr. Dimitar Stefanov Todorov the educational and scientific degree "Doctor" in the scientific specialty "Orthopedics and traumatology".

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Respectfully,

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