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Original Research

Treatment Outcome of Patellar Fractures Across Two Tertiary Centers: A Five-Year Retrospective Study.

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Abstract

Background: Fractures of the patella, though not so common, are prone to complications. Injuries to the patella often disrupts the extensor mechanism of the knee and increases the likelihood of patella-femoral joint incongruence. The aim of this study was to determine the outcome of treatment of patella fracture in two tertiary health institutions in South-south Nigeria.

Methodology: A retrospective descriptive study was conducted among patients who had patella fractures over a five-year period, using hospital records. The data obtained were analyzed and formed into tables, charts and figures.

Results: Thirty-nine patients were recruited into the study. Patella fractures were most predominant in the age bracket 31-40 years (30.8%), while the least was noted in the age group 61-70 years (5.1%). Road traffic accidents were the most common etiological factor (53.8%). Majority of the patients had transverse fractures (61.5%), while severely committed fractures constituted the least (2.6%). Four patients (10.3%) had open fractures. Majority of the patients had surgical treatment with tension band wiring (25 patients). The outcomes were good within the period of follow-up.

Conclusion: The result showed that patella fractures are common in young population. Patients receive optimum care with good outcome in the two centers involved in this study.

Key words: Patella Fractures; Treatment Outcome; Tertiary Centers; Retrospective Study.

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Introduction

The patella is the largest sesamoid bone in the body [1] located in front of the knee between the fibers of the quadriceps tendon and the patella tendon. It articulates with the articular surface of the distal femur to form the patello-femoral joint. The medial and lateral articular surfaces which articulate with the medial and lateral femoral articular surfaces at the patellofemoral joint are divided by a median ridge, articulating with the trochlear of the femur at knee flexion. [2,3]

Anatomically the bone forms a fulcrum for the extensor mechanism of the knee and is attached to the fibers of the quadriceps tendon superiorly and the patella tendon inferiorly. The medial retinaculum and ilio-tibial tract fibers are attached medially while the lateral retinaculum and the facia lata are attached laterally. The patella receives blood supply in a centripetal manner with sources from the medial and lateral geniculate arteries and the nutrient arteries at the inferior pole ensuring rich supply to the bone [4].

Its anterior surface is thoroughly subcutaneous, creating a lot of irritation to metallic implants used for fracture fixation and necessitating frequent implant removal for traditional fixation methods. Its posterior surface has a thick articular surface and is occasionally replaced during total knee replacement surgeries. This surgery alone either as primary or revision arthroplasty and the attendant post-operative complications currently constitute a major mechanism of patella fractures (peri-prosthetic fractures) [5,6].

Patella fractures make up 1% of all bone fractures [7]. Common mechanisms include direct blows to the patella [8] (from dashboard injuries, falls on a flexed knee, external brutal forces), indirect injury from eccentric contraction of the quadriceps with sudden knee flexion [8], peri-prosthetic mechanisms of penetrating trauma [5,6]. Open patella fractures are rare, constituting less than 8% of all patella fractures and usually connotes high energy impact with associated fractures of other bones within the region and injuries to other organs [9,10].

Choice of treatment is predicated on the fracture pattern, the level of displacement, articular congruence, status of the extensor mechanism and available skill. Surgical treatment options have evolved from the traditional use of stainless-steel k-wires and cast immobilization to the more stable tension-band principle-based fixations using cerclage wires and synthetic non-absorbable sutures to the current use of cannulated screw fixation and mesh-plate fixation [11]. This evolution is primarily driven by the need to provide more stable and less irritative implants that will improve union outcomes, allow early immobilization and reduce the rate of re-operation.

Conservative treatment with knee immobilization using a hinged knee brace, cast immobilization or a knee immobilizer remain a viable option with un-displaced fractures where the extensor mechanism is still intact. Ideal fractures for conservative treatment should have less than 3mm displacement and between 1-2mm articular displacement [1]. Displaced fractures in patients considered unfit for surgical treatment can also have conservative treatment. Ambulation is usually allowed during conservative treatment and physical therapy commences as soon as possible.

Indications for partial or total patellectomy are drastically reducing in current orthopaedic practice. Several treatment options now exist for previously tagged 'irreconstructible' inferior pole patella fracture. Use of anchor sutures, mesh plates, mini-plates and non-absorbable suture fixations have shown excellent results [12,13,14]. Partial patellectomy is reserved for the severely comminuted fractures with fragmentation and poor bone quality [15,16] while total patellectomy is reserved for non-ambulant patients, those with previous failed attempts at fixation, tumours affecting the patella and severely infected cases [16,17].

These surgeries can lead to 30-50% reduction in the quadriceps strength, distorts the quadriceps function and have been shown to cause patella-femoral osteoarthritis [15,16,17].

We present the profile and outcome of treatment of such fractures from two tertiary centers in Port Harcourt, South-South Nigeria within a five-year period.

Methodology

Study design: This study is a retrospective descriptive study of patients with patella fractures who presented to the orthopedic departments from 1st of January 2019 to the 31st of December 2023 (five-year period).

Sampling: a purposive sampling method was used. The clinical records, operation notes and follow-up notes of all patients who presented at the Accident and Emergency unit and Orthopaedic Out-patient clinic of both tertiary health institutions with patella fractures within the study period were consecutively sampled for recruitment into the study.

Exclusion criteria: Patients with the following clinical notes were excluded from the study: Incomplete clinical data; Lost to follow up; Patients who were unable to carry out simple radiological investigations like plain radiographs of the affected limb; Patients that presented with complications of patella fractures treated elsewhere and Patients with patella fractures and underlying evidence of infection at presentation.

Details of the study: Secondary data from patients who met the inclusion criteria were recruited into the study. Data retrieved from recruited patients' folders includes patient's biodata, time interval between injury and presentation at the study centers, possible etiology, severity of trauma involved, presence or absence of open wound and initial treatment at trauma scene.

Initial radiographs at presentation were also retrieved and evaluated. A radiograph of the affected limb which adequately reveals the fracture site, as well as the distal femur and proximal tibia were accepted for enrolment. This served as basic diagnostic tool for patella fractures, described the fracture pattern and revealed injuries to contiguous portions of the femur.

Treatment notes including operation notes, follow-up notes, follow-up radiographs and physiotherapy notes were also retrieved and analyzed. Where necessary, patients were contacted to obtain more information to augment what was available in the notes, especially with regards to patients' current complains about the surgery and ambulation status.

All surgeries were performed by the primary investigators and other orthopaedic surgeons in the study facilities.

Post- operative protocol for all patients in terms of intravenous fluids, analgesics, and intravenous antibiotics (third-generation cephalosporin and metronidazole) were similar.

Notes from follow-up visits done at 2weeks, 6weeks, 12weeks, 18weeks, and 24 weeks post intervention were analyzed. Radiographs of the limb which was done at the immediate post-operative period, 6 weeks, 12 weeks, and 18 weeks were also analyzed. Other Radiographs done at other times as requested were also retrieved and evaluated.

A fracture was considered to have united if no tenderness was elicited on palpation or attempted motion at the fracture site, attainment of full painless weight-bearing status as well as radiologic evidence of union across the fracture site.

The outcomes measures were the; Length of hospital stay; Duration of time from commencement of treatment to radiologic evidence of fracture union; Functional range of motion in the ipsilateral knee at the point of radiologic union; Wound healing; Return to work and school and Weight bearing status at 12 weeks post-intervention.

Data Analysis: Frequencies and cross tabulations were used to create two- way and multi-way tables. Charts and graphs were used to display appropriate variables. Certain numerical values were also expressed in mean, median (inter-quantile range), proportion and standard deviation.

Statistical methods were carried out using the Statistical Package for Social Sciences (SPSS) version 26.

Ethics and Confidentiality: The hospital numbers of the patients were used, instead of their names for data collection. Consent to retrieve and analyze the patient's notes were requested and obtained from the hospital ethics and research committee. All data were kept in strict confidentiality.

Results

Records from the orthopedic departments of both tertiary centers showed 48 cases of patella fractures during the study period. Records of 9 patients were incomplete. Information concerning thirty-nine was recruited into the study. There were a total of 2940 bone fractures within the study period giving a prevalence of 1.3%. The demographics of the patients are as presented:

Table 1: Patient Demographics

Age range	Frequency	Percentage
0-10	5	12.8
11-20	8	20.5
21-30	7	17.9
31-40	12	30.8
41-50	1	2.6
51-60	4	10.1
61-70	2	5.1
Above 70	0	0.0
Total	**39**	**100**
Male	22	56.4
Female	17	43.6
Total	**39**	**100**
Students	6	15.4
Drivers	11	28.2
Sports professionals	12	30.8
Other occupations	10	25.6
Total	**39**	**100**

Table 2: Mechanisms Of Injury

Etiologic considerations	Frequency	Percentage
Sports injury	10	25.6
Road traffic accident	21	53.8
Industrial injury	7	17.9
Peri-prosthetic fractures	1	2.6
Total	**39**	**100**

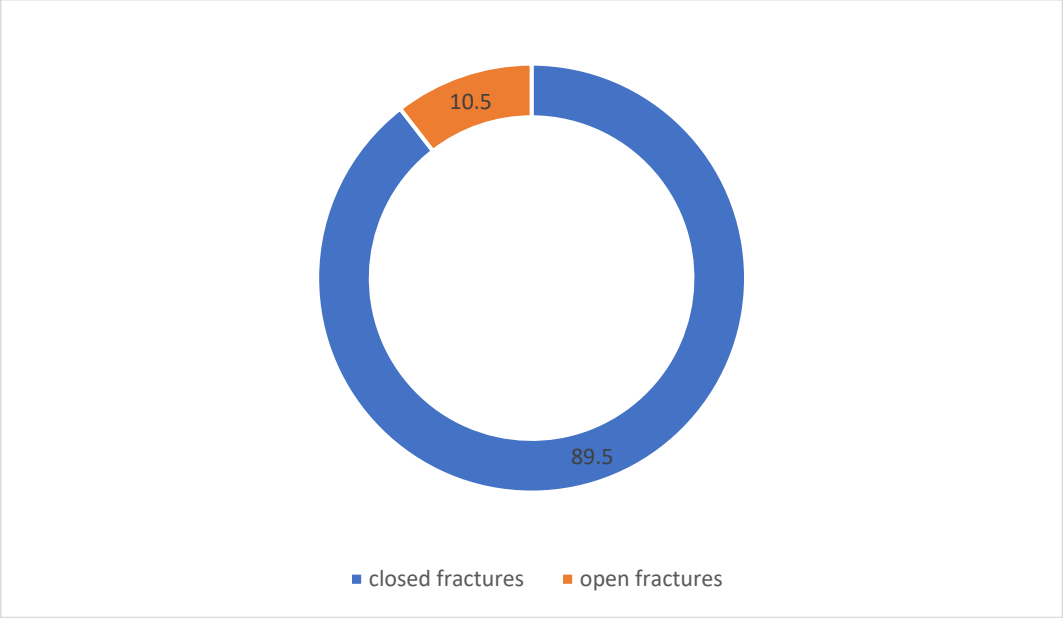

Figure 1: Frequency of Closed Vs Open Fractures

Table 3: Fracture Patterns

Fracture patterns	No	Percentage
Transverse	24	61.5
Stellate	5	12.8
Polar (inferior pole)	3	7.7
Polar (superior pole)	2	5.1
Severely comminuted	1	2.6
Longitudinal	0	0.0
Open fractures	4	10.3
Total	**39**	**100**

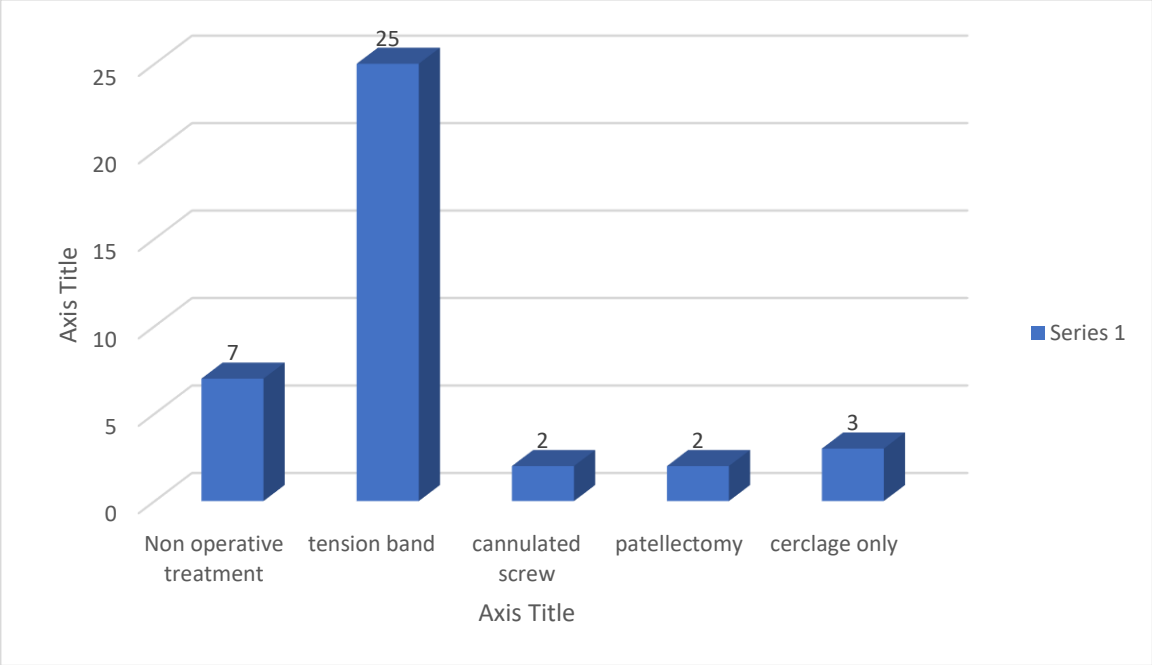

Figure 2: Treatment Modalities

Table 4: Outcome measures for various surgical modalities

Outcome measures	**Tension band wiring n=25**	**Cannulated screw n=2**	**Partial Patellectomy n=2**	**Cerclage wire alone n=3**
Bone union at 12 weeks	23(92.0)	2 (100)	-	2 (66.6)
Mean Length of hospital stay in weeks	2.3	1.4	1.0	2.1
Mean functional range of motion in the ipsilateral knee	-3^0 to 130^0	0^0 to 130^0	0^0 to 120^0	-5^0 to 125^0
Wound healing at day 14	24 (96.0)	2 (100)	1 (50)	3 (100)
Return to work/school by 18 weeks	25 (100)	2 (100)	1 (50)	3 (100)
Full Weight bearing at 12 weeks	24 (96.0)	2 (100)	2 (100)	2 (66.7)
Skin irritation complaints	4 (16)	0 (0.0)	0 (0.0)	1(33.3)

Discussion

Patella fractures account for 1.3 % of all bone fractures within the study centers. This collaborates findings by Henrishsen et al [7]. The low prevalence of these fractures neither demeans in any way, their relevance to orthopedic practice nor reduces the attention they attract whenever they occur.

The population less than 40years account for more than 80% of all patella fractures. This age bracket remains the most active, most productive and most abundant in Nigeria's young population. They are

therefore more exposed to road traffic accidents, sports injuries and industrial trauma. Larsen et al [18] shows a bimodal distribution with peaks at the youthful age and the elderly population (from Osteoporosis). Our study did not show any second peak. Osteoporosis is clearly a less serious epidemiological problem in the study population.

Peri-prosthetic patella fractures were very low in this study (2.6% n=1) this clearly contrasts with findings by Ortiguera & Berry [19] and Grace & Sim [6] who found more periprosthetic fractures in their population. The higher volume of both primary and revision total knee replacement surgeries done at those centers may explain the higher numbers reported from those studies. Peri-prosthetic patella fractures pose a huge challenge to treatment. Generally, these fractures occur intra-operatively or post-operatively with the risk factors reported [20,21,22,23] to include revision surgery, poor bone stock, presence of peri-prosthetic infections, remnant patella bone stock less than 10mm after reaming, poor cementing technique, patella mal-tracking as well as post-operative trauma. The patient from this study had trauma for 5 months after surgery.

Males were more common than females in a ratio of 1:1.2 with the most common fracture pattern being transverse fractures (61.5% n= 24). Kruse et al [24] also found transverse fractures as the most common pattern from a Swedish registry. They however found more female than males in their study (1:1.8). Other scholars [25,26 have however reported an even sex distribution.

Open fractures were quite uncommon 10.3% (n=4). These fractures may perhaps be more common in nations with higher prevalence of civil unrest and security concerns. Open fractures (n=4, 10.3%) required emergency operative treatment for wound debridement and initial stabilization with a slab. The poor soft tissue over the patella has the potential of creating challenges of wound cover, bone infection and delayed union. These were however not seen in the study as 75% of the patients had internal fixation after satisfactory wound healing while one patient had partial patellectomy for a severely comminuted fracture with missing fragments.

The single most common treatment modality was operative fracture fixation with tension band wiring. This typically involved the use of two parallel stainless-steel k-wires to maintain the fracture reduction and serve as anchors for placement of cerclage wires in a figure-of-eight pattern across the fracture. The tension band principle aims to convert the tensile forces generated at the convex anterior surface of the patella by the action of the quadriceps and patella tendons to compression forces on the articular surface needed to maintain fracture reduction and promote fracture healing. Meng et al [27] in their work on comparison of different methods of fixation of patella fractures have also found that tension band wiring was the most common method of fixation but admitted that some evolutions are emerging. The Arbeitsgemeinschaft fur Osteosynthesefragen (AO)/Association for the Study of Internal Fixation (ASIF) developed and propagated the tension band wire fixation technique as the standard of care for patellar fractures and have shown good results with the techinique[1]. It has been described by several reports as the gold standard for transverse patella fractures [28,29,30,31]. Though the tension band wiring technique is quite suitable for transverse patella fracture, which gives credence to its popularity in this study, modifications to the classical technique have been adopted and reported [27,32]. The investigators used an additional encircling row of cerclage wire after the figue-of-8 configuration to increase the stability of the construct and reduce the rate of wire cut out with subsequent implant failure. Luo et al [28] have called this the modified anterior tension band technique and recommend it for patella fractures with comminution.

One other modification reported in this study is the replacement of k-wires with cannulated screws with cerclage wire placed in a figure-of-8 configuration. This is believed to provide additional lag effect aimed at achieving better articular congruence and absolute stability. This appears to be an emerging technique however the sub-population it served is too few to make useful conclusions on its possible comparative

advantage in this study. Wild et al [33] and other workers [34,35,36] have reported that this technique has demonstrated superior stability in biomechanical studies, lower complication rates, and better functional outcomes than Tension Band Wiring alone. More studies are needed to validate this claim.

The use of encircling cerclage wires alone as reported in this study was reserved for stellate patella fractures. Absolute stability was sacrificed for maintaining the fragments of bone within the perimeter of the cerclage for fracture union to occur. The fixations were augmented by cylinder cast application for 6 weeks. The sub-population served by this technique was also too few to make any comments on its efficacy.

Sutures and plates were not used in the study centers at the time of the study. Partial Patellectomy was the reserved treatment for comminuted fractures of the inferior pole not salvageable by other techniques. The two cases reported were repeat surgeries from failed implant fixation from previous surgeries and from a missing large patella fragment in an open fracture. Anand et al [10] have reported that the retention of at least 60% of the native patella, with advancement of the patella tendon, will have good clinical outcomes.

Evaluation of the outcome of treatment showed that tension band wiring had good bone union at 12 weeks (92%, n=23/25), satisfactory range of motion in the knee at the end of treatment (-3^0 to 130^0) with good outcome in terms of return to pre-injury state. There was no case of implant failure during the period of the study and no wound problems, however four patients (16%) reported hardware irritation. Hardware irritation is a common complaint from tension band wiring. Both Hoshino et al[37] and smith et al [38] have reported the incidence of hardware irritation necessitating implant removal to be as high as 37%. Our patients were satisfied with surgeons' explanation as the reason for the irritation and all retained implant until bone union and subsequent removal.

Conservative treatment was used for only seven patients. Six of these patients (75%), patients had un-displaced fractures with intact extensor mechanism while one had ankylosed knee with preexisting severe limitation in knee motion. Cylinder cast immobilization was done for 6 weeks then converted to a hinged knee brace for another 6 weeks. Ambulation was restricted (Partial weight bearing) for the initial six weeks but allowed thereafter. Physical therapy involving muscle building exercise, passive and active stretches and knee range of motion exercises were used for all treatment modalities.

Study imitation: The inability to employ inferential statistics together with small to moderate sample size.

Conclusion

Findings from this study showed that though uncommon, patellar fractures receive optimal treatment with good outcomes from the study centers. Incidence of patella fractures is higher in the younger population (<40years old) with a male predominance. Tension band wiring is the single most common treatment modality, and the outcomes are comparable to findings from other centers.

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