

Knee Arthroplasty in Patients With Poliomyelitis and Extensor Mechanism Deficiency. Review and Experience in Nine Cases

Fernando González Morán

Orthopedics and Traumatology Service, Sanatorio Mater Dei, Autonomous City of Buenos Aires, Argentina

ABSTRACT

Objectives: To report the clinical and functional outcomes of patients affected with post-polio syndrome treated with total knee arthroplasty, evaluating whether the choice of the prosthesis is conditioned by the quadriceps functional deficit. **Materials and Methods:** patients with post-polio syndrome were evaluated in their muscle deficit condition and with functional tests such as the 10-meter walk test, 2-minute walk test and timed up and go test, as well as Knee Society Score preoperatively and 1 year after knee arthroplasty. **Results:** All patients significantly improved functional values that directly impacted their quality of life. The Knee Society Score did not present significant differences between the most severe cases with quadriceps deficit with recurvatum and those with less involvement, but the functional tests did show a significant difference between these subgroups. **Conclusions:** Total knee arthroplasty is a valid treatment alternative in this complex pathology, providing the patient with pain relief, recovery of function and improving their quality of life. The restoration of stability through constrained prosthetic designs is a key factor in the recovery of a functional gait pattern in patients with recurvatum. Patients with quadriceps strength who overcome the resistance of gravity have functional outcomes comparable to those of patients without post-polio syndrome and do not require hinged prostheses.

Keywords: poliomyelitis; total knee arthroplasty; rotating hinge.

Level of Evidence: IV

Artroplastia de rodilla en pacientes con poliomielitis y déficit de extensores. Revisión y experiencia en nueve casos

RESUMEN

Objetivos: Comunicar los resultados clínicos y funcionales de pacientes con síndrome pospolio sometidos a una artroplastia total de rodilla y evaluar si la elección de la prótesis está condicionada por el déficit funcional del cuádriceps. **Materiales y Métodos:** Se evaluó a pacientes con síndrome pospolio en su condición de déficit muscular y con escalas funcionales de tiempo de caminata en 10 m, distancia caminada en 2 min, y tiempo levántate y anda, y el Knee Society Score antes de la artroplastia de rodilla y un año después. **Resultados:** Los valores funcionales que impactaban directamente en la calidad de vida mejoraron notablemente en todos los pacientes. No se hallaron diferencias significativas en el Knee Society Score entre los casos más graves con déficit del cuádriceps con recurvatum y aquellos con menor afectación, pero las escalas funcionales sí mostraron una diferencia significativa entre estos subgrupos. **Conclusiones:** La artroplastia total de rodilla es una alternativa terapéutica válida en esta compleja enfermedad, que logra aliviar el dolor, recupera la función y mejora la calidad de vida. La restauración de la estabilidad mediante diseños de prótesis constreñidas es un factor clave en la recuperación de un patrón de marcha funcional en los pacientes con recurvatum. Los pacientes con fuerza de cuádriceps que vencen la resistencia de la gravedad tienen un resultado funcional equiparable al de los pacientes sin síndrome pospolio y no requieren prótesis abisagradas.

Palabras clave: Poliomielitis; artroplastia total de rodilla; bisagra rotatoria.

Nivel de Evidencia: IV

Received on August 7th, 2022. Accepted after evaluation on August 23rd, 2022 • Dr. FERNANDO GONZÁLEZ MORÁN • drgonzalezmoran@gmail.com  <https://orcid.org/0000-0002-6285-8550>

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INTRODUCTION

Poliomyelitis or “infantile paralysis” is a disease caused by an enterovirus transmitted by the fecal-oral route and is currently eradicated in our country.¹ In most cases, the infection is asymptomatic or only causes a flu-like state, but one in 200 patients develops a severe form with involvement of the motor neurons of the central nervous system that leaves flaccid muscle paralysis as a sequel. In Argentina, important epidemics occurred in 1953 and 1956 (Incidence: 33 cases/100,000 inhab.), and many patients suffered sequelae, such as mild to paralytic motor neurological involvement. This group with post-polio syndrome (PPS) with flaccid paralysis has adapted their lives to living with a motor deficit, and has managed to cope quite well with their disability, although typically, after the 5th to 6th decade of life, the progression of joint damage generates pain and gait limitation due to the progression of the recurvatum deformity. Degenerative joint disease subjected to unusual eccentric forces causes joint pain and functional limitations² to such a degree that walking is almost completely impossible. Total knee arthroplasty is a valid alternative for these patients to recover that ability.³ It is a technically demanding procedure associated with various difficulties, such as atypical joint deformity (Figure 1), genu recurvatum and instability, low patella (Figure 2), hypoplastic femur and tibia with narrow spinal canals, and quadriceps functional deficit.⁴



Figure 1. Atypical joint deformity.



Figure 2. Low patella.

OBJECTIVES

To report the clinical and functional outcomes of nine knee arthroplasties in seven patients with PPS whose quadriceps strength did not exceed the resistance of gravity and who received a constrained rotating-hinge prosthesis; and in two patients with antigravity strength who received a posterior stabilized prosthesis, and to assess the differences between these groups.

MATERIALS AND METHODS

We retrospectively reviewed the knee arthroplasties performed in patients with moderate or severe PPS, with quadriceps extension deficit against gravity, operated between 2006 and 2016.

Functional tests²

- Functionality was determined with tests aimed at this disease: 10-m walk test (10MWT): the time needed to walk 10 meters at a comfortable speed, tracked with a stopwatch.
- 2-minute walk test⁵ (2MWT): the distance traveled in meters walked at a comfortable speed in 2 minutes, tracked with a stopwatch.
- Timed up and go test (TUG): it is the time needed to get up from a chair from a sitting position, walk 3 m, return and sit down again while the time is tracked with a stopwatch.

The mean follow-up time was 85 months (range 20-180). The Knee Society Score and functional evaluation tests were used preoperatively and one year after surgery.

In all cases, a rotating hinge prosthesis (Endomodel®; Link, Germany) was used (Figure 3), except in two cases with antigravity quadriceps strength who received a posterior stabilized prosthesis (Scorpio®, Stryker, USA)



Figure 3. Endo-Model® hinged prosthesis (Link, Germany).

Surgical technique

Patients with quadriceps insufficiency underwent a median longitudinal approach and medial capsulotomy, except for one case in which the V-Y quadriceps technique was used. Freehand saw cuts were carefully made over the osteoporotic atrophic bone (Figure 4) anticipating unusual deformities and hypoplasia of the femur and tibia linked to the sequelae of poliomyelitis. The distal cut was intentionally limited at the expense of the condyles to decrease the space in extension and limit the recurvatum (Figure 5). All the rotating hinges were cemented with a plug, pulsatile lavage and a retrograde cementing gun.

After surgery, an early rehabilitation protocol started with partial weight-bearing on the operated limb and ambulation with a walker for four weeks, before moving on to a cane. In the two patients who had quadriceps strength against gravity, the standard technique was used and a posterior stabilized prosthesis was placed.

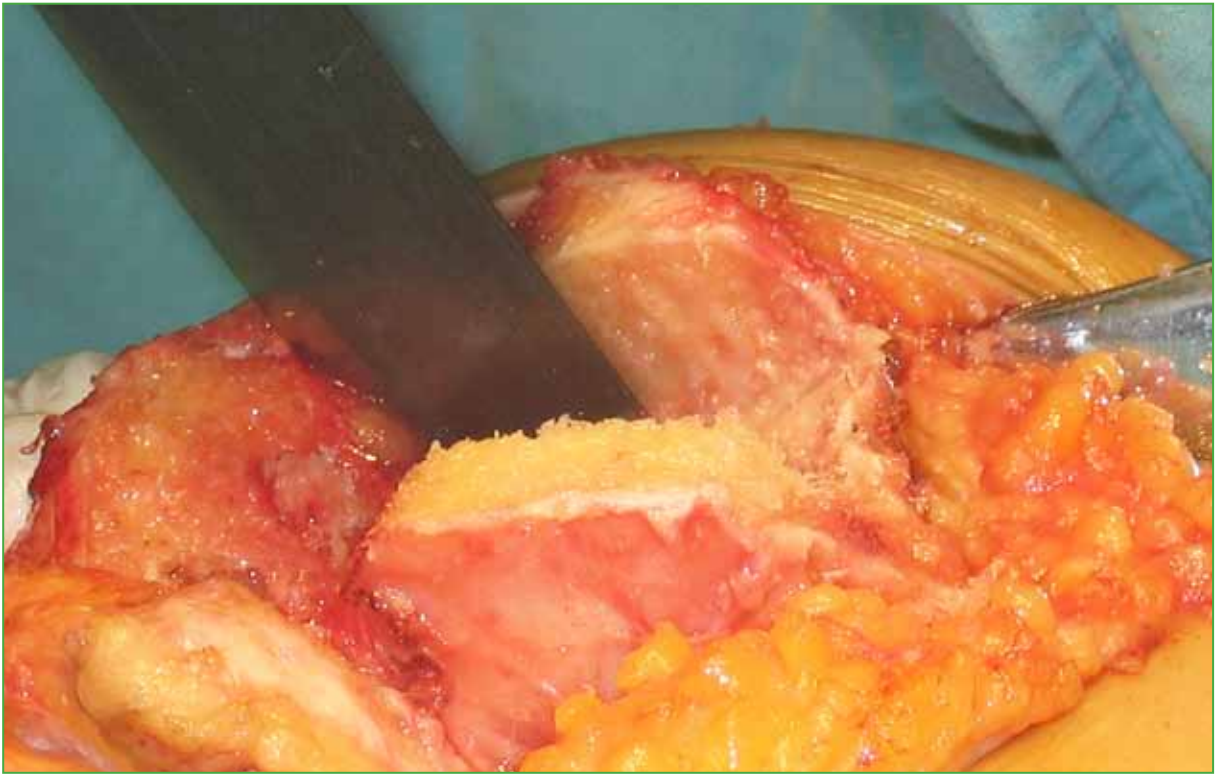


Figure 4. Osteoporotic atrophic bone.



Figure 5. Recurvatum limitation.

RESULTS

Nine arthroplasties in seven patients with PPS, operated between 2006 and 2016, were retrospectively reviewed (Table 1). Five were women and two were men, with a mean age of 62 years (range 52-73) when they underwent surgery. In this population, seven knees had moderate to severe post-polio sequelae with quadriceps extension deficit against gravity (77%): four of them had a grade 1/5 quadriceps muscle deficit according to the Medical Research Council (Table 2) with recurvatum, three had grade 3/5 knees; and two knees (22%) retained grade 4/5 antigravity extension. Clinical results were evaluated with the Knee Society Score (KSS) and the functional KSS before surgery and one year later. Scores <60 are considered poor.

KSS improved markedly in all patients, from a mean of 22 (range 13-43) preoperatively to 87 (range 80-100) postoperatively; and the functional KSS, from 24 before the intervention to 77 two years after the intervention. (Table 2). The range of motion was always >110°.

Table 1. Patient data.

Patient	Surgery	MRC	Age/year of surgery	Follow-up (months)
AF	May 2006	1	54/2006	20
MRG	June 2014	4	63/2014	34
AP	August 2008	1	70/2008	18
LM	September 2017	1	69/2015	48
MG (left knee)	September 2006	3	52/2007	180
MG (right knee)	November 2007	3	58/2008	166
PJ (left knee)	August 2008	3	64/2008	120
PJ (right knee)	September 2015	4	71/2015	36
MN	May 2008	3	58/2008	120
			62	82.44

MRC = Medical Research Council.

Table 2. Medical Research Council Scale

0	No muscle contraction
1	Flicker or trace contraction
2	Active movement if gravity is eliminated
3	Active movement against gravity
4	Active movement against gravity and some resistance
5	Active movement against gravity and full resistance

Clinical outcomes

The KSS did not present significant differences between the most severe cases treated with hinged prostheses and those with less compromise with muscular control and posterior stabilized prosthesis, at the end of follow-up. In four of the nine arthroplasties, the results were excellent (from 80 to 100) and in five, good (from 70 to 79). Function scores improved substantially in all cases, although the patients without antigravity quadriceps strength did not have excellent results (>80 points) in any case by contrast with the two patients who had sequelae of polio with less involvement (Table 3). The limitation of hyperextension by reducing the gap in extension did not generate difficulties in walking, as published in some studies. Regarding the specific functional tests, the values that directly impact quality of life improved markedly in all cases. The TUG test yielded mean preoperative values of 16.1 s (range 9.9-20.7) and improved to 13.2 s (range 8.9-20.7) postoperatively. The 10MWT value was 15.9 s before surgery (range 8.9-30) and 12.5 (range 7.7-21) after surgery, the 2MWT was 64 m (range 29-136) before surgery and improved to a mean of 107 m (range 47-168) after it (Table 4). No radiographic signs of loosening were observed two years after the intervention. Radiographic persistence of low patella in severe cases did not result in impaired range of motion.

Table 3. Knee Society Score (KSS).

Pre/postoperative KSS	29/84	28/100	13/80	14/80	13/83	15/85	13/94	43/100	14/80
Pre/postoperative F KSS	15/65	40/90	15/65	15/70	15/65	20/65	30/80	50/90	15/65
Global KSS	22/82	35/95	14/72	14/75	14/74	17/75	21/87	46/95	14/72

Table 4. Results in specific functional scales

Preoperative TUG (seconds)	Postoperative TUG (seconds)	Preoperative 10MWT (seconds)	Postoperative 10MWT (seconds)	Preoperative 2MWT (meters)	Postoperative 2MWT (meters)
20	17.3	14.7	12.5	62	97
11.3	9.1	9.9	7.7	90	159
15.2	12.3	14.5	12.8	39	89
19	13	19	15	29	80
23.2	20.7	30	21	35	47
20.7	18.7	21	15	47	80
11.7	9.4	10.5	8.3	99	149
9.9	8.9	8.9	7.8	136	168
14	10.1	14.8	12.4	45	98
16.1	13.2	15.9	12.5	64	107

Functional scales: TUG = timed up and go, 10MWT = 10-meter walk test, 2MWT = 2-minute walk test.

DISCUSSION

PPS is a condition that generates a severe disability that increases functional limitations from the 5th decade of life. The progression of the associated deformities (hyperextension and recurvatum, misalignment, deterioration of the joint surfaces) and instability cause an inefficient and painful gait. These patients, who had learned to live with the initial neurological sequelae, gradually began to lose the ability to move and suffered pain that, until then, had not represented a problem.

Total knee arthroplasty is a therapeutic alternative that relieves pain and restores the ability to move, which improves quality of life. By correcting these variables, restoring stability and limiting hyperextension, the functional capacity of the knee is restored and pain is mitigated. This is seen by performing simple and concrete functional tests that emulate the basic motion abilities of daily life. These abilities clearly improved in all patients in the cohort, and are consistent with the results reported in the few published scientific studies on the subject.⁶⁻⁹

Being able to raise the leg against gravity and some resistance marks a limit between two clearly differentiated groups. Those who do not have this ability require constrained implants (rotating hinge) and specific surgical actions, such as trying to achieve a tight extension gap to limit the recurvatum. In turn, naturally, they do not achieve high functional scores given the neurological limitation of poliomyelitis *per se*. However, the gain in functional capacity is evident and allows them to recover a highly satisfactory standard of living, with a good functional KSS. Patients with sufficient antigravity strength are treated with the conventional total knee replacement technique, achieving results comparable to those of patients without this condition.

CONCLUSIONS

Total knee arthroplasty is a valid therapeutic alternative in this complex disease, as it relieves pain, recovers function and improves quality of life. The strength of the quadriceps regarding the ability to move the leg against gravity is an important value in determining the choice of prosthesis. Restoration of stability using constrained prosthesis designs is a key factor in the recovery of a functional gait pattern in hyperextension patients. Patients with quadriceps strength against gravity have functional outcomes comparable to those without PFS and do not require constrained prostheses.

Conflict of interest: The author declare no conflicts of interest.

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