

EFFICIENCY OF BASKET PLATE OSTEOSYNTHESIS IN COMMUNUTED PATELLA APEX FRACTURES – EVALUATION OF KNEE EXTENSION IN LATE POSTOPERATIVE PERIOD

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SUMMARY – The aim of the study was to assess functional status of the knee extensor system in the late postoperative period (at least two years of the operation and implant removal) in patients submitted to basket plate osteosynthesis for transverse or comminuted fracture of the apex of patella. The study included 71 patients with comminuted patellar apex fracture who had undergone basket plate osteosynthesis. The status of the knee extensor system was evaluated by a modified Cincinnati test. Excellent results were recorded in 59.2%, good in 30.6% and satisfactory in 10.2% of study patients. There were no poor results. In addition to ensuring osteosynthesis stability and the potential of early weight bearing, basket plate osteosynthesis meets the requirements of modern traumatology and the authors are inclined to consider it the method of choice to treat comminuted or transverse fractures of the apex of patella.

Key words: Fractures – surgery; Patella – injuries; Patella – surgery; Orthopedic procedures – methods; Prospective studies; Treatment outcome

Introduction

Patella is a sesamoid bone located in tendon muscle of the quadriceps, and functionally it is part of the knee extensor system. According to the causative mechanism, patellar fractures can be direct or indirect, and according to the type of fracture line they may vary, however, always implying fall-out of the knee extensor system¹⁻⁴. Patellar fractures, the most common injuries of the knee extensor system, are treated operatively should it be the case of fragment dislocation and split of the retinaculum. The goals of operative treatment are anatomic repositioning of the fragments, stable osteosynthesis, reconstruction of the soft tissue section of the knee extensor system, and early rehabilitation^{1,2}. There are a number of methods used for operative management of patella fracture, e.g., cerclage (according to Berger, Quen, La Dente, Smilley), hemicerclage, *Zuggurtung* (according to Pauwels), and total or par-

tial patellectomy when repositioning of the fragments is not viable⁵⁻¹⁹

In 1988, Professor B. Smiljanić from Sestre milosrdnice University Hospital, Zagreb, Croatia, developed a basket plate for use in comminuted fracture of the patellar apex, meeting all the basic requirements of modern traumatology^{4,20-23}. The basket plate is so shaped as to collect all the patella apex fragments in one place, i.e. into the basket (Fig. 1). The distal part of the basket is provided with holes through which screws are inserted into the patella up to the healthy tissue. Two malleolar screws are positioned centrally through the bone-drilled holes, and two small spongiosa screws are placed laterally. The screws have to be placed according to Pauwels' principle in order to achieve dynamic compression at the site of fracture^{4,23}. The method was tested experimentally on a knee anatomic preparation as a biomechanical model by performing osteotomy followed by basket plate osteosynthesis with two malleolar and two spongiosa screws according to Pauwels. Thus produced osteosynthesis showed very high resistance, i.e. stability against fiber load exceeding 1000 N without any major shift of the fragments^{4,20-23}. This osteosynthesis method with basket plate was also tested clini-

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Received December 12, 2003, accepted in revised form May 21, 2004

cally over a 15-year period in a patient with patellar apex fracture. Upon basket plate removal, 6-8 months following osteosynthesis, clinical and radiologic evaluation of the operated knee showed excellent result, whereas biopsy specimen obtained on implant removal and histologic studies of bony tissue from the fracture area revealed osseous healing pattern with secondary callus^{4,22}.

Patients and Methods

Patients

During a 15-year period (1988-2003), 220 patients with acute injuries of the knee extensor system (200 with patellar fractures and 20 with complete rupture of the quadriceps tendon or patella ligaments) were operated on at University Department of Surgery, Sestre milosrdnice University Hospital in Zagreb. Basket plate osteosynthesis was performed in 130, total patellectomy in 25, other osteosynthesis methods in 45, and tendon or ligament repair in 20 patients (Table 1). It should be noted that partial patellectomy was not considered an appropriate option in any of the cases.

The aim of this prospective study was to evaluate functional status of the knee joint in the late postoperative period (at least two years of the operation or implant removal) in patients operated on for acute injury of the knee extensor system. Only patients submitted to basket plate osteosynthesis for comminuted or transverse fracture of the patella apex were included in the late postoperative evaluation. Other operative methods were not included because of the small number of patients available in the late postoperative period. The knee joint status was assessed by use of a modified Cincinnati test^{8,16,24,25}.

Thus, the study included 71 patients operated on by the basket plate method according to Smiljanić. The inclusion criteria were patient's response to testing and at least two-

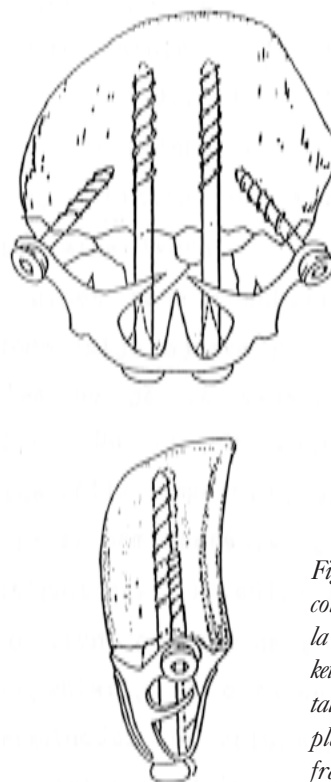


Fig. 1. Basket plate is shaped to collect the fragments of the patella apex into one place, into the basket. There are openings, in its distal part, through which screws are placed into the nearest patella fragment.

year time frame from the procedure of basket plate osteosynthesis and implant removal. There were 48 male and 23 female patients, mean age 46 (range 20-66) years, and mean follow-up 5 (range 2-13) years. The patients operated on for other acute injuries of extensor apparatus were not available for evaluation. During the 1988-2003 period, 130 patients had been operated on for patella fracture by basket plate osteosynthesis, however, only 71 (55%) of them responded to control screening and were included in this prospective study, whereas the rest of them were not available for some objective reasons (e.g., war and postwar period, death) or refused to take part in the study.

Table 1. Patients operated on for acute injury of extensor knee system (1988-2003) at University Department of Surgery, Sestre milosrdnice University Hospital, Zagreb

Diagnosis	Operation	Number of patients
Complete rupture of quadriceps tendon or patellar ligament	Reparation by «U» stitches	20
Patella fracture	Osteosynthesis by basket plate	130
	Total patellectomy	25
	Other methods of osteosynthesis	45
	Total	220



Fig. 2. Basket plate is impressed into the patellar ligament, so that all fragments are collected into the basket. Ultimately, the basket plate is to be fixed by two malleolar screws according to Pauwels' principle. If necessary, two additional little spongiosa screws may be used. It is necessary to stitch the split retinaculum of the patella.



Fig. 3. Postoperative radiograph after operation.

Description of the operation

The operative procedure is relatively simple and short. Longitudinal incision of the knee joint is made for access to the patellar fracture and split retinaculum. Then, the appropriately shaped basket plate is squeezed into the patella ligament so as to collect all fragments. After that, fixation is performed, followed by placement of the screws (two malleolar and two spongiosa screws, 4-0), according to Pauwels' principle. Two small spongiosa screws can also be used as necessary (Figs. 2 and 3). The system functions according to the principles of tension band and provides stable osteosynthesis. As a rule, immobilization was not used during the postoperative course, with pain limited weight bearing. The patients were as a rule monitored for 6-8 months, then they underwent an operation for basket plate removal, without any major complications⁴ (Fig. 4).

Evaluation

We decided to perform assessment of the knee status at least two years after osteosynthesis and implant removal, because we considered it was an adequate time frame



Fig. 4. Radiograph taken upon implant removal.

to evaluate the development of post-traumatic arthrosis. On this assessment, we used a modified Cincinnati knee rating system, i.e. test for assessment of the knee joint status^{8,16,24,25}. The test includes the following items: 1) subjective intrusions on the side of the knee (pain, swelling, knee trembling, knee mobility, and capacity for work); 2) clinical screening of the knee (volume of mobility, volume active movements and contracture, volume of musculature), dynamometry in relation to the healthy side, and measuring outflow of the knee joint); and 3) radiologic analysis of the operated knee with evaluation of joint crack narrowing, sclerosis, and cysts and osteophytes of the patellofemoral joint. The test was modified by using a manual dynamometer (Zadik type, INORAB), because a more sophisticated technique was not available. Data obtained by the questionnaire, clinical evaluation and radiographic analysis were pooled to give an up to 100-point patellofemoral score: 90-100 points, excellent; 80-89 points, good; 70-79 points, satisfactory; and <70 points poor. Statistical analysis of the study parameters was done by use of Student's t-test, analysis of variance, and χ^2 -test for independence of a two-way contingency table.

Results

Questionnaire

Eighteen (25%) subjects complained of discomfort in the knee area, however, only seven (10%) subjects felt pain restricting their daily activities. Seven (10%) patients complained of crepitation and six (9%) of knee trembling. Overall, there was no significant reduction in performance intensity after the operation in comparison with the condition prior to the knee injury.

Clinical findings

Slight outflow of the knee joint was recorded in seven (10%) patients. Comparison of active knee mobility between the healthy and involved leg revealed significant differences in four (5%) patients. Painful patellofemoral joint was reported by six (9%) patients. Neither extension contracture nor significant atrophy was recorded.

Average strength of the quadriceps muscle was determined by dynamometry on a feather-type Zadik device, comparing the healthy and operated leg. Expressed in percentage, on the operated leg it was 93% (59%-120%) of the healthy leg strength. Radiologic analysis showed signs of patellofemoral arthrosis in 21 (30%) patients. The

relation between patellar length and length of the patellar ligament (according to Insalla and Salvatti's criteria) indicated normal parameters in 60 (85%) subjects.

No major complications (infection or implant loosening) were recorded during the period of observation. A number of differences between the measured and reference parameters were indicated by Cincinnati test, however, there was no statistically significant correlation between the study parameters or with the ultimate clinical outcome of the patellar apex fracture treatment with basket plate osteosynthesis.

The results on the knee joint status in the late postoperative period following basket plate osteosynthesis were excellent in 59.2%, good in 30.6% and satisfactory in 10.2% of patients, whereas poor results were not recorded at all (Table 2).

Table 2. Results of knee joint status in late postoperative period after osteosynthesis by basket plate according to modified Cincinnati knee rating system test: to ?

Cincinnati score	Number of patients (%)	Result
91-100	42 (59.2)	Excellent
81-90	22 (30.6)	Good
71-80	7 (10.2)	Satisfactory
60-70	0	Poor
Total	71	

Discussion

The study was focused on patients operated on for patellar fracture by the basket plate method, a relatively new and in spite of very good results yet inadequately accepted method. The operative procedure of osteosynthesis with the use of basket plate for fracture of the apex of patella has been introduced in a number of institutions in Croatia and abroad, with very satisfactory results. According to data available so far, several hundred patients with patella fractures have been operated on with very good clinical results^{4,21,22}. The operative procedure is simple and fast, providing appropriate skills and know-how. The procedure is associated with early rehabilitation and knee weight bearing, resulting in full volume of knee movements and quadriceps muscle strength. Radiologically, osseous consolidation of the fracture regularly occurs 8-10 weeks of the operation. The use of basket plate was originally indicated in comminuted fractures of patellar apex, however,

because of its obvious advantages concerning a high degree of stability and early weight bearing, the indications could also extend to transverse fractures of distal sections of the patella. Partial patellectomy is a method that is usually employed for comminuted patellar fractures, however, it is associated with the loss of the range of motion (18 degrees on an average), greater quadriceps atrophy, and ligament instability²⁶. In a series of 40 patients evaluated by Cincinnati test, Saltzman *et al.* report on 8% of patients with poor result after partial patellectomy¹⁶. In a study by Pandey *et al.*, 80.3% of 175 patients undergoing partial patellectomy achieved excellent to good results. The data presented clearly show that healing of patellar fractures with the basket plate method was 100%. In a cohort of 71 patients evaluated by a modified Cincinnati test, excellent results were recorded in 59.2%, good results in 30.6% and satisfactory results in 10.2% of our patients; there was no case of poor result. Accordingly, there were nearly 90% of patients with excellent to good results.

Conclusion

Patellar fracture is the most common reason for the loss or reduction of the knee extensor system function. Osteosynthesis of comminuted or transverse fracture of the patella apex with basket plate is a simple operative method that provides a high degree of osteosynthesis stability and osseous healing of bone fragments without immobilization and with early postoperative weight bearing. In this way, the method meets the requirements of modern traumatology, thus deserving special place in the operative management of patellar fractures. The late results of the knee extensor system in patients operated on by use of basket plate are in favor of this method, and it should be introduced as a standard method for the treatment of comminuted and transverse fractures of the apex of patella.

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Sažetak

UČINKOVITOST OSTEOSINTEZE S KOŠARASTOM PLOČICOM KOD MULTIFRAGMENTNIH PRIJELOMA IVERN OG VRŠKA – PROCJENA EKSTENZIJE KOLJENA U KASNOM POSLIJEOPERACIJSKOM RAZDOBLJU

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Cilj ove prospektivne studije bila je procjena funkcijskog statusa ekstenzornog sustava koljena u kasnom poslijeoperacijskom razdoblju (najmanje dvije godine nakon operacije i uklanjanja usatka) u bolesnika podvrgnutih osteosintezi s košarastom pločicom zbog poprečnog ili multifragmentnog prijeloma ivernog vrška. Procjena je obuhvatila 71 bolesnika s multifragmentnim prijelomom patelarnog vrška u kasnom poslijeoperacijskom razdoblju nakon osteosinteze s košarastom pločicom. Status ekstenzornog sustava koljena procjenjivan je modificiranim testom Cincinnati. Izvršni rezultati su zabilježeni u 59,2%, dobri u 30,6% i zadovoljavajući u 10,2% bolesnika. Loši rezultati dosad nisu zabilježeni. Uz osiguranje stabilnosti osteosinteze i mogućnost ranog opterećenja, osteosinteza s košarastom pločicom ispunjava zahtjeve suvremene traumatologije, te prema našem mišljenju predstavlja metodu izbora u zbrinjavanju multifragmentnog ili poprečnog prijeloma ivernog vrška.

Ključne riječi: *Prijelomi - kirurgija; Patela – ozljede; Patela – kirurgija; Ortopedski zahvati – metode; Prospektivne studije; Ishod liječenja*