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Research Article

Treatment of Periprosthetic Knee Fractures with Plate and Screws and With Retrograde Intramedullary Nail: Indications, Limits and Medium-Term Follow-Up

Luca Gurrieri^{1*}, Siragusa Emilio¹, Marco Andolfi¹, Marco Caponnetto¹, Stefano Perez¹, Giuseppe Mobilia¹, Salvatore D'Amato¹, Pietro Maniscalco¹, Corrado Ciatti¹, Calogero Puma Pagliarello¹, Fabiana Valenti¹, Danilo Zuccalà¹, Fabio Sammartino¹, Gianluca Puglisi¹, Simona Ciccieri¹, Gianluca Testa¹, Vito Pavone¹

¹Department of General Surgery and Medical Surgical Specialties, Section of Orthopaedics and Traumatology, AOU Policlinico-San Marco, University of Catania, Via Santa Sofia 78, 95100 Catania, Italy

***Corresponding Author:** Luca Gurrieri, Department of General Surgery and Medical Surgical Specialties, Section of Orthopaedics and Traumatology, AOU Policlinico-San Marco, University of Catania, Via Santa Sofia 78, 95100 Catania, Italy; Email: lca29@hotmail.it

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Abstract

Periprosthetic knee fracture occur most frequently around the distal femur and are frequently complicated due to poor bone quality and comorbidities. Surgical treatment is typically necessary and requires varied techniques of open fixation, intramedullary fixation, or revision arthroplasty, due to fracture classification. The aim of the study is to report the results obtained in the treatment of periprosthetic knee fractures, comparing the results of two surgical techniques, retrograde intramedullary nail and ORIF with plate and screws.

At our institute, a sample of 23 patients with periprosthetic knee fracture were surgically treated.

In detail, our patient cohort consisted of 13 women (56.52%) and 10 men (43.48%) with a mean age of 71.91 years (SD $\pm$ 12.05) whose mean follow-up was 19.14 months (SD $\pm$ 9.90). In terms of treatment, 7 of 23 patients (30.43%) were treated with retrograde Intramedullary Nail (IMN), 2 patients (8.70%) underwent to revision of the prosthesis and 14 patients

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(60.87%) were treated with plate and screws (ORIF). The clinical evaluation was performed using two different clinical scores as reference, the Lysholm score and the Sanders score.

The goal of treatment of periprosthetic knee fractures should be an early mobilization of the patient, in order to reduce the risk of prolonged immobilization, limiting surgical risks.

Intramedullary nailing reduces blood loss and provides for shorter surgical times. However, it does not allow an anatomical reduction of the fracture and it is not always possible to achieve, due to the conformation of the prosthetic box. The mean results obtained from the evaluation by Lysholm Score was 58.75 ± 10.46 in group treated with IMN and 63.60 ± 6.82 in the group treated with ORIF. Sanders Functional Evaluation Score was 63.60 ± 6.82 in group treated with IMN and 28.26 ± 6.01 in the groups treated with ORIF. The results obtained are similar to the literature. Student's t-test showed no statistical significance ($p\text{-value} > 0.05$). Fractures healed on average at 4 months. We observed a case of mobilization of the nail. Intramedullary nailing reduces blood loss and provides for shorter surgical times. However, it does not allow an anatomical reduction and it is not always possible to achieve, due to the conformation of the prosthetic box.

The ORIF with plate and screws allows an anatomical reduction of the fracture, but involves in greater risks. It appears, therefore, more suitable in relatively young subjects. The reduction and synthesis with MIPO technique appears a good compromise. However, it is not very effective in comminuted and multi-fragmentary fractures.

Keywords

Periprosthetic Knee Fractures; Retrograde Intramedullary Nailing; MIPO Techniques; Total Knee Arthroplasty; Plate and Screws

Introduction

Periprosthetic knee fractures represent a problem for surgeons and are difficult to treat due to fracture morphology, bone quality, associated with osteopenia and osteoporosis and the comorbidities of older patients. These fractures are expected to become more common, due the increasing number of TKAs performed.

The Mayo Clinic reported that approximately periprosthetic knee fractures occurred in 2% of cases, of which 0.1% occurred intraoperatively, 0.9% occurred during prosthesis revision. The incidence of these supracondylar fractures according to the most up-to-date epidemiologic data can be placed in the range of 0.2-1.8% after TKA and between 1.6-38% following or concurrent with prosthesis revision [1,2].

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Periprosthetic tibia fractures, on the other hand, are less frequent; a series of 17,000 TKA cases showed an incidence of 0.1% of tibia FPP intraoperatively and 0.4% postoperatively [3].

The incidence of periprosthetic patellar fractures after TKA shows an incidence of 0.68% of which 44% are asymptomatic or poorly symptomatic [4].

Statistically, there is a greater tendency for these fractures to occur between 2 and 4 years after prosthesis, generally after low-energy trauma caused by torsional and compressive forces [5].

Meticulous surgical technique is essential to prevent the occurrence of intraoperative FPPs.

Between 40 and 52% of reported femur fractures are related to the presence of anterior notch [6].

The most widely used classification for periprosthetic knee fractures remains Rorabeck classification [7]. It classifies according to dislocation of bone fragments and stability of components but not considering bone reserve (Fig. 1).

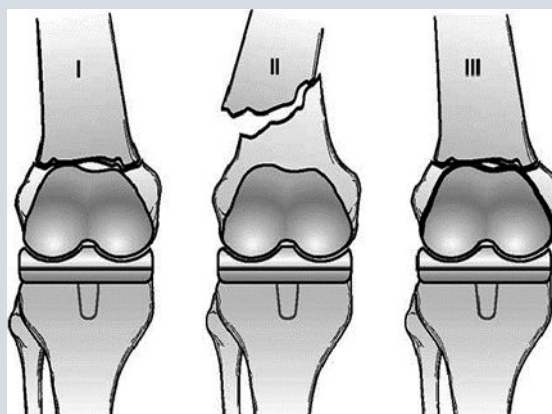


Figure 1: Rorabeck classification of periprosthetic knee fracture: Type I: Undisplaced fracture, prosthesis stable. Type II: Displaced fracture, prosthesis stable. Type III: Unstable prosthesis with or without fracture displacement.

In the case of periprosthetic knee fractures, the aim is to promote healing and recover joint function as quickly as possible, in order to prevent the complications of prolonged immobilization.

Alignments with a degree of translation of less than 5 mm, angulation of less than 5-10°, rotation less than 10° by defect and with a level of femoral shortening less than 1 cm are accepted [8].

Surgical treatments include the use of intramedullary retrograde nails, plates and screws and revision prostheses [9].

Prosthesis revision may be an option, but it is highly invasive and involves major bone loss. For this reason, it is reserved for type 3 fractures, in which there is prosthesis mobilization (Fig. 2).

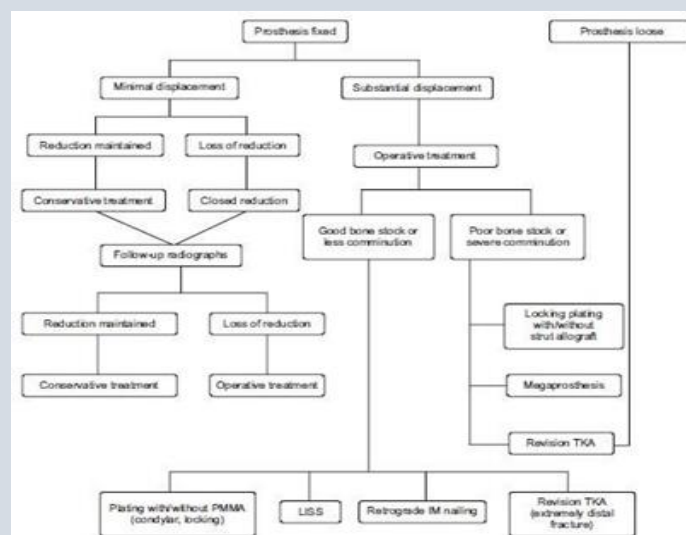


Figure 2: PPF flowchart.

Fixation with Plate and Screws

Open reduction and internal fixation with plate and screws is the most used technique, allow the surgeon anatomical reduction.

A study of Hassan, et al., inherent 26 patients treated with plate and screws concluded that the use of plate and screws allowed a union rate of 96% and that complete healing at six months after surgery was possible in 93% of cases [10].

The use of "Mini open" surgery (MIPO Technique) and the sliding LISS plate is the preferred technique to preserve soft tissues, with reduced infectious risk due to the small size of the surgical wound than open surgery, however it requires an experienced team and it is more difficult to perform in complex fractures (Fig. 3).

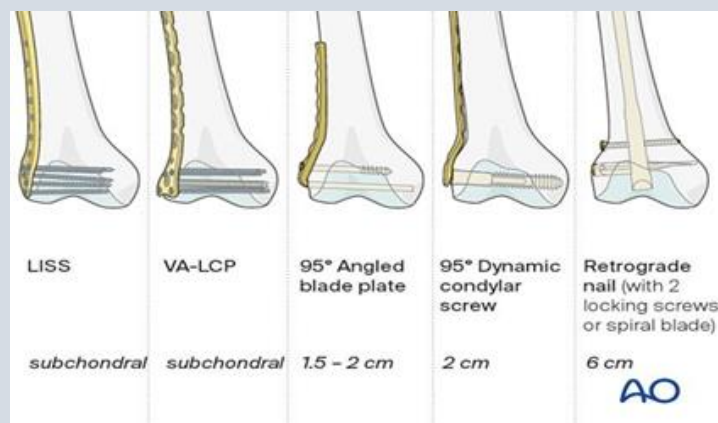


Figure 3: Fixation plate.

Retrograde Intramedullary Nail

The use of retrograde intramedullary nail turns out to be a viable alternative to osteosynthesis with plate and screws. Anterograde nailing is efficacious for the treatment of subtrochanteric and femoral diaphyseal fractures. Retrograde nailing has been shown to be equally effective in the treatment of fractures of the femoral shaft and very advantageous for distal one-third and supracondylar fractures, in which, the anterograde nail presents for the surgeon considerable difficulties in reducing. In fact, the retrograde nailing allows a better control of the rotation and reduction of the distal fragment [11,12]. However, in the literature, opinions are discordant [13].

The advantages of nailing are:

- The lower surgical exposure
- Reduced of blood loss
- Preserving periosteal blood supply
- Intervention of shorter duration
- It does not require exposure of the fracture

Retrograde nailing of supracondylar fractures should involve the use of locking nails with at least two distal and one proximal screw; the nail should be long enough to reach the small trochanter of the femur in order to bypass the isthmus and prevent the "wiper" effect, increasing the stability of the synthesis.

The limitations of this type of surgery are:

- Temporary inhibition of erythropoiesis for 48-72 h after surgery [14]
- Impossibility to pass the nail through the prosthesis box
- Impossibility to anatomically reduce the fracture

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Therefore, the use of this technique is limited to very elderly patients, with numerous comorbidities and low life expectancy and cannot be used in multifragmentary fractures [15].

Several types of prostheses, particularly those with cruciate retention, pose risks in inserting the nail posterior to the Blumensaat line, predisposing to deformity in curvature and misalignment [16].

An article by Thompson, et al., provides a careful examination of each model, size and type of prosthesis and the possibility of retrograde intramedullary nail insertion (Table 1) [17].

Manufacturer	Model	Size/Description	Minimal Intercondylar Distance (mm)	Compatible?	Notch Posterior?	Column1
Biomet	Vanguard CR and PS	Sizes 55-80	16.26-21.33	Yes	No	*
	AGC CR and PS	Sizes 55-80	18.0	Yes	No	**
	Maxim CR and PS	Sizes 55-80	21.0	Yes	No	***
	Universal	Sizes 55-80	18.0	Yes	No	***
Depuy (J&J)	Vanguard 55K160/DA360 (rev)	Sizes 55-80	Stemmed	Yes	No	***
	DA2000 (rev)	Sizes 55-75	Stemmed	Yes	No	***
	LCS Complete	FEM POR Small-Large	12.903-20.371	Yes	No	***
	LCS Complete RPS	FEM CEM Small-Large RT	13.462-20.371	Yes	No	***
	LCS CR	Small+ to Large+	13.7-21.9	Yes	No	***
	LCS PS		N/A	N/A	No	***
	AMC		20.000	Yes	No	***
	Coordinate		Closed Box	Yes	No	***
	Townley Knee		17.0	N/A	No	***
	PPC Press-Fit Condylar		20	Yes	No	***
DJO (Osteotec)	Sigma CR	Sizes 1.5-6	17.399-17.526	Yes	No	***
	Sigma CR 150	Sizes 1.5-6, and 4 N	17.399	Yes	No	***
	Sigma CS, PS & Lugged	Sizes 1.5-6, and 4 N	11.557	Yes	No	***
	Sigma TC3	Sizes 1.5-5	11.557	Yes	No	***
	Sigma PS RPF hiflex		Closed Box	Yes	No	***
	Insall-Burstein PS		15.0	Yes	No	***
	Total Condylar 1		15.0	N/A	No	***
	Total Condylar 2		18.0	N/A	No	***
	Cytor		25.0	N/A	No	***
	Foundation	Sizes 2-12	17 - 19	Yes	No	***
Exactec	3DKnee	Sizes 2-12	14 - 17	Yes	No	***
	Condylar		N/A	Yes	No	***
Hays Medical	PS		N/A	Yes	No	***
	Performance		14.0	N/A	No	***
Kirschner	Link		14.0	N/A	No	***
	Medial Rotation Knee		15 - 30	Yes	No	***
Matortho	Dual Bearing Knee		N/A	Yes	No	***
	TRICON		17.3	Yes	No	***
Smith & Nephew	TRICON M Series		15.9	N/A	No	***
	TRICON C Series		15.9	N/A	No	***
	PROFIX		22.0	Yes	No	***
	PROFIX - CR		14.6	Yes	No	***
	PROFIX - PS		20.0	N/A	No	***
	GENESIS I - CR		17.8	N/A	No	***
	GENESIS I - PS		16.3	Yes	No	***
	GENESIS II CR 1-8		16.5 - 19.0	Yes	No	***
	TC Plus CR		18.0	Yes	No	***
	TC Plus PS		Closed Box	Yes	No	***
Stryker	Triathlon CR and PS		16.15	Yes	No	***
	Triathlon TS (rev)		Closed Box	Yes	No	***
	PCA		18.5	Yes	No	***
	Kinemark CR		14.0	Yes	No	***
(Howmedica)	Kinemark PS		Closed Box	Yes	No	***
	Kinematic II		18.5	N/A	No	***
	Scorpio CR and PS		17-23	Yes	No	***
	Scorpio TS		Closed Box	Yes	No	***
Wright	Omni		23.0	N/A	No	***
	Series 7000		19.0	N/A	No	***
	Duracon CR		18.5	N/A	No	***
	Advance		18.0	N/A	No	***
Zimmer	Advance PS & CCK		N/A	N/A	No	***
	Evolution Medial Pivot		Closed box	Yes	No	***
	Axiom		N/A	N/A	No	***
	Axiom PS		17.0	N/A	No	***
	Advantim CR		20.0	N/A	No	***
	Advantim PS		N/A	Yes	No	***
	Advantim PS Open		15.9	Yes	No	***
	Advantim Medial Pivot		N/A	Yes	No	***
	Whitenides Modular		20.0	Yes	No	***
	Legacy CCK		20.0	Yes	No	***
Zimmer	RHK (Rotating Hinge Knee)		Closed box	Yes	No	***
	LPS/LPS-Flex & Flex Gender		Closed box	Yes	No	***
	CR/CR-Flex & Flex Gender		13.7-21.2	N/A	No	***
	Freeman Samuel		11.9-13.4	N/A	No	***
	Insall-Burstein I		15.0	N/A	No	***
	IBH CR		16.0	Yes	No	***
	IBH PS		15.3-21	Yes	No	***
	Innox		Closed Box	Yes	No	***
	NexGen CR		18	N/A	No	***
			12.2-13.3	Yes	No	***

Table 1: Several type of knee prosthesis and compatibility with IMN.

The aim of the present retrospective study is to report the results obtained in the treatment of periprosthetic knee fractures, comparing the results of the two surgical techniques and comparing our results to those of the relevant literature.

Patients and Methods

Demographic Data

Between January 2018 and December 2020, a sample of 26 patients with periprosthetic knee fracture were surgically treated at the orthopedic clinic of Catania University. On this cohort we conducted a retrospective study.

Of a total of 26 selected patients, 3 patients died, therefore they were ruled out from the statistical survey.

In detail, our patient cohort consisted of 13 women (56.52%) and 10 men (43.48%) with a mean age of 71.91 years ($SD \pm 12.05$) whose mean follow-up was 19.14 months ($SD \pm 9.90$). Considering the age of these patients, we carefully analyzed their comorbidities and risk factors. According to the most up-to-date recent literature, the main risk factors for periprosthetic fracture are older age, female gender, corticosteroid use, inflammatory arthritis, osteoporosis (Fig. 4) [18,19].

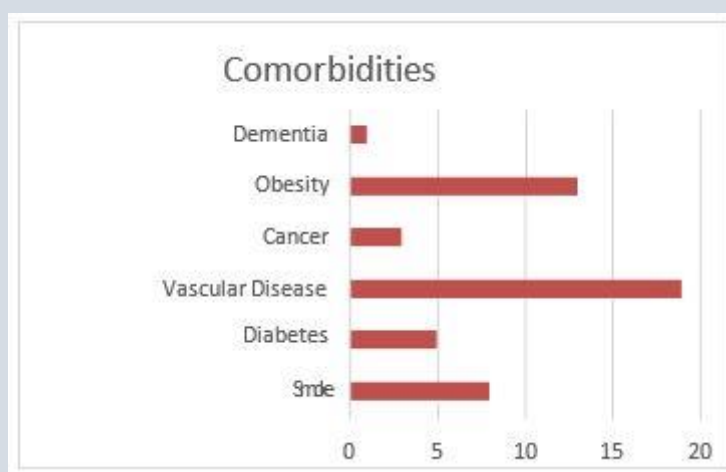


Figure 4: The graphic shows patients' comorbidities.

Periprosthetic fracture involved the left knee in 65.22% (15 patients) and the right knee in 34.78% (8 patients).

Of these fractures, 7 (30.43%) belonged to type I of the Rorabeck classification, 14 fractures belonged to type II (60.87%) and 2 belonged to type III (8.70%) and were therefore subject to revision of the prosthesis (Fig. 5).

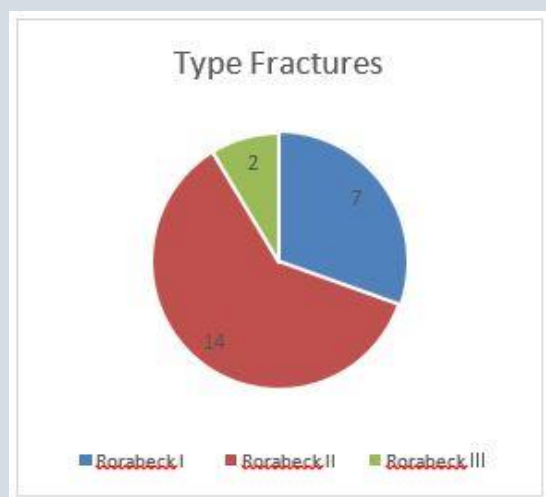


Figure 5: Diagram showing types of fracture found in order to Rorabeck classification.

In terms of treatment, 7 of 23 patients (30.43%) were treated with retrograde intramedullary nail, 2 patients (8.70%) as mentioned, underwent to revision of the prosthesis and 14 patients (60.87%) were treated with plate and screws.

Clinical and Radiographic Assessment

For the diagnosis of fracture, it is essential that the doctor collects a careful medical history, asking for information on comorbidities, chronic therapies, trauma, previous joint pain before the fracture or alleged fracture occurred. A meticulous physical examination and subsequent instrumental examination with radiographs in Antero-Posterior (AP) and Latero-Lateral (LL) projection. In periprosthetic fractures in order to correctly classify diagnostics and for preoperative planning, a CT study is essential [20].

In exceptional cases, the MRI, which is otherwise very susceptible to metal artifacts, can provide valuable additional information about the soft tissue envelope, occult fractures and the bone-prosthesis-interface [21].

The clinical evaluation was performed using two different clinical scores as reference, the Lysholm score and the Sanders score.

The Lysholm score is a complex surgical outcome assessment tool introduced by Lysholm in 1982.

The score is specific for knee ligament surgery, but also for cartilage injuries, osteoarthritis, traumatic dislocation, patellofemoral pain, patellar instability and meniscal injuries.

The score is intended to check how the patient performs activities such as walking, squatting, climbing stairs, with), use of cane or crutches, feeling of locking knee, knee instability, persistence of pain and level of discomfort (Table 2).

Depending on the degree of mobility or frequency of symptoms each of the items is given a score ranging from 0 to 25: the overall score ranges from 0 to 100.

Scores near 0 indicate severe symptoms or no recovery after surgery, values closer to 100 are indicative of poor knee symptoms and possible full recovery of function.

Lysholm Score	Surgery Outcome
<65	Poor
65-83	Fair
84-94	Good
95-100	Excellent

Table 2: Lysholm score in patients.

Sanders functional evaluation score (Fig. 6) is another post-operative patient assessment system, simpler than the Lysholm scale, which considers the presence of pain, deformity, range of motion possible in flexion and extension, femoral shortening, ability to walk, climb stairs and activities of daily living after surgery. We get a score ranging from 0 to 40 points (Table 3).

Sanders Functional Evaluation	Surgery Outcome
0-15	Poor
16-25	Fair
26-35	Good
36-40	Excellent

Table 3: Sanders functional evaluation.

Variables	Result	Points	Variables	Result	Points
Range of motion (°)			1.5 - 2.5	Fair	1
Flexion			> 2.5	Poor	0
> 125	Excellent	6	Walking ability		
100 - 125	Good	4	Walking		
90 - 99	Fair	2	Unrestricted	Excellent	6
< 90	Poor	0	> 30 minutes to < 60 minutes	Good	4
Extension			< 30 minutes	Fair	2
0	Excellent	3	Walks at home, is confined to wheelchair, or is bedridden	Poor	0
< 5	Good	2	Stair-climbing		
5 - 10	Fair	1	No limitation	Excellent	3
> 10	Poor	0	Holds rail	Good	2
Pain			One stair at a time	Fair	1
None	Excellent	10	Elevator only	Poor	0
Occasional or with changes in weather, or both	Good	7	Return to work (either A or B)		
With fatigue	Fair	5	A. Employed before injury		
Constant	Poor	0	Returned to preinjury job	Excellent	6
Deformity			Returned to preinjury job with difficulty	Good	4
Angulation (°)			Altered full-time job	Fair	2
0	Excellent	3	Part-time job or unemployed	Poor	0
< 10	Good	2	B. Retired before injury		
10 - 15	Fair	1	Returned to preinjury life-style	Excellent	6
> 15	Poor	0	Needs occasional help with shopping or laundry	Good	4
Shortening (cm)			Needs assistance at home with activities of daily living	Fair	2
0	Excellent	3	Moved in with family or moved to nursing home	Poor	0
< 1.5	Good	2			

Figure 6: Variables considered in Sanders evaluation score.

For the purpose of a clinical evaluation, patients performed tests which included Active and Passive Range of Motion (ROM). For active ROM, patients maximally extended and flexed their injured knee without assistance or use of the upper extremities. For passive ROM, the observer moved the patient's knee from full extension to full flexion.

Clinical and radiological follow-up was performed at 1-2-3- 6 and 12 months. Radiographic evaluation was performed using standard radiographic techniques, anteroposterior and lateral knee radiographs.

Post-operative

The physiotherapy treatment strategy in the postoperative period of a patient treated for periprosthetic fracture cannot disregard the patient's general condition. In the first month the rehabilitation protocol included isometric exercises, active and passive mobilization of the knee, in order to achieve joint ROMs compatible with the subject's condition. Weight bearing is allowed no earlier than 30 days and in any case depends on the X-ray evolution. It is observed that the return to walking in the nailed patient begins earlier than in the patient who has undergone synthesis with plate and screws, especially, partial weight-bearing with crutches or rollator at 30-40 days with IMN, 40-60 days with plate . Fully wight bearing was granted at approximately 2 months in nailing patients and 2-3 months in patients treated with plate and screws.

However, the rehabilitation process remains a long and complex path not without pitfalls, requiring the assistance of the specialist and careful vigilance. Let us not forget that we are dealing with fragility fractures and as such they predominantly affect the elderly population, with different comorbidities, slower recovery and greater need for care.

Statistical Evaluation

Statistical evaluation involves comparing the averages of the clinical scores obtained for the two most frequently used surgical procedures; to assess the statistical significance of the results obtained, we refer to Student's t-test, a statistical test of whether the mean value of a distribution deviates from the reference value ($p < 0.05$).

Results

The mean results obtained from the evaluation by Lysholm Score and the Sanders Functional Evaluation Score at a mean follow-up of 19.14 ± 9.90 months showed, for the Group of patients treated with plate and screws, the values shown in the Table 4.

	Lysholm Score	Sanders Evaluation Score
Mean $\pm$ SD	63.60 ± 6.82	28.26 ± 6.01

Table 4: Mean results obtained from evaluation by Lysholm Score and the Sanders Functional Evaluation Score.

The clinical results obtained with the retrograde intramedullary nail are expressed in the following Table 5.

	Lysholm Score	Sanders Evaluation Score
Mean $\pm$ SD	58.75 ± 10.46	23.63 ± 6.61

Table 5: clinical results obtained with the retrograde intramedullary nail.

Next, we show the two distribution curves of values for the Lysholm score obtained:

We observe how, in comparing the averages and their distribution, the values obtained have a very close mean, the two distribution curves cross to demonstrate the non-statistically significant difference between the two surgical techniques for the two groups we considered (Fig. 7).

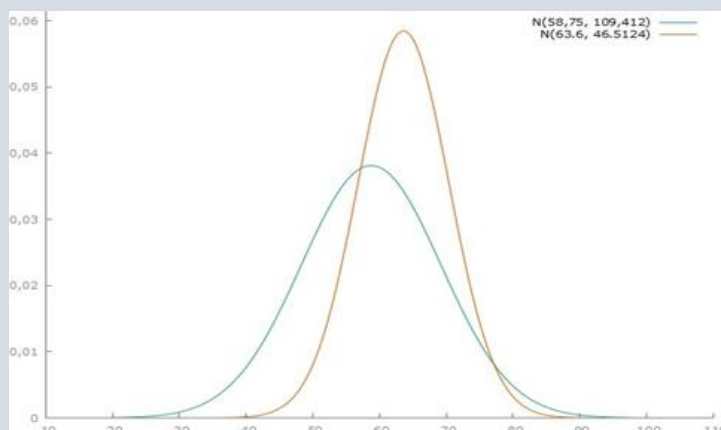


Figure 7: The graphic shows two curves refer to lyshome score values, the yellow curve refers to plate and screw treatment, instead the green line refers to IMN.

Also, regarding Sanders' score, the curves show overlapping distributions aimed at demonstrating absent difference between one technique and the other (Fig. 8).

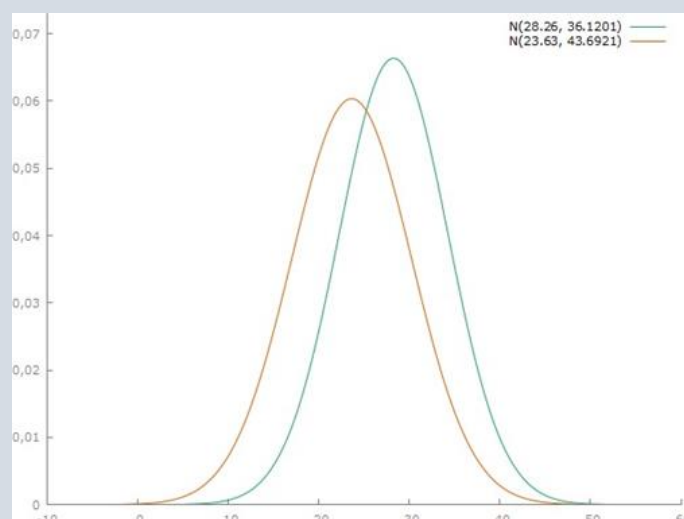


Figure 8: The graphic shows two curves refer to sanders score values, the green curve refers to plate and screw treatment, instead the yellow curve refers to IMN treatment.

We have deepened this aspect also evaluating how sex affects the outcome of the intervention, averaging the same scores as a function of gender alone, obtaining the values expressed in the Table 6.

	Lysholm Score	Sanders Evaluation Score
Mean $\pm$ SD Women (n=13)	63.00 $\pm$ 7.17	28.54 $\pm$ 6.57
Mean $\pm$ SD Men (n = 10)	58.22 $\pm$ 7.26	22.78 $\pm$ 3.83

Table 6: Scores as a function of gender.

The results obtained again show mean values not too far apart, the DS value is high and the curves cross by a wide margin of correspondence (Fig. 9).

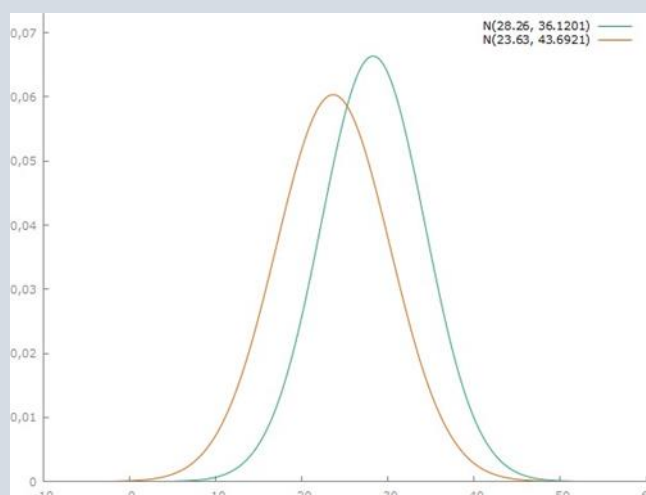


Figure 9: The graph shows the distribution curves of average values. The green curve refers to the female scores of the Lysholm score, the yellow one to the male scores. The purple curve refers to the female scores of the Sanders score, the pink one to the male scores.

In statistical terms by placing the null hypothesis "difference between the averages = 0" we get $t(n=23) = (63.6 - 58.75)/4.09601 = 1.18408$

Two-tailed P-value = 0.2638 ($p > 0.05$), not statistically significant test. There is no difference between the two averages (Fig. 8).

The same applies to Sanders' score evaluation, $t(n=23) = (28.26 - 23.63)/2.80527 = 1.65047$

Two-tailed P-value = 0.1228 ($p > 0.05$) There is no difference between the averages.

We carried out the investigation with Student's t-test to analyze whether according to the populousness of our two samples. The results obtained could represent the general population or whether they were to be attributed to chance (Fig. 10).

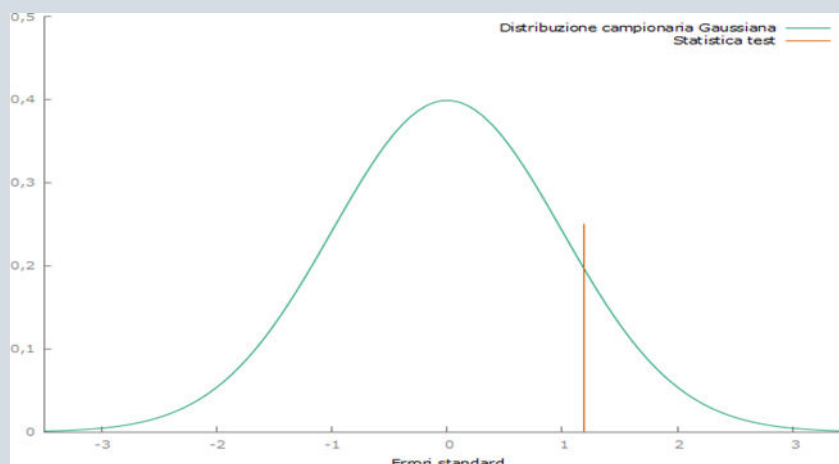


Figure 10: The graphic shows $p\text{-value} = 0.2638 (>0,05)$. There is no difference between the two averages

In calculating Student's t we get a $p\text{-value} < 0.05$, if there is a 95% probability that the result reflects that of the general population.

In our case $t(23)$ results in $p\text{-value} = 1.28 (p > 0.05)$, the result shows us that the sample is not representative of the general population.

Radiographic healing was achieved in all patients at 4 months after surgery, demonstrating homology in healing results between plate and screws compared with retrograde intramedullary nailing.

Only one case of mobilization (nail) was observed.

We get partial weight bearing with crutches/axillary canes or rollator on average at 30-40 days after surgery in the group treated with retrograde nailing, at 40-60 days on average in the group treated with plate and screws.

All patients achieved full knee ROMs in extension, while ROMs in flexion averaged between 90-140 degree.

Only one patient did not regain deambulatory function, while 3 patients regaine de ambulatory function limited, with the aid of crutches/axillary canes.

Clinical Case 1

Patient CG. male, age 27. The patient, suffering from genetic pathology n.d. presents with a periprosthetic fracture of the left knee on a revision prosthesis, placed when he was 25 years old after the previous implantation performed at the age of 21.

The X-ray study also makes it known of an arthrodesis surgery of the Cervical Start Column reaching the lumbar spine, to make up for the vertebral instability presumably caused by the genetic disease (Fig. 11).

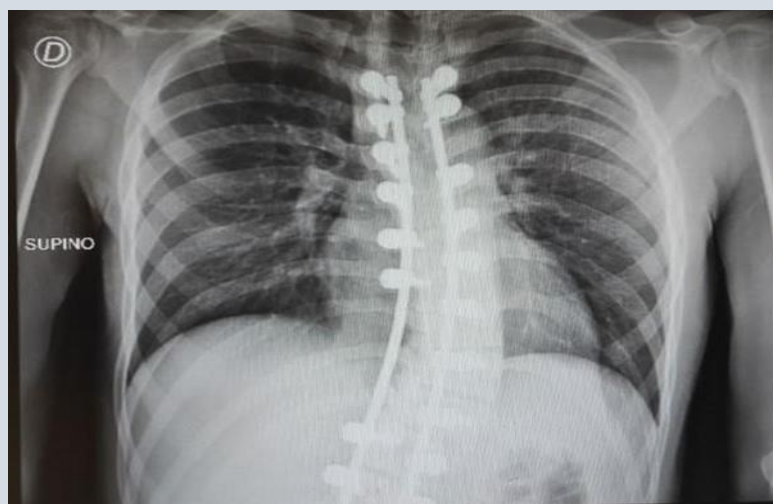


Figure 11: Rx imaging of vertebral arthrodesis, patient CG, male.

Radiographic investigation performed on the left knee shows a displaced fracture classifiable as type II according to Rorabeck Classification (Fig. 12).

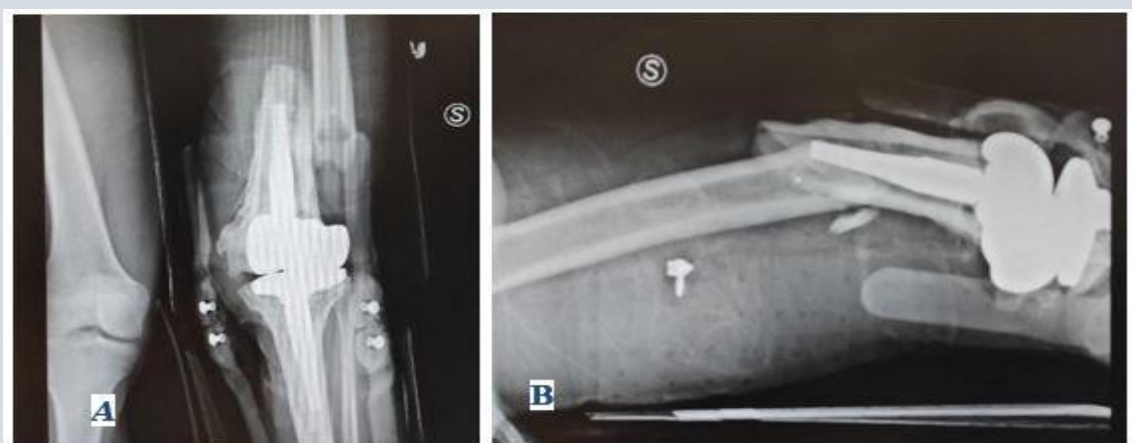


Figure 12: Rx imaging of left knee, there is a decomposed fracture grade II according to Rorabeck classification system. (A) A-P projection, (B) L-L projection.

The patient was treated with the use of plate, screws and cerclage at the fracture site (Fig. 13).



Figure 13: Rx imaging after surgery.

We can see in the figure opposite the formation of bone callus at 4 months after surgery, with proper alignment of the fracture stumps (Fig. 14).



Figure 14: Rx imaging after 4 months from surgery.

Clinical Case 2

Patient PA, female, age 84 years. The patient underwent prosthesis of the left femur and left hip.

On radiography, a left supracondylar periprosthetic fracture is demonstrated (Fig. 15).

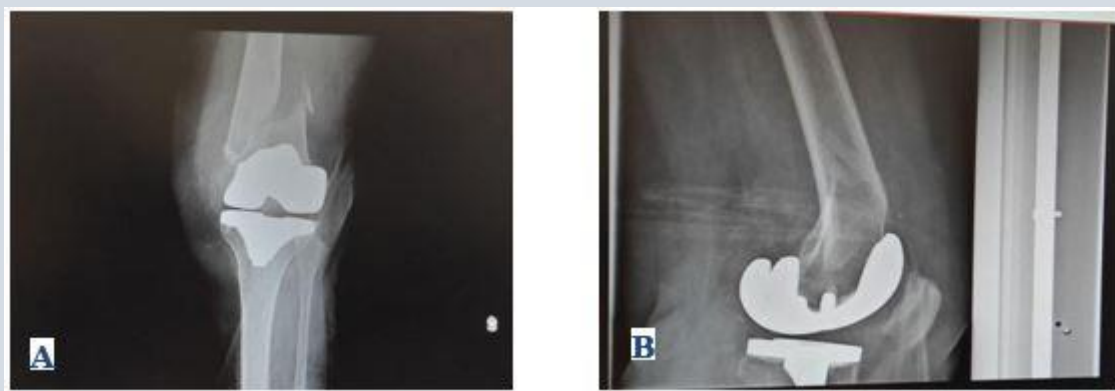


Figure 15: Rx imaging of the PPF of the right femur. (A) The A-P projection, (B) L-L projection.

The lateral projection of this fracture allows us to open a parenthesis on the behavior of periprosthetic knee fractures; in fact, they tend to decompose posteriorly by the action of the twin muscles (Fig. 15).

The patient underwent retrograde intramedullary nailing surgery; the presence of the hip prosthesis prevented the placement of a long nail reaching the small trochanter of the femur.

One-month follow-up is shown, demonstrating correct placement of the Nail (Fig. 16).

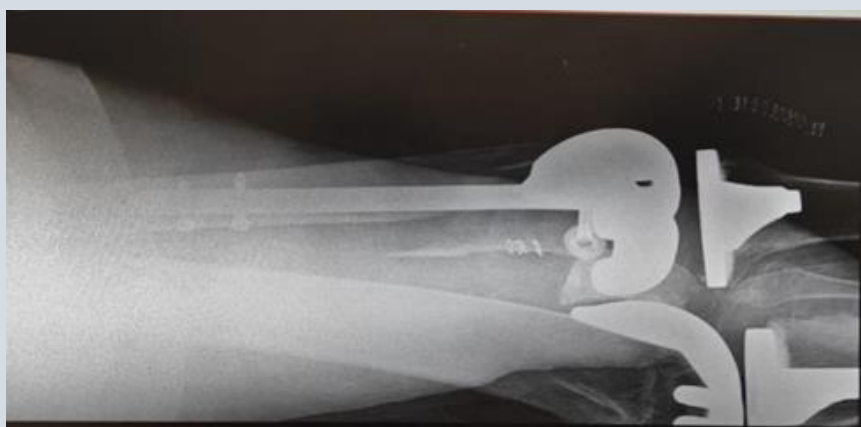


Figure 16: Rx imaging after IMN surgery.

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The patient unfortunately underwent nail's mobilization in the 4-month follow-up, as can be appreciated in the images below (Fig. 17,18).



Figure 17: Rx imaging after 4-month follow up shows nail's mobilization. A-P projection.



Figure 18: L-L projection.

In the adjacent image, you can appreciate the formation of bone callus that demonstrates a good recovery of regenerative function; the shortened length of the nail due to the impediment of the hip replacement is also shown.

The patient was offered removal of the Nail following complete healing of the fracture; the patient declined.

However, the nail did not result in any impediment in knee ROMs; the patient can flex between 0-120°.

Discussion

The description we have given with respect to periprosthetic fractures and the main treatments arranged is the result of an ever-increasing trend toward prosthetics, an exponential growth of study regarding materials, surgical techniques and types of prosthesis to be used.

Increasing life expectancy clashes with the need not to affect the quality of life of these patients by counteracting the physiological mental and physical deterioration of the individual.

It has been discussed the need to put the patient in a position to do physical therapy as quickly as possible.

An interesting fact is the average age of the incidence of these periprosthetic fractures, which is lower in the female sex than in the male sex.

This is attributable to an earlier incidence of osteoporosis in the female sex due to hormonal factors [23].

Conversely, in the male sex, periprosthetic fractures occur at a higher average age and have a worse functional recovery, as the older patient collaborates less on the rehabilitation protocol.

Our study shows that both types of surgery have been effective, giving overlapping scores in both scores. From the comparison with the most modern literature, we can extrapolate similar results to those obtained in our study, although some studies show a higher risk of complications with IMN surgery.

There was no statistically significant difference between the values of the averages on the two groups in our study, but the small population of our sample makes the results not representative of the general population.

With regard to complications, systematic reviews by Herrera, et al., and Ebraheim, et al., show a higher rate of complications in IMN surgery than Plate and screws (P-value<0.003), especially in they must be attributed to a higher non-union score and non-anatomical reduction [24,25].

An inherent meta-analysis on early complications and reoperation rate conducted by Quinzi, et al., showed a similar rate of early major complications [26].

A meta-analysis of Shin, et al., recognizes how, while retrograde nail treatment might be preferred for the biomechanical and biological advantages, plate is often preferred because of limitations in clinical practice to nailing [27]. The meta-analysis data do not support the theoretical advantage of retrograde intramedullary nail over plate considering the nonunion rate. Thukral et al claim that plate is most effective for comminuted fractures [28].

However, Magill, et al., analyzed ten cohort studies about periprosthetic knee fractures treated with plate and screws or retrograde intramedullary nail and, considering for qualitative and quantitative analysis the KOOS score, fusion time, nonunion index and revision rate, showed, as results, outcome without any statistically significant differences; time to union, non-union rate and revision rate with no significant differences [29].

In a systematic review of Shah, et al., the effectiveness of both surgical techniques is recognized without, however, identifying a gold standard of treatment [30].

Conclusion

The goal of treatment of periprosthetic knee fractures should be an early mobilization of the patient, in order to reduce the risk of prolonged immobilization, limiting surgical risks.

Intramedullary nailing reduces blood loss and provides for shorter surgical times. However, it does not allow an anatomical reduction of the fracture and it is not always possible to achieve, due to the conformation of the prosthetic box.

The ORIF with plate and screws allows an anatomical reduction of the fracture, but involves large surgical incision, greater surgical times and greater infectious risks. It appears, therefore, more suitable in relatively young subjects. The reduction and synthesis with plate and screws with MIPO technique appears a good compromise. However, it is not very effective in comminuted and multi-fragmentary fractures.

Future research goal is to develop an optimal flowchart for these fractures and to define a gold standard of treatment.

It will be even more important to focus on prevention; in fact, these are fragility fractures and as such have a close correlation with all the determinants of fragility.

Countering osteoporosis and sarcopenia, educating on the proper diet and joint economy, promoting a healthy, non-sedentary lifestyle and removing risk factors such as smoking, alcohol, are all goals to be achieved in order to protect the elderly and the prosthetists from fractures.

Conflict of Interest

The authors declare no conflict of interest.

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