ACI/STRUČNI RAD

UDK 616.718.4-001.5-089
DOI 10.2298/ACI1501039F

# Intramedullary nailin the treatment of pertrochanteric fractures in elderly patients

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**Introduction. Intramedullary nail is an important component of modern treatment of pertrochanteric femur fractures. Objective. In elderly population, pertrochanteric fractures treated with unreamed intramedullary nails cause less deep infections when compared to reamed intramedullary nails. Patients and Methods. From April, 2010 to May, 2012 at the Department of Orthopedics and Traumatology, Gaetano Rummo Hospital (Benevento, Italy), 156 patients with pertrochanteric fracture, average age 82.7 years (75-102 years), were treated. In the analyzed case, there were 90 females and 66 males with pertrochanteric fractures. The respondents were divided into two groups. The first group consisted of 78 respondents who were treated with reamed intramedullary nails and the second group of 78 respondents treated with unreamed intramedullary nails. Discussion. Infections are not the most common postoperative complications. The risk of infection is increased in patients with comorbidity and in cases when there is an empty space between the intramedullary nail fixation and bone. Proximal femoral fractures carry a high mortality, but its causes are unclear. Conclusion. Our research has shown that the application of unreamed intramedullary nails in the treatment of pertrochanteric femoral fractures reduces a mortality risk and risk of infection.**

Key words: pretrohanteric fracture, femur, intramedullary nail, infection

## *INTRODUCTION*

Intramedullary nail is an important component of modern treatment of pertrochanteric femur fractures. Emami M. and associates predict that the annual incidence of petrochanteric femur fractures in the United Kingdom will amount to 70.200 cases in 2016. In addition, it is estimated that the number of these fractures is 1.26 million cases annually worldwide, which is expected to amount to 2.6 million cases in 2025 and to 4.5 million cases in 2050. In fact, there is an increase in the incidence of these fractures in correlation with the aging of the population, especially at age brackets of over 50 and the odds are doubled with a 10-year increase in age.[1]

A great problem that pertrochanteric fractures carry is a recovery and independent performance of daily living activities.[1] In 50% of cases, patients with pertrochanteric femoral fractures demand a 6 weeks long assistance to conduct basic life activities, whilein 25% of cases there is a long-term need for assistance.[1] In the US, 14.4 million people have at least one broken bone and they have the osteosynthesis fixated, while 11.3 million people have one joint endoprosthesis.[2] A complication of osteosynthesis of pertrochanteric fractures with intramedullary nails is the occurrence of deep infection.[3,4]

## *OBJECTIVE*

In elderly population, pertrochanteric fractures treated with unreamed intramedullary nails cause less deep infections when compared to reamed intramedullary nails.

## *PATIENTS AND METHODS*

From April, 2010 to May, 2012 at the Department of Orthopedics and Traumatology, Gaetano Rummo Hospital (Benevento, Italy), 156 patients with pertrochanteric fracture, average age 82.7 years (75-102 years),were treated. In the analyzed case, there were 90 females and 66 males withpertrochanteric fractures.The respondents were divided into two groups (Table 1). The first group consisted of 78 respondents who were treated with reamed intramedullary nails (RIMN) and the second group consisted of 78 respondents treated with unreamed intramedullary nails (UIMN). The respondents were elderly patients and comorbidity index is presented in Table 2.

TABLE 1

DESCRIPTION OF PUPULATION

| Description | RIMN | UIMN |
|---|---|---|
| No of patients | 78 | 78 |
| Average of patients | 8.6 | 83.8 |
| Range of age of patients | 65-90 | 65-93 |
| Gender ratio (m:f) | 0.64(30:47) | 0.84 (36:43) |
| Type fractures | A1:24 (30.77%) | A1 27(34.61%) |
| According AO | A2: 46 (58.97%) | A237 (47.44%) |
| Classification 31 A | A3: 8(10.26%) | A3 14(17.95%) |
| ASA physical status classification system | ASA I 6(7.96%) | ASA I 5 (6,41%) |
| | ASA II 20(25.64%) | ASA II 23 (29,49%) |
| | ASA III 50(64.10%) | ASA III 42 (53.84%) |
| | ASA IV 2(2,57%) | ASA IV 8 (01.26%) |

The respondents were treated in accordance with the Declaration of Helsinki on ethical principles. Each patient was provided with detail explanation about the method of treatment with reamed and unreamed intramedullary nail in cases of pertrochanteric fractures. After the interview, a statistical test sheet was distributed to the respondents in order for them to read it and, if necessary, seek additional information. The respondents affirmed their consent to the examination and method of treatment with their signature.

All the respondents received antibiotic prophylaxis with Cefazolin. The average hospital stay for all the respondents was about 5.4 days after the surgery (1-9 days). Control checkups were carried out at the clinic. Radiographic controls of the pelvis and both hips, hip and complete femur (AP, LL, and the axis of the femur) were carried out 15 days, 1 month, 3 months, 6 months, 12 months, 24 months and 36 months after the surgery.

Furthermore, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) and Procalcitonin (PCT) were controlled every hour before the surgery as well as 15 days, 1 month, 3 months, 6 months, 12 months and 24 months postoperatively. The Widmer's classification was used to classify the infection.[5] Data review was entered in the electronic sheet for further processing and statistical analysis (statistically significant difference, $p < 0.05$).

*RESULTS*

Postoperative complications, during first 3 months after the surgery, are shown in Table 3.

During the first 3 months, there was no statistically significant difference in postoperative complications (chest infection - urinary tract infection) ($p = 0.6176$).

7 (4.48%) out of 156 patients who were surgically treated for pertrochanteric fracture, died in hospital. During the surgery itself, 3 patients died (1.92%), while 4 patients died (2.56%) postoperatively in hospital. Upon the completion of surgical treatment, 149 patients were discharged from out institution. Postoperatively, during the first year after the surgery, 37 (25%) out of 149 patients died. (Table 4.)

30 respondents who had their fracture stabilized with reamed intramedullary nails and 7 who had it stabilized with unreamed intramedullary nails died during the first postoperative year. There was a statistically significant difference in mortality between the patients with reamed intramedullary nails and patients with unreamed intramedullary nails. Statistically, considerably more patients with reamed intramedullary nails died ($p < 0.001$).

In the remaining 112 cases (44 RIMN and 68 UIMN), during an average follow up of 28.3 months, an acute infection according to the Widmer's classification did not occur. There was a case of chronic infection around the nail in 2 (4.55%) respondents from RIMN group and 1 respondent (1.47%) from UIMN group, (Table 5.). Along with clinical signs, osteomyelitis wasdiagnosed laboratorically in all cases: increased erythrocyte sedimentation rate, C- reactive protease, scintigraphy, bone radiography, and the discovery of the cause upon the revision of the implant and the sample taken for bacteriology. In all three patients, a negative staphylococcus was verified.

TABLE 2

COMORBIDITY AND POSTOPERATIVE COMPLICATIONS IN 156 ELDERLY PATIENTS WITH PERTROCHANTERIC FRACTURE

| Comorbidity | RIMN | | UIMN | | Total | |
|---|---|---|---|---|---|---|
| | f | % | f | % | f | % |
| Cardiovascular disease | 26 | 14.69 | 59 | 26.22 | 85 | 21.14 |
| Stroke | 9 | 5.08 | 20 | 8.89 | 29 | 7.21 |
| Respiratory disease | 52 | 29.38 | 56 | 24.89 | 108 | 26.87 |
| Renal disease | 18 | 10.17 | 20 | 8.89 | 38 | 9.45 |
| Diabetes mellitus | 8 | 4.52 | 8 | 3.65 | 16 | 3.98 |
| Rheumatoid disease | 2 | 1.13 | 2 | 0.89 | 4 | 1.00 |
| Parkinson's disease | 8 | 4.52 | 8 | 3.56 | 16 | 3.98 |
| Severe mental dterioration in old age | 39 | 22.03 | 38 | 16.89 | 77 | 19.15 |
| Paget's disease | 1 | 0.56 | 1 | 0.44 | 2 | 0.50 |
| Current smokers | 11 | 6.21 | 10 | 4.44 | 21 | 5.22 |
| Enteral steroids | 3 | 1.69 | 3 | 1.33 | 6 | 1.49 |
| TOTAL | 177 | 100 | 225 | 100 | 402 | 100 |
| No of comorbidities | RIMN | | UIMN | | TOTAL | |
| | f | % | f | % | f | % |
| 1 | 12 | 15.38 | 11 | 14.10 | 23 | 14.74 |
| 2 | 23 | 29.49 | 24 | 30.77 | 47 | 30.13 |
| ≥3 | 43 | 55.13 | 43 | 55.13 | 89 | 55.13 |
| TOTAL | 78 | 100 | 78 | 100 | 156 | 100 |

Diagnostics was averagely 5 days long. On the 5th day, averagely, the intramedullary nail was removed, debridement and excochleation were performed and antibiotic-impregnated cement spacers (the spacer) were positioned. After stabilization of the infection, approximately 6 months afterwards, cement spacers were replaced with cementless revision hip endoprothesis.

*DISCUSSION*

Intramedullary stabilization with a locked nail has become the standard method of treatment of closed fractures of long bones due to satisfying bone fracture rehabilitation and a low infection rate.[6] Infections are not the most common postoperative complications.[7] The risk of infection is increased in patients with comorbidity and in cases when there is an empty space between the intramedullary nail fixation and bone.[6-7] Proximal femoral fractures carry a high mortality but its causes are unclear.[8] In their retrospective study, Meessen et al. [8]assessed 2-year mortality rate in elderly patients after the hip fracture. The study analyzed the following: respondents' comorbidity, body mass index, smoking and alcohol. In the abovementioned study, 635 patients (77%) out of 828 were femalesand 183 were males (23%), aged 70-99 years in the Province of Varese 2009.[8]

Hip fractures incidence was higher in females (8.4 in contrast to 3.7 in males) and in elderly patients (2.4 for 85-99 years and 4.4 for 70-84 years).The mortality rate after 1, 6, 12, and 24 months was 4.7%, 16%, 20.7%, and 30.4%, respectively.[8] The annual mortality rate of hip

TABLE 3

POSTOPERATIVE COMPLICATIONS DURING THE FIRST 3 MONTHS AFTER SURGERY

| Postoperative complications | RIMN | | UIMN | | Total | |
|---|---|---|---|---|---|---|
| | f | % | f | % | f | % |
| Chest infection | 8 | 7.14 | 11 | 9.40 | 19 | 8.30 |
| Carciac failure | 20 | 17.86 | 20 | 17.09 | 40 | 17.47 |
| DVT/PE | 9 | 8.04 | 8 | 6.84 | 17 | 7.42 |
| Urinary tract infection | 56 | 50 | 60 | 51.28 | 116 | 50.66 |
| Gastrintestinal haemorrhage | 3 | 2.68 | 3 | 2.56 | 6 | 2.62 |
| Myocardial infarction | 7 | 6.25 | 7 | 5.98 | 14 | 6.11 |
| Stroke | 9 | 8.04 | 8 | 6.84 | 17 | 7.42 |
| TOTAL | 112 | 100 | 117 | 100 | 229 | 100 |
| No of complications | RIMN | | UIMN | | TOTAL | |
| | f | % | f | % | f | % |
| 1 | 40 | 52.63 | 45 | 58.44 | 85 | 55.56 |
| 2 | 28 | 36.84 | 23 | 29.87 | 51 | 33.33 |
| ≥3 | 8 | 10.53 | 9 | 11.69 | 17 | 11.11 |
| TOTAL | 76 | 100 | 77 | 100 | 153 | 100 |

fractures was related to sex, age and comorbidity. Male sex, aged older than 85 years, with a Charlson Comorbidity Index score greater than 1 have a higher risk of death. Surgical delay was significant in the Kaplan-Meier survival time analysis but not in the Cox hazard analysis, suggesting that early surgery reduces risk in patients with numerous comorbidities.[8]

Approximately 5.8 million people die annually as the result of injuries, more people than die of HIV/AIDS, tuberculosis, and malaria combined.[9] Over 90 % of these fatal injuries occur in low- and middle-income countries (LMIC). For every death from injury, 3–10 more people survive injury with a permanent disability.[9]The costs of treatment of fractures with intramedullarynails in many low-and-middle-income countries are not achievable and the infection rate in the treatment of fractures with intramedullary nails is used as an excuse.[10]

In their study, Young and associates presented 137 patients treated with intramedullary nails, and postoperative deep infection occurred in 7 (5%). 2 HIV-positive respondents died.[10]

In their study, Battistelli et al[11] included a total of 51 patients. Serum CRP and PCT concentrations were obtained before surgery, on the 1st, 3rd, and 7th postoperative day. If the result had been within thephysiological limits, serum CRP and PCT concentrations were obtained postoperatively on the 14th and 30th day an at 2 years. Both markers were increased postoperatively. The serum CRP showed a marked increase on the 3rd postoperative day. Then, they declined slowly approaching the baseline values by the second postoperative week.[11]

In 2003, Chen et al[12] treated 23 infections after intramedullary nailing for femoral fractures. All fractures were unhealed at presentation. All patients were followed for at least 1 year after the infection. Acute infection occurred in 13 patients, sub-acute infection in 5, and chronic infection in 5. The patients were divided into two groups on the basis of the method of the initial treatment. In group I (12 patients), the intramedullary nails were retained, and there were 11 men and 1 woman, with an average age of 36 years (range, 15-55 years). In group II (11 patients), the nails were removed at the time of debridement and the fractures were stabilized with external fixation, and there were nine men and two women, with an average age of 44 years (range, 25-69 years).[12]

In group I, all fractures healed within an average period of 9 months after surgical debridement.[12] There was no recurrence of infection at an average follow-up of 25

TABLE 4

44 PATIENTS TREATED FOR FEMORAL FRACTURE DIED

| Period of deaths | RIMN | UIMN |
|---|---|---|
| Died during the surgery | 2 | 1 |
| Died during the hospital stay | 2 | 2 |
| Died during the 1st year after the surgery | 30 | 7 |

TABLE 5

THE NUMBER OF IM INFECTION ACCORDING TO THE WIDMER'S CLASSIFICATION

| Time of infection | RIMN | UIMN |
|---|---|---|
| Early postoperativery (=2-4 weeks after the surgery) | 0 | 0 |
| Late chronic (=1 month after the surgery) | 0 | 0 |
| Hematogenous (=2 years after the surgery) | 2 | 0 |

months).[12] In group II, seven fractures healed within an average of 10 months after treatment. At an average follow-up of 33.8 months, infected nonunion was noted in two patients from group II. More complications occurred in group II patients in comparison with group I patients.[12]

According to Makridis et al[13], while treating the infection of broken bones, which is stabilized by the intramedullary nail, a surgeon has to choose the most suitable treatment in order to achieve good clinical outcomes and to reduce the risk of surgical revision. If the clinical findings and laboratory findings, made within two weeks postoperatively, indicate to the acute infection, in most cases they are cured with antibiotics and with or without incisions or debridement. There is no unique attitude towards the postponed infections that occurs two to ten weeks postoperatively. Some authors suggest incision, drainage and antibiotics, others rinsing and replacement of intramedullary nail, yet others suggest the removal of intramedullarynail, etc. In the above mentioned postponed infection, the choice of treatment and surgeon expertise are quite significant. Many authors believe that in case of late infections that occur postoperatively, after 10 weeks, the intramedullary nail should be removed and fracture stabilized with external fixators.The existence of bone defect demands external fixation with Ilizarov fixator.[13] In patients with chronic infections, the removal of intramedullary nail is absolutely necessary.[5]

*CONCLUSION*

Although our research is still preliminary, it has shown that the application of unreamed intramedullary nail fixation in the treatment of femoral pertrochanteric fractures reduces the mortality riskand risk of infection.

*SUMMARY*

Intermedularni klin je važan dio savremenog liječenja pertrohanternih preloma butne kosti. Pertrohanterni prelomi liječeni nerimovanim intermedularnim klinom daju manje duboke infekcije u odnosu na rimovane intermedularne klinove kod osoba starije životne dobi. Od aprila 2010. do maja 2012. u našem odjelu za ortopediju i traumatologiju, Gaetano Rummo bolnice (Benevento, Italija), sa pertrohanternim prelo mom liječeno je 156 pacijenata prosječne životne dobi od 82,7 godine ( 75-102). U ispitivanoj seriji 90 žena i 66 muškaraca imalo je pertrohanterni prelom. Ispitanike smo podijelili u dvije grupe. Prvu grupu činila su 78 ispitanika koja su liječena sa rimovanim intramedularnim klinom a druga grupa od 78 ispitanika liječena je sa nerimovanim intramedularnim klinom. Infekcije nisu najčešće postoperativne komplikacije. Rizik od infekcije povećan je kod pacijenata sa komorbiditetom i ako postoji prazan prostor između intramedularnog klina i kosti. Prelom proksimalnog femura nosi velik mortalitet ali njegovi uzroci su neizvjesni. Naša istraživanja su pokazala da primjena neboranog intramedularnog klina u liječenju pertrohanternih preloma femura smanjuje rizik smrtost i infekcije.

Ključne reči:pretrohanterni prelom, femur, intramedularni klin, infekcija

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