Objective: Significant advances in the surgical treatment of intracapsular fractures of the femoral neck began in the mid-twentieth century, because of the better understanding of the characteristics and biomechanics of the fractures. The aim of this study is to precisely identify the characteristics of the fractures, that will be taken into account in the individualization of treatment of intracapsular fractures of the femur.

Materials and Methods: We analyzed, in a retrospective study, 148 patients with intraarticular fractures of the femoral neck from the registry of the Orthopaedic Department in Pozarevac, in the period from 2009 to 2014. Fractures were classified by the modified Garden’s classification. Garden type III fractures were divided into two sub-types. Garden type IIIa included fractures in which the distance between the fragments of the medial cortex was less than ½ the diameter of the femoral neck. Garden type III b included fractures in which the distance of the medial cortex of the fracture fragments was larger than ½ the diameter of the femoral neck.

Patients with the Garden type I fracture (6 cases), Garden type II (22 cases), Garden type IIIa (35 cases) and Garden type IV (5 cases) were treated by closed reduction and internal fixation. Patients with Garden type IIIb (28 cases) and Garden type IV (52 cases) were treated by primary total hip replacement.

Results: All fractures in patients with the fracture Garden type I (6 cases) and Garden type II (22 cases) have healed and avascular necrosis did not occur. In the group of patients with the Garden type III b fracture, 3 patients with non-union were treated with total hip arthroplasty. In the same group in two patients avascular necrosis occurred.

In the group of patients with the Garden type IV fracture who were treated by closed reduction and internal fixation (5 cases), two patients with non-union were treated with total hip arthroplasty. In patients with Garden sub-type III b, in the time of monitoring we found 4 dislocations after primary total hip arthroplasty. One patient underwent acetabular revision in the same group. In the group of patients with Garden type IV fracture, we found 7 dislocations after total hip arthroplasty and two patients underwent acetabular revision surgery.

Conclusion: Our results indicate that fractures Garden type I, II and Garden type III a can be successfully treated with internal fixation. Fractures Garden type III b and IV should be treated by primary hip arthroplasty, because of internal fixation of these fractures lead to unsatisfactory results.

Key Words: Hip fracture, internal fixation, hip arthroplasty, Garden classification

INTRODUCTION

The pioneering work in the field of subtotal arthroplasty Moore made an invaluable contribution to the treatment of intracapsular fractures of the femoral neck and opened new horizons of the development of hip arthroplasty. Expansive development of hip arthroplasty brought with its efficiency to a dominant use in the treatment of diseases and injuries of the hip. Excellent results that were obtained in its application gave it the flattering name of “The operation of the XX century”.

Today, subtotal arthroplasty retains an important place in solving intracapsular femoral fractures in elderly patients with minimal functional requirements and short life expectancy. Surgical treatment of intracapsular fractures of the femoral neck by reduction and internal fixation, pushed toward specific groups of younger patients, patients with neuromuscular weakness, patients with non-dislocated (Garden type I) and fractures angulated in valgus (Garden type II). There are opinions that even in these patients arthroplasty has an advantage due to better function and less incidence of secondary intervention.
A good insight into the mechanism of intracapsular fractures of the femoral neck Gardens classification laid the foundations of successful surgical treatment. Defining the type of fracture determines the methods and treatments and there prognosis. In our more decade of systematic work on this problem, we have found that varus angulation and not completely displaced fractures of the femoral neck (Garden type III) are prognostically a heterogeneous group of fractures. From minimally angulated fractures in varus with minimal fragment impaction, to significant angulated fractures with significant impaction and bone loss. This fact is integrated into our work on this issue, considering patients with a fracture of Garden type III as patients in whom we with particular attention individualize the choice of treatment.

The aim of this research is to determine early complications of surgical treatment of fracture fixation and hip arthroplasty in intracapsular fractures of the femoral neck. The second aim is to define amore precise fracture classification of Garden type III fractures based on the distance of the medial cortex fracture fragments and determining the impact of the proposed classification to the choice of treatment.

MATERIALS AND METHODS.

We analyzed 148 patients (95 woman and 53 man) with intraarticular fractures of the femoral neck from registry of the Orthopaedic department in Pozarevac (Serbia) in the period from 2009 to 2014. The average age of patients was 69 years.

Fractures were classified by a modified Garden classification. Garden’s type III was divided into two sub-types. Type IIIa included fractures in which (on AP x-ray) the distance between the medial cortex fracture fragments was less than ½ the diameter of the femoral neck. Garden type III b included fractures in which the distances of the medial cortex fracture fragments were larger than ½ the diameter of the femoral neck.

All fractures were fixated by a DHS-YU implant (Fig. 1). Reduction was done on extension table with the foot in extension position. In patients younger than 65 years of age, we implanted a cementless prosthesis, among patients from 65 to 75 years of age a hybrid prosthesis and in patients older than 75 years of age, a cement prosthesis. (Figure 1)

In patient with low functional requirements, where the prognosis of survival was up to 2 years, we did subtotal arthroplasty. These patients are not included in this analysis. Patients with Garden type I (6 cases), type II (22 cases) and type III a (35 cases) were treated by internal fixation. Patients with Garden type III b (28 cases) were treated with primary total arthroplasty. Patients with Garden type IV fractures were treated (5 cases) by closed reduction and internal fixation and (52 cases) by primary total arthroplasty. (Table1)

RESULTS

All fractures in patients with the fracture Garden type I (6 cases) and Garden type II (22 cases) have healed and avascular necrosis did not occur. In the group of patients with the Garden type IIIb fracture, 3 patients (8,6%) with non-union were treated with total hip arthroplasty. In the same group in two patients (5.7%) avascular necrosis occurred.

In the group of patients with the Garden type IV fracture who were treated by closed reduction and internal fixation (5 cases), in two patients with non-union were treated with total hip arthroplasty. Five patients with a Garden type IV fracture were treated with closed reduction and internal fixation. In two patients (40%) non-union occurred and were converted into total hip arthroplasty.

In patients with the sub-type Garden IIIb, we found 4 dislocations (14,2%) of the prosthesis and two patients underwent acetabular revision surgery. In the group of patients with Garden type IV fracture we found 7 dislocations (13,4%) of the prosthesis and two patients underwent acetabular revision surgery. (Table 2)
TABLE 2

<table>
<thead>
<tr>
<th>COMPLICATIONS AFTER INTERNAL FIXATION OR ARTHROPLASTY</th>
<th>Garden I and II</th>
<th>Garden IIa</th>
<th>Garden IIb</th>
<th>Garden IV IF</th>
<th>Garden IV THA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonunion</td>
<td>28</td>
<td>35</td>
<td>28</td>
<td>5</td>
<td>52</td>
</tr>
<tr>
<td>AVN</td>
<td>0</td>
<td>3(8.6%)</td>
<td>-</td>
<td>2(40%)</td>
<td></td>
</tr>
<tr>
<td>Dislocation</td>
<td>4 (14.2%)</td>
<td>7 (13.4%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSION

Intracapsular fracture of the femoral neck is an event that irreversibly disturbs the vascularisation of the femoral head. In addition, it leads to a smaller or larger loss of bone mass in the head and neck, in the form of comminution and/or impaction. The surgeon is faced with the possibility that he/she cannot reduce the fracture, because with obtaining anatomical reconstruction, in the true sense of the word, we have a gap that remains in the place of the impacted bone. The amount of bone loss is proportional to the intensity of the force with which the fracture occurs and the weakness of bone tissue.

Garvan type II fractures of the femoral neck (impaction in valgus) bone loss is dominant in the top and in the back of the head and neck. With these fractures more or less we lose anatomic relationships between the head and neck. The head and neck are positionedstably. By the appropriate choice of implant and its appropriate placement it can definitely solveatraumatically regardless of the age of the patients. Our results suggest that Garvan type II and Garvan type I fractures can (in a surgical sense) be regarded as one group of fractures, because they have the same way of treatment and prognosis. Garvan type III fractures of the femoral neck (impaction in varus) loss of bone mass have predominantly at the back and at the bottom of the head and neck. There is no inherent stability of these fragments. The fracture fragments are held in the angulated position by the strong capsule, because the loss of bone mass is not sufficient to achieve full dislocation of the fracture. In these fracture the loss of bone mass is very different, ranging from very small fractures in a small varus position with the distance of the medial cortex of a few millimeters, to a significant angulation and bone loss. Progressive angulation of the fractured fragments increase bone loss and reduce the stability of the fracture. Garvan type III fractures are very heterogeneous in the sense of loss of bone mass and thus the stability of the fracture. The fact of these have led us to divide this group of fractures into two sub types. Our results show that in a significant number of cases in Garvan type III, we can achieve stable positioning of the fractured fragments, and with adequate internal fixation the fracture will heal. In our opinion, in this type of fractures, we have to look for the border line between internal fixation and arthroplasty.

Great angulation of the primary fractured fragments, that are over half the diameter of the femoral neck, bring these fractures closer to Garvan type IV, in which the bone loss is enough to dislocate the fragments from each other. These are heterogeneous fractures in terms of loss of bone mass. With reduction, cooptation of the fractured fragments can be obtained, which will always have the characteristics of instability. A stable fixation of the fracture in a significant number of cases is not sufficient enough to ensure the stability of the system implant-fractures until bone healing. In our analysis we have a small number of these fractures (5 cases) that are reduced and fixated. Early destabilization had been done in two cases (40%). Alloarthroplasty is a choice of treatment for fractures under Garvan type III b and Garvan type IV. Significant level of postoperative hip dislocations should be prevented by a conserving surgical technique, implant selection and adequate postoperative rehabilitation.

CONCLUSION.

The choice of treatment, beside the physical and mental status of the patient, is determined by the type of fracture which has an important role. Our results indicate that fractures Garvan type I and II therapeutically and prognostically do not differ and should be treated by osteosynthesis. Garvan type III fractures represent a heterogeneous group of fractures, which vary in the degree of bone loss and in different possibilities to achieve stability after closed reduction and internal fixation. It is our opinion, that in patients who sustained a fracture Garvan subtype IIIa we should reduce and fixate with good prospects for the fracture to heal. Fractures Garvan type IIIb and IV alwayes have significant bone loss in the neck. Therefore, the method of choice is arthroplasty in patients with these type of fractures. Closed reduction and internal fixation should be done only in exceptional cases where high level of complications after arthroplasty are expected.
SUMMARY
INTRAKAPSULARNI PRELOMI VRATA FEMURA. UNUTRAŠNJA FIKACIJA ILI ARTROPLASTIKA

Cilj rada: Značajan napredak u hirurškom lečenju intrakapsularnih preloma vrata femura nastaje sredinom dvadesetog veka, pre svega zbog boljeg razumevanja karateristika i biomehanike ovih preloma, kao i pojavom novih implantata. Cilj ove studije je da preciznije identifikuje karakteristike preloma, koje će se uzimati u obzir pri individualizaciji lečenja pacijenata sa intrakapsularnim prelomom vrata femura.


Zaključak: Naši rezultati ukazuju da prelomi tipa Garden I, II i podtipa IIIb treba da se leče unutrašnjom fiksacijom. Prelome tipa Garden IIIb i IV treba primarno rešavati alloartroplastikom, jer osteosinteza ovih preloma veoma često ne dovodi do zadovoljavajućih rezultata.

Klučne reči: Prelom kuka, unutrašnja fiksacija, artroplastika kuka, Garden-ova klasifikacija

LITERATURE