

„CAROL DAVILA” UNIVERSITY OF MEDICINE AND PHARMACY
BUCHAREST
DOCTORAL SCHOOL
MEDICINE FIELD



HABILITATION THESIS

ABSTRACT

CANDIDATE:

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Faculty of Medicine

“Carol Davila” University of Medicine and Pharmacy, Bucharest

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EVALUATION OF ERROR FACTORS IN TOTAL KNEE ARTHROPLASTY

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ABSTRACT

The habilitation thesis entitled “EVALUATION OF ERROR FACTORS IN TOTAL KNEE ARTHROPLASTY” includes the most important academic, scientific, and research achievements of the candidate Crețu Bogdan Ștefan, attained before and after obtaining his PhD in Medicine almost 3 years ago.

The habilitation thesis is structured in three parts, each with a title and subtitles.

The first part, suggestively entitled “The academic teaching and development of university research. Contributions to the evolution of the Orthopedics-Traumatology field in Romania”, reviews the stages of professional development and achievements to date. The evolution, both as a clinician and as a faculty member, has been gradual and continuous.

My passion for science and the will to help people inspired me to study medicine ever since high school.

The choice of my specialty was a crucial moment, opting for Orthopaedics-Traumatology, following the evaluation of my skills, objectives, and interests.

During the last years as a student of “Carol Davila” University of Medicine and Pharmacy Bucharest, my main interest in the medical field has been Orthopaedics-Traumatology, working daily in the Orthopaedics and Traumatology Clinic of Bucharest Clinical Emergency Hospital (Floreasca).

Once I passed the residency exam, I chose the Orthopaedics-Traumatology field, one of the reasons being the affinity with both the theoretical and practical parts of medicine.

I did 5 years of residency training at Bucharest Clinical Emergency Hospital (Floreasca), “Foișor” Clinical Hospital, but also Bucharest University Emergency Hospital, where I treated patients with various pathologies, cases of elective surgery (oncological surgery, orthopaedics) and major emergencies, such as the polytraumatized patient.

I participated in many congresses, training courses, and symposia, both nationally and internationally, my interest being knee arthroplasty.

After passing the medical specialty exam, I also passed the employment test at Bucharest University Emergency Hospital, where I currently work as a specialist physician.

Regarding academic teaching, it was the natural consequence of the physician job, because I believe that the most important obligation that I have as a specialist involved in research in the medical field is to pass on my knowledge to future generations.

Since February 2020 I have held the position of Assistant Professor at the Bucharest University Emergency Hospital. As a faculty member, I have tried to ensure an appropriate learning environment for both students and resident physicians, I have organized clinical case presentation sessions in which resident physicians had the opportunity to share their experiences about diagnosis

and treatment approaches, and I have held weekly classes on the subject of the residency curriculum for the theoretical preparation specifically to pass the specialty exam.

I have also held classes for 4th-year students at the Faculty of Medicine, who are in the Orthopaedics-Traumatology training, encouraging their active participation in the practical classes, to get acquainted with the main treatment options, as well as the correct diagnosis of the patient.

The second part of the habilitation thesis, “Postdoctoral activity: past, present and perspectives” describes the main directions of my scientific activity after defending my PhD thesis. Immediately after, I followed the natural direction, namely the study of total knee arthroplasty.

In the context of the need to perfect this essential surgical step, I identified the existing digital methods that measure the tensions in the two compartments, and at the same time, I designed my own, improved device to fulfill the requirements of correct measurement of tensions while rebalancing the soft tissue.

Thus, I conducted a study that assessed the implications of modifiable risk factors such as obesity or blood glucose on postoperative complications and functional outcomes.

Next, I conducted a comprehensive review of the preoperative and postoperative radiological evaluation. This is the foundation of a PTG, and correct preoperative evaluation is required to improve results for both the surgeon and the patient. This review provided useful information regarding patient positioning, multiple incidence options depending on the pathology investigated, and important data regarding the correct analysis after total knee arthroplasty surgery.

With an artificial neural network, based on a Bayes network, I laid the foundations of an automatic identification system for the correct positioning of the tibial component in the total knee arthroplasty. The base of this system was the need to standardize postoperative radiological evaluation to create predictions regarding post-operative evolution, but also to find correlations of adverse developments with associated pathologies. The use of artificial intelligence in diagnosis, as well as periodic evaluations, has proved effective in many medical fields, orthopaedics being currently in an early stage, but an increasing number of patients and the need for standardization of surgical procedures will lead to the emergence of such systems.

The correct positioning of the prosthesis in the knee arthroplasty is probably the most debated subject. Currently, total knee arthroplasty is performed using the measured resection technique or the tension gap technique (extension space is equal to the flexion space). Both have proven to be effective in terms of the correct positioning of components, but also from the point of view of postoperative functional results. Regarding the rotation, the correct positioning in both techniques remains an incompletely elucidated subject, with a high number of patients in whom, although no intraoperative positioning incidents are present, the result is not an excellent one. These patients often need a

thorough postoperative radiological evaluation to be able to correlate various symptoms with malpositioning.

The evaluation of prosthetic components from the point of view of the rotation is performed by a CT. Even with the best metal artifact minimization software, certain anatomical landmarks cannot be properly visualized. A major problem was identified in the postoperative CT evaluation of the femur component rotation, which led to the need to use a new, constant, anatomical landmark for a better evaluation. The innovative use of the linea aspera as a constant anatomical landmark for rotation evaluation has proven to be effective.

One of the main factors of error in this intervention remains insufficient ligament balancing or inconsistency with the positioning of the prosthetic components. For a long time, the way to present this surgical maneuver was done with a laminar spreader, a device inserted into the extension and flexion space, with which the ligament tension could be verified, being a manual check. The problem with the use of this device is the lack of information about how much tension should be in the two compartments, both in extension and flexion, given that the deformity is different from patient to patient, the bone trenches cannot be the same, and ultimately the strength of the ligaments is unique for each patient. The use of plastic spacers is subject to error, the friction forces at their introduction are important, and the subsequent decision to release one compartment or another is made only based on the experience of the surgeon. A modern technique for checking ligament balance is using sample inserts with integrated pressure sensors. The results are encouraging, but the fact that the insert is not universal, the cost is high, they are for single use, and they are used at the end of the surgery without the possibility of repeating the steps, makes them not an optimal option. The need to present this maneuver and make it much more reproducible has led to the creation of a medical device, a spacer with integrated pressure sensors. It can be used from the moment the extension space is checked, it is reusable and has a low cost, and may in the future represent an alternative for balancing the soft tissue in knee arthroplasty.

Subsequently, I analyzed prospects regarding total knee arthroplasty, exposing both the pros and cons of certain decisions or techniques based on recent literature data. The latter can be the answer to solving some of the error factors that occurred in total knee arthroplasty. Maintaining the kinematics of the knee after arthroplasty could be the solution for improving functional outcomes, increasing satisfaction rates, and reducing complication rates. This can be done through a series of intraoperative maneuvers, using implants intended for this function, and, last but not least, using adjuvant techniques such as robotic surgery.

Finally, I presented information regarding certain intraoperative and postoperative behaviors to avoid some of the complications. This information comes from the data from the hospitals where

I did my training as an orthopedist, but knowing them can lead to avoiding the development of complications that endanger the functional results of patients.

The final part of the habilitation thesis, “Plans for the development of academic career and activity”, provides an insight into my plans both from an academic, publicistic, and above all scientific perspective, describing local, national, and international collaborations that I either have at present or wish to implement.

As a leader in this field, I would like to encourage the creation of research groups that define clear objectives and prioritize subjects of interest.

I also intend to promote collaboration between physicians of related specialties inside and outside the hospital. I intend to support the publication of research results in peer-reviewed journals and important scientific events. I will work with designated government agencies, as well as with other research institutions, to find opportunities to discover the best sources of funding to support research.

I plan to develop new interactive teaching methods so that students can participate actively in classes and practical training. I would like to continue to encourage resident physicians to deliver continuous case presentations to process the materials for specialty exams as efficiently and promptly as possible and to improve the quality of medical practice.

I want to help young colleagues who wish to improve their skills through internships abroad. I am interested in attending academic meetings and conferences to exchange ideas and pave the way for future collaborations with other professors.

I would consider introducing a new state-of-the-art technology that would allow medical teams to access diagnosis and initiate treatment as soon as possible, appropriate to save the patient’s life. This project is based on identifying microorganisms using new metagenomic sequencing (mNGS) techniques in periprosthetic joint infections.

In conclusion, I would like to emphasize that all my activities, didactic, clinical, and research, will also intertwine in the future, which guarantees a high quality of the medical act, and research, as well as the development of the didactic activity in the Department of Orthopedic-Traumatology of “Carol Davila” University of Medicine and Pharmacy, Bucharest.