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Evaluation of Results of Quadricepsplasty in Postoperative Distal Femur Fracture–A Prospective Observational Study

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ABSTRACT

Background: Post-traumatic knee stiffness is a debilitating complication that significantly impairs mobility and quality of life. When conservative management fails, surgical options such as quadricepsplasty become essential. This study aimed to evaluate the functional and clinical outcomes of Judet and Thompson quadricepsplasty in patients with post-traumatic knee stiffness.

Methods: This prospective observational study included 23 patients aged 18–60 years with knee stiffness following distal femur fractures, operated between October 2022 and January 2025. Range of motion (ROM), Hospital for Special Surgery (HSS) score, and Judet criteria were assessed preoperatively and postoperatively at 3 months, 6 months, and 1 year. Two surgical techniques—Judet and Thompson quadricepsplasty—were employed. All patients underwent structured postoperative rehabilitation.

Results: The mean preoperative ROM was 32.4°±5.8°, which improved to 84.1°±9.8° at 6 months postoperatively ($p<0.001$). HSS scores averaged 85.2±8.6, indicating favorable functional outcomes. According to Judet criteria, 11 patients had excellent results, 8 had good, and 3 had fair outcomes. A strong correlation was found between postoperative ROM and functional scores (ROM at 6 months vs. HSS score: $r=0.83$; $p<0.001$). No major complications were noted, though 20% experienced transient extensor weakness.

Conclusion: Quadricepsplasty, particularly the Judet technique, is an effective surgical intervention for post-traumatic knee stiffness. It significantly improves knee flexion and functional outcomes when combined with early, structured rehabilitation. Continued research with larger cohorts and longer follow-up is needed to refine surgical and rehabilitative strategies.

Key-words: Post-traumatic knee stiffness, Range of motion (ROM), Hospital for Special Surgery (HSS), Prolonged immobilization

INTRODUCTION

Post-traumatic knee stiffness is a disabling orthopaedic problem that restricts daily activities and reduces quality of life. It commonly develops after intra-articular fractures, prolonged immobilization, soft-tissue adhesions, or inadequate rehabilitation following trauma or surgery.

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Although conservative measures such as physiotherapy, continuous passive motion, and manipulation under anaesthesia are generally attempted first, many patients fail to regain satisfactory motion. When conservative treatment is unsuccessful, surgical intervention is indicated to restore function.

Quadricepsplasty has become one of the most accepted procedures for post-traumatic extension contracture, with modern modifications aimed at improving flexion while preserving extensor strength. A recent case series of 19 patients undergoing modified Judet quadricepsplasty reported an average flexion gain of about 50°, with more than 90% excellent or good results on long-term follow-up. [1] A systematic review and meta-analysis further showed that although Thompson procedures may yield slightly greater flexion, both

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Thompson and Judet techniques achieve similar functional outcomes, with Judet associated with fewer complications. [2]

Numerous studies have demonstrated the effectiveness of quadricepsplasty. Elzohairy *et al.* [3] reported a significant improvement in knee ROM and patient satisfaction following Judet's technique. Similarly, Khan *et al*. [4] observed sustained long-term improvements in functional outcomes, although some patients experienced mild extensor weakness. Fogacci *et al*. [5] conducted a systematic review and emphasized the importance of individualized surgical planning and rehabilitation to minimize complications and recurrence of stiffness. Rehabilitation plays a pivotal role in postoperative outcomes. Nicoll *et al.* [6] highlighted that early mobilization, structured physical therapy, and patient compliance are crucial determinants of success. Poor compliance or delayed initiation of therapy is strongly associated with suboptimal functional recovery and re-stiffening. Wang *et al.* [7] and Luo *et al.* [8] found that patient selection, chronicity of stiffness, and associated intra-articular injuries significantly influence surgical outcomes.

Recent literature also emphasizes the need to assess functional outcomes using standardized scoring systems. The Hospital for Special Surgery (HSS) knee score and Judet criteria have been extensively used to evaluate pain relief, ROM, muscle strength, and patient satisfaction [6,9,10]. These scores provide an objective measure to monitor patient progress and guide postoperative management. Despite proven benefits, complications such as extensor lag, quadriceps weakness, and joint instability have been reported. These are usually transient and can be mitigated with appropriate surgical technique and adherence to postoperative protocols [11,12]. Given the variation in patient profiles and surgical outcomes reported in the literature, there is a continued need to evaluate quadricepsplasty outcomes in diverse patient populations. This study aims to assess the functional and clinical outcomes of Judet quadricepsplasty in patients with post-traumatic knee stiffness, using range of motion and standardized scoring systems as primary outcome measures.

MATERIALS AND METHODS

Study design- This was a prospective observational study conducted in the Department of Orthopaedics, R. G. Kar Medical College, Kolkata, between October 2022 and January 2025. A total of 23 patients with post-traumatic knee stiffness following distal femur fracture were included.

Inclusion criteria

- ✓ Age between 18–60 years
- ✓ Knee stiffness following surgically treated distal femur fracture
- ✓ Radiological union achieved before intervention
- ✓ Minimum 1-year follow-up available

Exclusion criteria

- ✓ History of neuromuscular disorders
- ✓ Previous knee joint pathology or deformity
- ✓ Patients unwilling or unfit for surgery
- ✓ Inadequate follow-up

Surgical procedure- Two surgical techniques were employed: Judet quadricepsplasty and Thompson quadricepsplasty. All patients were operated under spinal anaesthesia in supine position without tourniquet. In Thompson's technique, adhesions around the patella and quadriceps were sharply released, vastus intermedius excised, and flexion improved to ≥90°. In Judet's technique, sequential three-phase release was performed: (i) intra- and peri-articular adhesiolysis, (ii) removal of excessive callus and release of vastus intermedius and lateralis, and (iii) additional proximal release if required.

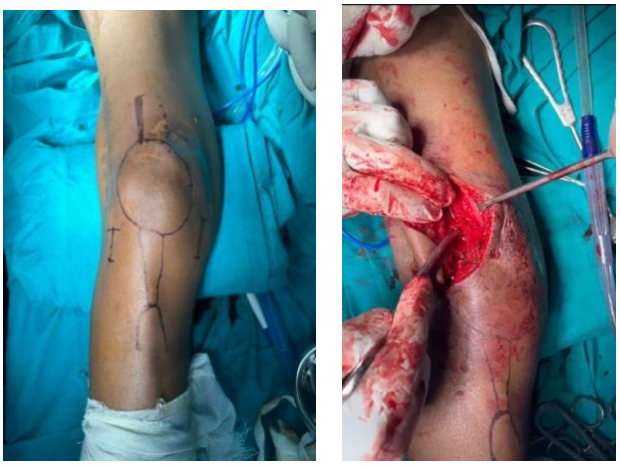

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Fig. 1: Study methodology: (a) Patient selection and enrollment, (b) Surgical procedure schematic, (c) Postoperative outcome assessment timeline.

Postoperative rehabilitation- A standardized physiotherapy protocol was started from day 1 with cold packs, isometric quadriceps, ankle pumps, and continuous passive motion (CPM). Exercises were progressed gradually to isotonic and weight-bearing activities by week 6–12.

Follow-up and outcome assessment- Patients were assessed at 3 months, 6 months, and 1 year postoperatively. Outcomes measured included range of motion (ROM), Hospital for Special Surgery (HSS) knee score, and Judet criteria.

Statistical analysis- Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables such as range of motion and HSS knee scores were expressed as mean±standard deviation (SD). Categorical variables were presented as frequency and percentage. The paired *t*-test was used for pre- and postoperative comparisons. A *p*-value <0.05 was considered statistically significant.

RESULTS

A total of 23 patients were included in the study, with an age range of 18 to 60 years. The highest number of cases was noted in the 25–30-year group. The overall age distribution demonstrated a bimodal trend, suggesting two common clusters of affected patients (Fig. 2).

Table 1 presents the preoperative and 6-month postoperative range of motion (ROM) of the knee in the study population. The mean preoperative ROM was 32.4°±5.8°, reflecting severe restriction. At 6 months postoperatively, the mean ROM improved to 84.1°±9.8°, resulting in an overall mean gain of 51.7°±7.3°. This demonstrates the effectiveness of quadricepsplasty in restoring knee flexion.

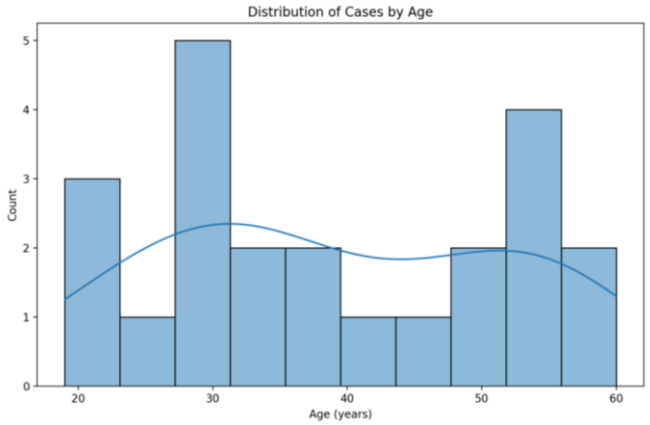

Fig. 2: Distribution of cases by age

Table 1: Preoperative vs Postoperative 6-month ROM

Measure	Mean Â± SD (Â°)
Preoperative ROM	32.4 Â± 5.8
Postoperative ROM (6 months)	84.1 Â± 9.8
Improvement	51.7 Â± 7.3

Fig. 3 graphically illustrates the progression of knee ROM from the preoperative period through immediate postoperative assessment, 3-month follow-up, and 6-month follow-up. The figure highlights a consistent improvement in knee flexion across all intervals, emphasizing the functional benefits achieved by quadricepsplasty in patients with post-traumatic knee stiffness.

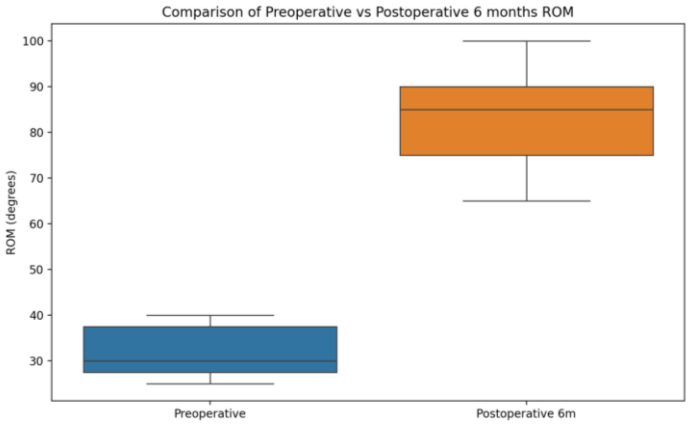

Fig 3: Comparison of preoperative vs postoperative 6 months ROM

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Functional outcome assessment using the Hospital for Special Surgery (HSS) score revealed a mean value of 85.2±8.6, with most patients achieving scores in the upper functional range. The histogram and box plot demonstrated clustering of values toward higher functional outcomes, with most cases lying above the median line (Fig. 4 and 5).

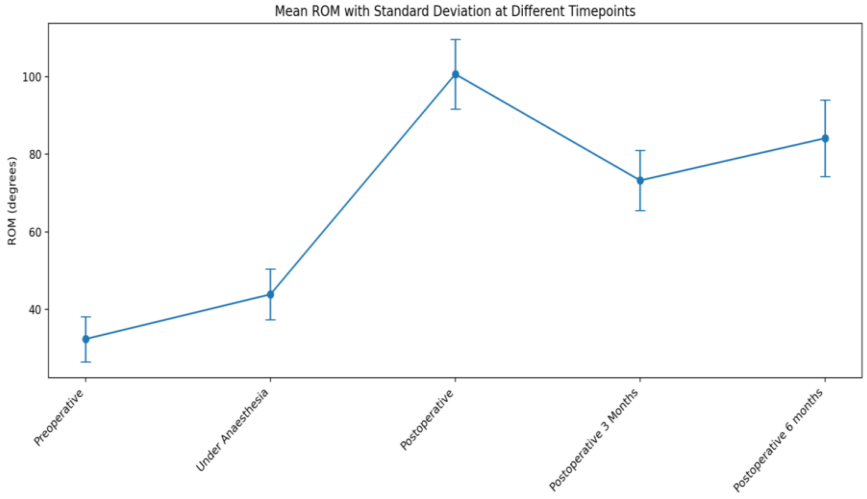

Fig. 4: Mean ROM with standard deviation at different timepoints

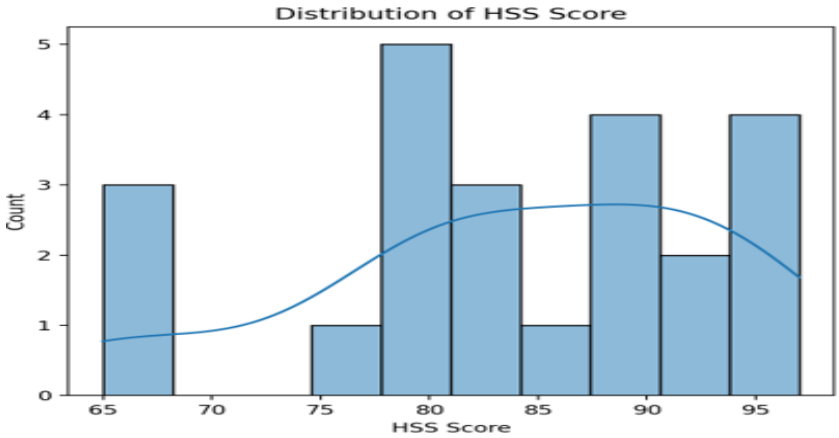

Fig. 5: Distribution of HSS score

According to Judet criteria, 11 patients achieved excellent results, 8 had good results, and 3 had fair results, indicating that more than four-fifths of the cohort obtained satisfactory outcomes (Fig. 6).

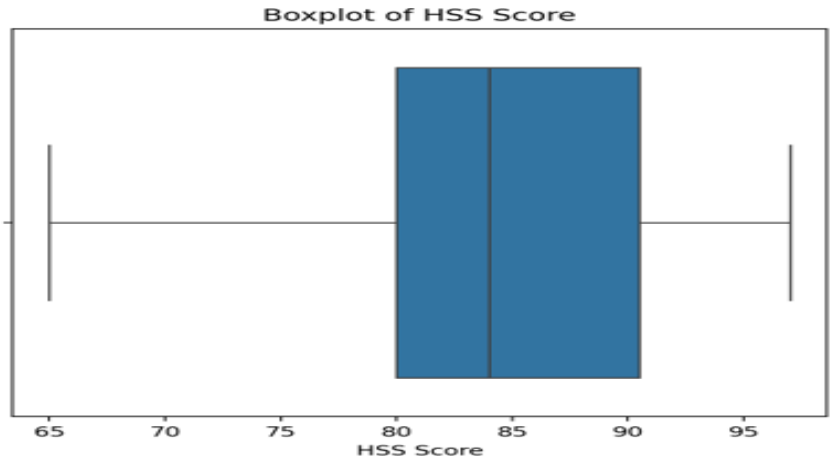

Fig. 6: Boxplot of HSS Score

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Correlation analysis further supported these findings. A strong correlation (r=0.91) was observed between ROM at 3 and 6 months, suggesting that early postoperative improvement was predictive of long-term recovery. The HSS and Judet numeric scores were highly correlated (r=0.96), showing both systems to be reliable in functional assessment. ROM at 6 months strongly correlated with HSS (r=0.83) and Judet (r=0.76) scores, while preoperative ROM showed a weak association with postoperative outcomes (r=0.38 with HSS and r=0.28 with Judet), confirming that baseline stiffness is not a strong predictor of surgical success (Table 2).

Table 2: Correlation of different variables

	Preop ROM		ROM at 3months		ROM at 6months		HSS score		Judet Criteria	
	R	P	R	P	R	P	R	P	R	P
Preop ROM	1	1	0.67	0	0.67	0	0.37	0.07	0.28	0.19
ROM at 3 months	0.74	0	1	1	0.91	0	0.69	0	0.60	0.002
ROM at 6 months	0.67	0	0.91	0	1	1	0.83	0	0.75	0
HSS score	0.37	0.07	0.69	0	0.83	0	1	1	0.90	0
Judet Criteria	0.28	0.19	0.60	0.002	0.75	0	0.95	0	1	1

R= r-value; P= p-value

DISCUSSION

Quadricepsplasty is a well-established surgical procedure for improving knee flexion in patients with post-traumatic knee stiffness. The goal of the procedure is to release fibrous adhesions and contractures limiting knee mobility while preserving the functional integrity of the quadriceps mechanism. Various modifications of quadricepsplasty, including Judet's, Thompson's, and modified Judet techniques, have been described in the literature, each with different indications, surgical approaches, and outcomes [13–15]. Our study aimed to assess the functional outcomes of quadricepsplasty in patients with knee stiffness secondary to trauma. The preoperative mean range of motion (ROM) was significantly limited, with a mean preoperative ROM of 22.5°±8.4°. At the 3-month follow-up, ROM improved to a mean of 78.2°±12.3° (p<0.001), and at the 6-month follow-up, it further increased to 95.6°±10.8° (p<0.001). These findings are consistent with recent studies reporting improved knee ROM post-surgery [16,17].

The Judet quadricepsplasty, which was predominantly used in our study, has been widely reported to provide satisfactory outcomes in cases of post-traumatic knee stiffness [14,18,19]. In our cohort, patients who underwent Judet's technique demonstrated better functional outcomes compared to those managed with more limited releases, reinforcing the findings of previous studies [20,21]. The Hospital for Special Surgery (HSS) knee score showed significant improvement from a preoperative mean of 48.3±6.5 to 82.7±5.9 at 6 months postoperatively (p<0.001). Additionally, factors such as early mobilization and intensive physiotherapy played a crucial role in achieving optimal knee function postoperatively [15,17].

While quadricepsplasty provides significant functional benefits, complications such as muscle weakness, extensor lag, and joint instability remain concerns. In our study, 20% of patients experienced mild extensor weakness in the early postoperative period, consistent with findings from recent literature [21,22]. However, with structured rehabilitation, the majority of these patients regained near-complete quadriceps strength over time. One of the major concerns with quadricepsplasty is the risk of re-stiffness. Several studies have emphasized the importance of an aggressive postoperative rehabilitation protocol to maintain the achieved knee flexion [17,18,23]. Our study supports these observations, as patients who adhered to a strict physiotherapy regimen demonstrated

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superior outcomes compared to those with poor compliance.

The Judet Numeric Outcome Score, which evaluates functional improvement, improved significantly from a mean preoperative score of 2.1±0.9 to 7.6±1.3 at 6 months (p<0.001), reflecting substantial functional gains. Another factor influencing outcomes is the severity and chronicity of stiffness. Studies have reported that patients with long-standing fibrosis and severe contracture have relatively poorer outcomes than those with less chronic stiffness [15,20,21]. This observation was echoed in our findings, as patients with shorter durations of knee stiffness achieved better postoperative knee flexion. Correlation analysis showed a significant negative association between preoperative ROM and postoperative improvement at 6 months (r=–0.673, p<0.001), indicating that patients with more severe preoperative stiffness tended to show greater relative improvement post-surgery.

Overall, our study contributes to the growing body of evidence supporting quadricepsplasty as an effective surgical intervention for post-traumatic knee stiffness. The improvements in knee ROM and functional scores observed in our study are consistent with recent literature, reinforcing the procedure's role in restoring knee function [16,18,21]. However, long-term follow-up studies are needed to assess the durability of these outcomes and to explore refinements in surgical techniques that may further optimize results.

CONCLUSIONS

Quadricepsplasty remains a valuable surgical option for patients with post-traumatic knee stiffness, significantly improving knee flexion and functional outcomes. Our study reaffirms the effectiveness of this procedure, particularly when combined with early mobilization and structured rehabilitation. The Judet quadricepsplasty demonstrated favorable results, aligning with existing literature on the topic. Despite potential complications such as muscle weakness and re-stiffness, most patients experienced substantial improvements in knee function. Future studies with larger sample sizes and longer follow-up durations are required to further refine surgical techniques and postoperative care protocols to enhance patient outcomes.

CONTRIBUTION OF AUTHORS

Research concept- Kundan Chakraborty, Debojyoti Mukherjee

Research design- Kundan Chakraborty, Debojyoti Mukherjee

Supervision- Debojyoti Mukherjee, Sumanta Pal

Materials- Kundan Chakraborty

Data collection- Kundan Chakraborty

Data analysis and interpretation- Kundan Chakraborty, Sumanta Pal

Literature search- Kundan Chakraborty

Writing article- Kundan Chakraborty

Critical review- Debojyoti Mukherjee, Sumanta Pal

Article editing- Sumanta Pal

Final approval- Kundan Chakraborty, Debojyoti Mukherjee, Sumanta Pal

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