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Special Situations in Total Knee Arthroplasty

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1. Introduction

Total Knee Arthroplasty TKA has become a highly successful joint reconstruction procedure.

Surgical outcomes, patients satisfaction and implant survival have improved, and the operation has become widely accepted to afford relief pain, restoration of range motion and function. TKA has been shown to have durable and predictable results in elderly patients.

The principals indications for TKA are severe pain and functional disability. Others indications include deformity, instability and loss of motion.

The diagnosis associated with this features for which TKA has been successfully performed include osteoarthritis, rheumatoid arthritis, inflammatory arthritis, osteonecrosis, and others disability disorders, including tumors and fractures.

The indications and contraindications to perform a TKA have been well established and documented.

Nevertheless there are situations well-known as special or complex, where sometimes could be considered controversial or relative contraindications, and require a deep analysis and take difficult decision.

Up today, specials situations are not presented in elderly patient only. These situations occur in young patient less than 55 or 40 years old too. (De Cárdenas et al 2009) at present, on the basis of obtained results and different reported, the indications for TKA have been expanded eventually to younger people.

Total Joint Arthroplasty continues to confer immense benefits upon patients with joint disease, and it is considered as one of the most cost-effective surgical procedures (Dunbar et al 2009).

In special situations, TKA may be performed in patients in any age to salvage a knee or even to restore motion and relief pain where other procedures are not possible. This indication, however, remains controversial and could be considered relatives contraindications.

The aim of this study is present our modest experience and valuate a group of patients with different situations to whom were performed a complex TKA in specials situations using a Kalisté Knee System.

1.1 Special situations

Complex TKA in specials situations have been presented and development by differents Orthopaedics Surgeons and although controversial criterions have been collected, the concept and the outcomes has been well accepted by orthopedic community.

While the literature does not resolve all the controversies in TKA, sometimes we will encounter apparently disparate advice in some areas; some of which is due to honest differences in opinion and personal experiences and some related to the type of implants. Based in the evidence of scientific papers, literature, experts opinion and by consensus, we would like to present our modest experience and results.

Different representative patients with specials situations: Fig. 1

- Stiff and ankylosed Knee
- Knee angular deformity: Varus / Valgus (figure 1.a / figure 1.b)
- High Tibial Osteotomy HTO (after) (figure 1.c)
- Patellar problems (after Maquet osteotomy or patellectomy)
- Rheumatoid Arthritis (Total Joint Collapsed) (figure 1.d)
- Post-traumatic Osteoarthritis
- Arthrodesed Knee
- Achondroplasic

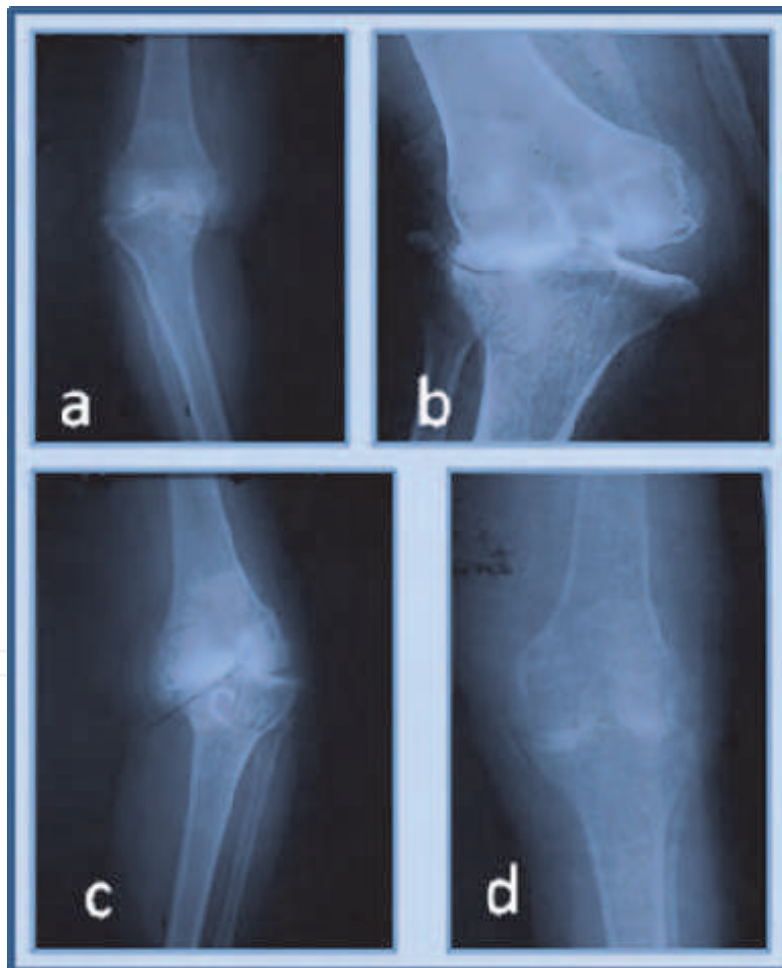


Fig. 1. Different special situations of the knee.

Many of these conditions are associated or combined with:

Instability, flexed or extended painful rigid knee and/or bone defect.

In summary all this patients have diagnosis of Severe Osteoarthritis of the Knee. (figure 2.)



Fig. 2. Severe Bilateral Osteoarthritis of the Knee

2. Material and method

This is a longitudinal, prospectively and follow-up study. Between January 2004 and January 2010 the authors did 636 consecutive Total Knee Arthroplasty in 582 patients with moderate to severe Osteoarthritis of the Knee. They were treated using Kalisté Knee System (FHorthopedic. France).

From this group were selected 132 patients (146 TKA) to be included in this study. They were 14 Bilateral in two stage and 118 Unilateral, 69 left Knee and 49 right Knee. 81 patients (61,4 %) were female and 51 (38,6 %) male, with a mean age of 62.5 years old (range 25 to 82 years old).

2.1 Patient selection

The patient selected to be included in this study has been patients with special situations as was described.

All of them has severe primary knee osteoarthritis IV-V Alback's radiographic classification or secondary to others conditions like post-traumatic, rheumatic arthritis with total joint collapse, angular deformity: varus / valgus.

Stiff or ankylosed knee, patellar problems as after Maquet osteotomy or patellectomy, history or failed high tibial osteotomy, arthrodesed knee and achondroplastic.

Gender, race or age not were criteria to exclude. The authors excluded patients with light or moderate primary knee osteoarthritis and varus / valgus/ flexed deformity less than 10 degrees, additional exclusion criteria included history of septic arthritis of the knee, neuropathic knee, and hemophilic arthritis not was criteria to be included.

2.2 Ethical considerations

The study was approved by the institutional review board.

All the patients were well informed and documented about the methodology, purpose and procedure of this study, and have given their consent in writing.

2.3 Clinical assessment

Pre-operative clinical evaluation include detailed medical history, full name, identification card number, gender, race, age and all dates according to the standard file to all patients

admitted in this hospital, and thorough clinical-functional and radiographic examination using the Knee Society Scoring KSS, because it is one of the more acceptable and standardized instruments to evaluation of results, and it is a powerful tool for comparing specific dynamics of the knee arthroplasty.

The Knee Society Clinical Rating System available since 1989 (Insall et al.1989), have been the preferred method of outcome assessment after knee replacement for many surgeons.

The new KSS is being validated and updated to reflect current trend in Knee Arthroplasty and contemporary expectation and activities levels that were not well addressed in earlier assessment models. It includes visual analog and pain assessment, as well as objective measures of knee motion and stability.

The functional component of the KSS is relevant to contemporary patients of any demographic background (Lonner JH, 2009).

2.4 Radiographic evaluation

Pre-operative image evaluation includes standard different Knee radiographs:

Comparative anterior-posterior AP standing view (if the patient could be stand) or in supine position, lateral view in 25-30 flexion degree (each one) and patella axial view (all of this, if it was possible according to the knee joint condition).

Additionally radiographic studies of the both hip and both ankle were taken to know the conditions of these joints.

Pangonogramme not was possible, and anterior-posterior radiographic views were done standing or supine position with 14" x 17" cassettes.

Radiographic analysis permitted the determination of the preoperative knee osteoarthritis classification (Alback S, 1968) and included measurement of the mechanical axis, measurement of the femorotibial axis and assessment of the degree of correction.

On standing AP radiographic view, were measured the varus or valgus deformity.

On lateral radiographic view, were measurement the posterior slope of the tibia and observed the posterior knee aspect and the patella localization.

On axial radiographic view were observed patellofemoral alignment, joint space and joint surface.

All this measurements were done using a goniometer.

To the determination of the preoperative osteoarthritis classification an co-author (RJTR) who did not do surgeries reviewed all available radiograph taken before surgery, and at the most recent follow-up for evidence of component loosening, radiolucencies, and overall alignment, using the Knee Society total knee roentgenographic evaluation and Scoring System (Ewald FC, 1989).

Using the X-Ray template (transparences) of the Kalisté components systems were calculated the size of the each component during pre-operative plannification.

2.5 Surgical technique

2.5.1 Kalisté Total Knee System

Kalisté Total Knee System (FHorthopedic.France) is a tricompartmental resurfacing prosthesis.

The femoral and tibial resections are independent.

This design allows the surgeons to begin with either the tibial stage or the femoral stage.

It is mainly based on intramedullary femoralalignment. Pre-operative control of the femoral guide alignment is performed with the help of extramedullary rods.

The pre-operative planning (radiographic studies) allow the surgeon to calculate the anatomical axis of the leg, in order to calculate the angle of femoral valgus.

The resections (distal femoral and proximal tibial) are perpendicular to the mechanical axis of the leg. Tibial viewing is intramedullary, if the entry point used is located at the level of the insertion of the anterior cruciate ligament or external (tibia varus). Definition of the axes and estimation of the size of the implants are determined thanks to X-Rays template at a 1.15 scale.

The Kalisté Total Knee System was designed to admit posterior cruciate ligaments PCL-retaining or posterior stabilized PS Knee prosthesis. (Fig. 3.a, 3.b)

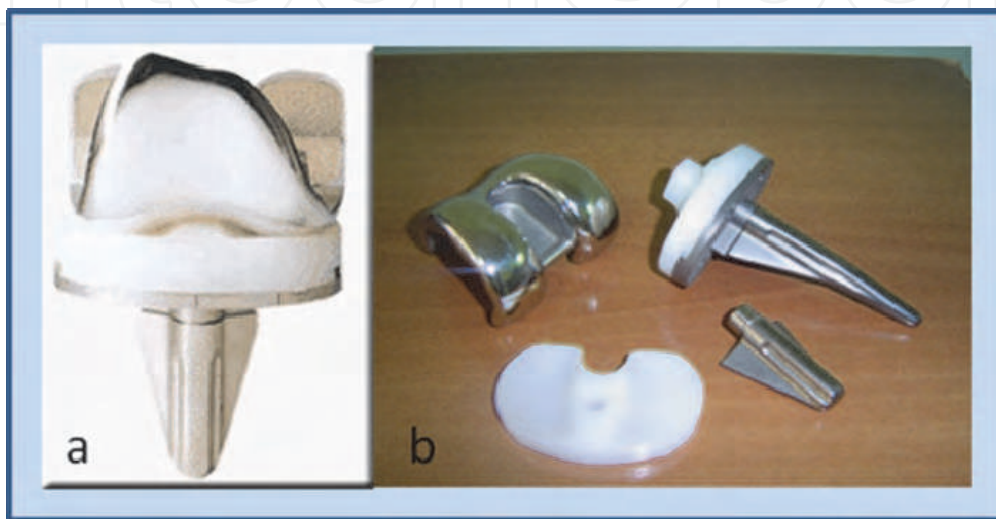


Fig. 3. a. Kaliste Total Knee System (PCL retaining), b. Kaliste Total Knee System (Posterior Stabilized) (with permission FHorthopedic. France)

The accessories, augmentation devices, and short or long stem for the operative technique are available in the instrumentation sets.

The surgeon decides if use or not use the patellar prosthesis component and it is available too.

2.5.2 Surgical protocol

All surgeries were done by one surgeon (OMCC), the same surgical team and at one institution (CCOI Frank Pais, La Habana, Cuba) all procedures followed a standard operative protocol. Surgeries were done with the patient in supine position.

All surgical procedures were performed in a standard operation theatre with standard air conditions (not ultra-clean air, not laminar flow). Standard clothing was used by the surgical team. 87% of the surgeries were with spinal, epidural anesthesia using intravenous sedation too, and only in selective patients with specific clinical conditions were under general anesthesia as anesthesiologist advised. Pneumatic tourniquet not were used in nobody case. Hemostasis achieved with use of cauterization and diathermy.

The limb washed and draping technique for TKA was done as usually. Ancillary leg-holding device was placed on the limb and operating table to provide stable and gradual positioning of the Knee during surgery.

In all cases of this study were used posterior-stabilized Kalisté Knee System cemented with Polymethylmethacrylat.

The procedure to implant the components was according to the standards total knee arthroplasty, using the instrumentation designed to it. Variants were used as advisable in each special situation (Lotke PA, 1999, 2002, Nelson CL 2002, Scuderi GR 2002, Padgell D. 2002, Griffin FM 2002, Lombardi AV et al. 2009).

In general, a straight anterior longitudinal (midline) skin incision was the most appropriate performed when skin condition was possible, followed by a medial parapatellar capsular arthrotomy (Fig. 4).

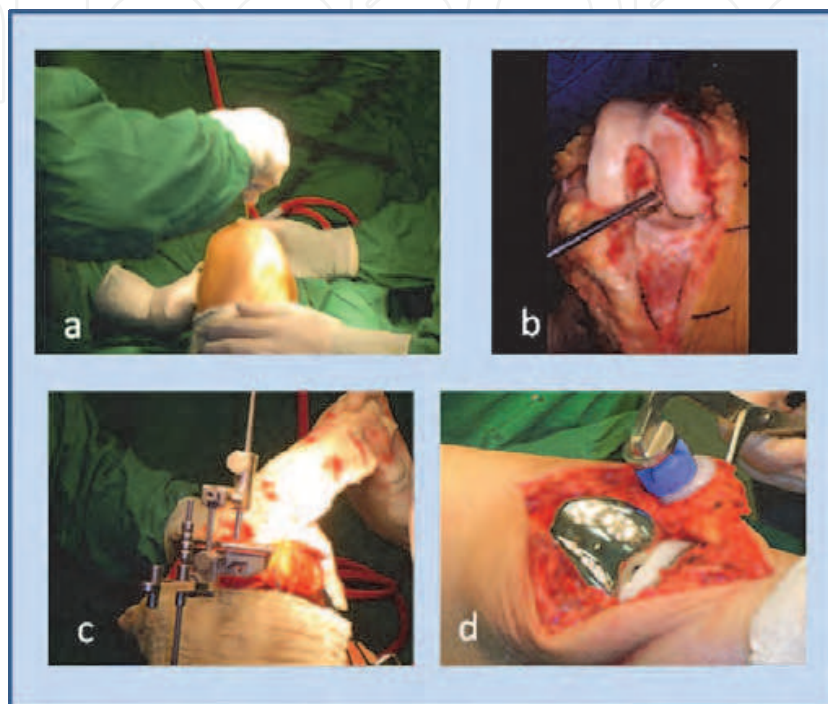


Fig. 4. a. b. c. d. Different phases of the surgical procedure to implant the knee prosthesis.

It provides adequate access to medial or lateral aspect of the limb. In some cases was necessary a variant, selected of classical approach options according the need.

All patients had placement of drain 24-48 hours post-operation according to standard practice peri-operative prophylaxis consisted of intravenous cephalosporin (Cephazoline 1 gr) starting one hour prior to surgery and continue for 24 to 72 hours. Patients also received subcutaneous low molecular weight heparin LMWH for prophylaxis against deep vein thrombosis DVT started in the evening of the operation day till 10 days according to the conditions of the patients.

2.6 Rehabilitation protocol

All the patients were assigned to regimen for post-operative early mobilization.

Day of the operation: Following skin closure and wound dressing, the knee was placed straight on the bed until early next morning, in an extension splint, with a pillow under the foot, in order to increase the venous backflow and decrease edema. An ice bag over the knee is allowed for the reduction of the hyperemia, the edema and the inflammation.

Post-operative day 1: The regime of rehabilitation program consists in "to leave make" or "allow make" by him/her self (patient) under physiotherapist guide.

We never used continues passive motion CPM machine.

The physiotherapist passively and actively moved the Knee and taught the patient to repeat different exercises during the day alone (5 times daily, at least 3 times), and after each, ice bag over Knee. (figure 5 a, b, c, d)



Fig. 5. a. b. c. d. The patient in the postoperative first day, doing exercises intensive rehabilitation program under the guidance of the physiotherapist.

The patient is allowed to sit on the bed or on a seat, bending the knee as tolerated, isometric strengthening of the quadriceps and concentric dynamic exercises of periarticular hip and ankle muscles were encouraged. The knee was placed in the extension splint again overnight.

Post-operative day 2: Continue the same as day 1, increasing the range of motion ROM. The patient started to walk with walker and muscular strengthening recovery was intensified.

Post-operative day 3: The same as day 2, but increasing the ROM, bending the knee to 90° and started to walk with two crutches.

Between the post-operative days 3 to day 5, the patient can go at home with Doctor's orderly and exercises program written and follow-up by outpatient department OPD.

2.7 Evaluation and follow-up

To evaluate the patients, they were checked and recorded according to the KSS all categories were collected in data base and processed in the Med Cal program.

Clinical and functional assessment was performed pre-operatively and post-operative at 3, 6, 12 months and yearly. Patients were evaluated prospectively by means of the Knee

Society Scoring System KSSS and by Analogical Visual Scale AVS to the Health Perception Criteria.

A locally-designed patient satisfaction questionnaire was also given to all patients before operation and yearly after operation, asking them to rate their replacement on a scale from 0 to 10, with 0 being very dissatisfied and 10 being very satisfied.

A deep infection was any infection that concurred inside the knee joint, requiring prosthesis removal.

A superficial infection was any infection of the skin that responded well to antibiotic with not residual problems.

Aseptic loosening was considered to be the presence of a radiolucent line larger than 2 mm around the entire prosthesis which was not related to infection.

Fatal deep venous thrombosis was an acute thromboembolism episode that ended in death.

2.8 Statistical analysis

Statistical analysis was performed to study the possible differences between clinical-functional conditions of the patients before and after operation and radiographic changes for evidence of component loosening, radiolucencies and overall alignment. Before operation each patient was valued clinical-functionally according KSS. Postoperative were repeated the valuation with the same Scoring System (KSS) at 3, 6 months and yearly. The obtained results were compared. The primary information was recorded in data base elaborated for this study. The results were presented in tables and graphics performed using Microsoft Office Excel and Word program, Window seven operative systems.

Statistical technique of absolute and relative frequency were applied, odds ratio and p-value.

3. Results

All the patients in this study had substantial pain and functional limitation before the surgery. Some of them used wheelchair and many used walker, crutches or cane (support dependence).

This study is one of the largest series of specials situations in TKA. Several authors has reported on the results of total knee arthroplasty in patients with specials situations and reported significant improvement in KSS and ROM.

The study population of this series composed by 132 patients (100%) are summarized in the table 1, and were according gender 81 (61,4%) female and 51 (38.6) male and the age distribution were 38 (28.8%) less than 50 years old and 94 (71,2%) more than 50 years old.

GENDER	AGE (Years Old)					
	< 50		> 50		TOTAL	
	N	%	N	%	N	%
Female	29	22.0	52	39.4	81	61.4
Male	9	6.8	42	31.8	51	38.6
TOTAL	38	28.8	94	71.2	132	100

Table 1. Study population between age and gender distribution (Sources: Data Base)

The primary diagnosis distributions have been summarized in table 2.

"Special Situations" Diagnosis	PATIENTS	
	N	%
After High Tibial Osteotomy	42	31.8
Rheumatoid Arthritis (Joint Collapsed)	14	10.6
Post-traumatic Osteoarthritis	19	14.4
After Patellectomy	5	3.8
Severe Knee deformity Varus/Valgus	31	23.5
Stiff and Ankylosed Knee	18	13.6
After Maquet Osteotomy	3	2.3
TOTAL	132	100

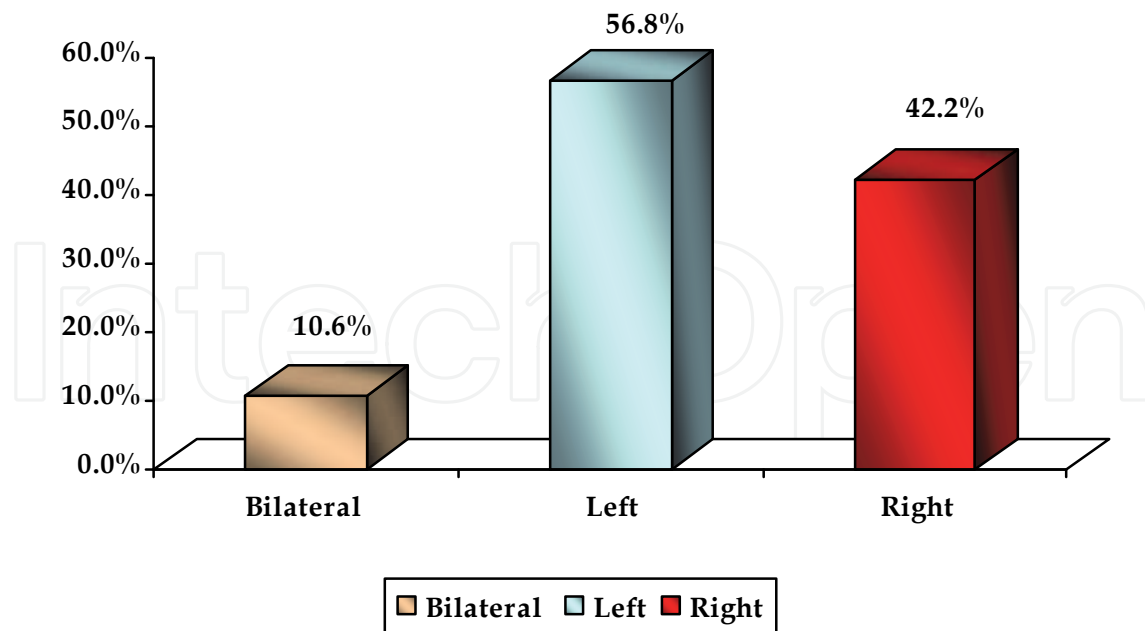
Table 2. "Special Situations". Diagnosis Distribution

In our series study, the side distribution of the knees operated was as showed the Table 3 and Graphic 1.

Number operated knee							
Bilateral		Unilateral					
		Left		Right		Total	
N	%	N	%	N	%	N.	%
14	10,6	67	56,8	51	42,2	118	89,4
Odds ratio	1,0742	Odds ratio	2,4219	Odds ratio	2,3355		
p value	0,0593	p value	0,0374	p value	0,0453		

Table 3. Number of Knee operated with "Special Situations" CCOI Frank País. January 2004 – January 2010. (Source: Data Base)

In the sample, 118 patients were operated unilaterally on one knee to 56.8% and 42.2% distributed left knee and right knee respectively. As the number of patients who underwent bilateral knee represent 10.6% of the total. Patients undergoing unilateral knee had both left and right odds ratio of 2.4219 and 2.3355 respectively, indicating that there are two times more likely a patient could be operated on one knee than both, particularly, the left knee.



Graphic 1. Number of knees operated according to location

The clinical and functional pre-operative (1 year to follow-up) results according KSS were summarized in the Table 4 and Graphic 2.

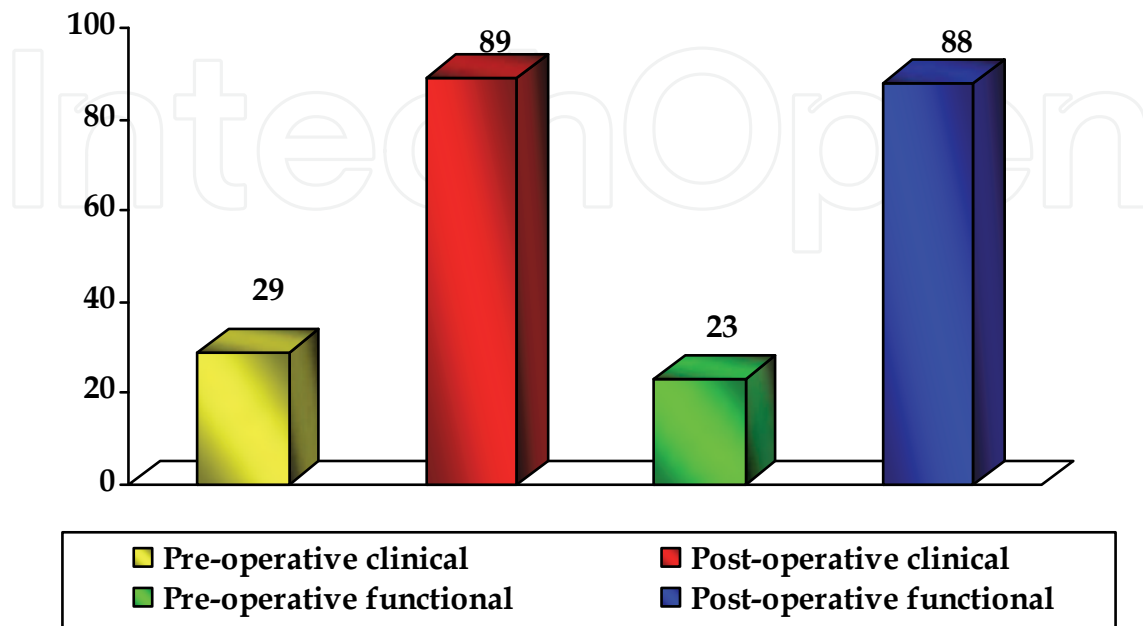
Indicator	Clinical				Functional			
	Pre operative	Post operative	Odds ratio	P - value	Pre operative	Post operative	Odds ratio	P - value
Mean	29	89	3,4673	0,0321	23	88	4,0284	0,0382
Range	14 - 49	64 - 100	3,1632	0,0493	0 - 58	62 - 100	4,4570	0,0302

Table 4. Clinical and Functional pre-operative and post-operative (1 year follow-up) Results according KSS. CCOI "Frank País" January 2004 - January 2010 (Source: Data Base).

The mean preoperative scale application in clinical phase KSS was 29, indicating that there is a limited deterioration in the knee as a result of joint degeneration, a year is a significant improvement of this parameter as it close to 100 which is the optimum value (89), indicating a favourable clinical evolution of these patients after total knee arthroplasty. According to the level in the preoperative stage, it is appreciated that there was a path of the mean values in the clinical assessment between 14 and 49 points, and in the postoperative phase was reached 64 to 100 points, which is evidence of clinical improvement of patients after surgery. For the value that represents the odds ratio 3.1632 of the clinical phase is to infer that a patient operated year total knee arthroplasty has 3 times more likely to improve in the KSS scale score that if does not apply this surgical procedure.

As for the functional parameter the patients were on average 23 points which shows result in loss of function after knee surgery, and in the postoperative phase is reached near 88 to 100, showing a significant recovery in the functional state of the knees operated patients. The functional range of this phase before the operation is relatively moderate to low once the replacement will elevate this range from 62 to 100 which show functional improvement

in knee patients after surgery. For the value 4.4570 represents the odds ratio in this functional setting. We must infer that a patient per year to operate for total knee arthroplasty has 4 times more probabilities to improve his-her functionality according to the KSS scale score that if does not apply this surgical procedure.



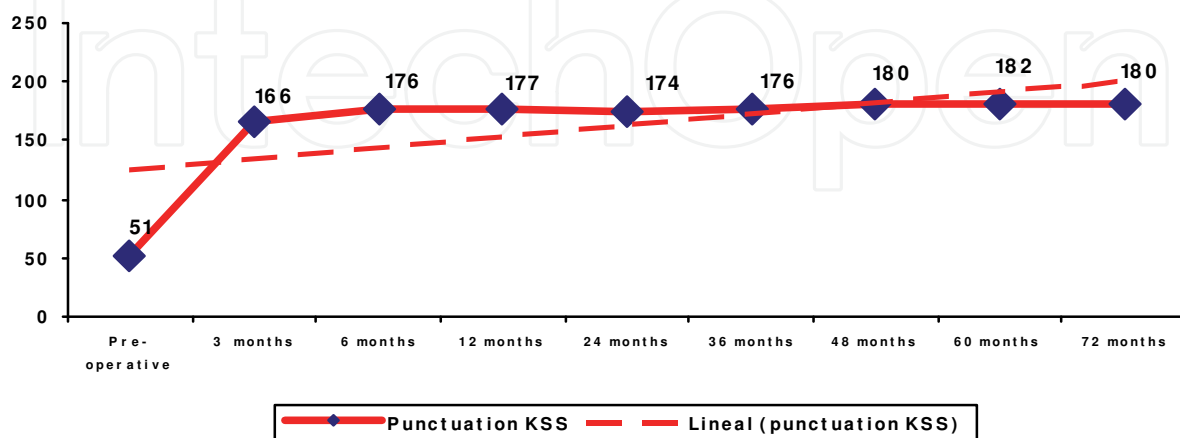
Graphic 2. Graphic behaviour and the year according to preoperative level in patients with knee osteoarthritis KSS operated by ATR.

And finally clinical-functional pre-operative and post-operative, evolution according KSS during 6 years follow up study were showed as a total mean punctuation in the Table 5 and Graphic 3.

Indicator	Pre-operative total mean punctuation	Post-operative total mean punctuation	Follow-up (months)	Odds ratio	P - value
	51	166	3	4,0932	0,0352
		176	6		
		177	12		
		174	24		
		176	36		
		180	48		
		182	60		
		180	72		
Reference Value	200	200	.		
Mean	51	177			

Table 5. Clinical - functional pre-operative and post-operative. Evolution according KSS during 6 years follow-up study. (Source: Data base).

It is observed in the preoperative average score achieved on average in the six years was 51 points, and in the postoperative period shows that every year the score is close to 200, the average score is 177, significantly favourable outcome once the total knee arthroplasty. For the odds ratio value reached 4.0932 as can be inferred that a patient operated for total knee arthroplasty from 3 months of surgery is four times more likely to improve their clinical and functional rating scale that a patient KSS not yet been operated with this procedure.



Graphic 3. Graphic trends in overall behavior and functional clinical phases, of the knee as punctuation in the KSS scale.

The graph shows trends as there is a significant evolution ($P < 0.05$) clinical and functional satisfactory phases in the recovery of patients undergoing knee for knee replacement as early as three months after surgery, where this evolution remains a tendency to increase average scale score as KSS.

The final radiographic evaluation showed that 138 (94,5%) of the 146 (100%) operated knee were in neutral alignment, 4 were in valgus and 4 flexed less than 10 degrees each one.

About complications, were 2 deep infection that required revision, prosthesis removed and arthodesis. 3 were superficial infection, 3 mechanical problems: 1 patellar tendon rupture (revision and reconstruction) and 2 patella dislocation (1 arthroscopy to release and 1 revision and realignment). About death (before 90 days post-operative): 1 multiple organic failure in a 78 years old man with high risk and 1 fatal deep venous thrombosis DVT (suddenly).

Our results showed not significant differences in complications between others reported in the medical literature in terms of death, infections, dislocations or revision.

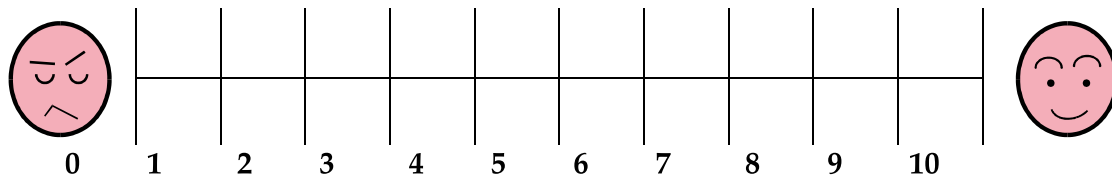
None of the knees had evidence of aseptic loosening, radiolucent or implant migration at the time of the lasted follow up. It may be that a longer follow-up will be required to reveal any difference in outcome.

An efficient surgery, with an aggressive post-operative rehabilitation program and a proper patient selection should maximize favorable results and limit perioperative morbidity.

Every surgeon must evaluate the risk-to-benefit ratio for each individual patient; by the way, the management of these specials conditions has changed over the last years.

Up-today TKA is considered "high tech" procedures.

All patients in our study had functional improvement at the time of latest follow-up. There was a substantial improvement in pain relief and in the range of motion of the knees after TKA in specials situations and the degree of satisfaction of patients significantly improved according to criteria autoperccepción as shown in Table 6 according to the visual analog scale and of course, improved the quality of life.



PRE-OP	VS	POST-OP
MEAN: 1.5	VS	MEAN: 8.7
RANGE: 0 - 3	VS	RANGE: 7 - 10

Table 6. Analogical visual scale avs. (Source: Data Base)

3.1 Evolutive cases presentation.

Finally, as evidence of the results were showed some evolutive cases off this study.

The first case, was 64 years old, female, with that diagnosis severe bilateral osteoarthritis of the knee, combined with genu varus and flexion contracture, she has history of high tibial osteotomy in her left knee eight years ago. A sequence evolutive was showed in the figure 6. a, b, c, d, e, f, g, h.



Fig. 6. a. Genu varus deformity, b. X-ray AP view showed severed OA in both knee with HTO in the left, c. X-ray AP view showed bilateral TKA implanted in both knee with two screw reinforced the medial side of the tibial to solve the bone loose and corrected deformity, d. Lateral view of both knee whit TKA implanted, e. f. g. h. the patient rehabilitated with range of motion and full stability.

The second case showed was a 34 years old, female with diagnosis of Rheumatoid arthritis and total joint collapse of both knee in wheelchair the last 3 years, and of course both knee were in fixed flexion the figure 7 a, b, c, d, e, f, g, h showed the sequence of follow - up.

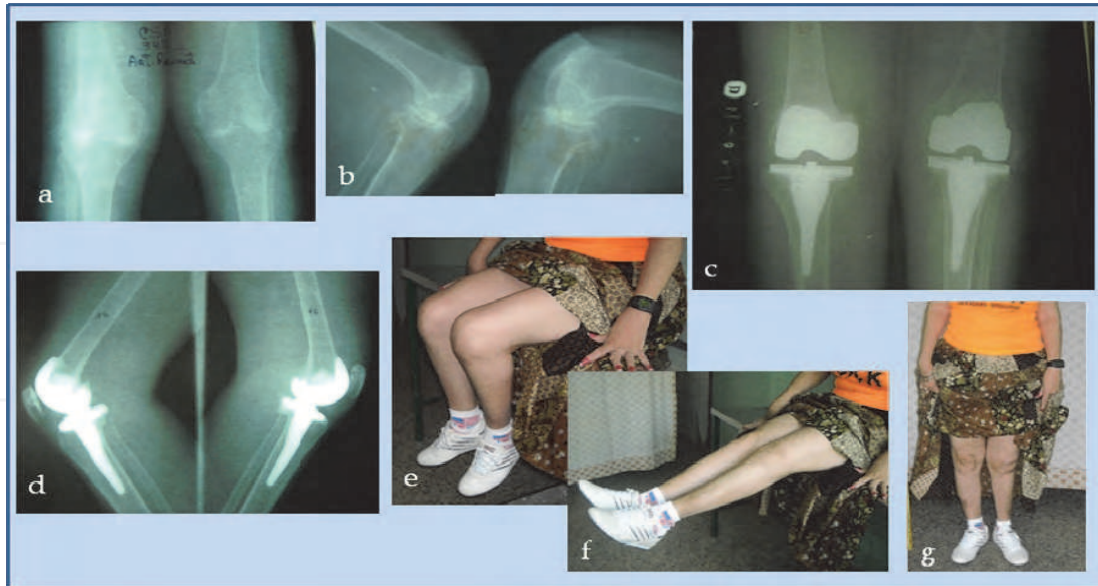


Fig. 7. a. b. Pre-operative AP and Lateral view X-ray of both knee showed the total joint collapse and fixed flexion deformity, c. d. Post-operative bilateral TKA implanted, and e. f. g restored the patient, showing full extension.

The last case presented was a 32 years old, male, with history of multiple injured patient involved in route traffic accident RTA 2 years ago, that actually has diagnosis of post traumatic severe oostearthritis , with stiff and posterior subluxated left knee. The figure 8 a. b. c. d. e. f. g. h. showed the sequence of pre and post operative results to recovery assessed at one year of evolution.



Fig. 8. a. b. c. Evident deformity of the left knee sequel of trauma that required extensive soft tissue release (d.) and TKA implanted (e. f.) and final recovery of the patient with excellent range of motion.

4. Conclusion

In this study about complex Total Knee Arthroplasty in special situation according to our results an outcome, till now the evidence permitted arrive to the following conclusions: patients with specials situations in the knee may look complex or difficult, but the Total Knee Arthroplasty using Kalisté System has been a very successful operation with a high level of patient satisfaction and functional improvement like others reports.

Best results were achieved when the surgeon has carefully evaluated all the factors influencing in each individual special situation and did a preoperative plannification according to it.

The selections of patient and prosthesis design were very important, but we believe that efficient surgery and overall the experience and skill of the surgeon could be more important.

At one to six years follow-up postoperative, the functional outcome between before and after operation appears to be significant different, nevertheless we considered the weakness of this study is the short-mid time's follow-up and need further investigation and follow-up at least ten to fifteen years after implantation.

We believe that the use of Kalisté Knee System improved our results and we can advice this design as an excellent system of TKA.

Finally, our study showed the aim of the evaluation and the evidence: improved the Quality of Life of the Patient in Relation with Health QLPRH.

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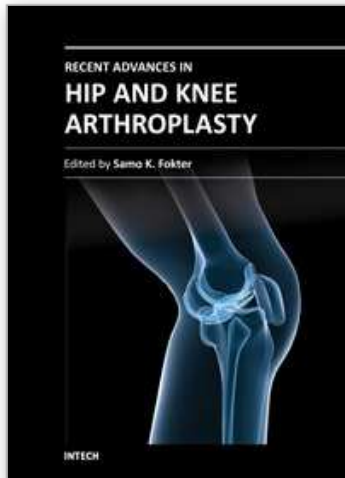
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The purpose of this book is to offer an exhaustive overview of the recent insights into the state-of-the-art in most performed arthroplasties of large joints of lower extremities. The treatment options in degenerative joint disease have evolved very quickly. Many surgical procedures are quite different today than they were only five years ago. In an effort to be comprehensive, this book addresses hip arthroplasty with special emphasis on evolving minimally invasive surgical techniques. Some challenging topics in hip arthroplasty are covered in an additional section. Particular attention is given to different designs of knee endoprotheses and soft tissue balance. Special situations in knee arthroplasty are covered in a special section. Recent advances in computer technology created the possibility for the routine use of navigation in knee arthroplasty and this remarkable success is covered in depth as well. Each chapter includes current philosophies, techniques, and an extensive review of the literature.

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