1. INTRODUCTION

Out of all diseases and hip injuries, most surgical medical, social and economic difficulties are created by femur neck fractures (FNF), their frequency is increased by age, most often with persons above 65 years of age. (1)

Hip joint replacement, which enables painless and functional joint, is one of the greatest achievements of modern medicine. Type of prosthesis that is implanted is adjusted to each individual patient and depends on his/her age, cause of damage, hip condition (2, 3). Most common surgical approaches used for hip endoprosthesis nowadays are the following: Hueter most medial approach to hip (Figure 1), Watson Jones, Austin-Moore, and modified Gibson's posterolateral approach (2, 3, 4, 5). For the purpose of clinical evaluation of hip status, evaluation scale after Harris-Harris Hip Score was applied, which is calculated by adding points obtained through anamnesis and clinical examination.

Complications with endoprosthesis implantation are: deep vein thrombosis of leg, very seldom lung embolia, damage to the ishiadic nerve, unequal length of legs, luxation or fracture in the area of endoprosthesis, surface and...
deep infections in the area of endopros-
thesis, looseness, hematomas and death
(6, 7, 8, 9, 10).

Selection of surgery approach at en-
doprostheses implantation does influ-
ence the quality of surgical treatments
and the overall result.

2. AIM OF THE PAPER

Aims of this research is to define
the importance of surgical approach
with implantation of hip endopros-
thesis (Hueter, Moor and Gibson’s ap-
proach). Parameters that were analyzed
are: Harris Hip Score before and after
the surgery, length of incision, duration
of surgery, quantity of transfusion used,
post-operation time of the first upright
position and full weight bearing.

3. MATERIAL AND METHODS

All examinees were treated in the
same manner whereas the results of
the research were entered in the ques-
tionnaire.

At the orthopedic department of the
MC Travnik in the period from January
1st 2005. to December 31st 2009, 56 hip
prosthesis were implanted using Moor’s
posterior approach, 34 hip prosthesis
using Hueter approach (Figure 1) and
46 prosthesis by means of Gibson’s ap-
proach. When treating FNF with pa-
tients whose average age is 80.6 years
of age, Austin-Moor endoprosthesis
was used. For Hueter approach there
was used the instruments made for this
approach and Medacta non-cemented
prosthesis was implanted. Rehabilitation
process started in extensive care
room by breathing exercises and static
contractions, movements in an upright
position and weight bearing on the op-
erated leg. The patient was trained in
order to be able to meet his basic liv-
ing needs after he got released from the
hospital.

Assessment of the surgical treat-
ment outcomes was performed on the
basis of Harris Hip Score.

For statistical data procession there
were used methods of descriptive sta-
tistics (measurement of the central ten-
dency, measurement of dispersion and
graphic presentation), as well as t-test
and χ² for calculation of significant vari-
ations tested, whereby variations at the
level p<0.05 were treated as statistically
important.

4. RESULTS

Out of total 136 patients, Hueter ap-
proach was used with 34 (25.00%) pa-
tients, Moor’ approach with 56 (41.18%)
patients, and Gibson’s approach was
used with 46 (33.82%) patients. By sex,
50 female patients and 86 male patients
were operated. Hueter’s approach was
applied with 11 male patients and 23
female patients. Moor’s approach was
used with 29 male and 27 female pa-
tients, whereas Gibson’s approach was
used with 10 male and 36 female pa-
tients. Results of the test of variations
between the groups by means of Hi-
square test indicate high statistic sig-
ificance in relation to the sex of pa-
tients (p=0.061).

All examinees were grouped into
five groups by their age. The first group
involved patients in the age from 40 to
50 years old, the second one patients
from 51 to 60 years, the third one pa-
tients form 71 to 80 years of age and the
fifth group involved those from 81 to 90
years old. Results of tests of variations
between the groups by using Hi-square
test indicate that there is no statistic
significance in relation to the age of exam-
inees tested (p=0.3781).

In the tested sample of 136 patients
with coxartroza level III and IV there
was an indication for implantation of
endoprosthesis with 84 (61.76%) pa-
tients. Hueter approach was used with
22 patients, Moor’s approach with 38
and Gibson’s approach was used with
24 patients. Out of 136 patients, 52
(38.24%) were treated for femur neck
fracture: Garden type III were found
at 16 patients and Garden IV at 36 pa-
tients. Fractures were treated by im-
planting of endoprosthesis. Twelve
patients were treated by Hueter’s ap-
proach and noncemented Medacta
prosthesis were implanted, 18 patients
were treated by Moore’s approach and
22 non-cemented prosthesis were im-
planted by the means of Gibson’s ap-
proach.

Results of test of variations between
the groups by means of Hi-square test
show that here is no statistically signif-
icant variation in relation to the type of
fracture-coxarthrosis (p=0.5733).

Chronic illnesses in the examined
sample were as follows: hypertensio
arterialis 57 (41.91%), diabetes mellitus 44
(32.35%), myocardiopathia chr.17 (12.5
and insuficientio renalis at 5 (3.67).
It is obvious that each operated patient
had 1.2% chronic illness (Table 1).

When choosing the surgical line,
chronic illnesses did not condition the
approach. It is obvious that patients
where lateral approach was not used had
the highest level of chronic diseases.

Results of tests in variations be-

### Table 1. Distribution of patients by research groups compared to secondary disease

<table>
<thead>
<tr>
<th>Group</th>
<th>Insuficientio renalis</th>
<th>Diabetes Mellitus</th>
<th>Miocardiopa-tio cronicha</th>
<th>Hipertensio arterialis</th>
<th>Rheumatoid arthritis</th>
<th>No secondary disease</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>f %</td>
<td>f %</td>
<td>f %</td>
<td>f %</td>
<td>f %</td>
<td>f %</td>
<td>f %</td>
</tr>
<tr>
<td>I (Hueter)</td>
<td>1 20.00</td>
<td>13 29.55</td>
<td>2 11.76</td>
<td>19 33.33</td>
<td>0 0.00</td>
<td>10 2000</td>
<td>45 2601</td>
</tr>
<tr>
<td>II (Moor)</td>
<td>0 0.00</td>
<td>9 20.45</td>
<td>13 76.47</td>
<td>8 14.04</td>
<td>0 0.00</td>
<td>31 6200</td>
<td>61 3526</td>
</tr>
<tr>
<td>III (Gibson)</td>
<td>4 80.00</td>
<td>22 50.00</td>
<td>2 11.76</td>
<td>52 63.63</td>
<td>0 0.00</td>
<td>9 18.00</td>
<td>67 3873</td>
</tr>
<tr>
<td></td>
<td>5 100.00</td>
<td>44 100.00</td>
<td>17 100.00</td>
<td>57 100.00</td>
<td>0 0.00</td>
<td>50 100.00</td>
<td>173 100.00</td>
</tr>
</tbody>
</table>

Table 2. Distribution of patients by research groups compared to time when physical therapy started (days after the surgery)

<table>
<thead>
<tr>
<th>Group</th>
<th>Time of physical therapy start (days after the surgery)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First day</td>
<td>Second day</td>
</tr>
<tr>
<td>I (Hueter)</td>
<td>26 44.83</td>
<td>8 18.60</td>
</tr>
<tr>
<td>II (Moor)</td>
<td>0 0.00</td>
<td>21 48.84</td>
</tr>
<tr>
<td>III (Gibson)</td>
<td>32 55.17</td>
<td>14 32.56</td>
</tr>
<tr>
<td></td>
<td>58 100.00</td>
<td>43 100.00</td>
</tr>
</tbody>
</table>
between the groups by using Hi-square test show that there is highly significant variation in relation to chronic diseases \((p=0.000)\) (Table 1).

Results of tests in variations between the groups by using Hi-square test show that there is no significant variation in relation to post-surgery complications \((p=0.3198)\).

Mean time spent in hospital for patients who got endoprosthesis implanted by using Hueter approach is 8.91 days, by Moor’s approach it is 13.52 days and where Gibson’s approach was used the mean time in hospital was 9.87 days.

Time of physical therapy start, movement in upright position and weight bearing on the operated leg can be seen in Table 2.

Due to a small number of patients in the sample and extremely dominant use of Hueter approach compared to the time and number of patients when the full weight bearing started on the leg to which endoprostheses was implanted compared to Moor’s and Gibson’s approach, there were no conditions to test variations by Hi-square test between the researched groups in relation to the time of full weight bearing. Nevertheless, examination of variations between groups by the use of T-test showed the following:

Groups: Hueter-Moor: There is statistically highly significant variation in relation to the time of full weight bearing \((p=1.7596°E^{-4})\);

Groups: Hueter-Gibson: There is statistically highly significant variation in relation to the time of full weight bearing \((p=1.097°E^{-14})\);

Groups: Moor-Gibson: There is statistically very significant variation in relation to the time of full weight bearing \((p=5.3081°E^{-19})\);

Groups: Hueter-Gibson: There is statistically very significant variation in relation to the quantity of blood used \((p=0.0066)\);

Groups: Moor-Gibson: There is statistically very significant variation in relation to the quantity of blood used \((p=6.8188°E^{-14})\).

Surgical approaches: Hueter, Moor and Gibson have different skin incision length. In the examined sample t-test indicates that there is statistically very significant variation between Hueter and Moor’s approach as well as between Hueter and Gibson’s approach in relation to the skin incision length at surgery. There is no statistically significant variation between Moor and Gibson’s approach in relation to the length of surgical approach \((p=0.9959)\).

Surgical work is unconceivable without assistants. Hueter approach was dominant in the test sample: 15 patients were treated with only one assistant whereas two assistants were engaged with 19 patients. There is no significant statistical variation of the number of assistants and the approach used, Moor’s and/or Gibson’s approach in relation to the number of assistants \((p=0.0001)\).

Every surgical work has its time duration of the operation. The time duration of surgical work has an impact on the work of other organs and the outcome of the surgical work. There is statistical variation in the duration of surgical work when implanting endoprostheses using Hueter, Moor and Gibson’s approach total number of patients.

Test of variations between research groups by means of Hi-square test shows statistical significance in relation to the time duration of operation (to 90 min and above 90 min) \((p=0.0185)\). Test of variation between the groups by means of t-test shows the following:

Groups: Hueter-Moor: There is statistically very significant variation in relation to the duration of the surgery \((p=0.084)\);

Groups: Hueter-Gibson: There is statistically very significant variation in relation to the duration of the surgery \((p=0.0000)\);

Groups: Moor-Gibson: There is no statistically significant variation in relation to the duration of the surgery \((p=0.1374)\).

In case of patients who came for treatment because of coxartrosis (implantation of endoprostheses), HIPS score was applied. HIP Score was not applied pre-operatively at hip fracture.

There are no conditions to establish variations of HIP Score before the operation between the research groups by means of Hi-square test.

Test of variations between the groups in relation to HIP Score before the operation using t-test shows the following:

Groups: Hueter-Moor: There is very
significant statistic variation in relation to HIP score before the operation (p=0.0063);

Groups: Hueter-Moor: There is very significant statistic variation in relation to HIP score before the operation (p=0.0299);

Groups: Hueter-Moor: There is no significant statistic variation in relation to HIP score before the operation (p=0.4992);

Post-operatively, HIP score was performed approximately six months after the surgical treatment (Table 4).

Determination of variations of HIP score after the operation between the research groups by applying Hi-square test indicates no significant statistic variations (p=0.1933). Test of variations between the groups in relation to HIP score after the operation by applying t-test shows the following:

Groups: Hueter-Moor: There is very significant statistical variation compared to HIP score after the operation (p=0.0099);

Groups: Hueter-Gibson: There is no significant statistical variation compared to HIP score after the operation (p=0.8812);

Groups: Moor-Gibson: There is very significant statistical variation compared to HIP score after the operation (p=0.0126).

The main issue that requires the answer in the research conclusion is the quality of surgical treatment. This research conclusion shall use quantitative method taking into consideration values of the research variables, and namely:

Duration of surgery (min),
Quantity of blood used (ml),
Length of surgery incision (cm),
Number of assistants,
Time spent in hospital (days),
HIP before the surgery, HIP after the surgery.

Quality of surgery (as dependant variable) is relevant to independent variables with linear function:

\[ Y_{qst} = K_{vto} \cdot X_{vto} + K_{kpk} \cdot X_{kpk} + K_{dor} \cdot X_{dor} + K_{bhu} \cdot X_{bhu} + K_{il} \cdot X_{il} + K_{na} \cdot X_{na} + K_{tsh} \cdot X_{tsh} + K_{HIPbefore} \cdot X_{HIPbefore} + K_{HIPafter} \cdot X_{HIPafter} \]

where:

- \( Y_{qst} \) is a dependant variable qst – quality of surgical treatment,
- \( K_{vto} \) – weighting coefficient of impact variable \( X_{vto} \) (vto – time/duration of operation),
- \( X_{vto} \) – independent variable (vto – time/duration of operation),
- \( K_{kpk} \) – weighting coefficient of impact variable \( X_{kpk} \) (abu – amount of blood used),
- \( X_{kpk} \) – independent variable (abu – amount of blood used),
- \( K_{dor} \) – weighting coefficient of impact variable \( X_{dor} \) (il – incision length),
- \( X_{dor} \) – independent variable (il – incision length),
- \( K_{bhu} \) – weighting coefficient of impact variable \( X_{bhu} \) (na – number of assistants),
- \( X_{bhu} \) – independent variable (na – number of assistants),
- \( K_{il} \) – weighting coefficient of impact variable \( X_{il} \) (tsh – time spent in hospital),
- \( X_{il} \) – independent variable (tsh – time spent in hospital),
- \( K_{HIPbefore} \) – weighting coefficient of impact variable \( X_{HIPbefore} \) (HIP before operation),
- \( X_{HIPbefore} \) – independent variable (HIP before operation),
- \( K_{HIPafter} \) – weighting coefficient of impact variable \( X_{HIPafter} \) (HIP after operation),
- \( X_{HIPafter} \) – independent variable (HIP after operation).

In order to allow calculation of variable (quality of surgical treatment), transformation of all independent variables was done preliminary, those that had uneven number of groups (categories), into an even number of groups and namely:

- Time duration of operation (min) with 20 groups (categories) in total were transformed into three groups: 60 and less, 65-90, >90;
- Amount of blood used (ml) with total of five groups transformed into three groups and namely: <6, 6-10, >10;
- Incision length (cm) with total of 11 groups transformed into three groups and namely: 6, 7-10, >10;
- Number of assistants had in total four groups was transformed into three groups and namely: <6, 6-10, >10;
- HIP before operation with the total of 5 groups were transformed into three groups and namely: <59, 59-69, >69;
- HIP after operation with total of 6 groups were transformed into three groups and namely: <80, 80-99, >99;

Further on in the procedure of determination of quality of surgical treatment the following actions were performed:

New (transformed) values of independent variables were calculated in the manner that the best group was accompanied with value 3, the following group with value 2, the third group with value 1;

Numeric value of each independent variable is multiplied with the appropriate weighting impact coefficient; For the needs of this analyses, numeric values of independent variable with even weighting impact coefficient were calculated by the following formula:

\[ Y_{qst} = 1 \cdot X_{vto} + 1 \cdot X_{kpk} + 1 \cdot X_{dor} + 1 \cdot X_{bhu} + 1 \cdot X_{il} + 1 \cdot X_{na} + 1 \cdot X_{tsh} + 1 \cdot X_{HIPbefore} + 1 \cdot X_{HIPafter} \]

Amounts of individual variables were added up and the score of quality of surgical treatment;

Quality of surgical treatment was determined by even weighting coefficient of variables:

- Law (score value: <8);
- Mean (score value: 8-10);
- High (score value: >10);

It can be seen in (Table 5) that the research group I (Hueter approach) has the highest quality of surgical treatment as none of the patients had the value score of quality of surgical treatment below 8, 16 patients had the value score of surgical treatment quality between

<table>
<thead>
<tr>
<th>Quality of surgical treatment (with even weighting coefficient of variables)</th>
<th>Groups</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Law (score value: &lt;8)</td>
<td>0</td>
<td>56</td>
</tr>
<tr>
<td>Mean (score value: 8-10)</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>High (score value: &gt;10)</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>56</td>
</tr>
</tbody>
</table>

Table 5. Distribution of patients by groups in relation to surgical treatment (with even weighting coefficient of variables)
8 and 10, whereas 18 patients had the value score of surgical treatment quality above 10. The second quality surgical treatment is lateral approach where 29 patients had value score of surgical treatment quality between 8 and 10. The worst quality of surgical treatment was identified with Moor approach as all 56 patients had the value score of quality of surgical treatment below 8.

Analyses of the quality of surgical treatment when applying the same algorithm but with different coefficients of weighting impact indicate that the best approach is Heter approach, then the second best is lateral approach whereas the worst one is Moor’s approach.

It can be seen from (Table 7) that the research group I (using Hueter approach) has the highest quality of post-operative treatment of HIP score, whereas those that had posterolateral approach whereas the weakest HIP Score was found with patients related with Moor’s approach.

5. DISCUSSION

Almost 200,000 hip replacements are performed every year in USA, and the number is getting higher as well as the population age. There is no age limit for this type of treatment except when general health condition of a patient makes the surgery too risky (5,6).

Dr. Robert Berghoff and his colleagues in Phoenix, on February 8th 2010, stated their experience in the afore mentioned minimal invasive surgery which is connected with shorter stay in hospital, shorter incision, less trauma on muscles, less pain and blood loss, and which reduces the risk from wrench after surgery, faster recovery and faster come back to normal everyday activities (7,8,9). General or spinal anesthesia is used for the work that usually lasts for one to two hours (10).

In the research series all surgical works were done in anesthesia. Both spinal and general anesthesia was used. General anesthesia was applied with all patients who had endoprosthesis implanted by Hueter approach. The reason for this was the fact that such operations were attended by doctors who tried to get education so that education was involved in the work done. Moor’s approach and general anesthesia were applied with 18 patients, and Gibson’s approach was used with 16 patients. In spinal anesthesia and the use of Moor’s approach 38 patients were treated, whereas Gibson’s approach was used with 16 patients.

Incision over skin and muscles was between 25 and 38 cm long on the side of the operated hip in order to have a full insight into the attacked hip and the possibility to remove it(11).

Approximate time spent in hospital was four to five days, as stated by dr. Joel M. Matta at St. John’s Health Center in Santa Monica (12,13). He has been working on AMIS for the last 20 years and has designed a special surgery that has simplified surgical treatment (14,15).

Cemented hip prosthesis is implanted with elderly, less active patients with weaker quality of bones, where there is a risk of fracture to occur during the implantation of prosthesis and inability of primary fixation. The prosthesis is fixed with bone cement and there is no direct contact of prosthesis with the bone. The cement that fills the space between the bone and prosthesis, in the long run loses its characteristics and breaks so that the prosthesis becomes more loose, which demands revision (15). Uncemented prosthesis is intended for younger patients and those who have good bone mass (16).

With firm primary fixation and rough matter on the surface of prosthesis allows creation of the bone tissue around the prosthesis, which brings permanent fixation (16,17). Durability of both types of prosthesis is equal.

The biggest interest of surgeons, when it comes to new surgery procedures, is directed to complications (5,6,7). In artificial hip surgery this refers first of all to dislocations, infections and thromboembolism. In the analyzed group of patients, there was no dislocation, in five cases we recorded slow healing of the surgical wound, but without dehiscence, surface or deep infection. There was no thromboembolic complications in the sense of lung embolia or verified thrombosis of veins in legs (7,8,9). Intra operational positioning of endoprosthetic components shall not be analyzed in details in this paper, given that for a valid evaluation we would need to compare with a group of patients treated by a standard surgical procedure, which is not the subject of this study.

Modified mini incision approach to hip at total arthroplastic has a set of advantages for patients: less post-operative pain, less damage to soft tissue and pressure of muscle fibre, shorter hospitalization, less blood loss, shorter incision, faster return to work and functional activities (2).

The process of shortening the mini incision approach to hip at total arthroplastic is 7-15 cm whereas with conventional treatment the open approach is 15-30 cm and gives a good visual insight in the area of hip being operated (3). Mini- Incision Total Hip Arthroplasty is considered by some surgeons as the approach that brings the risk of implantation components of endoprosth-
thesis in the wrong way, in particular the acetabular components (4). They also state that in the course of rotary treatment of acetabulum and implantation of femoral part of prosthesis, surgical work is small whereas conventional instruments can damage the soft tissue. An important criteria for minimally invasive hip surgery are: implant designed for MIS operation as well as instruments (19,20).

For MIS – Less blood loss (12), less time for the operation (13), small number of complications (14), shorter cut/ incision (16). Better functional result (16), safe operation, (15), requires training, (17), technic demanding (17), patients can walk up stairs longer 6 months after the operation and lamess (13).

Against MIS – because it gives more necrosis of sub-acute tissue and weaker healing of the wound after MIS operation (14), study on cadavers showed that MIS technique of cut at rotary treatment of acetabulum “on blind” substantially damage the abductors of external hip rotators (14), we recorded 7% and 9% femur fractures (6) and 6. 4-10% early re-operations of femur fractures, dislocations or infections (7).

The most supported/used method of treatment was implantation of partial hip endoprostheses. It was mostly implanted with dislocated fractures of femur neck, with heavy injuries of mobile patients, with expressed co morbidity (9). Kyle (1994) in his work stated the opinion that dislocated fractures of the femur neck with older patients should be treated by alopastic procedures. Dunic et al (2003) stated in their work that dislocated fractures of the femur neck should be treated operatively, although they advocate alopastic surgery with older patients compared to internal fixation of the fracture (10).

Conventional implantation of hip endoprosthesis is performed through the big posterior approach (12) used by many surgeons. Other surgeons use anterolateral or anterior approaches. Conventional posterior approach is rather widely using the method of gluteus maximus inputs on thigh bones. It also involves comprehensive tempts of soft tissues, muscles (7) in order to allow anterior placement of head to ease unscREWing of acetabulum. This allows precise implantation of definite acetabular components into the right antever sions and inclinations (3,4,5,7). The series publishes by Tomislav Međedović 2008. in his research after implantation of uncemented prosthesis, 26 patients had longer leg/extremity after the operation, but no one had deviations bigger that 2 centimeters; 4 examinees had shorter leg, whereas 10 examinees had equal length of leg before and after the operation. Most patients (92%) have endoprostheses of the type Intraplant, whereas with 8 % of patients Zimmer endoprostheses was implanted.

Descriptive analyses of physical therapy introduced showed that getting to upright position and bearing started on the first day of and that all patients operated were in the upright position and had full weight bearing on the second day. With this group of patients endoprostheses was implanted by Hueter approach. Patients who were treated by Moor approach were in the upright position and weight bearing on the operated leg on the second day after the operation, whereas all patients were in the upright position and had full weight bearing on the twelfth day. Patients who were treated by lateral approach were in the upright position and had weight bearing on the operated leg on the first day after the operation, and on the second day they all were in the upright position and had full eight bearing.

6. CONCLUSION

In this research, analyses of the quality of surgical treatment by using the same algorithm with different coefficients of weighting impact showed that the best approach is Hueter approach, the second best is posterolateral (Gibson) approach, whereas the weakest one is Moor approach. Hueter approach has advantages when used when treating patients with centered hip. Hueter approach for implantation of endoprostheses requires an experienced team of surgeons, instruments construed for minimal invasive surgery of hip and selected patients. Visualization is smaller at Hueter approach. Gibson approach ensures comfort for surgeons, reduces the number of intera operative complications, but this approach increases the risk of postoperative luxtations of prosthesis as primary treatment of external rotators.

Moor approach to hip with implantation of total prosthesis ensures comfort for surgeons and reduces the number of intra operational complications with patients with BMI > 30. This approach increases the risk of postoperative luxtations of prosthesis because primary treatment of external rotators. Moor approach brings a higher number of surface and deep infections. More assistants are required for the operation and bigger amount of transfusion. Operation and post operative pain last longer whereas walking is shorter and limping longer after the implantation of endoprostheses.

REFERENCES