

Total knee arthroplasty following fractures around the knee

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ABSTRACT

Introduction: Surgical treatment in post-traumatic osteoarthritis consecutive to peri-articular fractures in distal femur or proximal tibia is infrequent and complex. Total knee arthroplasty is a valid option. Aims: Functional and radiologic revision of total knee arthroplasty in post-traumatic osteoarthritis.

Materials and Methods: Retrospective and multicentric revision of 29 patients (19 females, 10 males; 59 years old on average) subject to total knee arthroplasty due to post-traumatic osteoarthritis between 2008 and 2015. Twenty-three cases were secondary to proximal tibia fracture; 6, to distal femur fracture; 6, to extra-articular fractures and 23, to intra-articular fractures. Initial treatment was conservative in 8 patients, open reduction and internal fixation in 21 cases. Surgeries before arthroplasty: 2.14. Assessment was carried out using the KSS and X-rays. Pre-operative ROM was: 60°-flexion (45-90°), and 15°-extension (0°-90°). KSS: for pain, 30 (10-45); for function, 25 (20-45); total, 30 (20-60).

Results: Follow-up of 45 months. ROM improves to 112°-flexion (60°-140°) and 5°-extension (0°-30°). The KSS for pain was 40 (30-50); for function, 35 (30-50); total, 81 (50-90). Results were good (KSS ≥80) in 22 patients (75.8%), regular in 6 (20.6%), poor in one case (3.44%). Mechanical axes were recovered in all patients. There were 13% of major complications.

Conclusions: Total knee arthroplasty in post-traumatic osteoarthritis is a technically challenging surgery. Complications rates are higher than those in primary osteoarthritis, but it is a valid procedure for complex reconstruction, relieving the pain and improving functional results.

Key words: Total knee arthroplasty; post-traumatic osteoarthritis

Level of evidence: IV

REEMPLAZO TOTAL DE RODILLA EN SECUELA DE FRACTURAS ALREDEDOR DE LA RODILLA

RESUMEN

Introducción: El tratamiento quirúrgico de la artrosis postraumática por fracturas periarticulares del fémur distal o de la tibia proximal es poco frecuente y complejo. El reemplazo total de rodilla es una opción válida. Objetivos: revisión funcional y radiológica del reemplazo total de rodilla después de la artrosis postraumática.

Conflict of interests: The authors have reported none.

Materiales y Métodos: Revisión retrospectiva y multicéntrica de 29 pacientes (19 mujeres, 10 hombres; media de edad: 59 años) sometidos a un reemplazo total de rodilla por artrosis postraumática entre 2008 y 2015. Veintitrés casos fueron secundarios a fractura de tibia proximal; 6, a fractura de fémur distal; 6, a fracturas extrarticulares y 23, intrarticulares. El tratamiento inicial fue no quirúrgico en 8 pacientes, reducción abierta y fijación interna en 21 casos. Cirugías antes de la artroplastia 2,14. Los controles se realizaron con el KSS y radiografías. El rango de movilidad preoperatorio fue: flexión 60° (45-90°) y extensión 15° (0-90°). KSS: para dolor 30 (10-45), funcional 25 (20-45), total 30 (20-60).

Resultados: Seguimiento de 45 meses. El rango de movilidad mejora la flexión 112° (60-140°) y la extensión 5° (0-30°). KSS: para dolor 40 (30-50°), funcional 35 (30-50°), total 81 (50-95°). Los resultados fueron buenos (KSS ≥80) en 22 pacientes (75,8%), regulares en 6 (20,6%), pobres en un caso (3,44%). Se restableció el eje mecánico en todos los pacientes. Hubo un 13% de complicaciones mayores.

Conclusiones: El reemplazo total de rodilla después de la artrosis postraumática es una cirugía técnicamente exigente. La tasa de complicaciones es más alta que la de la artroplastia primaria, pero es válido para reconstrucciones complejas, alivia el dolor y mejora los resultados funcionales.

Palabras clave: Artroplastia total de rodilla; postraumática; artritis.

Nivel de Evidencia: IV

Introduction

Total knee arthroplasty is one of the surgical procedures most frequently and successfully carried out, giving the patient substantial pain relief and improvement in functional impairment in the case of primary knee osteoarthritis. Nowadays, however, there are few bibliographic records that relate this procedure to osteoarthritis consecutive to fracture. The treatment of post-traumatic knee osteoarthritis that follows a peri-articular fracture in distal femur or proximal tibia implies a complex procedure. Predisposing factors are joint unevenness and cartilage defects in intra-articular fractures, or mal-union consecutive to failure in bone reduction in extra-articular fractures.¹ With respect to epidemiology, there is a bimodal distribution, with young patients in association with high energy fractures and as an early complication related to metaphyseal or intra-articular non-union, malalignment, infection, bone defects and numerous incisions. The second group includes elder adults with poor bone quality and, sometimes, previous osteoarthritis due to low energy trauma. Conservative treatment, arthroscopic debridement and osteotomies are rescue therapeutic options. Total knee arthroplasty (TKA) is an option for these patients, although published studies on results are based on retrospective studies (level of evidence=IV). All authors coincide with the fact that technical difficulties and complications rates are high as compared to those seen in patients subject to TKA for primary osteoarthritis.¹⁻⁴ This might stem from bone deformity with mechanical axis misalignment, poor bone stock, non-union, osteosynthesis material, multiple previous surgeries or injury sequela in soft tissues.¹

The aim of this study was to evaluate TKA results in patients with osteoarthritis secondary to knee peri-articular fractures.

Materials and Methods

This is a retrospective, multicentric study in which we evaluated 29 patients with knee osteoarthritis secondary to distal femur or proximal tibia fracture, subject to TKA between 2008 and 2015 (Table). The study group was made up of 10 (34.48%) males and 19 (65.51%) females who averaged 59.20 years old (ranging from 30 to 81). Only one fracture was open (Gustillo II). Twenty-three fractures involved the proximal tibia: Three extra-articular fractures type 41A2 in the AO/ASIF⁵ Classification and 20 intra-articular fractures as outlined by the Schatzker classification—⁶ type II (3 cases), type III (3 cases), type IV (4 cases), type V (4 cases), and type VI (4 cases) (Figure 1). Six patients had distal femur fracture (AO/ASIF Classification): type 33A1 (3 cases), 33B2 (1 case) (Figure 2), 33C1 (1 case), and 33C3 (1 case). Eight patients (27.58%) were treated conservatively as primary treatment, whereas the rest of them received open reduction and internal fixation (ORIF) with screws or plates. The average time between the treatment of the initial fracture and the arthroplasty was 3.7 years (ranging from 1 to 10), whereas the average number of surgeries performed until arthroplasty was 2.14 (ranging from 1 to 7).

We carried out an extended medial para-patellar approach in 27 patients (93.1%) so as to improve joint exposure. In two cases it was necessary to carry out a lateral approach due to the patient's pronounced osteoarthritic valgum knee deformity. To release contracture in the extensor apparatus of the knee we performed quadriceps cutting (*snip*) in seven patients and release of the external patellar retinaculum in five cases. In three cases it was necessary to carry out osteotomy of the anterior tibial tuberosity. At the end of the procedure we fixed it back by multiple wire cerclages. In 13 patients we removed the osteosynthesis

Table. Demographic data

Case	Age	Sex	Initial fracture	Treatment	Pre-operative KSS	Treatment	Post-operative KSS	Complications
1	64	F	Schatzker III	R-O	25	Stem	80	
2	45	F	Schatzker VI	R-O	25	Stem	80	
3	40	F	Schatzker VI	R-O	40	Stem	85	
4	70	F	41A2	Conservative	40		95	
5	30	F	Schatzker VI	R-O	20	Stem	80	
6	30	F	Schatzker VI	R-O	20		75	
7	65	F	Schatzker V	R-O	30	Stem	50	Infection
8	45	F	Schatzker V	R-O	25	Stem	70	Rigidity
9	65	F	33A1	R-O	40		90	
10	59	M	33C2	R-O	30	Stem	85	Stroke
11	70	F	Schatzker III	R-O	20		85	
12	60	M	33B2	R-O	35	Stem	85	
13	65	M	33A1	Conservative	20		85	
14	53	M	Schatzker II	R-O	35		85	
15	48	M	41A2	R-O	30		80	
16	50	F	Schatzker I	R-O	45		75	
17	62	F	Schatzker IV	Conservative	20	Stem	80	
18	78	F	Schatzker V	R-O	25		80	
19	75	F	33C3	R-O	40	Stem	84	
20	56	M	33A1	Conservative	35	Stem	70	
21	81	F	Schatzker I	Conservative	20		95	
22	72	F	Schatzker II	R-O	20		90	
23	86	F	Schatzker II	Conservative	25		75	
24	75	F	Schatzker V	R-O	18	Stem	81	Infection
25	63	M	41A2	R-O	30		80	
26	57	M	Schatzker IV	Conservative	35	Stem	90	
27	45	M	Schatzker IV	Conservative	25	Stem	76	
28	37	M	Schatzker IV	R-O	60	Stem	89	
29	71	F	Schatzker III	R-O	56		91	

F = female, M = male, R-O = reduction and osteosynthesis; KSS = *Knee Society Score*



▲ **Figure 1.** Twenty year-old female. **A.** Sequela of tibial plateau fracture Schatzker VI, one year after the surgery. Multiple surgeries. Infection by methicillin-resistant *Staphylococcus aureus*. Peroneal nerve palsy. **B.** Previous removal of material. **C.** Total knee arthroplasty with semi-constrained implant with tibial wedge and cemented long stem. **D.** Functional result at two-year follow-up.



▲ **Figure 2.** Seventy year-old patient with ten-year history of distal femur fracture type 33B2; five previous surgeries. History of infection. A. Distal femur mal-union. B. Total knee arthroplasty with cemented long stem.

material during the same surgery—only in one case did we perform additional minimal approaches to remove screws. In 10 cases we had removed the osteosynthesis material previously. In all patients we asked for intra-operative microbiological studies to rule out infection.

The choice of the implant was based on pre-operative physical examination and X-ray assessment. We used semi-constrained implants in 12 cases and posterior-stabilized implants in 17. We used long stems in 15 cases (51.7%) and cementless stems in six (20.6%), whereas the rest of the patients received cemented implants. We always used cement associated with antibiotic.

In three patients with loss of bone stock we used metallic wedges to correct the defect. We used allograft to reconstruct the extensor apparatus of the knee in one patient.

The post-operative rehab protocol consisted of assisted passive and active mobilization plus reduced weight bearing on the first post-operative day. In patients with pre-operative rigidity, we prescribed immediately post-operative continuous passive mobility.

Functional and X-ray assessment was carried out during the pre-operative evaluation and at last follow-up. Average pre-operative ROM was: 60°-flexion (ranging from 45° to 90°) and 15°-extension (ranging from 0° to 30°). For function and pain evaluation we used the *Knee Society Score* (KSS).⁷ Pre-operative KSS figures were 30 (ranging from 10 to 45) for pain and 25 (ranging from 20 to 45) for func-

tion; average total KSS= 30 (ranging from 20 to 60). We took X-rays (A-P and lateral knee X-rays) immediately after the surgery and at post-operative month 6, and then on a yearly basis, to evaluate signs of prosthetic loosening.

Results

The average follow-up was of 45 months (ranging from 6 to 104). We restored the mechanical axis in all the cases. At last follow-up, average ROM was 112°-flexion (ranging from 60° to 140°) and 5°-extension (ranging from 0° to 30°); the KSS for pain was 40 (ranging from 30 to 50) and 35 (ranging from 30 to 50) for function, with an average total KSS of 81 (ranging from 50 to 95). Results were considered as good (KSS ≥80) in 22 patients (75.8%), regular in six (20.6%), and poor in one case (3.44%).

Four patients had major complications. One of them with history of heart disease suffered a stroke immediately after the surgery, with motor sequela (facio-brachio-cranial hemiplegia contra-lateral to the arthroplasty); the treatment was based on neuro-rehab, with motor function recovery of 95% at last follow-up. In this case, we implemented a slower rehab protocol based on neurologic progression, and we got a ROM of 0°-100° with no pain. One female patient with history of proximal tibia fracture Schatzker type V and seven surgeries, after arthroplasty

showed deep infection, surgical wound dehiscence and loss of soft tissues stock. She was treated with multiple surgical toilets and antibiotic treatment. We used a gastrocnemius flap so as to combat infection and cover the defect with no satisfactory results; therefore, we decided on knee arthrodesis. The second case of infection occurred in a patient with persistent wound leakage. After medical and lab studies, we decided on two-stage prosthetic revision, with good results. The fourth patient showed joint rigidity at post-operative month three, because of which she was subject to forced mobilization under anesthesia, to release adhesions, and we got a ROM of 0° to 100°.

Discussion

The results of this study confirm the ones already seen in previous pieces of research.^{1,2,8,9} TKA for the treatment of osteoarthritis secondary to peri-articular knee fracture improves the patient's symptoms and function, although results are poorer when compared to those in primary TKA.^{10,11} In this series, the results of the KSS were good in 71.4% of the cases. The percentage of major complications was of 21%, with one poor result (7%). These results come as additional to the preliminary results of the study that has already been published, in which functional results keep constant with twofold increase in long-term major complications.¹²

Scar tissues consecutive to either the initial injury or previous surgeries hamper surgical exposition and ligament balance; moreover, they are associated with rigidity, surgical wound dehiscence and infection.¹ All authors recommend carrying out pre-operative puncture-aspiration to rule out infection.¹⁻⁴ Saleh et al.⁴ also carried out intra-operative direct bacteriological analysis. In this sample, all the patients were studied during the surgery, and results were always negative.

Weiss et al.³ recommend undertaking pre-operative vascular assessment in the affected limb so as to avoid the latter two complications, and evaluating the need for flap if there is coverage deficit. Saleh et al.⁴ suggest using the previous wounds as approach to the joint and extending them only if necessary—skin at knee level is irrigated by vessels from the patellar arterial arch, likely to have been injured in the first surgeries. So as to avoid skin necrosis, they recommend using a delicate dissection technique, minimizing the injury at the level of the sub-dermal vascular plexus and avoiding excessive traction.

The surgeon should be trained in carrying out appropriate exposure of the joint. The osteotomy of the anterior tibial tuberosity, the release of the extensor apparatus, or the quadriceps cutting (*snip*) are necessary procedures.^{1,13,14} In our series, functional results were not poorer than those in patients that had not been subject to these procedures.

Shearer et al.¹¹ report on worse results when deformity is at metaphyseal or intra-articular level as compared to the cases affected at distal femur or proximal tibia diaphysis level. They found that patients whose soft tissues were considerably involved did not improve significantly in terms of pain relief and function. In our sample, we did not find differences with respect to the location of the previous injury. On the contrary, patients with history of multiple surgeries showed worse pain and function results.

In patients with sequela of peri-articular fracture, pre-operative planning is essential; generally speaking, the surgical technique and the implant to use are the same as the ones used in arthroplasty revision.¹ It is important to have metallic wedges and foresee the need for bone graft to correct defects and improve the limb axis. We suggest using long stems to decrease excessive bone stress and the migration of the components. Excessive bone resection while trying to restore the limb axis is associated with ligament unbalance and risk of avulsion.¹³

It is widely acknowledged that peri-articular fracture at knee level is associated with high risk of osteoarthritis¹⁻⁴ due to the cartilaginous or sub-chondral injury characteristic in fracture or due to failure in intra-articular reduction; moreover, mal-union alters the limb axis accelerating consecutive osteoarthritis development. It is very important that treatment in the initial fracture follows the principles of anatomic reduction and stable fixation, together with meticulous management of soft tissues, so as to delay osteoarthritis, especially in young patients. Soft tissues management is essential, since this is one of the most influential parameters at the time of knee arthroplasty.

The limitations of this study are based on its retrospective design and the short follow-up for detection of loosening signs. Although knee osteoarthritis secondary to peri-articular fracture is a frequent condition, the incidence of conversion into TKA is low. However, our results coincide with those in anterior series. In these patients TKA improves symptoms and function, although it does not reach the standards seen in patients with primary TKA and it is associated with higher complications rates.

Conclusions

Total knee arthroplasty after post-traumatic osteoarthritis is a technically-challenging surgery. It requires meticulous pre-operative planning, surgical skills and a careful management of soft tissues. It is essential to select the implants previously for them to be available at the time of the surgery—for greatest complexity arthroplasties, if need be. Although the complications rates are higher than those in primary arthroplasty, it is a valid procedure for complex reconstructions, relieving the pain and improving the patient's functional results.

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