

Research article

Functional Outcomes and Complications Following Patellar Fractures: A Retrospective Cohort Study

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Abstract: Patellar fractures represent an important traumatic pathology of the knee, with a significant impact on the extensor mechanism and joint functionality. This retrospective study evaluated the epidemiological, clinical, and therapeutic characteristics of a group of 187 patients diagnosed and treated for patellar fractures within an orthopedic and traumatology department. The analysis included the distribution by sex and age groups, traumatic mechanisms, fracture morphology, therapeutic methods applied, and post-traumatic and postoperative complications. Among the 187 patients, females predominated (132/187, 70.6%). Road traffic accidents (70 cases, 37.4%) and domestic accidents (57 cases, 30.5%) were the most common mechanisms of injury. Transverse/vertical fractures (64 cases, 34.2%) and comminuted fractures (45 cases, 24.1%) represented the most frequent fracture patterns. Surgical treatment was mainly indicated for displaced and multifragmentary fractures, with cerclage fixation performed in 64 patients (34.2%) and tension-band wiring in 43 patients (23.0%). Conservative treatment with femorotibial plaster immobilization was applied in 48 patients (25.7%). Clinical outcomes demonstrated the importance of anatomical reduction and early functional rehabilitation in preventing complications such as anterior knee pain, joint stiffness, and post-traumatic osteoarthritis. The study conclusions support the need for individualized therapeutic management based on fracture characteristics and restoration of the biomechanics of the extensor mechanism, in order to optimize functional recovery and reduce long-term complications.

Keywords: Patellar fracture; orthopedic traumatology; surgical treatment; osteosynthesis; functional rehabilitation; post-traumatic complications; knee biomechanics

1. Introduction

Patellar fractures account for approximately 1% of all skeletal fractures; however, their clinical importance is considerable due to the essential biomechanical role of the

patella in the function of the knee extensor mechanism and in the stability of the femoropatellar joint [1]. The integrity of the patella contributes significantly to the transmission of quadriceps force and to the achievement of complete knee extension; therefore, any traumatic injury affecting this structure may lead to significant functional impairment and long-term complications [2].

Over the last decades, interest in the management of patellar fractures has increased considerably due to the development of modern osteosynthesis techniques and early rehabilitation protocols [3]. The literature highlights that the most common traumatic mechanisms are direct trauma to the anterior knee region, road traffic accidents, and sports-related injuries [4]. Depending on the intensity of the trauma and the patient's bone quality, fractures may range from stable, non-displaced forms to complex multifragmentary lesions associated with articular surface involvement and disruption of the extensor mechanism [5].

The therapeutic management of patellar fractures remains a topic of interest and controversy in orthopedic practice. While conservative treatment is recommended for stable fractures without significant displacement, numerous authors support surgical treatment in displaced or comminuted fractures in order to restore articular congruence and prevent degenerative complications [6]. Although surgical treatment is widely recommended for displaced and comminuted fractures, questions remain regarding treatment selection and the indications for different fixation techniques in routine orthopedic practice. Therefore, evaluating the distribution of therapeutic approaches and their relationship to fracture morphology remains clinically relevant [7]. Some studies emphasize the benefits of early mobilization in preventing joint stiffness and muscular atrophy, whereas other authors draw attention to the risk of loss of reduction and complications related to osteosynthesis materials [8].

Immediate and late complications associated with patellar fractures continue to represent an important issue in orthopedic practice. Persistent anterior knee pain, joint stiffness, nonunion, and post-traumatic femoropatellar osteoarthritis are frequently reported in the literature, especially in intra-articular fractures and cases of incomplete anatomical reduction [9]. In addition, functional outcomes depend not only on bone healing but also on restoration of the biomechanics of the extensor mechanism and on the effectiveness of the rehabilitation program [10-12].

The aim of the present study was to evaluate the epidemiological, clinical, and therapeutic characteristics of patellar fractures, as well as to analyze the associated complications and post-traumatic functional outcomes. The study sought to identify the main traumatic mechanisms, the morphological distribution of fractures, and the relationship between injury severity and the therapeutic options applied. The results highlight the importance of early diagnosis, individualized management, and adequate functional rehabilitation in optimizing the prognosis of patients with patellar fractures [11-13].

The study hypothesis was that patellar fractures would predominantly affect female patients, be most commonly associated with road traffic and domestic accidents, and frequently present as transverse or comminuted fracture patterns requiring surgical treatment. Additionally, anatomical reduction and early functional rehabilitation were expected to improve functional outcomes and reduce long-term complications.

2. Materials and Methods

2.1. Study design

The present research was designed as a retrospective observational study conducted to evaluate the epidemiological, clinical, and therapeutic characteristics of patellar fractures, as well as the immediate and late complications associated with these injuries. The study included patients hospitalized and treated within the Orthopedics

and Traumatology Department of the Arad County Clinical Hospital between January 1, 2011, and December 31, 2016.

The study was developed in order to identify the main patterns regarding fracture incidence, traumatic mechanisms, fracture morphology, therapeutic management, and post-traumatic evolution in patients presenting with patellar fractures. In addition, the study aimed to evaluate the relationship between fracture characteristics and the type of treatment applied, while also assessing the frequency and distribution of associated complications.

The methodological approach was based on the retrospective analysis of medical documentation, imaging investigations, hospitalization records, operative protocols, and discharge summaries. Data collection was performed using information extracted from patient observation sheets and hospital databases, allowing the centralization and statistical interpretation of the evaluated clinical parameters.

The study protocol included the assessment of demographic variables, including age and sex distribution, alongside clinical and radiological parameters associated with fracture morphology and traumatic etiology. Furthermore, therapeutic approaches were analyzed comparatively in relation to fracture severity and clinical presentation.

The retrospective design allowed the evaluation of a relatively broad spectrum of patellar fracture cases encountered in routine orthopedic practice, providing clinically relevant information regarding treatment strategies and post-traumatic evolution. The study was conducted according to the ethical principles of medical research and respected patient confidentiality throughout all stages of data processing and analysis.

2.2. Study setting and participants.

The data were collected from the hospital archives for patients hospitalized between January 1, 2011, and December 31, 2016, and were analyzed retrospectively, during which patients diagnosed with patellar fractures were hospitalized, investigated, and treated according to the therapeutic protocols available throughout the study period.

A total number of 187 patients diagnosed with patellar fractures were included in the present study. The analyzed cases involved both male and female patients belonging to different age categories, allowing the evaluation of demographic and clinical variability associated with this pathology.

Patient selection was performed based on the review of hospitalization records and medical documentation. Inclusion criteria consisted of confirmed diagnosis of patellar fracture established through clinical and radiological examination, hospitalization within the study period, and availability of complete medical records necessary for retrospective analysis. Patients with incomplete medical documentation, uncertain diagnosis, associated malignant pathology, or insufficient imaging evaluation were excluded from the study as shown in Table 5.

All included patients underwent clinical orthopedic examinations at admission, followed by imaging investigations used to confirm the diagnosis and evaluate fracture characteristics. Standard radiographic assessment included anteroposterior and lateral knee radiographs, which allowed evaluation of fracture displacement, comminution, articular involvement, and integrity of the extensor mechanism. In selected cases, additional imaging investigations such as computed tomography were performed in order to obtain a more detailed evaluation of complex fracture patterns and intra-articular involvement.

The analyzed study parameters included patient age, sex distribution, traumatic mechanism, fracture morphology, type of fracture focus, affected limb, therapeutic management, and post-treatment complications. Additional variables such as duration

of hospitalization, surgical indication, associated lesions, and functional evolution were evaluated where available in the medical records.

The traumatic mechanisms responsible for patellar fractures included road traffic accidents, domestic accidents, falls from the same level or from height, sports-related trauma, and direct trauma to the anterior aspect of the knee. These mechanisms were comparatively analyzed in relation to patient sex, fracture type, and therapeutic approach.

The fracture morphology was classified according to radiological appearance and included transverse fractures, vertical fractures, comminuted fractures, multifragmentary fractures, and associated osteochondral lesions. The degree of fracture displacement and the integrity of the extensor apparatus were also considered during therapeutic decision-making.

Table 5. Baseline demographic and clinical characteristics of the study group

Variable	Rural	Urban	Total
Road traffic accidents	22	48	70
Domestic accidents	30	27	57
Pathological fractures	16	22	38
Other causes of fracture	7	15	22
Total	75	112	187

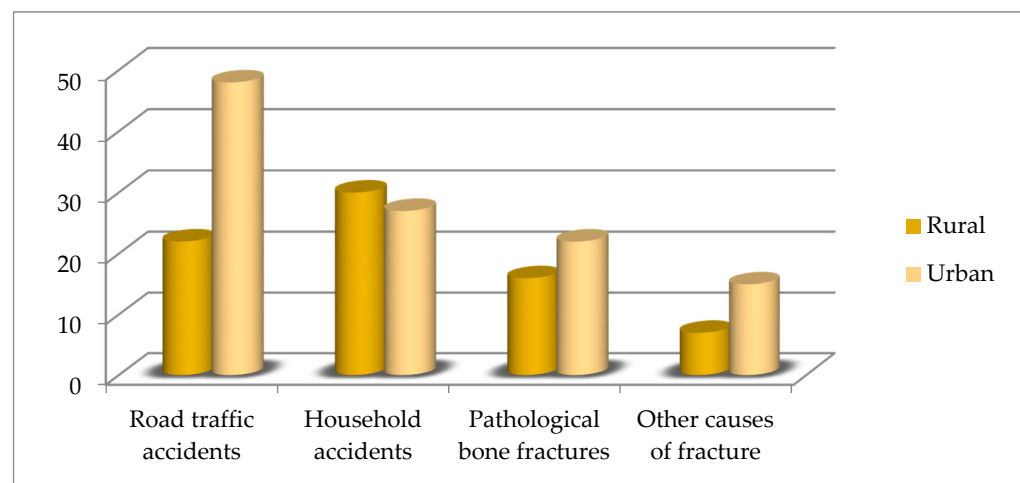


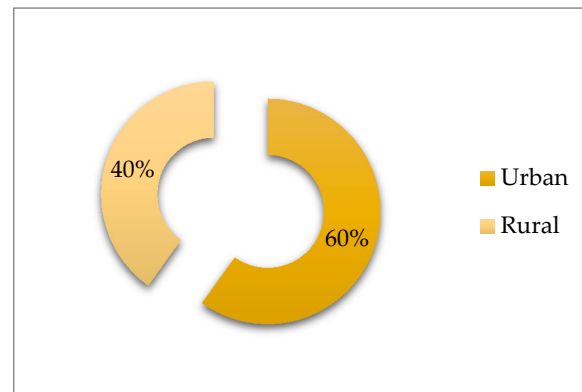
Figure 9. Distribution of fracture causes between rural and urban environments

Road traffic accidents represent the main cause of fractures in the urban environment, with a significantly higher frequency compared with the rural environment (approximately 50% vs. 24%). Domestic accidents are more frequent in rural areas than in urban areas (approximately 32% vs. 29%), representing the second major cause of fractures. Pathological fractures show a moderately higher incidence in urban environments compared with rural areas (approximately 24% vs. 18%). The category “other

causes of fracture" is present in both environments but occurs more frequently in urban areas (approximately 17% vs. 9%), as illustrated in Figure 9. The distribution of patients according to place of residence is illustrated in Figure 10.

Figure 10. Distribution of patients between urban and rural environments

The therapeutic management of patellar fractures was individualized according to fracture stability, displacement, integrity of the extensor mechanism, patient age, and associated lesions. Conservative treatment was generally indicated in stable, non-



displaced fractures with preserved extensor mechanism continuity, while surgical treatment was preferred in displaced fractures, comminuted lesions, and fractures associated with disruption of the extensor apparatus.

The conservative therapeutic approach included immobilization using plaster casts or orthotic devices, analgesic and anti-inflammatory medication, functional monitoring, and progressive rehabilitation protocols. Surgical management consisted primarily of osteosynthesis procedures intended to restore patellar congruence, stabilize fracture fragments, and preserve the biomechanical function of the extensor mechanism.

The post-treatment evolution of the patients was monitored clinically and radiologically, with particular attention directed toward fracture consolidation, restoration of knee mobility, functional recovery, and the occurrence of immediate or late complications. The distribution of fracture types according to the affected limb is presented in Table 6.

Table 6. Distribution of fracture types according to the affected limb

Limb	Transverse or Vertical	Stellate fracture	Incomplete or non-displaced fracture	Comminuted fracture	Total
Left	38	31	19	28	116
Right	26	15	13	17	71
Total	64	46	32	45	187

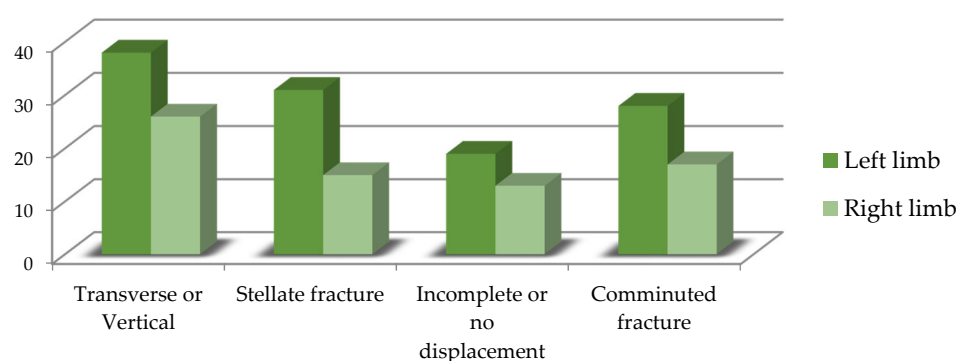


Figure 11. Percentage distribution of fracture types according to the affected limb (left vs. right).

Transverse or vertical fractures were the most frequent types, predominating in the left limb compared with the right limb (approximately 40 vs. 28 cases). Stellate fractures also showed a higher frequency in the left limb than in the right limb (approximately 33 vs. 17 cases). Incomplete or non-displaced fractures had the lowest frequency in both groups, being slightly more frequent in the left limb (approximately 20 vs. 15 cases). Comminuted fractures were relatively frequent as well, also predominating in the left limb (approximately 30 vs. 19 cases), as illustrated in Figure 11.

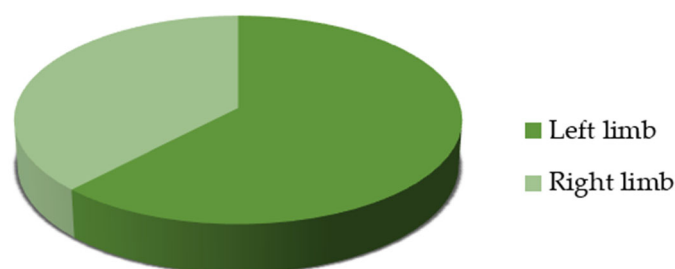


Figure 12. Overall distribution of affected limb involvement.

The majority of fractures were located in the left limb, accounting for approximately two-thirds of the total cases. The right limb was affected less frequently, representing approximately one-third of the cases. A clear predominance of left limb involvement compared to the right limb was observed. This difference may suggest the influence of the traumatic mechanism, limb dominance, or the mode of accident occurrence, as shown in Figure 12.

2.3. Therapeutic management

The therapeutic management of patellar fractures was established according to fracture morphology, degree of displacement, integrity of the extensor mechanism, patient age, associated traumatic lesions, and general clinical condition. The primary therapeutic objective was represented by restoration of the anatomical congruence of the patella and preservation of the functional integrity of the knee extensor apparatus.

Treatment strategies included both conservative and surgical approaches, each selected according to the stability and severity of the fracture pattern identified during clinical and radiological evaluation. The therapeutic decision was individualized for each patient in order to obtain optimal functional recovery and minimize the risk of post-traumatic complications and long-term disability.

Conservative treatment was generally indicated in stable fractures without significant displacement and in cases where the extensor mechanism remained functionally intact. The conservative therapeutic protocol consisted of immobilization using plaster casts or orthopedic braces positioned in knee extension for a period of approximately

4–6 weeks, depending on fracture stability, degree of bone healing, and the patient's clinical evolution. During this period, patients received analgesic and anti-inflammatory treatment, as well as periodic clinical and radiological monitoring, followed subsequently by progressive functional rehabilitation protocols aimed at restoring joint mobility and muscular strength.

Clinical and radiological follow-up was periodically performed during the immobilization period in order to evaluate fracture stability, pain evolution, and the progression of fracture consolidation. Progressive mobilization and physiotherapeutic recovery protocols were initiated following radiological evidence of fracture healing and reduction of pain symptoms.

Surgical treatment was indicated in displaced fractures, multifragmentary lesions, fractures associated with extensor mechanism disruption, articular incongruence, or instability of fracture fragments. The operative procedures aimed to achieve anatomical reduction of fracture fragments, stable internal fixation, restoration of patellofemoral congruence, and early functional mobilization of the knee joint.

The surgical techniques used included osteosynthesis procedures based on tension-band fixation, cerclage wiring, screw fixation, or combined fixation techniques depending on fracture morphology and surgeon preference. In selected severe cases characterized by extensive comminution or irreparable fragmentation, partial or total patellectomy was considered as a salvage procedure.

Postoperative management included pain control, prevention of thromboembolic complications, wound monitoring, gradual mobilization, and individualized physiotherapy protocols focused on restoring knee mobility, muscle strength, and gait function. The therapeutic outcomes were evaluated according to fracture healing, restoration of knee function, recovery of range of motion, pain reduction, and the occurrence of immediate or late postoperative complications.

The analysis of immediate postoperative complications demonstrated that knee soreness represented the most frequent complication, being identified in 11 patients (5.88%). Secondary displacement of the fracture focus was observed in 8 cases (4.27%), particularly in patients presenting complex fracture patterns or insufficient postoperative stability. Superficial postoperative hematoma at the surgical wound level was identified in 5 patients (2.67%), while postoperative hemarthrosis occurred in 4 cases (2.13%).

These findings underline the importance of careful postoperative monitoring, stable fixation techniques, and early rehabilitation protocols in order to reduce complication rates and optimize functional recovery following patellar fracture treatment Table 7.

Table 7. Distribution of treatment modalities according to fracture type

Immediate complications	Knee soreness	Displacement of the fracture outbreak	Superficial hematoma of the surgical wound	Postoperative hemarthrosis
Number of cases	11	8	5	4
Percentage of cases	5,88%	4,27%	2,67%	2,13%

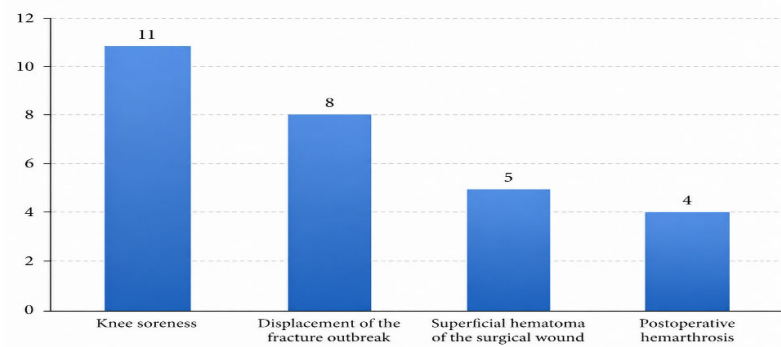


Figure 13. Distribution of the main postoperative complications or manifestations observed in patients.

Knee soreness represented the most frequent postoperative manifestation, being recorded in approximately 11 cases. Fracture site displacement was the second most common complication, observed in approximately 8 cases. Superficial surgical wound hematoma was identified in approximately 5 cases. Postoperative hemarthrosis was the rarest complication, being present in approximately 4 cases, as shown in Figure 13.

Table 8. Distribution of treatment methods according to patient sex.

Late complications	Limitation of joint mobility	Calus vices	Early osteoarthritis
Number of cases	9	6	3
Percentage of cases	4,81%	3,20%	1,60%

The analysis of late complications demonstrated that limitation of joint mobility represented the most frequent long-term complication, being identified in 9 patients (4.81%). This complication was associated particularly with prolonged immobilization periods, delayed functional rehabilitation, and complex fractures that required extensive surgical treatment, as presented in Table 8.

Malunion was observed in 6 patients (3.20%), suggesting the presence of defective bone healing or incomplete anatomical reduction of the fracture site. This complication may lead to altered biomechanics of the extensor mechanism, persistent pain, and limitation of knee function.

Early post-traumatic osteoarthritis was identified in 3 patients (1.60%), representing the least frequent of the late analyzed complications. The occurrence of early degenerative changes may be correlated with residual articular incongruence, patello-femoral cartilage damage, and the severity of intra-articular fractures.

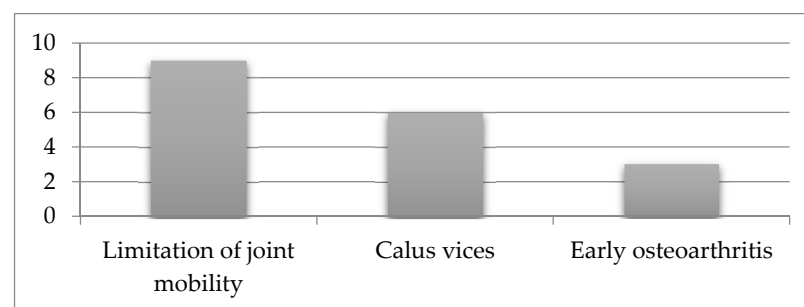


Figure 14. Therapeutic management according to fracture morphology

The most important functional consequence following fracture was reduced knee mobility. Bone healing complications, such as malunion, showed a moderate frequency. Early degenerative changes (osteoarthritis/arthritis) were less common but may negatively influence long-term prognosis, as illustrated in Figure 14.

2.4. Clinical and radiological Follow-Up

The clinical and radiological follow-up of the patients was performed throughout hospitalization and during the post-treatment recovery period in order to evaluate fracture healing, restoration of knee function, and the occurrence of potential complications.

Clinical evaluation included assessment of pain intensity, local inflammatory signs, knee stability, range of motion, muscular strength, gait abnormalities, and functional capacity of the extensor mechanism. Particular attention was directed toward identifying postoperative complications such as infection, joint stiffness, extensor lag, secondary displacement, and delayed functional recovery.

Radiological follow-up was performed using standard anteroposterior and lateral knee radiographs obtained at regular intervals during the recovery period. Imaging evaluation allowed assessment of fracture reduction quality, stability of osteosynthesis materials, progression of bone consolidation, and identification of secondary displacement or delayed union.

The evolution of fracture healing was analyzed comparatively according to fracture morphology and treatment modality. Patients treated conservatively were monitored for maintenance of fracture alignment and progressive consolidation, while surgically treated patients were additionally evaluated for implant-related complications and postoperative patellofemoral congruence.

Functional recovery was assessed based on progressive restoration of knee mobility and return to daily activities. The rehabilitation protocol included gradual passive and active mobilization exercises, quadriceps strengthening, gait re-education, and progressive functional loading adapted to the clinical evolution of each patient.

Immediate complications evaluated during hospitalization included local infection, hematoma formation, wound dehiscence, vascular or neurological impairment, secondary fracture displacement, and postoperative pain syndrome. Late complications assessed during follow-up included chronic anterior knee pain, decreased range of motion, osteoarthritis-related changes, pseudarthrosis, delayed consolidation, extensor mechanism dysfunction, and residual patellofemoral instability.

The incidence and distribution of complications were comparatively analyzed in relation to fracture morphology, therapeutic approach, and patient-related factors in order to identify possible prognostic indicators associated with unfavorable clinical evolution.



Figure 15. Lateral knee radiograph showing a transverse patellar fracture with significant displacement of the fragments.

Severe displacement of bone fragments, in which the fragments are significantly separated, as illustrated in Figure 15.



Figure 16. Postoperative radiograph following treatment of a left patellar fracture.

The postoperative radiograph in Figure 16 shows findings compatible with osteosynthesis for a transverse patellar fracture, with an apparently favorable postoperative radiological evolution on this image.



Figure 17. Radiographic representation of a comminuted patellar fracture.

The radiographs in Figure 17 show a comminuted patellar fracture, meaning that the patella is fragmented into multiple pieces. The images demonstrate a severe multifragmentary fracture of the patella, with evident displacement of the bone fragments and predominant involvement of the inferior and central portions of the patella. The radiological appearance is compatible with high-energy trauma or a powerful quadriceps contraction mechanism.

2.5. Statistical analysis

The collected clinical and epidemiological data were centralized, processed, and analyzed to evaluate the distribution of patellar fractures according to demographic characteristics, traumatic mechanisms, fracture morphology, therapeutic management, and associated complications.

Descriptive statistical analysis was performed using JASP software (version 18.0). Quantitative variables were summarized using means, standard deviations, minimum values, and maximum values, where applicable. Qualitative variables were presented as absolute frequencies and percentages.

The analysis focused on describing the epidemiological, clinical, and therapeutic characteristics of the study population and illustrating the distribution of the analyzed variables. Results are presented through tables, frequency distributions, and graphical representations to facilitate interpretation of the findings.

Graphical representation of the results was performed using percentage distribution charts, comparative diagrams, and frequency histograms, allowing a clear visualization of the epidemiological and therapeutic characteristics identified throughout the study.

2.5.1. Analysis of demographic and epidemiological variables

The demographic and epidemiological analysis included evaluation of patient age, sex distribution, annual hospitalization frequency, traumatic mechanisms, and environmental origin of the patients included in the study group.

The frequency of patellar fractures was analyzed comparatively in relation to the total number of fractures affecting the knee region during the evaluated study period. The annual incidence of hospitalization for patellar fractures was centralized and statistically represented in order to identify possible variations in frequency throughout the analyzed interval.

Sex distribution was evaluated comparatively according to traumatic mechanisms and fracture morphology. Age-related analysis was additionally performed in order to identify the most affected age categories and possible correlations between patient age and fracture severity.

The traumatic etiology of patellar fractures was classified into road traffic accidents, domestic trauma, sports injuries, falls, and direct trauma to the anterior aspect of the knee. Comparative statistical evaluation was performed in order to determine the predominance of specific traumatic mechanisms within the analyzed population.

The environmental origin of the patients, classified as urban or rural, was additionally evaluated in relation to the type of accident and fracture distribution.

2.5.2. Analysis of fracture morphology and therapeutic management

The morphological analysis of patellar fractures was performed based on radiological evaluation and included assessment of fracture focus characteristics, displacement, fragmentation, and articular involvement.

Fracture morphology was classified into transverse fractures, vertical fractures, comminuted fractures, multifragmentary lesions, and associated osteochondral injuries. Comparative evaluation was performed between fracture morphology and demographic variables, including age and sex distribution.

The degree of fracture displacement and extensor mechanism involvement were additionally considered during therapeutic decision-making. Comparative analysis was conducted between fracture characteristics and the selected therapeutic approach in order to evaluate the relationship between fracture severity and treatment indication.

Therapeutic management was statistically analyzed according to treatment modality, including conservative treatment and surgical treatment. The frequency of osteosynthesis procedures and conservative immobilization protocols was comparatively evaluated within the study population.

Additional analysis was performed in order to identify possible associations between fracture morphology and postoperative evolution, as well as the incidence of treatment-related complications.

2.5.3. Analysis of immediate and late complications

The analysis of complications included evaluation of both immediate and late post-traumatic or postoperative complications identified during hospitalization and follow-up.

Immediate complications included postoperative infection, hematoma formation, wound dehiscence, secondary displacement of fracture fragments, acute pain syndrome, vascular impairment, neurological complications, and limitation of early mobilization.

Late complications included chronic anterior knee pain, joint stiffness, delayed fracture consolidation, pseudarthrosis, extensor mechanism dysfunction, reduced functional mobility, post-traumatic osteoarthritis, patellofemoral instability, and residual gait abnormalities.

The incidence of complications was statistically analyzed according to fracture morphology, treatment modality, and patient-related factors. Comparative evaluation was additionally performed between conservative and surgical treatment groups in order to identify differences regarding postoperative evolution and complication rates.

Functional recovery was assessed according to restoration of knee mobility, pain reduction, return to daily activities, and radiological evidence of fracture consolidation. The relationship between postoperative complications and long-term functional outcomes was also considered during statistical interpretation.

2.6. Ethical approval.

Ethical approval for this study was obtained from the Research Ethics Committee of the Faculty of Medicine, "Vasile Goldis," Western University of Arad (Approval No. 6/30.03.2026), and the Research Ethics Committee of the Clinical Emergency County Hospital Arad (Approval No. 112/09.12.2025).

The study was conducted in accordance with the principles of the Declaration of Helsinki. Participation in the study was voluntary. Written informed consent was obtained from all participants.

3. Results

3.1. Annual hospitalization frequency and incidence of patellar fractures

During the analyzed study period, a total number of 187 patients diagnosed with patellar fractures were hospitalized and treated within the Orthopedics and Traumatology Department of the Arad County Clinical Hospital. The retrospective analysis of hospitalization records demonstrated that patellar fractures represented an important proportion of traumatic injuries affecting the knee joint, with variable annual frequency throughout the evaluated interval.

The analysis of annual hospitalization frequency revealed fluctuations in the number of admitted cases from one year to another, which may be associated with variations in traumatic exposure, road traffic incidents, occupational activities, and pathological fractures. Despite these variations, patellar fractures remained a relatively constant traumatic pathology encountered in orthopedic clinical practice.

The comparative analysis between the number of patellar fractures and the total number of fractures involving the knee region demonstrated that patellar fractures accounted for a clinically significant proportion of knee trauma cases. The results underline the functional and biomechanical importance of the patella within the extensor apparatus of the knee, as traumatic lesions affecting this structure frequently required prolonged treatment and functional recovery.

The statistical evaluation additionally demonstrated that the incidence of patellar fractures was higher among active adult patients, particularly within the age interval of 51-70 years. This observation may be explained by the increased exposure of this population category to high-energy trauma, occupational accidents, and road traffic accidents.

A comparative analysis of hospitalization frequency according to sex revealed a predominance of female patients within the study group. This predominance may be associated with the higher frequency of domestic accidents, pathological fractures, osteoporosis-related bone fragility, and age-related degenerative changes observed among female patients in the study population.

The annual distribution of hospitalizations related to patellar fractures is presented in Table 1 and graphically illustrated in Figure 1.

The comparative distribution of patellar fractures relative to the total number of knee fractures demonstrated that patellar injuries represented approximately 3.24% of all fractures involving the knee region during the analyzed period.

The percentage distribution of patellar fractures compared to total knee fractures is presented in Table 1 and illustrated in Figures 1 and 2.

Table 1. Annual hospitalization frequency of patients with patellar fractures

Parameter	Number of cases	Percent
Total number of hospitalizations	5768	100%
Patellar fracture	187	3.24%

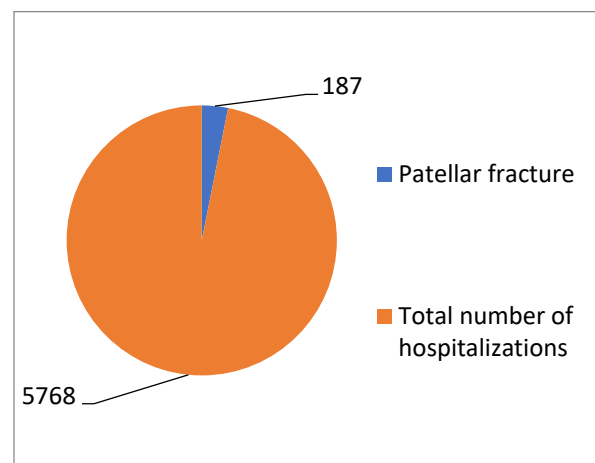


Figure 1. Percentage distribution of patellar fractures compared to total knee fractures.

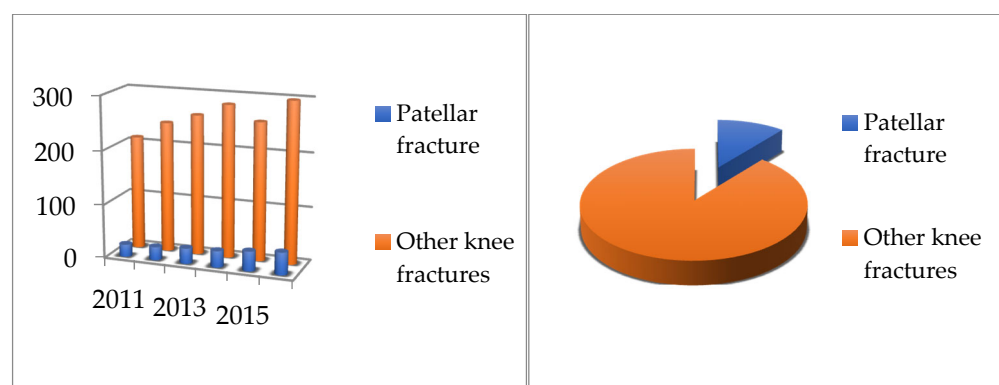


Figure 2. Overall percentage distribution of patellar fractures within the total number of knee fractures

The obtained epidemiological data emphasize the clinical relevance of patellar fractures within traumatic knee pathology and support the necessity of accurate diagnosis, individualized therapeutic management, and adequate functional recovery protocols in these patients.

3.2. Distribution of patellar fractures according to sex and traumatic mechanism

The analysis of the study population according to sex demonstrated a predominance of female patients among individuals diagnosed with patellar fractures, accounting for 132 cases out of the total of 187 analyzed patients, compared with 55 cases in males. Comparative evaluation of traumatic etiology revealed that road traffic accidents represented one of the most frequent causes of patellar fractures, being identified in 70 patients, including 46 women (65.71%) and 24 men (34.29%). Domestic accidents were also frequently encountered, with 57 recorded cases, including 38 women (66.67%) and 19 men (33.33%), particularly among elderly patients and individuals with associated degenerative or osteoporotic changes.

Pathological bone fractures were observed in 38 patients, with a clear predominance among women—31 cases (81.57%) compared with 7 cases in men (18.43%). Other causes of fractures were identified in 22 patients, including 17 women (77.27%) and 5 men (22.73%). The relationship between sex and traumatic mechanism demonstrated distinct distribution patterns between male and female patients. Although the literature frequently describes a higher prevalence of high-energy trauma in the male population, within the analyzed cohort female patients presented a higher frequency of domestic accidents, pathological fractures, and low-energy trauma.

These findings suggest that the traumatic mechanism plays an important role not only in the occurrence of patellar fractures but also in the severity of fracture morphology and subsequent therapeutic management. High-energy trauma was more frequently associated with displaced and comminuted fractures requiring surgical stabilization, whereas low-energy trauma was more commonly associated with stable fracture patterns managed conservatively. The analysis showed that patellar fractures associated with direct trauma to the anterior knee were more frequently observed than indirect traumatic mechanisms involving sudden contraction of the quadriceps muscle.

The distribution of patellar fractures according to sex and traumatic mechanism is presented in Table 2 and shown in Figures 3 and 4.

Table 2. Distribution of patellar fractures according to sex and traumatic mechanism

Mechanism	Women	Men	Total
Road traffic accidents, N (%)	46 (65,71)	24 (34,29)	70
Domestic accidents, N (%)	38 (66,67)	19 (33,33)	57
Pathological bone fractures, N (%)	31 (81,57)	7 (18,43)	38
Other causes of fractures, N (%)	17 (77,27)	5 (22,73)	22
Total (N)	132	55	187

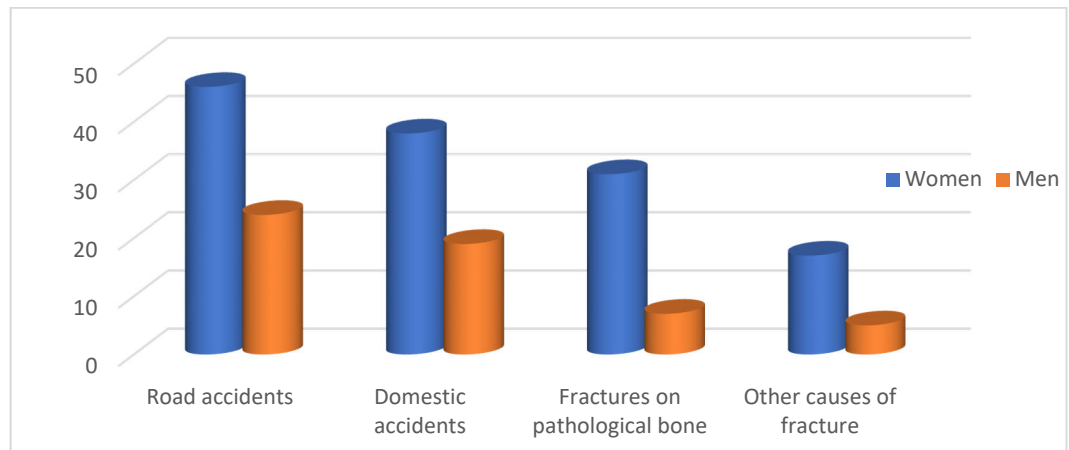


Figure 3. Percentage distribution of patellar fractures according to sex and traumatic mechanism

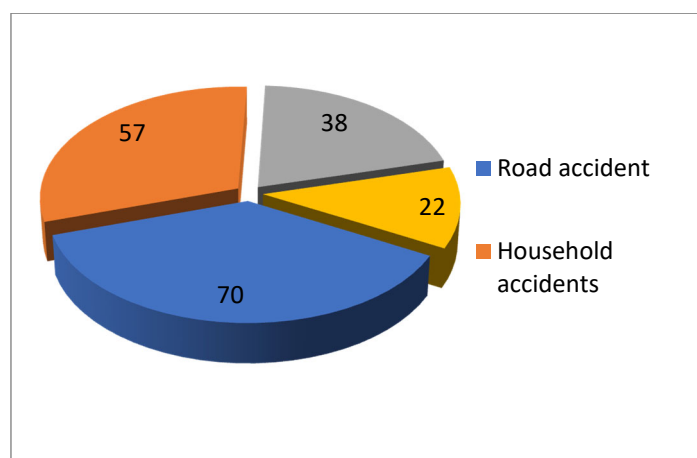


Figure 4. Overall percentage distribution of traumatic mechanisms within the study group

The results highlight the multifactorial traumatic etiology of patellar fractures and demonstrate the influence of demographic and biomechanical factors on the occurrence and distribution of this pathology. Furthermore, the predominance of high-energy traumatic mechanisms among active adult patients emphasizes the importance of preventive strategies and early therapeutic intervention in reducing functional impairment and long-term complications associated with patellar fractures, Figure 4.

3.3. Distribution of patellar fractures according to fracture morphology and age

The radiological evaluation of the analyzed cases demonstrated the presence of multiple fracture patterns, with important variability regarding fracture morphology, degree of displacement, and fragmentation. The morphological characteristics of the fracture focus represented an important factor influencing therapeutic management, postoperative evolution, and functional recovery.

The comparative analysis of fracture morphology revealed that transverse fractures represented one of the most frequently encountered fracture patterns within the study group. Comminuted and multifragmentary fractures were also identified in a considerable number of cases, particularly among patients exposed to high-energy trauma such as road traffic accidents or severe direct impacts involving the anterior aspect of the knee.

Vertical fractures and osteochondral lesions were observed less frequently, generally being associated with lower-energy traumatic mechanisms and more stable fracture configurations. The distribution of fracture morphology demonstrated significant differences according to patient age and traumatic etiology.

The analysis according to age categories showed that younger and active adult patients presented a higher frequency of displaced and comminuted fractures, while elderly patients more frequently exhibited fracture patterns associated with decreased bone resistance and low-energy trauma. This observation may be explained by age-related changes in bone quality and differences in traumatic exposure between age groups.

Furthermore, the severity of fracture fragmentation appeared to increase proportionally with the intensity of the traumatic mechanism. High-energy trauma was frequently associated with complex fracture configurations requiring surgical stabilization and prolonged functional recovery.

The comparative evaluation of fracture morphology additionally demonstrated that multifragmentary and displaced fractures were associated with a higher incidence of postoperative complications and delayed functional recovery when compared to stable fracture patterns.

The distribution of fracture morphology according to patient age is presented in Table 3 and graphically illustrated in Figures 5 and 6.

Table 3. Distribution of patellar fractures according to fracture morphology and age group

Age	Transverse or vertical	Stellate fracture	Incomplete or non-displaced fracture	Comminuted fracture	Total
Under 31 years old	4	7	6	5	22
31-50 years old	11	9	6	10	36
51-70 years old	33	21	14	17	85
Over 70 years	16	9	6	13	44
Total	64	46	32	45	187

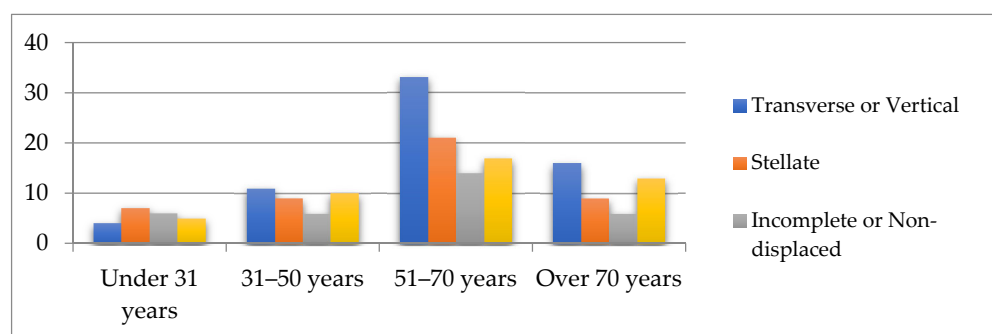


Figure 5. Percentage distribution of fracture morphology according to age group

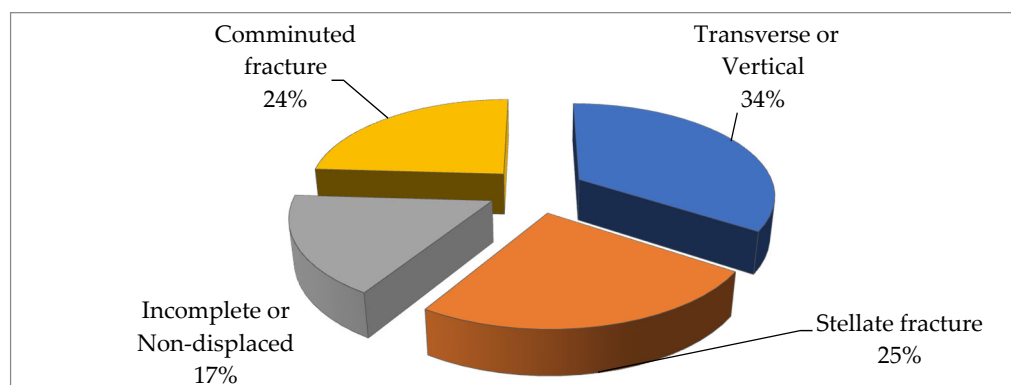


Figure 6. Overall percentage distribution of fracture morphology within the study population

The results obtained underline the importance of radiological classification and fracture morphology assessment in establishing the therapeutic strategy and predicting the functional evolution of patients diagnosed with patellar fractures.

3.4. Distribution of therapeutic management according to sex and fracture characteristics

The analysis of therapeutic management demonstrated that treatment selection was directly influenced by fracture morphology, degree of displacement, integrity of the extensor mechanism, and overall fracture stability. Both conservative and surgical approaches were used within the analyzed group. Conservative treatment was indicated primarily for stable fractures without significant displacement and in patients who preserved extensor mechanism function. Surgical treatment was performed predominantly in displaced fractures, comminuted lesions, multifragmentary fracture patterns, and cases associated with articular incongruence or disruption of the extensor mechanism.

Comparative evaluation according to sex revealed important differences regarding the therapeutic modalities applied. Among female patients, femorotibial immobilization in a plaster cast was used in 33 cases (25%), tension band wiring osteosynthesis in 32 cases (24.24%), cerclage technique in 41 cases (31.06%), and partial or total patellectomies in 26 cases (19.7%). Among male patients, plaster cast immobilization was applied in 15 cases (27.27%), tension band wiring technique in 11 cases (20%), cerclage technique in 23 cases (41.82%), and partial or total patellectomies in 6 cases (10.91%). Overall, the cerclage technique represented the most frequently used surgical therapeutic method, being applied in 64 patients, followed by femorotibial immobilization in 48 cases, tension band wiring technique in 43 cases, and partial or total patellectomies in 32 cases.

Conservative therapeutic management mainly consisted of immobilization with plaster casts or orthopedic devices associated with analgesic medication, anti-inflammatory treatment, and progressive functional rehabilitation protocols. Surgical treatment included osteosynthesis procedures aimed at restoring patellar congruence, ensuring fracture site stability, and allowing early mobilization of the knee joint.

Analysis of treatment distribution demonstrated that displaced transverse fractures and comminuted fractures represented the main indications for surgical stabilization. Stable fractures without significant fragment displacement were managed predominantly conservatively, with favorable clinical outcomes. Postoperative clinical evolution demonstrated that surgically treated patients benefited from superior anatomical reduction and restoration of the extensor mechanism; however, these patients also presented a higher risk of immediate postoperative complications associated with surgery and osteosynthesis materials.

Comparative analysis between fracture morphology and treatment modality demonstrated a strong association between fracture severity and the need for surgical management. Complex fracture configurations frequently required longer hospitalization and rehabilitation periods compared with stable fracture patterns treated conservatively.

The distribution of treatment modalities according to sex and fracture characteristics is presented in Table 4 and shown in Figures 7 and 8.

Table 4. Distribution of treatment modalities according to sex

Parameter	Femorotibial plaster cast	Tension band wiring technique	Cerclage technique	Partial or total patellectomies
Women, N (%)	33 (25)	32 (24,24)	41 (31,06)	26 (19,7)
Men, N (%)	15 (27,27)	11 (20,00)	23 (41,82)	6 (10,91)
Total	48	43	64	32

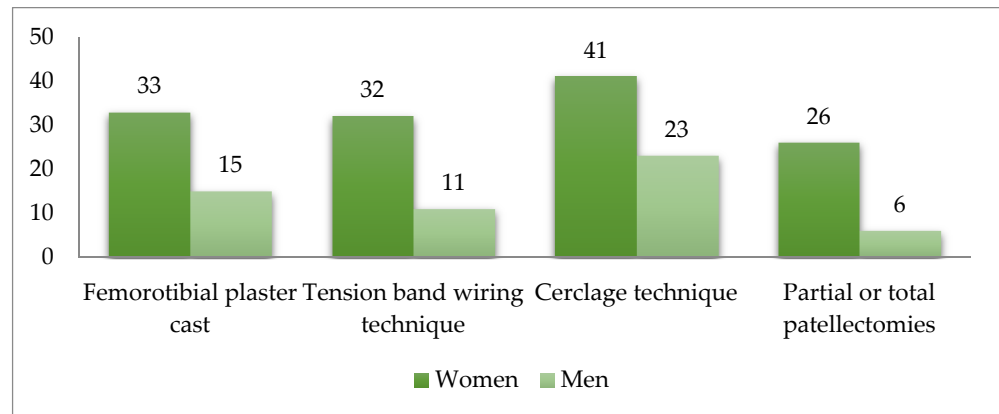


Figure 7. Overall percentage distribution of conservative and surgical treatment approaches

The most frequently applied method was trans-skeletal traction followed by osteosynthesis and plaster cast immobilization, suggesting the predominance of complex or unstable fractures that required surgical stabilization and reconstruction of the extensor mechanism. Osteosynthesis associated with plaster cast immobilization also represented a significant proportion, confirming the major role of surgical treatment in the management of displaced fractures, as illustrated in Figure 7.

Exclusive conservative treatment using plaster cast immobilization accounted for a lower percentage, indicating that stable fractures without significant displacement were less frequent within the analyzed cohort. The results suggest that treatment selection was closely correlated with the morphological severity of the fracture and with the need for rapid restoration of joint stability and knee extensor mechanism function, findings illustrated in Figure 8.

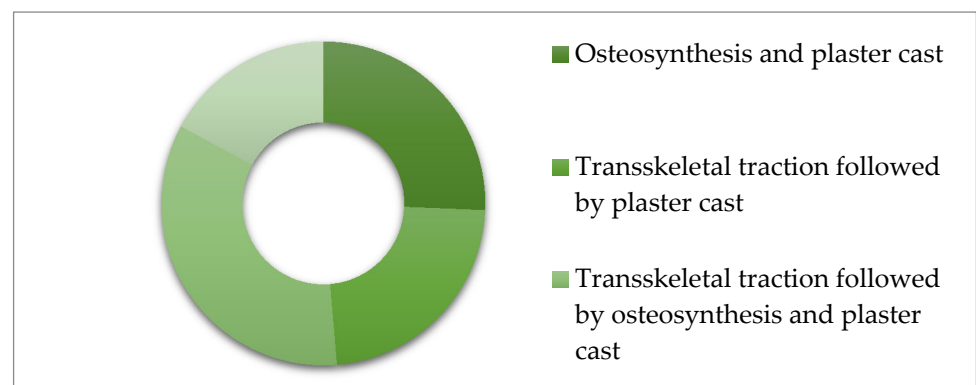


Figure 8. Distribution of the patient cohort by treatment method.

The results emphasize the importance of individualized therapeutic management in patellar fractures and support the role of fracture morphology and traumatic severity as essential determinants in selecting the optimal treatment strategy.

4. Discussion

4.1. Epidemiological and clinical characteristics of patellar fractures

Patellar fractures represent a relatively rare traumatic pathology compared with other fractures affecting the lower limb; however, they remain clinically significant due to the essential biomechanical role of the patella in the knee extensor mechanism. The present study highlighted several important epidemiological and clinical characteristics associated with this pathology, particularly regarding demographic distribution, traumatic etiology, fracture morphology, and therapeutic management [2,4,12].

The analyzed cohort included 187 patients diagnosed with patellar fractures, among whom 132 were women and 55 were men. Regarding traumatic etiology, road traffic accidents represented the most frequent cause, being identified in 70 patients, including 46 women (65.71%) and 24 men (34.29%). Domestic accidents were recorded in 57 patients, with female predominance—38 women (66.67%) and 19 men (33.33%). Pathological bone fractures were observed in 38 cases, including 31 women (81.57%) and 7 men (18.43%), while other traumatic causes were identified in 22 patients, including 17 women (77.27%) and 5 men (22.73%) [14].

These findings demonstrate a predominance of female patients within the analyzed cohort, differing from numerous orthopedic studies reporting a higher prevalence among men due to more frequent exposure to occupational trauma, road traffic accidents, and sports activities. Nevertheless, the high prevalence among women in the present study may be explained by the increased frequency of domestic trauma and pathological fractures associated with osteoporosis and age-related degenerative changes [15-17].

The analysis of traumatic etiology demonstrated that direct trauma to the anterior knee region and road traffic accidents represented the most frequent mechanisms involved in the occurrence of patellar fractures [16]. These findings are consistent with previous studies describing the patella as vulnerable to direct impact because of its superficial anatomical position and the limited protection provided by surrounding soft tissues. High-energy trauma was frequently associated with displaced and comminuted fractures, whereas low-energy trauma more commonly produced stable fracture patterns [18-19].

The identified relationship between fracture morphology and trauma intensity supports the biomechanical mechanisms involved in the production of patellar fractures. Analysis of morphological distribution revealed 64 transverse or vertical fractures, 46 stellate fractures, 32 incomplete or non-displaced fractures, and 45 comminuted fractures [20-22]. The 51–70 years age group presented the highest fracture frequency, with 85 cases, followed by the group over 70 years with 44 cases. Young and active adult patients more frequently presented complex and multifragmentary configurations, whereas elderly patients exhibited fractures associated with reduced bone strength and low-energy trauma [21-24].

Another clinically relevant observation identified in this study refers to the prolonged functional impact associated with patellar fractures. Although these injuries represent a small percentage of total knee fractures, they frequently result in impairment of knee extension, reduced mobility, and the need for prolonged functional rehabilitation. Analysis of therapeutic management showed that the cerclage technique was used in 64 patients, tension band osteosynthesis in 43 cases, femorotibial immobilization in plaster cast in 48 patients, and partial or total patellectomies in 32 cases [23]. Among women, the cerclage technique accounted for 31.06% of the therapeutic methods used, whereas among men it represented 41.82%, reflecting the increased frequency of complex fractures within this category [25].

The epidemiological and clinical data obtained support the importance of early diagnosis, precise radiological evaluation, and individualized therapeutic planning in order to minimize functional impairment and optimize postoperative recovery.

4.2. Therapeutic management and functional implications

The therapeutic management of patellar fractures remains strongly dependent on fracture morphology, degree of displacement, and preservation of the extensor mechanism. The findings of the present study confirm the current orthopedic principle that

restoration of anatomical congruence and preservation of extensor apparatus functionality represent the primary therapeutic objectives in the treatment of patellar fractures [26].

Conservative treatment demonstrated favorable outcomes in stable fractures without significant displacement and in cases where extensor mechanism integrity was preserved. Immobilization associated with progressive rehabilitation allowed satisfactory fracture consolidation and acceptable functional recovery in carefully selected patients. These findings are consistent with the literature supporting non-operative management for minimally displaced fractures with preserved biomechanical stability [27].

However, the present study additionally demonstrated that displaced and comminuted fractures frequently required surgical treatment due to the increased risk of extensor dysfunction, articular incongruence, and long-term biomechanical impairment. Surgical stabilization through osteosynthesis techniques allowed restoration of patellar alignment and facilitated earlier mobilization compared to prolonged conservative immobilization.

The increased frequency of surgical treatment among male patients observed in the analyzed population may be explained by the predominance of high-energy traumatic mechanisms within this subgroup. Road traffic accidents and severe direct trauma were more frequently associated with complex fracture configurations requiring operative stabilization.

The results obtained also underline the biomechanical importance of preserving the patella whenever possible. Historically, total patellectomy was considered an acceptable therapeutic option for severely comminuted fractures; however, modern orthopedic concepts favor patellar preservation and reconstruction due to its essential role in increasing quadriceps efficiency and maintaining normal knee biomechanics. Within the analyzed cohort, partial or total patellectomies were performed in 32 patients, representing one of the least utilized therapeutic methods compared with osteosynthesis and cerclage techniques. Among women, this method was used in 26 cases (19.7%), whereas among men it was performed in 6 cases (10.91%), reflecting the current tendency toward patellar preservation even in complex fractures [28].

Restoration of the extensor mechanism was identified as one of the most important prognostic factors influencing postoperative evolution and functional recovery. Insufficient reduction or persistent articular incongruence may contribute to chronic anterior knee pain, extensor deficit, reduced mobility, and accelerated degenerative changes of the patellofemoral joint. In this context, surgical stabilization methods were frequently applied to restore the biomechanical continuity of the extensor mechanism. The cerclage technique was used in 64 patients, representing the most frequently applied surgical method, with a prevalence of 31.06% among women and 41.82% among men. Osteosynthesis using the tension band wiring technique was performed in 43 patients, accounting for 24.24% of women and 20% of men.

Postoperative rehabilitation also played a major role in functional recovery. Early controlled mobilization, muscle strengthening, and restoration of knee range of motion were essential in preventing joint stiffness and improving long-term outcomes. Patients treated conservatively with femorotibial immobilization in a plaster cast—a method used in 48 patients, including 33 women (25%) and 15 men (27.27%)—more frequently experienced prolonged recovery periods and an increased tendency toward limited mobility compared with patients who underwent early postoperative mobilization.

Overall, the findings of the present study support the importance of individualized treatment selection based on fracture characteristics and biomechanical considerations, while also emphasizing the necessity of appropriate rehabilitation protocols following both conservative and surgical treatment [29].

4.3. Immediate and late complications associated with patellar fractures.

The analysis of complications performed in the present study demonstrated that patellar fractures may be associated with both immediate and long-term complications capable of significantly influencing functional outcomes and quality of life.

Immediate complications identified during hospitalization and early postoperative evolution included local infection, hematoma formation, postoperative pain, wound complications, and secondary displacement of fracture fragments. These complications were observed more frequently among surgically treated patients, particularly in cases involving complex fracture morphology and extensive soft tissue trauma [28].

Although operative stabilization offers superior anatomical reconstruction and earlier mobilization, surgical treatment inherently carries additional risks associated with implant placement, tissue dissection, and postoperative wound healing. The presence of fixation materials may additionally contribute to local irritation, discomfort, and the necessity for secondary surgical procedures in selected patients [29].

Late complications represented an important aspect of the post-traumatic evolution observed in the study group analyzed. Chronic anterior knee pain was one of the most frequently encountered long-term complications and appeared to be associated with residual patellofemoral incongruence, cartilage degeneration, and persistent biomechanical alterations of the extensor mechanism.

Joint stiffness and limitation of knee mobility were also identified in a considerable number of patients, particularly among individuals requiring prolonged immobilization or presenting delayed postoperative rehabilitation. These findings underline the importance of early mobilization and structured physiotherapeutic recovery protocols following fracture stabilization [29,30].

Post-traumatic osteoarthritis represented another clinically significant late complication identified during follow-up evaluation. Degenerative changes affecting the patellofemoral joint may develop progressively following intra-articular fractures, especially in cases with imperfect anatomical reduction or residual articular incongruence. The risk of degenerative evolution appears to increase proportionally with fracture severity and cartilage involvement.

The study additionally demonstrated that comminuted and multifragmentary fractures were associated with a higher incidence of complications and less favorable functional outcomes compared to stable fracture patterns. This observation supports previous literature indicating that fracturing complexity remains one of the main prognostic factors influencing postoperative evolution.

Delayed consolidation, pseudarthrosis, extensor weakness, and persistent gait abnormalities were less frequently observed but represented severe complications capable of producing prolonged disability and reduced functional independence.

The findings of the present study emphasize the necessity of accurate fracture reduction, stable fixation, appropriate postoperative rehabilitation, and long-term clinical monitoring in order to reduce complication rates and improve functional recovery following patellar fractures [31].

4.4. Comparison with previous studies and current orthopedic concepts

The findings of the present study are generally consistent with data reported in contemporary orthopedic literature regarding the epidemiological distribution, therapeutic management, and postoperative evolution of patellar fractures. Similar studies have demonstrated that patellar fractures occur more frequently among active adult males and are commonly associated with direct high-energy trauma affecting the anterior aspect of the knee. Although previous studies reported a predominance among

active adult males, our cohort showed a predominance of female patients (70.6%), likely related to the higher frequency of domestic and pathological fractures.

The predominance of transverse and comminuted fractures identified in the analyzed study group corresponds to observations reported in previous clinical studies, where direct trauma and road traffic accidents represented the leading traumatic mechanisms associated with patellar injury. The increased frequency of complex fracture patterns among younger and professionally active patients has likewise been described in multiple orthopedic series evaluating traumatic knee injuries [28,30].

The therapeutic principles observed throughout the present study also align with modern orthopedic concepts emphasizing preservation of the patella whenever possible. Historically, total patellectomy represented a relatively common therapeutic option for severely comminuted fractures; however, long-term functional studies demonstrated that complete removal of the patella leads to decreased quadriceps efficiency, altered biomechanics of the extensor mechanism, and significant functional impairment.

Current orthopedic practice therefore favors anatomical reconstruction and stable osteosynthesis in order to preserve patellar function and maintain normal patellofemoral biomechanics. The results obtained in the present study support this therapeutic tendency, as surgically treated patients generally demonstrated improved restoration of anatomical congruence and extensor mechanism continuity compared to cases with residual displacement or inadequate fracture reduction.

The importance of early mobilization following fracture stabilization is another concept strongly supported both by literature and by the findings of the present study. Prolonged immobilization has been associated with increased risk of joint stiffness, muscular atrophy, reduced mobility, and delayed functional recovery. Consequently, modern rehabilitation protocols recommend controlled early mobilization whenever fracture stability permits.

From a rehabilitation perspective, the findings of the present study further emphasize that successful recovery following patellar fractures depends not only on fracture healing and surgical stabilization but also on the restoration of knee function. Structured physiotherapy programs focused on improving range of motion, quadriceps strength, extensor mechanism performance, and gait rehabilitation play a crucial role in achieving favorable functional outcomes. Patients presenting displaced and multifragmentary fractures may require prolonged rehabilitation and closer functional monitoring due to the increased risk of mobility limitations and delayed recovery.

Several published studies additionally reported that postoperative complications remain relatively frequent in patellar fractures despite advances in surgical techniques and fixation materials. Chronic anterior knee pain, hardware irritation, joint stiffness, and post-traumatic osteoarthritis continue to represent major causes of long-term morbidity following patellar injury. The present study confirms these observations, particularly in patients presenting severe fracture comminution and articular involvement [29,30].

Another important aspect highlighted by current orthopedic research concerns the relationship between anatomical reduction quality and long-term functional outcome. Residual articular incongruence and imperfect reduction may contribute significantly to patellofemoral degeneration and persistent pain syndrome. The findings of the present study further support the necessity of achieving accurate reduction and stable fixation in order to minimize long-term complications.

Overall, the results are in agreement with current orthopedic literature and reinforce the importance of individualized therapeutic management, biomechanical restoration, and structured rehabilitation protocols in the treatment of patellar fractures [31].

4.5. Study limitations

Several limitations of the present study should be acknowledged when interpreting the results and conclusions obtained.

The retrospective design of the study represents one of the principal limitations, as the analysis relied primarily on previously recorded medical documentation, hospitalization records, imaging investigations, and operative reports. Consequently, the accuracy and completeness of the analyzed data depended on the quality of the available clinical documentation.

Another important limitation concerns the relatively limited number of analyzed patients compared to larger multicenter orthopedic studies. Although the study provided valuable epidemiological and therapeutic observations regarding patellar fractures, a larger sample size could have allowed more extensive statistical analysis and stronger correlations between fracture morphology, treatment modality, and postoperative evolution.

The absence of long-term standardized functional assessment scales additionally limited the possibility of objectively quantifying postoperative recovery and quality-of-life outcomes. Parameters such as pain intensity, knee function scores, patient satisfaction, and return to professional activity were not systematically evaluated throughout the follow-up period.

The heterogeneity of fracture patterns and therapeutic approaches also represents a potential limitation. Patients included in the study presented variable fracture severity, associated traumatic lesions, and different rehabilitation protocols, factors that may influence postoperative evolution and complicate direct comparison between treatment groups.

Furthermore, the duration of postoperative follow-up varied between patients, potentially influencing the detection and evaluation of late complications such as osteoarthritis, chronic anterior knee pain, and extensor mechanism dysfunction. Certain late degenerative changes may require prolonged follow-up periods in order to be accurately identified and evaluated.

The study additionally did not include advanced imaging techniques or objective biomechanical evaluation methods capable of providing more precise assessment of patellofemoral congruence and postoperative functional recovery. Modern methods such as computerized gait analysis, isokinetic muscle testing, or advanced magnetic resonance imaging evaluation could provide additional information regarding long-term biomechanical outcomes following patellar fractures.

Despite these limitations, the present study offers clinically relevant information regarding the epidemiological characteristics, therapeutic management, and complication profile associated with patellar fractures encountered in routine orthopedic practice.

4.6. Future perspectives

The results of the present study emphasize the importance of accurate diagnosis, individualized therapeutic management, and early rehabilitation in patients presenting with patellar fractures. Due to the essential biomechanical role of the patella within the extensor mechanism of the knee, inadequate treatment may result in prolonged disability, persistent pain, and significant functional impairment.

One of the principal clinical implications highlighted by the study concerns the necessity of preserving the patella whenever possible through stable osteosynthesis and anatomical reconstruction. Restoration of patellofemoral congruence and extensor mechanism continuity remains fundamental for maintaining normal knee biomechanics and reducing the risk of long-term degenerative complications.

The findings additionally support the importance of early postoperative mobilization and structured rehabilitation protocols. Functional recovery following patellar fractures depends not only on fracture consolidation but also on restoration of muscular strength, joint mobility, and gait stability. Delayed rehabilitation may contribute significantly to joint stiffness, muscular atrophy, and prolonged functional limitations.

The relatively high frequency of postoperative complications identified in the study underlines the necessity of careful long-term monitoring in these patients. Chronic anterior knee pain, post-traumatic osteoarthritis, and extensor mechanism dysfunction continue to represent important causes of morbidity even after technically successful treatment.

Future research directions should focus on prospective multicenter studies involving larger patient populations and standardized postoperative functional evaluation protocols. Comparative studies evaluating different osteosynthesis techniques and rehabilitation strategies may contribute to optimization of therapeutic management and improvement of long-term outcomes.

The development of modern fixation systems and minimally invasive surgical techniques may additionally improve fracture stabilization while reducing soft tissue trauma and postoperative complications. Advances in biomaterials and implant design could potentially decrease hardware-related irritation and improve postoperative comfort.

Another important future perspective involves the integration of objective biomechanical assessment methods into postoperative evaluation protocols. Computerized gait analysis, muscle performance testing, and advanced imaging techniques may provide more precise information regarding functional recovery and long-term biomechanical adaptation following patellar fractures.

Finally, preventive strategies aimed at reducing traumatic knee injuries, particularly those associated with road traffic accidents and occupational trauma, remain essential for decreasing the incidence and socioeconomic impact of patellar fractures within active adult populations.

5. Conclusions

Patellar fractures represent an important traumatic pathology of the knee joint due to the essential biomechanical role of the patella within the extensor mechanism. Although less frequent compared to other lower limb fractures, these injuries may produce significant functional impairment, prolonged rehabilitation, and long-term complications affecting knee mobility and quality of life.

The present study demonstrated that patellar fractures occurred predominantly among female patients (70.6%) and were most frequently associated with road traffic and domestic accidents. High-energy traumatic mechanisms were commonly correlated with displaced and comminuted fracture patterns requiring surgical stabilization.

The radiological morphology of the fracture represented one of the principal factors influencing therapeutic management and postoperative evolution. Stable fractures without significant displacement were generally treated conservatively with satisfactory outcomes, whereas displaced and multifragmentary lesions frequently required surgical treatment in order to restore anatomical congruence and preserve extensor mechanism functionality.

The results of the study support current orthopedic principles favoring preservation of the patella through stable osteosynthesis whenever possible. Anatomical reduction and restoration of patellofemoral congruence were associated with improved functional recovery and reduced risk of long-term biomechanical impairment.

Postoperative rehabilitation played an essential role in restoring knee mobility, muscular strength, and functional independence. Early controlled mobilization and individualized physiotherapeutic protocols contributed significantly to reducing joint stiffness and improving postoperative outcomes.

Immediate and late complications remained relatively frequent, particularly in patients presenting complex fracture morphology and severe articular involvement. Chronic anterior knee pain, limitation of mobility, extensor mechanism dysfunction, and post-traumatic osteoarthritis represented the most important factors negatively influencing long-term functional recovery.

The findings of the present study emphasize the importance of early diagnosis, accurate radiological evaluation, individualized therapeutic planning, stable fracture fixation, and structured rehabilitation in the management of patellar fractures. Beyond fracture healing, successful functional outcomes depend on the restoration of knee mobility, extensor mechanism strength, and the patient's ability to safely return to daily and occupational activities.

Further prospective studies involving larger patient populations and standardized functional evaluation protocols are necessary in order to optimize therapeutic strategies and improve long-term clinical outcomes in patients diagnosed with patellar fractures.

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