Clinical and experimental assessment of the anterior hip approach and the capsule

Ph.D. Thesis

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Introduction

In medicine, surgery methods to replace large joints have a history of many decades. Prior to shoulder, hip, and knee replacement surgeries, cures could only be cured by sacrificing the joints if the joints are associated with advanced disease. The sacrifice of the large joints has been associated with loss of function, and thus the restriction of movement, which is the presence of a viable quality of life. These joint sacrificial interventions suffer from a limitedly known science, a lively lifestyle, and after its healing, with the shortening of the limb, the lack of movement speech, the lack of load capacity, the multitude of those who have been involved, and the reason for its integration.

Large joint interventions that replace or replace a joint appeared in everyday practice more than 50 years ago. Of the highly successful interventions, many millions of surgeries are performed worldwide each year. A major advantage of prosthesis implantation over previously used methods is that the affected limb remains loadable, does not result in loss of function, and joint movements are retained as the patient's painful symptoms cease. In terms of implanted implants, surgical techniques and pain relief rehabilitation around surgery, prosthesis implants (endoprosthetics, prosthetics) show continuous development.

Application of hip joint excavations in traumatology

"Not as deep as a well, not as wide as a church door, but well enough for me" (Shakespeare, Romeo and Juliet)

Several techniques are known for approaching the hip joint. Most commonly, we use three approaches in traumatology: 1. posterior approach, 2. lateral approach, 3. anterior approach.

During posterior approach, the hip joint can be approached between the muscle fibers of the large pharyngeal muscle by detaching the chirator muscles and opening the posterior capsule. The extended Kocher-Langenbeck excavation of this excavation is suitable for the reconstruction of the posterior wall of the acetabulum. The excavation provides good visibility, the excavation can be easily extended if necessary.In Hungary, the approach is mainly used for the treatment of acetabulum fractures and the necessary prosthesis implants. Care should be taken to protect the sciatic nerve during excavation. A common complication

is posterior prosthesis sprain, which can be reduced by reconstructing the capsule and chirators and adjusting the appropriate ventral anteversio, stem antetorsio, proper inlay, and offset. With proper preoperative planning, the risk of sprains can be reduced, regardless of exploration. In the USA and Anglo-Saxon orthopedic surgery, this excavation is considered a gold standard during prosthesis implants.

Lateral approach (anterolateral / ALA /, direct lateral, transgluteal) became widespread in German and Hungarian orthopedic surgery. The surgery is performed by lifting the hip to be operated on, the surgery can also be performed in a supine position. During the operation, the tendon part of the tensor fasciae latae is incised lengthwise, and the abductor muscles are usually and partially detached. These abductor muscles play a significant role in the stability of the hip joint and pelvis, so their protection or reconstruction is essential for later functional outcomes. Insufficient functioning of the abductor muscles leads to Trendelenburg's symptom and “duck-walking”. Surgical excision provides the surgeon with good visibility and easy extensibility.

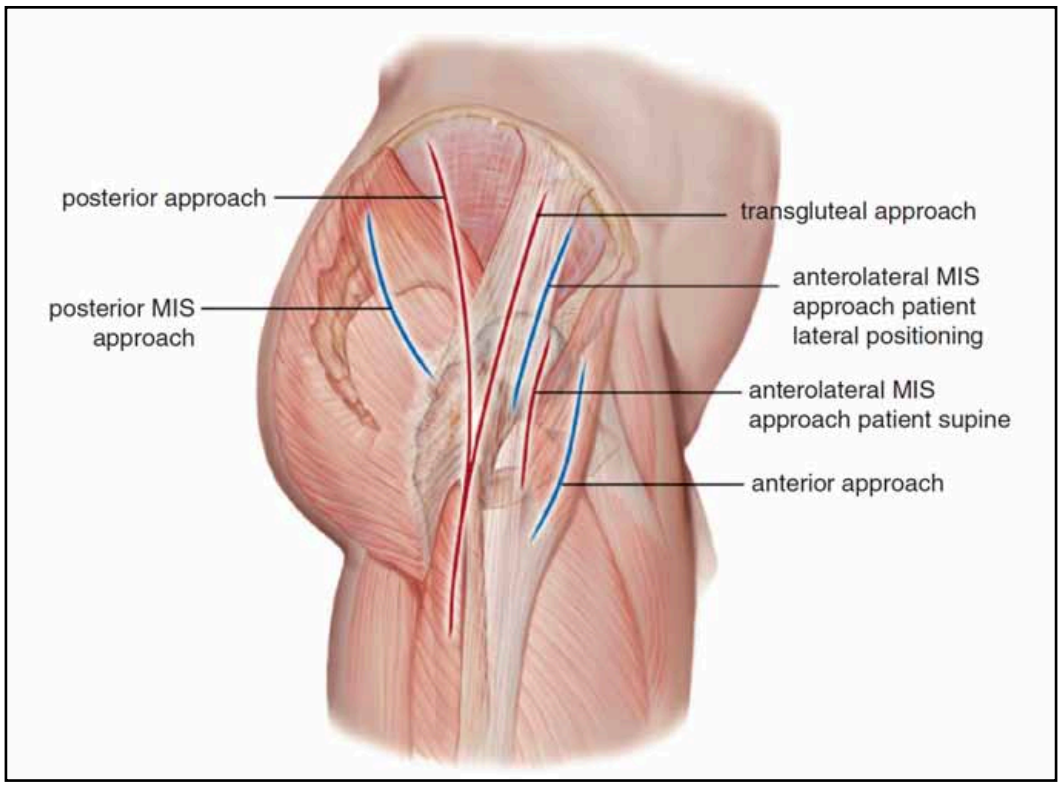

Figure 1. : most common hip approaches in othopedics and traumatology

During anterior or anterior (DAA) direct anterior approach, the hip joint can be approached in the anterior-lateral part of the hip joint, between the abdominal muscles. Compared to all excavations, the proportion of anterior excavations has increased significantly in the last 20 years in prosthetic implants with an orthopedic indication. The main advantage of the method is that the hip joint can be held with hooks placed between the muscle abdomen so that they are not detached, i.e. the muscle sheath around the hip joint remains intact. The patient experiences this in the form of less pain and faster early rehabilitation.

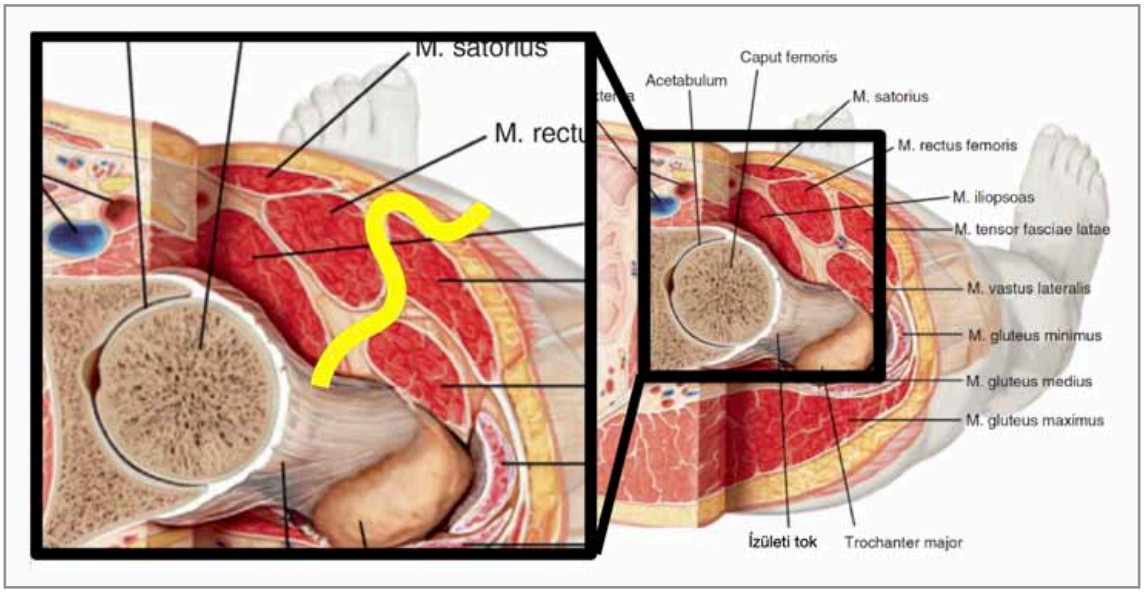

Figure 2. : anatomy of the hip joint and muscles, the yeloow line shows the anterior approach

DAA requires the use of modified exploration hooks, possibly the use of an extension table. Visibility is narrower, but extensibility is already surgically developed. The patient is lying on his back, so intraoperative radiological control may result in better positioning. Prosthesis is rare, and duckwalking is less common in patients. In obes patients, subcutaneous adipose tissue is the thinnest here, however, superficial wound healing disorder occurs due to skin sensitivity and relative thinness. A common complication was injury to the lateral femoris cutaneus (NCFL), which was associated with transient femoral numbness, however, the frequency of this complication could be reduced by lateralizing the surgical incision.

Research field

At the Department of Traumatology and Hand Surgery of the University of Pécs, in 2015 we started performing hip prosthesis implants from anterior excavation. The anterior exploratory surgical technique created an opportunity to perform our hip prosthesis implants even while retaining the joint sheath.

There is a long-standing research relationship and work between our clinic and the DSC working group of the Institute of Biophysics. Numerous researches have been conducted in recent years on various musculoskeletal disorders using calorimetric methods.

TIOP-2.2.2-08 / 2-2010-0001 “Janus Pannonius Emergency Program - Modern Emergency Care in the Historical Region” and TIOP-2.2.7-07 / 2F / 2-2010-0001 “Janus Pannonius Program - Modern Thanks to the refurbishment and equipment acquisition of a 400-bed clinic under the Healthcare in the Historic Region ”projects, the Department of Traumatology received a fully carbon extension operating table supplement developed for hip surgeries with anterior hip arthroplasty. Together with this and the implant instruments purchased, it became possible to apply this technique in everyday clinical practice.

In collaboration with the Institute of Pathology of the University of Pécs, we initially acquired proficiency in cadavere surgery using the technique without muscle incision. Already during cadaver surgeries, it has become apparent that the sheath of the hip joint, which is removed during routine surgeries, plays a significant supporting role in terms of the stability and range of motion of the hip joint. (7137- PTE 2018)

In our curative activity, we gradually began to introduce the method. Following the recommendations of the “learning curve” well known in the literature, resection arthroplasties (Girdlestone surgery) from anterior incision were performed in the first step. In the next step, simple prosthetic implants with orthopedic indications were performed under designed conditions. Once we gained routine in primary and planned prosthesis implants, we began to perform both posttraumatic and acute prosthesis implants from this exploration. After reaching the appropriate number of cases, we also performed our complex traumatic cases

from this surgical exploration. Of course, in our clinic, both lateral and posterior exploration remained in everyday practice, anterior exploration was and is only used as an alternative to hip joint approaches.

After obtaining the appropriate number of cases and routine, we delved into anterior hip surgery and the examination of the hip joint as an area of our clinical research.

We received a research ethics permit for our further research entitled “The role of retention of the hip joint capsule in the stability of the hip prosthesis” submitted to the Regional and Institutional Research - Ethics Committee of the University of Pécs. (Case number: 7137-PTE 2018)

In the 2019 application submitted to the research fund of the University of Pécs, ÁOK-KK Collaboration Fund (ÁOK-TANDEM), Dr. András Pintér received a grant of HUF 2,000,000 for research in the field.

Completed research was conducted in two main areas:

1. Thermodynamic investigations of the hip joint in connection with primary hip surgeries diseases or revision surgeries for pseudotomes
2. Evaluation of our clinical experience with bipolar hemoprosthesis implants retrospective methods.

The hip capsule is a structure that completely surrounds the walnut joint, the outer part of which is covered by the ligament system of the hip joint, the inner part plays a role in the production of synovial fluid in the hip joint. Our clinical observation was that this joint capsule may show a macroscopically different structure in different hip joint diseases. Our general observation was that in inflammatory processes, the thickness of the hip joint capsule increased. During revision surgeries, we encountered a specifically scarred hip capsule.

In our patients with hip prostheses operated by anterior approach, we found that their early mobilization was faster, their initial functional results were better, they needed to use an assistant for a shorter time, and they complained less about pain.

During our calorimetric examinations, in connection with hip prosthesis implantations - approaching the joint from anterior excavation - we took samples from the front of the sheath in a size of 4x4x8 mm. These samples were submitted under standardized conditions to calorimetric and histological examinations at the Institute of Biophysics and Pathology of the University of Pécs. Calorimetric examinations were performed with a SETARAM Micro DSC-II calorimeter, and histological examinations were performed with hematoxylin-eosin staining.

For anterior approach, we examined our femoral neck fracture patient material over an 18-month patient enrollment period, comparing lateral and anterior exploration in the postoperative period. The high number of cases and standardization provided an opportunity to compare the two surgical techniques groups based on the effectiveness and functional outcome of the exploration.

Objectives

1. As an experimental research, we wanted to study the changes of the hip joint capsule in different diseases by thermodynamic methods, to set the calorimetric standards for physiological and primary hip diseases, which have not been included in the international literature so far.

2. As a further basic research, we wanted to investigate the forms of hip joint pseudots in different diseases, to analyze them with thermodynamic and histological methods and to set the calorimetric standards of the pseudots.

3. As a clinical research, we wanted to analyze the postoperative experience with bipolar hip arthroplasty with anterior and lateral exploration.

4. Taking into account the change of approach in hip arthroplasty and the patient-centered re-evaluation of hip arthroplasties, we wanted to present anterior hip arthroplasty, its applicability and extensibility in relation to accidental prosthesis implants.

Study of anterior bipolar hip replacement in elderly femoral neck fractures

Based on our clinical protocol, we perform bipolar hemoprosthesis implantation for the treatment of medial femoral neck fractures with age-related displacement. Anterior (DAA) and anterolateral (ALA) excavations are used most frequently and routinely for this prosthetic surgery.

During anterior approach, the hip joint can be approached by preserving the muscle. Based on literature data, this exploration is beneficial due to the acceleration of postoperative pain and rehabilitation in patients with total hip replacements in hip wear cases. Patients with femoral neck fractures are elderly, often in poor general condition, and their rehabilitation is challenging in many cases.

We compared whether, in terms of hip prosthesis, this difficult-to-treat patient material has the advantage of anterior hip exploration over anterolateral exploration in intra- and postoperative terms. We examined the amount of bleeding during and after surgery, the time of surgery, the pain level of patients (VAS) in the postoperative period, the need for transfusions, the degree of mobilizability in the postoperative period, the need for rehabilitation hospitalization, and functional outcomes at 2, 6 weeks, and 3 months.

Evaluation of experience:

Most of the blood loss during surgery comes from the medullary cavity, in addition to anterolateral excision, we encounter bleeding from cutting through the muscles, which does not occur during anterior excavation. Accordingly, postoperative blood loss also comes primarily from the marrow and musculature. In our study, we found no significant difference in the amount of blood loss between the two groups studied. Although the frequency of transfusions was higher in the anterolateral case, the surgical outcome of this could not be verified.

Examining the time of surgery and the time spent in the operating room, we concluded that pure surgery takes a similar amount of time in the two groups, however, in the case of anterior approach, preparation for and removal from the extension table increases the time spent in the operating room. time. However, this period does not increase the surgical burden on the patient, it can only be assessed as a longer time in terms of work organization.

The pain detected at 6 and 12 hours postoperatively can be attributed to immediate postoperative pain. This pain could be controlled in a significant proportion of cases without the use of opiate-based analgesics. In the postoperative days, we found that pain in the anterior group decreased more rapidly and to a greater extent with a similar analgesia protocol, which is probably due to the surgical technique. In the case of anterior excavation, the muscle is held only by hooks, while in the anterolateral case, a part of the muscle is cut or detached. Reconstruction of this muscle is done with sutures, the active use of the muscle creates tension, thus generating pain in the patients in the postoperative period. Importantly, the tendon part of the tensor fasciae lata is not affected by anterior excavation, and tension in this part of the tendon can cause pronounced pain during movement in the postoperative period.

There is an association between pain reduction and better early functional outcomes, with patients with less pain also performing better during physiotherapy. In the case of anterior exploration, nothing happens in the muscles other than contusion-type injury, i.e., the function of the muscles is almost complete from the moment after surgery. This functional surplus may explain the fact that cases operated with anterior exploration meet the conditions for repatriation earlier in terms of their mobilization.

We also found a difference between the two groups in terms of rehabilitation needs, but in addition to their illness, a number of social factors were also decisive in the patients' decision. However, we observed that in the anterior group, those who had adequate conditions for home rehabilitation preferred home recovery rather than hospital rehabilitation.

The Harris Hip Score was used for functional evaluation of the hip joint. In calculating the baseline value, the patient's condition before fracture and the status of the contralateral hip joint were taken into account, and a value of around 95 was obtained in both groups. In the

temporal evaluation of HHS, we found that we obtained significantly better results in the 2-week and 6-week studies of patients undergoing anterior exploration, but this large difference was already significantly reduced for the 3-month control. This is explained by the fact that from 6 weeks onwards, the scarred muscles regained their function in the anterolateral group as well.

In the anterolateral group, we found a larger number of limb length differences, which may be due to the temporary instability of the hip joints due to muscle detachment and the difficulties of control due to laying. During anterior hip arthroplasty, the patient lies on his back, no highlighting is placed under his pelvis, so the limb length can be precisely adjusted intraoperatively with greater safety, and the joint remains stable even with a shorter prosthesis head due to the tensile force of the muscles.

Limping can be caused by numerous factors: muscle weakness, limb length difference, pain, impigement, etc. We found a difference in the frequency of limping between the two surgical approaches, the anterior hip prosthesis heals with better function in terms of limping, in the background of which the m. tensor fascia lata ,, a m. gluteus medius and minimus (adductors) may be due to lack of functional separation.

Summary of experiences:

Like anterior TEP surgeries for degenerative hip diseases, anterior HEP surgeries in patients with femoral neck fractures can be performed safely. Implantation of a bipolar hemoprosthesis with an anterior, non-muscular technique allows the patient to mobilize faster and experience less pain compared to the anterolateral technique, which involves shorter hospital stays, less need for hospital rehabilitation, and short-term functional outcomes for patients. Anterior excavation allows for more accurate limb length adjustment and less frequent duck walking by patients after surgery. Although functional differences between anterior and anterolateral excavations are virtually eliminated by the 3rd postoperative month, for this elderly, poor general condition patient population, the period immediately following surgery is the greatest challenge for recovery. This postoperative rehabilitation period may be facilitated by anterior hip arthroplasty during implantation of bipolar hemiportesis.

Anterior hip exploration is a safe method of care for patients with femoral neck fractures that, like degenerative hip TEP implants, can accelerate patient rehabilitation in the postoperative period. Less pain and easier mobilization help these patients live longer before their injury after a shorter period of time.

Experience with extensibility of anterior hip joint exploration

If a new method is introduced in everyday practice, there will be numerous concerns about the applicability, safety, complication and risk factors of the method in the initial period. These concerns have a place in medicine, and getting to know and addressing them makes the method suitable for everyday use.

In our department, we have performed a significant part of the primary prosthesis implantations from anterior exploration in the last 5 years. In terms of indication, we also performed orthopedic and traumatological cases from this exploration.

In the following, I would like to present, through case studies, which complex traumatological cases are suitable for DAA exploration extension. All surgeries were performed on an extension table, using an image intensifier, using an anterior exploration technique:

1. Manninger screw OS post-dislocation
2. Dislocation after PFN-A
3. Complication after hemoprosthesis implantation
4. Two-step revision of periprosthetic infection
5. Revision of stem loosening, periprosthetic fracture and insert wear
6. Treatment of a complex orthopedic-traumatology case
7. Cut-out syndrome after gamma nailing
8. Surgical treatment of head fractures after long nailing
9. Surgical treatment of DHS post-traumatic coxarthrosis
10. Fracture of a hybrid prosthesis and treatment of a Vancouver type B fracture
11. Surgical care of dislocation after DHS synthesis
12. Surgical treatment of femoral head fractures after femur medullary nailing

Experience with thermodynamic examination of the hip joint capsule

The hip joint capsule plays an important role in the functioning of the hip joint: it stabilizes, protects the cartilage, participates in the coordination of hip movements with its proprioceptive reflexes and produces synovial fluid. Prosthetic surgeries can also be performed by removing the sheath (capsulectomy) or by holding the sheath (capsulotomy). During these surgeries we can see the difference in the tension, the thickness, the thickness of the synovial layer, the amount of synovial fluid and the strength of the capsular system even macroscopically. The secondary or pseudotox shows a macroscopic image similar to the primary hip joint capsule, although it appears much stronger, tighter than the original joint capsule. Its role in stability is also probable because the frequency of hip joint luxation decreases 6-12 weeks after surgery, and in revision surgeries the prosthesis cannot be spliced in many cases without the removal of pseudotomes.

Differential scanning calorimetry has already proven to be a good test method in many degenerative and inflammatory musculoskeletal disorders.

In the first stage of our studies, we performed thermodynamic examination of normal (femoral neck fractures), head necrosis and coxarthrosis, inverted femoral neck fractures and revision joint sheaths.

Samples were taken from the anterior capsule of the hip joint in a size of 4x4x8 mm, purified from pericapsular adipose tissue, blood, and synovial fluid, wiped dry, and frozen in a native tube until the calorimetric assay.

Thermal parameters (Tm, maximum denaturation temperature, and mass-normalized calorimetric enthalpy change, H: Jg-1) were examined with a SETARAM Micro DSC-II calorimeter in the range of 20–90 C at a heating rate of 0.3 Kmin-1.

Thermodynamic curves for different hip joint diseases were analyzed in a coordinate system. The exact thermodynamic parameters (Tm, maximum denaturation temperature, and mass-normalized calorimetric enthalpy change, H: Jg-1) are summarized in the table. When comparing the DSC curves and parameters, the denaturation curves showed characteristic differences in each disease. Denaturation curves also showed a specific, characteristic change in joint sheaths taken from different hip joint diseases in cases of abrasion, avascular

headache, and femoral neck fractures. The thermal enthalpies of OA and AVN show a slight increase compared to the hip sheaths of fracture cases.

In comparison, there is a noticeable difference between OA vs. Among AVN results (Tm (° C) OA: 64.5 ± 0.4 and AVN: 65.3 ± 0.5 vs. AFX: 64.7; ΔHcal (J / g) OA: 8.9 ± 0.4 and AVN: 8.3 ± 0.4 vs. FX: 9.4). It is important to note that there is a significant increase in the thermal characteristics of inverted femoral neck fractures compared to fresh femoral neck fractures. (Tm (° C) IFX: 63 vs. AFX: 64.7; ΔHcal (J / g) IFX: 5.7 vs. AFX: 9.4). In addition, the thermal characteristics of the pseudotypes and fibrous lesions showed similar thermodynamic differences to healthy (fresh femoral neck fractures) cases. (Tm (° C) PSC: 63.5 ± 0.4 vs. AFX: 64.7; ΔHcal (J / g) PSC: 6.8 ± 0.3 vs. AFX: 9.4).

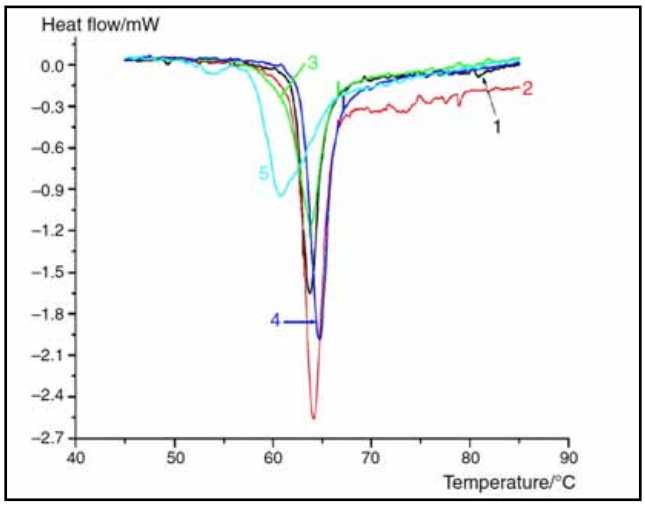

Figure 3.:Thermal denaturation curves of samples listed in Table 1. The data are mean and SD (standard deviation) only in case where n C 5. The calorimetric enthalpy change is normalized to sample wet mass. Endotherm is downward deflection

Table 1 Denaturation parameters of joint capsule samples collected during hip surgeries performed with different orthopaedic indications

Diagnosis	Thermal parameters	
	T_m/°C	ΔH_{cal}/Jg^{-1}
1. Acute femoral neck fracture (in the first 48 h) (AFX)	64.7	9.4
2. Primary hip osteoarthritis (OA)	64.5 ± 0.4 (n = 5)	8.9 ± 0.4
3. Avascular head necrosis (AVN)	65.3 ± 0.5 (n = 6)	8.3 ± 0.4
4. Inveterate femoral neck fracture (IFX)	63	5.7
5. Pseudo-capsule after revision arthroplasty (PSC)	63.5 ± 0.4 (n = 5)	6.8 ± 0.3

T_m stands for maximum temperature of denaturation and ΔH for calorimetric enthalpy change, normalized to the sample mass (SD, standard deviation, was calculated only in case when the number of samples was $n \geq 5$)

In the second phase of our research, we examined the thermodynamic changes of pseudotases in secondary hip surgeries, which were supplemented with histological examinations.

After the prosthesis is implanted, the artificial joint is surrounded by a scar of connective tissue, this is called a pseudote.

Calorimetric studies followed a protocol similar to the primary capsules. For histological examinations, samples were fixed in 4% formaldehyde solution. Samples were cut to size, dehydrated, embedded in paraffin, cut into 4 micrometer slices with a microtome, and finally stained with hematoxylin-eosin.

Samples found at aseptic relaxation were found to be cell-poor and collagen-rich tissue without signs of inflammation. histological images found in septic lazula were found to be richer in cells with focal inflammatory areas and macrophages. After spacer implantation, the pseudotases of the samples mostly contained cells rich in cell-poor fibroblasts.

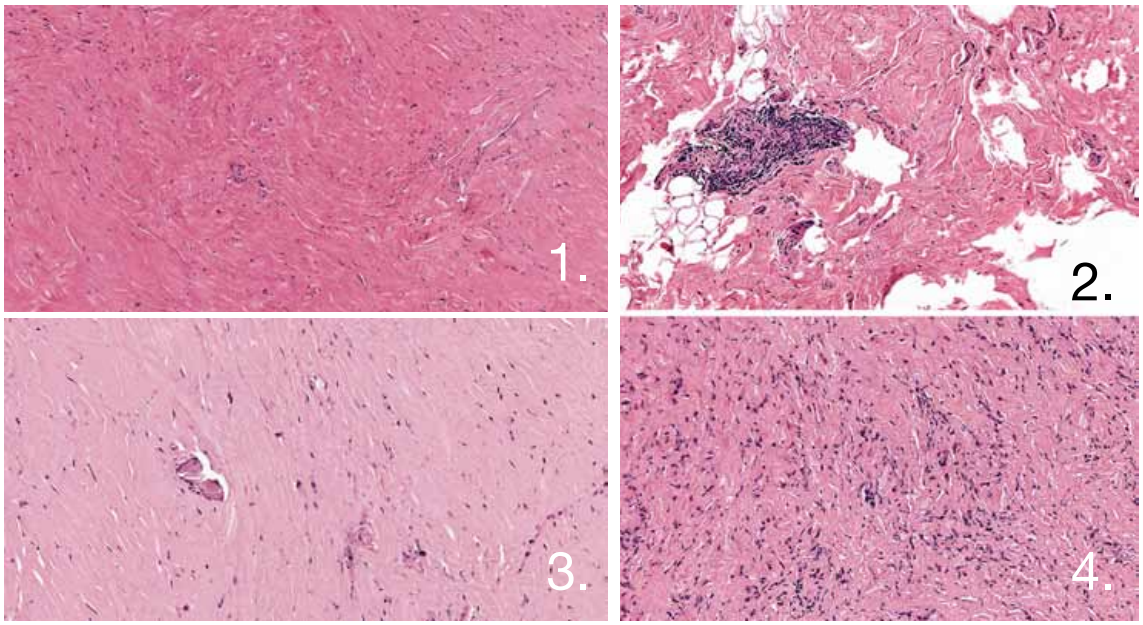

Figure 4.: histological images with stained with hematoxylin-eosin, 1 and 4 are aspetic loosening, 2 is septic revision and the 4 is with antibituc

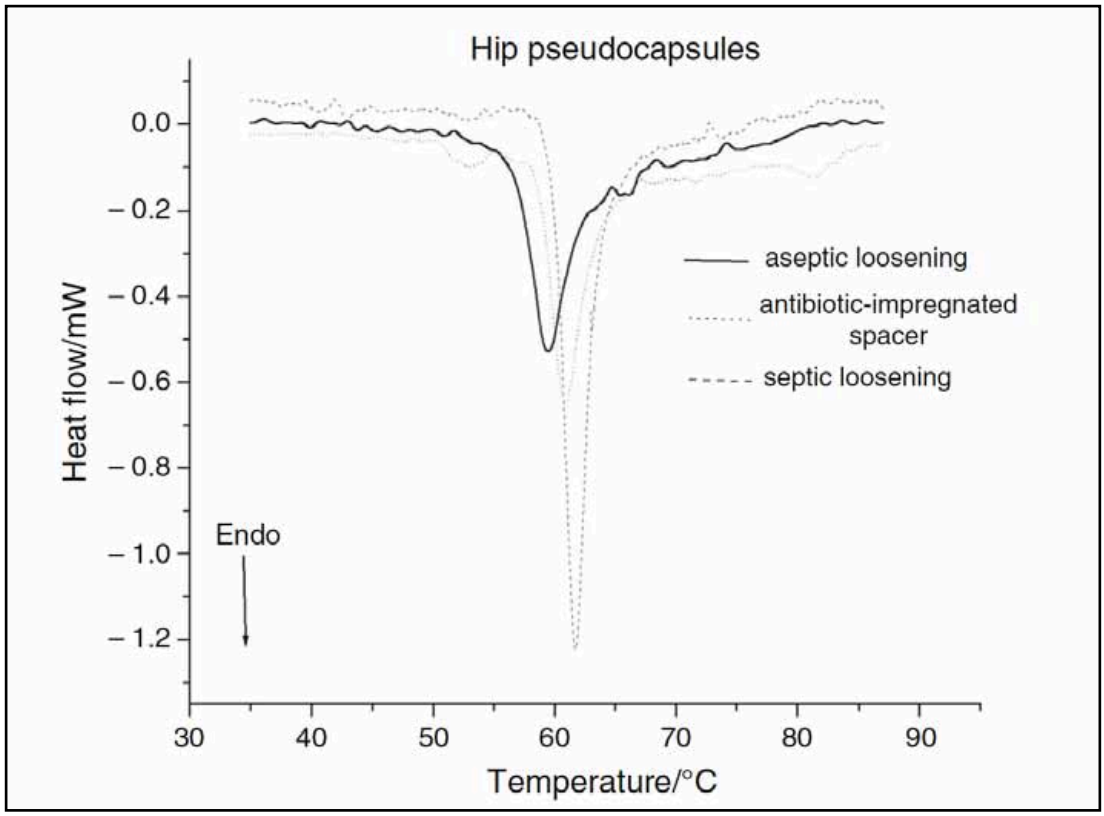

Figure 5: DSC scans of hip pseudo-capsules. Symbols: solid line: aseptic loosening, dotted line: effect of antibiotic-impregnated spacer and dashed line: septic loosening. The curves are averages (Table 2), and endotherm deflection is directed downwards

Sample	Thermal parameters	
	T_m/°C	ΔH_{cal}/J g^{-1}
Aseptic loosening (n = 3)	60.85	4.28
Antibiotic-impregnated spacer (n = 3)	60.02	3.40
Septic loosening (n = 2)	61.53	2.33

Table 2: Maximal denaturation temperature (T_m) and mass-normalized calorimetric enthalpy (DH_{cal}) of hip pseudo-capsules (data show average values, rounded to two places)

Summary, new results and findings

The hip joint case is an important gear in the functioning of the hip joint. In addition to its stabilizing and proprioceptive function, it optimizes the sensitive role of the hip joint in movement by producing synovial fluid.

In various primary hip diseases, the iliac capsule changes, which can be well detected in calorimetric studies. Similar changes can be seen in the pseudotockets of already operated hip joints and recorded by DSC examination. These differences also correlate with the changes found in histological examinations. Standards for calorimetric curves for each hip patient were determined.

There is a strong correlation between the thermodynamic changes measured with a calorimeter in the hip joint in different hip diseases, and in different diseases these DSC curves are well reproducible. Calorimetric capsule studies can help establish a correct diagnosis in clinical practice due to the specificity and sensitivity of the procedure.

At the Department of Traumatology and Hand Surgery in Pécs, we managed to introduce hip prosthesis surgeries with anterior exploration and apply them in everyday practice. Anterior hip excavation is a good alternative to the now common anterolateral, lateral, and posterior excavations. Elderly patients may benefit from using this method in hopes of less surgical strain, less pain, and faster rehabilitation.

Our patient population operated on CN bipolar hemiprosthesis for anterolateral and anterior exploration was surveyed. In addition to faster mobilization, less pain, and a faster improvement in Harris Hip Score, we found significantly better results in limb length adjustment and Trendelenburg gait image than in anterior exploration.

In addition to simple hip prosthesis implants, we also started to use the anterior approach in our complex care services, which we could safely use in our patient care. Even in the case of these complex services, we experienced faster mobilizability for the patient.

Acknowledgments

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List of publications:

Publication related to the thesis:

1. **Bűcs G**, Nöt LG, Dandé Á, Wiegand N, Lőrinczy D. Detection of joint capsule changes by differential scanning calorimetry (DSC) in different types of hip disorders to evaluate surgical techniques (a preliminary report). *Journal of Therm Analysis and Calorimetry 2017; https:// DOI10.1007/s10973-017- 6455-5.* ***IF: 2.209***

2. **Bűcs G,** Nőt LG, Dandé Á, Kereskai L, Lőrinczy D. Calorimetric examination of hip pseudo-capsule after secondary hip surgeries. *Journal of Therm Analysis and Calorimetry (2019) 138:397–400 https://doi.org/10.1007/s 10973-019-08152-5* ***IF2018: 2.471***

3. **Gábor Bűcs**, Árpád Dandé, Balázs Patczai, Andor Sebestyén, Róbert Almási, László G Nőt, Norbert Wiegand. Bipolar hemiarthroplasty for the treatment of femoral neck fractures with minimally invasive anterior approach in elderly. *Injury - International Journal of the Cared of the the Injured, February 27, 2020;7:13, DOI: https://doi.org/10.1016/j.injury. 2020.02.053* ***IF2018: 1.834***

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5. E. Joshua, S. Kovács, **G. Bűcs,** I. Boncz, A. Sebestyén, A. Zemplényi. Economic evaulation of anterior approach of total hip arthroplasty in a tertiary hospital setting in Hungary: a cost minimization study. *Value in Health 21:S297, October 2018, DOI: 10.1016/ j.jval.2018.09.1772* ***IF: 5.037***

6. **Bűcs G,** Nőt LG, Dandé Á, Wiegand N, Lőrinczy D. Introduction of differential scanning calorimetry (DSC) in the diagnostics of joint capsule damages. *European Biophysics Journal 2017;46 (Suppl1):S327.* ***IF:1.935***

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List of presentation on conference, related to the thesis:

1. **Bűcs G.** Nőt LG, Dandé Á, Wiegand N, Lőrinczy D. Detection of joint capsule changes by differential scanning calorimetry (DSC) in different types of hip, *Calorimetry Conference and 6th V4 (Joint Czech-Hungarian-Polish-Slovakian) Thermoanalytical Conference June 6-9, 2017 Budapest, Hungary.*

2. **Bűcs Gábor,** Patczai Balázs, Naumov István, Wiegand Norbert: Izomátvágás nélkül végzett anterior csípőprotézis beültetés - combnyaktörés esetén, *Magyar Traumatológus Társaság 50 éves Jubileumi Kongresszusa, Budapest, 2016.szeptember 1-3.*

3. **Bűcs Gábor**: Hueter-féle csípőízületi feltárás alkalmazása a baleseti sebészetben, *A Magyar Traumatológus Társaság 51. Kongresszusa, Pécs, 2017.09.14-16.*

4. **Bűcs Gábor**: Az izomátvágás nélküli, elülső csípőfeltárás rehabilitációs jelentősége a mozgásszervi sebészetben, *MOHE 19. Kongresszusa, Pécs, 2017.10.25-27.*

5. **Bűcs Gábor**, Zimonyi Ákos, Wiegand Norbert: Szövődményes traumatológiai esetek ellátása anterior csípőfeltárásból, *XXIV. Dél-Magyarországi Traumatológus Kongresszus, Békéscsaba, 2019. május 31-június 01.*

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7. **G. Bűcs**, LG Nőt, Á. Dandé, N. Wiegand, D.M. Lőrinczy: Introduction of differential scanning calorimetry (DSC) in the diagnostic of the joint capsule demages, *19. IUPAB and 11 EBSA Congress, Edinburgh, Scotland, 16-20 July, 2017.*

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