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**A NEW METHOD IN MUSCULOSKELETAL
SURGERY IN MILITARY MISSION**

**MINIMAL INVASIVE HIP REPLACEMENT
VIA ONE INCISION POSTERIOR APPROACH IN MOBILE MILITARY
HOSPITAL**

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INTRODUCTION

It is greatly rewarding, when a practicing surgeon can spend time and effort uncovering a research area he is otherwise in daily contact with and which stands close to his heart. It is especially fulfilling when the main topic of the dissertation is a technique that he himself had devised and introduced into the clinical practice and completed in largest numbers both in Hungary and Austria.

In the life of an orthopaedic surgeon there is a fine line between success and the development of complications. Fortunately surgical interference can claim more successes than failures.

The surgical vocation is intended for people with an interest in success, an interest which is supplemented with a commitment to provide the best possible care for the patient. In order to improve surgical procedures there is an ongoing search for more developed implants, which are easier to implant and have a higher endurance. It is important to develop and utilize procedures that are most effective and efficient, causing the least amount of disturbance for the patient and surgeon. The key is the realization of ‘intelligent surgery’, namely minimal trauma, maximal effectiveness. The above mentioned attitudes enable the quickest possible rehabilitation and reinstatement of everyday life for the orthopaedic patient. Thus the significance of improved treatment can also take on an economic dimension.

The less traumatising procedures that can be made with minimal invasion of the human body have made possible the completion of such types of operations even in extraordinary circumstances, that before were not in the reach of the Army Medical Service.

The overlapping area of orthopaedic surgery in peace and war time will be discussed in this paper. The injuries and degenerative changes that are most often sustained in peace times is perhaps of less significance, however when looked at in the context of the new methods described by this dissertation the missionary health provision can actually be applied.

The results uncovered by research have opened new windows of understanding and perspectives into everyday civilian treatment, can lead us to the modification or exclusion of past dogmas present within the Army Medical Service and uncover new prospects in dealing with interventions, which are completed with an exceptional background in missionary circumstances.

My experience gained through research and patient care – underlined by results from the implantation of total hip replacement (THR) via the one incision minimal invasive posterior approach that was first introduced in Hungary by me – have led me to the conclusion that the technique can be adopted in exceptional circumstances in a military environment. The healthcare support provided by the army – knowledge that is part of the art of war – can be enriched with an intervention that can be utilized in an operational area that satisfies the requirements the set by NATO MC 326/1.

1. RELEVANCE, DESCRIPTION OF PROBLEM, AIMS

TOPICALITY OF THE RESEARCH AREA

The previously often amended and continually evolving “National Military Strategy” states the responsibility of the Hungarian Armed Forces to partake in the provision of humanitarian aid and to play an active role as an integral part of international military coalitions.

In the past years, after many decades of absence, the treatment in an exceptional environment of patients serving on a mission has been reinstated as a responsibility of the Hungarian Armed Forces. Missions that can be recognized in this category at the present time include the provision of healthcare for peacekeeping organizations in the areas of Saudi-Arabia, Iraq, Kosovo and Afghanistan.

The primary role of these healthcare missions is the provision of acute care. Within my own specialty area of orthopedics and trauma, it is the treatment of acute musculoskeletal injuries. A few of the above missions deal not only with the treatment of military serviceman. A new demand has been identified based on experience gained through military mission work, namely the treatment of similar problems – musculoskeletal injuries and subsequent rehabilitation of bone and joint deformities - presenting themselves within resident populations.

In some of the modern field hospitals steps have been taken towards the employment of previously unused intramedullary (IM) nailing techniques when dealing with specific types of injuries. The IM nailing technique, (deep implants) which until now had been rejected in military surgical practice has become a viable and recognized option in modern, mobile, field hospitals, (Role III hospitals) and even in exceptional circumstances with military mission background, due to more deeply sunk implants and the procurement of the necessary conditions for the procedure.

The treatment of injuries sustained around the hip-joint, for example the commonly occurring fracture neck of femur, hip dislocations due to high energy impact, acetabular fractures and rare fractures of the femoral head all require complicated and precise surgical work. In addition thorough patient preparation, exact operational strategy and committed post-operative care are pre-requisites for the optimal patient recovery. The completion of these steps of patient care may prove to be difficult in a mission environment. Such military injured are first safely removed from the war-zone and their care continues in their own home countries following repatriation.

In Afghanistan, complex treatment of the civilian population with injuries around the hip-joint – post-trauma deformities following injury, degenerative joint changes as well as the large numbers of untreated fracture neck of femur – is extremely difficult. There are many individuals suffering injuries to the hip region, and posttraumatic sequelae are also not uncommon, including deformities and posttraumatic arthritis of the hip joint. Exact figures are hard to come by, but reports from our orthopaedic surgeons stationed in Afghanistan as part of the external service show that during 6 months 32 such patients visited the emergency area of the field hospital.

Ideally these patients would be treated in regional, national traditional hospitals. However the technical support and professional skills needed for successful completion of all

stages of patient care are unfortunately lacking or do not reach the benchmark level set by our doctors. There are shortages in both the number and skill level of musculoskeletal surgeons and supporting specialized staff. The ongoing war means the better qualified doctors flee the area; thus a national professional body is missing. In this sense external support not only means providing practical care, but perhaps more importantly also education.

I believe the humanitarian and international missionary dedication of the Hungarian Armed Forces may provide further opportunity for the development of specialized 'battle zone' surgery and the revival of a vocation with a shortfall of professionals which can increase our presence and the recognition of our medical staff within NATO, UN and other missionary organizations.

The missionary hospital would be suitable for the care and treatment of this patient group with hip joint pathologies, or at least to provide significant part of this care. The pre- and post-operative care could take place in the regional institutions. The missionary hospitals would be where the operative intervention and the early post-operative care – the time of which thanks to the minimal invasive technique is significantly reduced in comparison to traditional surgical approaches - could take place. The above actions would not only aid patients with such complex hip injuries, but would also lead to additional indirect benefits, in that with each successful case the sympathy and trust of the residents towards the foreign military organizations partaking in the missionary effort is won. This is especially crucial when confronted with the tense political situation that exists in Afghanistan. Again I would like to highlight the importance of education and the opportunity to pass on professional skills.

By analyzing the benefits of the 284 hip replacement cases completed through minimal invasive anterior approach (in peace time), the possibility of using the same technique under missionary conditions in extraordinary circumstances to treat injuries in the hip-joint area and provide post-operative care can be recognized. Thus a new operative technique, which is less invasive and traumatic than the traditional extensive approaches and has already been successfully implemented in a civilian setting with outstanding results, could enter the sphere of missionary surgery.

The method can be thus be used in a military setting even if the number of cases may not be as high as the ratio of these in the civilian sphere. However, no one can dispute that the total hip arthroplasty from posterior, minimal invasive approach is a topical issue.

THE SCIENTIFIC PROBLEM

Prosthetic hip operations via traditional approaches, which for decades have been successfully implemented in surgery and expanded in use, lead to significant post-operative pain. Due to the relatively large amount of blood loss, long hospitalization and rehabilitation period, the conduction of these operations is not feasible in a missionary setting.

Minimal invasive hip-joint arthroplasty has only recently joined the repertoire of orthopaedic surgery. After the initial marketing type introduction, the background and details of the procedure were elucidated and started to appear at academic forums and symposiums after 2003. Hungary did not lag behind other countries in the acceptance and introduction of the technique, which at the time was a great section topic at many national and international congresses. The technique caused a stir in the academic world, constituting a highly debated issue among both Hungarian and international authorities, with strong arguments both for and

against the procedure. Today the views have become more unified and positive. Indeed the technique has become common practice in most of the orthopaedic surgeries today.

The technique, which had been successfully employed among civilian patients and which answers a need that has been posed by missionary health associations encouraged me to complete research encompassing both traditional extended, and minimal invasive hip opening procedures and to prove the undisputed benefits of the latter method in contrast to the traditional one. With these studies I would also underline the fact that such procedures can be successfully adapted in the operative theatres of mobile, battle supporting hospitals.

AIMS

The academic aims drawn up by the study were the following:

1. The assimilation and analysis of data – both from Hungarian and international sources – on the topic of indications and minimal invasive and traditional approaches in total hip replacement surgery (osteoarthritis, fracture neck of femur).

Furthermore to collect data regarding the activities and achievements of Hungarian Military Musculoskeletal Surgeons involved in the provision of missionary healthcare.

2. Summary and evaluation of different techniques in traditional and minimal invasive hip-joint interventions.

3. Analysis of clinical results (own) from minimal invasive posterior hip-approach and the prosthetic hip operations completed with this method.

- a. Definition of technique.
- b. Study into the practicability of certain prosthetic types and fixing techniques.
- c. Discuss the applicability of the technique with relation to the patients' build and pathology type.
- d. Theoretical consideration of the adaptability of the technique in exceptional conditions, in missionary circumstances.

4. Comparison studies (own clinical research) between alloplastics performed using traditional and minimal invasive methods. Drawing on these results, I would like to prove that the clinical results yielded through the employment of the advanced technique do not lag behind those of the traditional method, indeed show extra benefits for the patient in terms of efficacy and being less traumatizing.

- a. Study of operation times, general contra-indications and average age.
- b. Evaluation of post-operative radiological data and positioning of prosthetic components.
- c. Explore possibility for mobilization and rehabilitation.
- d. Compare post-operative laboratory results.
- e. Discuss demand for transfusion, intra- and post-operative bleeding.
- f. Assess post-operative pain and patient satisfaction.

- g. Appraisal of duration of hospitalization.
- h. Discuss the applicability of comparative studies for missionary surgery.

Many of the above aims were postulated during the research process. The clinical study began in October 2003, following the attainment of the relevant theoretical and practical experience (the first prosthetic hip implantation operation via minimal invasive opening method was performed by Hungarian surgeons in the Central Military Hospital on October 17th 2003) and I finished my research work on 31st March 2008.

2. STRUCTURE, METHODS, HYPOTHESIS

STRUCTURE OF THE DISSERTATION

The paper consists of four parts.

In the **first chapter** I present those clinical scenarios (osteoarthritis and fracture neck of femur) in which the use of the minimal invasive posterior approach with one skin incision is possible.

I elaborate on the methods and their historical development, which has enabled the successful treatment of the above cases.

I describe the traditional surgical approaches since it is through these that the evolution of minimal invasive approaches of the hip could occur.

I present the area of missionary bone and joint surgery as part of a missionary health service, to which the topic of the dissertation can add value.

The **second chapter** examines the different types of minimal invasive approaches to the hip joint. The consideration of the advantages and disadvantages of alternative techniques allows me to justify the use of one cut posterior access in surgical practice.

In the **third chapter** I analyze the potentials of particular implants via application of the minimal invasive posterior approach.

I divide my research and comparative studies in this section into three parts. In the first, I look into those circumstances, which make it difficult, or even impossible to utilize minimal invasive techniques. In the second, I examine those characteristics that are common to both types of approaches. Lastly, I highlight the advantages of minimal invasive intervention.

Within this chapter I also draw attention to the different complications that can occur in both traditional and minimal invasive methods of surgery.

From this comparative study, I describe in further detail those positive results that could be utilized in the area of bone and joint missionary surgery.

I summarize the conclusions of my own research and the applicability of these, with special reference to the military sector in the **fourth and final chapter**.

RESEARCH METHODS

To carry out my research comprehensively, I adopted comparative and historical general research tools. To be more precise, the following devices give the scientific backbone of my work: examination, analysis, synthesis, comparison, induction, deduction, analogy, mathematical and hypothesis research methods.

I evaluated the environment in which the potential surgical interventions would take place through the analysis of the experiences gathered from military and humanitarian missions. I studied the evolution of surgical methods in the relevant historical periods associated with the professional and military applications. I noted the clinical practices adopted by colleagues in Hungary through the use of protocol, carried out consultations and scientific discussions and published papers to measure scientific approval. I followed a number of surgical cases from beginning to end and evaluated the duration of the healing process and the various phases this embodied. I drew conclusions on the effectiveness of the different methods of intervention through a comparative analysis.

HYPOTHESES

1. The reduction of surgical trauma experienced, blood loss, a reduction in hospitalization and fast rehabilitation are all important elements of the missionary and humanitarian action in all corners of the world. By acknowledging and putting these factors into practice, we improve the name and status of our military surgery.

2. The method involves decreased blood loss, less surgical trauma, fewer days spent in hospital and a speedier recovery compared to traditional methods, justifying its adoption in both civil and military surgery.

3. The potential for using implants does not differ and the indication for surgery – taking into consideration body build and past medical history – is not significantly narrower comparing to the traditional surgical approaches. The probability of occurrence of those clinical cases in the field of missionary surgery where the adoption of the technology is questionable is very low.

4. The probability of complications is not higher than for traditional methods, indeed in some cases there are fewer.

5. The advantages of this method identified and highlighted in my research can play a significant role in opening a new chapter in the practice of missionary musculoskeletal surgery.

3. INDIVIDUAL RESEARCH, RESULTS

For the study of the predetermined hypothesis, I took as a basis 284 minimal invasive cases carried out between 17th October 2003 and 31st March 2008 and the same number of randomly selected cases using traditional approaches for THR. These were carried out in the same time period.

The scientific evaluation included the study of all patients' (2 x 284) clinical data with particular attention afforded to the following areas: the past medical history, body mass index, age distribution, use of implants, type of fixing technique adopted, surgical time, the length of the incision for the intervention, the quantity of blood transfusion needed, length of hospital stay (limited to Hungarian hospital cases: 2 x 241) and the occurrence of complications. I analysed the check X-rays of 60 randomly selected patients from both groups (the position of femoral and acetabular implants), the amount of blood loss, pain and patient satisfaction measured on a visual analogue scale, the dosage of epidural pain killers and the length of time taken for rehabilitation. This process included the collection and analysis of the path lab results of 2 x 60 patients.

On the most part, the available literature, cited in chapters, regarding the minimal invasive group, compares the results of select patients displaying the following characteristics: young, motivated, thin and suffering from "anatomic arthritis", with the results of an average control group. Thus the value and objectivity of these results is questionable. The patient selection in my study was more balanced due to the detailed advantages of the minimal invasive posterior approach and the lack of limiting factors regarding applicability of this technique. The broader nature of the questions that I pose and study also ensures that the objectivity of my conclusions are more underpinned and the results derived from a larger numbers add value to existing literature.

For the purpose of achieving most scientific goals set, I evaluated the whole patient case material and in the case that I was only able to make use of a fraction of the clinical results in response to a certain issue, this is detailed in the respective sub chapter. The reduced patient case material was however sufficient to permit analysis and to draw valuable conclusions.

I divided the scientific questions that I dealt with into four parts, drew the respective conclusions and set up my thesis.

	Minimal invasive	Traditional
Clinical presentation	No difference noted	
Surgical techniques	Contraindicated in cases of potential acetabular augmentation and large deformities following osteotomies.	
BMI	No difference noted	
Type of obesity	If in lateral position, the greater trochanter is not palpable, not recommended.	

Factors minimally limiting the applicability of the technique.

During the course of my research I noted that there is little difference in the factors limiting surgery in both the case of minimal invasive one cut posterior and traditional anterolateral approach. We did not use the technique for revisions or for tumour cases. However, there is very little chance of these clinical presentations occurring in a missionary environment, thus were not relevant to the focus of the paper. It is clear that in cases such as potential acetabular augmentations and large deformities due to acetabular osteotomies, minimal invasive techniques are applicable. Such cases are rarity and in the control group there was only 1 case, (0,3 %) in which acetabular augmentation has been performed. Being overweight can also be viewed as a limiting factor, in that it contributes to the greater trochanter not being able to be felt when the patient is on their side, however contrary to other minimal invasive interventions, the body mass index is in an absolute sense not a decisive factor. The prevalence of the listed limiting factors in the missionary environment is insignificant.

	Minimal invasive	Traditional
General contra indications	No difference noted.	
Age	No difference noted.	
Type of implant	No difference noted.	
Fixing technique	No difference noted.	
Post surgery radiological analysis	No difference noted	
Surgery times	No difference noted.	

Factors, where there are no differences in the two techniques, neither in peace or special time.

After examining the outcomes from the implanted hip prosthesis via both the minimally invasive one incision posterior and traditional anterolateral approaches, it was apparent, that from the perspective of general contra indications, age distribution, type of implant used and fixing technique adopted there was no difference between the two methods. It is possible to use the method to implant hemiarthroplasty, which is particularly relevant for

the treatment of fracture neck of femur in the older age group. The advantages of minimally invasive surgery have special significance in the treatment of older patients in a generally poor condition. The primary application of the technique in the missionary environment could also be foreseen in the surgical treatment of fracture neck of femur. My analysis of the post operative X-Rays did not reveal a significant difference between the positioning of the acetabular and femoral component despite the different intervention methods. The surgical times did not show a significant difference either. (When considering the outcome from the minimal invasive group I did not include the data from the first 60 patients since it is not fair to compare the results from interventions from the learning phase with those from a well practiced method.)

	Minimal invasive	Traditional
Average length of cut	7,6 cm	21,3 cm
Average reduction of haemoglobin	19,2%	27%
Average reduction in haematokrit levels	18,2%	25,6%
Average CK level on 1. po. day	859,3 U/l	1704,4 U/l
Average CRP level on 3. po. day	100,46 mg/l	163,1 mg/l
Average blood loss intraop.	436 ml	518 ml
Average blood loss postop.	578 ml	829 ml
Total average blood loss	1014 ml	1347 ml
No. of patients receiving transfusion	89	143
No. of blood units given	188	312
Average level of pain (according to VAS) on 1. po. day	5,3	6,8
Reduction of gluteus medius power 2. week		-23,1%
Reduction of quadriceps power 2. week		-35,3%
Average level of patient satisfaction (according to VAS)	9,3	8,9
Average length of hospital stay	7,2 days	11,1 days

Advantages that can be exploited in missionary bone joint surgery.

My study allowed me to conclude that the length of the surgical cut from a minimally invasive posterior approach is significantly shorter. From the blood tests it is apparent that the drop in haemoglobin and haematokrit levels is smaller, the increase of creatinin-phosphokinase (CK) levels is more discrete and the decline in C-reactive protein (CRP) levels minimally faster. With the patients, where the minimally invasive surgical method was adopted the volume of blood lost was smaller, the need for blood transfusions was lower. Pain levels measured on a visual analogue scale were lower and rehabilitation took place faster. Patient satisfaction levels were also higher. The length of hospital stay was much shorter. The practical advantages stemming from later revisions cannot be shown through any parameter, so this question remains one of a theoretical nature. The aforementioned advantages may have an even more significant role to play in the missions.

	Minimal invasive	Traditional
Haematoma requires drainage	0	4 (1,4%)
Confirmed thromboembolic event	4 (1,4%)	6 (2,1%)
Nerve lesion (temporary)	4 (1,4%)	6 (2,1%)
Nerve lesion (permanent)	1 (0,3%)	0
Fractured femur	3 (1%)	4 (1,4%)
Acetabular defect	3 (1%)	3 (1%)
Loosening of acetabular component	2 (0,7%)	1 (0,3%)
Dislocation	3 (1%)	4 (1,4%)
Deep infection leading to revision	0	4 (1,4%)

Complications which do not limit the missionary applicability of the method.

Following an evaluation of the complications arising from the two different intervention methods, I can conclude that general complications (haematoma, thromboembolia) occur more often (although with little difference) in the cases when the traditional intervention method was adopted. There is no significant difference between the numbers of specific complications either, only a few from these can be labelled as method-specific. Septic complications were also more common in the case of the traditional surgical approach, however the number of cases affected was again very low.

4. SCIENTIFIC RESULTS

My research was carried out using comparative analytical methods, taking into consideration the decisive factors in the area, opening the possibility to further analysis of a similar nature.

1. By examining a large sample (2 x 284 patients) – based on the finding using appropriate scoring systems – I have proved, that my preferred method of minimal invasive hip surgery, which results in a shorter incision, lower level of surgery related trauma experienced, lower volume of blood loss and quicker rehabilitation – factors which are particularly determinate in field hospital environment – is more successful than a THR using traditional surgical approaches.

2. I have developed criteria and methods for a comparative analysis of musculoskeletal surgery in a field hospital environment, which enabled the evaluation of the advantages and disadvantages of surgery carried out through both the traditional and minimally invasive methods.

3. I proved that the method can be effectively applied by the personnel of Hungarian Armed Forces in their missionary activities (humanitarian and multinational peace efforts) and offers a new opportunity.

4. I detailed the conditions to enable the Hungarian Army Medical Services to be equipped with the necessary personal, technological and methodological skills, which they can use in the treatment of both civilians and military personnel.

RECOMMENDATIONS FOR THE USE OF MY OWN SCIENTIFIC RESULTS

Through the course of my research I have been able to ascertain that the completion of a total hip replacement through a minimally invasive one incision posterior approach, a very successful method already widely used in traditional circumstances, is limited by few factors. I verified that the age distribution, the type of implant and fixation technique used, the radiological results and the length of surgery do not differ from the traditional method. The superiority of the technique in comparison to the traditional alternative is clear given the following measures: the incision required is much smaller, surgery related trauma and pain experienced are lower, less blood loss, fast rehabilitation, hospital stay is shorter and complications, albeit minimally are less likely to occur. Thanks to the results of this study and the number of hip implants I have carried out through the minimally invasive posterior approach, the method is applicable in the operating theatres of the modern Role III., mobile military hospitals. In our country, in the military health care establishments, we have the adequately trained professionals to provide the treatment. We have the professional as well as technological background, to be able to pass on this knowledge to the local doctors and health care staff. This opens new dimensions for the potential surgical treatment of various conditions in the framework of missionary musculoskeletal surgery, and new type of surgical procedures can enter the weapon stock of Army Medical Services.