

ORIGINAL RESEARCH

Effective rehabilitation for a successful outcome in post-traumatic and post-surgical knee stiffness due to quadriceps contracture

¹Dr. Kandasamy Natesan, ²Dr. Makesh Ram Sriraghavan, ³Dr. Prabhu Aloy, ⁴Dr. Poornima Kumararaja

^{1,3}Assistant Professor, Department of Orthopaedics, Government Thoothukudi Medical College Hospital, Thoothukudi, Tamilnadu, India

²Associate Professor, Department of Orthopaedics, Government Thoothukudi Medical College Hospital, Thoothukudi, Tamilnadu, India

⁴Assistant Professor, Department of Pathology, ACS Medical College Hospital, Chennai, Tamilnadu, India

Corresponding Author

Dr. Kandasamy Natesan

Assistant Professor, Department of Orthopaedics, Government Thoothukudi Medical College Hospital, Thoothukudi, Tamilnadu, India

Email: akkshay999@gmail.com

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ABSTRACT

Background: Kneestiffness due to post-traumatic and post-surgical aetiology can either cause decrease or absence of knee range of movement due to injuries or surgery around/ adjacent to the knee areas. Before soft tissue release is performed, any bony impingements if present should be removed. Open quadriceps release alone or combined with anterior arthroscopic arthrolysis is usually performed to release the knee stiffness. Postoperative care like analgesia and effective rehabilitation is very essential to maintain the knee range of motion which is obtained preoperatively. Quadricepsplasty has complications like extension lag, persistence of stiffness and wound dehiscence. **Methodology:** This is a prospective study of 40 patients with knee stiffness operated for fractures around the thigh and knee region, admitted in the Department of Orthopaedics, Thoothukudi Medical College Hospital from August 1st 2015 to March 31st 2023. All the patients included in this study had no improvement in knee range of motion even after vigorous rehabilitation, when they were taken up for quadriceps release. **Results:** All cases were analyzed based on Judet criteria to assess the knee range of motion. Out of 40 patients, 30 had excellent, 7 had good, 2 had a fair and 1 had a poor functional outcome. **Conclusion:** Incidence of knee stiffness is on the rise due to increased surgical interventions of trauma around knee joint. Those cases with knee stiffness should be diagnosed at the earliest and they should be subjected to rehabilitation to improve the range of motion. In few patients with resistant knee stiffness which failed mobilization, require surgical release after fracture union to have a favorable outcome.

Key words: Knee stiffness, Extension lag, Rehabilitation, Quadriceps release

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INTRODUCTION

Knee stiffness or tightness is due to limitation or decrease in knee range of movement, which is usually encountered after any intra-articular or extra-articular injury or surgery to the knee area¹. It can be caused by either flexion contracture or an extension contracture and sometimes a combined one (both flexion and extension contractures) relative to the contra lateral side (if normal). There can be posterior adhesions in the thigh area with or without anterior impingement and anterior adhesions with or without posterior impingement respectively. This knee stiffness can also occur due to post-surgical causes like internal or

external fixation done for distal femur fractures, proximal tibia fractures, and few cases of healed septic arthritis knee and in few cases after knee arthroplasty.

The components of knee stiffness have two parts¹:

- A. Extra-articular part: Any kind of adhesions or contracture of the quadriceps muscle due to callus formed in femoral region, sometimes gets attached to the femoral aponeurosis or to the lateral intermuscular septum. It can result in retraction and fibrosis of the muscle further leading to formation of dense scar tissue.
- B. Intra-articular part: Mainly due to intra-articular malunion or unreduced fractures which can cause

bony impingement, poor tissue remodeling resulting in adhesions, excessive growth of fibrous scar tissue, and retraction of the peri-articular soft tissues.

There are bony and soft tissue causes or a combination of both which is responsible for blocking of the knee flexion. They are¹:

- A. Bony cause: Bony adhesions between the femoral condyles and the under surface of the patella.
- B. Soft tissue causes:
 1. Fibrosis and contracture of the vastus intermedius muscle which is present in the suprapatellar recess and the region above it, also along the deep surface of the rectus femoris tendon, or near the front of the femur.
 2. Actual shortening of the rectus femoris muscle component itself.
- C. Combination of bony and soft tissue cause: Shortening of vastus lateralis and their adhesions to the lateral aspect of the femur and callus that is adherent to quadriceps muscle.

AIM AND OBJECTIVE

To assess the functional outcome of post-traumatic and post-surgical knee stiffness treated with Quadricepsplasty. To increase the range of knee flexion and for the betterment of the patient, a quadricepsplasty² must be performed to relax the contracted quadriceps muscle.

METHODOLOGY

Study design: Prospective study

Study period: August 1st 2015 to March 31st 2023

Study population: Forty patients, admitted with Knee stiffness - operated in same hospital (17 cases) and also in other hospitals (23 cases)

Study center: Department of Orthopaedics, Government Thoothukudi Medical College Hospital, Tamilnadu, India

INCLUSION CRITERIA

- Age 18 to 64 years
- Knee stiffness following trauma/surgery around knee
- Knee flexion limitation < 90 degree
- Lacking underlying systemic disease
- Complete fracture union

EXCLUSION CRITERIA

- Positive H/O neuromuscular disorder
- Previous disorder of knee joint
- Patients with Complex Regional Pain Syndrome
- Stiffness following knee arthroplasty

ANALYSIS OF STIFFNESS

In this study, for patients with knee stiffness³, fracture should have united before quadriceps release is carried out, necessitating minimum of six months waiting period from any kind of fixation for the fractures sustained. However, it should be remembered

that even after six months, any forms of knee mobilization procedures will not produce any favorable outcome. In our case series⁴, we observed extensor lag only in one case in a patient who underwent V-Y plasty of quadriceps.

SURGICAL PROCEDURE

Patients were positioned supine - under regional anesthesia without using tourniquet,

Step 1: Anterior midline skin incision⁵ made extending from proximal one fourth of the thigh up to above the level of tibial tuberosity.

Step 2: Adhesions that were determined clinically and radiologically preoperatively and those that were encountered intraoperatively were the key field of surgical dissection. In all cases, intra-articular dense fibrotic band-like adhesions were noticed and they were released meticulously by sharp dissection. Extensor expansions of the knee were found fibrosed and were released on both sides of the patella.

Step 3: Vastus intermedius and rectus femoris were identified and divided slowly step by step, and extra- and intra-articular adhesions were also identified and released^{6,7}. In every case, the vastus intermedius was found fibrosed and so removed extraperiosteally. Any protruding bony spikes (due to malunion) were nibbled off, and the exposed bone was covered with fat graft if necessary.

Step 4: Vastus lateralis and vastus medialis were released up to proximal one third of the thigh.

Step 5: Now the knee was manipulated gently up to 90 degrees of flexion, at any cause excess force should not be given to get the knee flexion. We were able to get more than 120 degrees of knee flexion in 19 patients per operatively.

Step 6: Electric cautery was used throughout the surgery to achieve hemostasis and drains were placed to prevent hematoma formation (key element to avoid restiffness).

Step 7: The released retinaculum on either side of the patella was held in place with just a few loose stitches, and the knee was kept less than 90° flexion.

Step 8: After skin closure, knee range of motion should be less than 15° of flexion which was achieved before closure.

REHABILITATION PROGRAMME

Immediate postoperative period: Limb immobilized using a Bohler-Braun splint for 48-72 hours. Parenteral analgesics were given for the first three post-operative days and oral analgesics were continued for another two weeks. Continuous passive motion (CPM) was started on the first day after surgery, and the patient went from 0° to 60° flexion in the first week as pain tolerated.

In between, patients were advised for active assisted quadriceps exercises, particularly extension of the knee. Patients were taught all these exercises preoperatively so that they could perform these exercises better in the postoperative period with good

compliance. The CPM range was gradually increased until maximum possible flexion could be achieved within first two weeks of surgery.

Late postop period: Patients were kept non-weight bearing for two weeks, were discharged after achieving at least 90° flexion usually by 10 to 14 days after surgery. All of these patients were in periodic follow up for six weeks to undergo physiotherapy as outpatients.

Follow up period: For the next 2-3 months, patients were advised to increase the knee flexion and, along with isometric quadriceps and hamstring strengthening exercises. They were followed every 3rd week for the first three months and subsequently at six-monthly interval at minimum for a period of 3 years.

OUTCOME ASSESSMENT

The results were assessed according to Judet's criteria (based on knee flexion):

Excellent	final flexion > 100°
Good	flexion was between 80° to 100°
Fair	flexion was between 50° and 80°
Poor	flexion <50°

RESULTS

Forty patients were treated surgically and analyzed with an average follow up of three years and mean patient age was 42 years. We had cases of distal femur fractures, proximal tibial fractures and floating knee injuries (shown in table below).

S.no	Distribution of cases	Number of patients (n=40)
1	Distal femur fractures	
	Intraarticular fractures – 6 cases	Extra articular Fractures -18 cases
2	Proximal tibia fractures	
	Intraarticular fractures – 5 cases	Extra articular Fractures -1 case
3	Floating knee injuries	
Total		40

The average range of flexion before surgery was 21° (the range was 5° to 45°). The range of intra-operative flexion was 90° to 120° (with an average of 102° flexion) in all but one case, we encountered an undisplaced distal femur fracture during surgery (later it went on to heal well but the fracture was protected in splint for six weeks). One of the patients who had V-Y plasty of rectus femoris, developed extensor lag. After at least three years of follow-up, 30 patients had excellent outcome, 7 patients had good outcome, 2 patients had fair outcome, and 1 patient had poor outcome. The average loss of flexion in the postoperative period was 11° of what was achieved during surgery.

COMPLICATIONS

Early: Superficial wound infection and dehiscence were observed in two cases, it continued to heal well in one case with good range of knee motion, but in another case even though the skin flap healed, the patient had knee stiffness same as presurgery level.

Late: There was extensor lag (of 12 degrees) in one case but it did not affect the activities of daily living.

DISCUSSION

Post-traumatic knee stiffness requires an accurate assessment and early intervention. Knee flexion of upto 90 -110 degrees is necessary for most of the patients for their day to day activities (customary and

religious purpose). A 6 months wait seems reasonable before any release surgery is carried out in fracture cases; however, the final decision is made on case to case basis according to the clinical and imaging findings.

After 6 months, there is almost no role to do an isolated manipulation under anesthesia. In a well-planned surgery, open techniques can be used to treat the different causes of stiffness. Quadricepsplasty is the gold standard method to treat knee stiffness, but sometimes an anterior quadriceps adhesion release will improve knee range of motion and many patients may require sequential quadriceps release for better outcome. Nicoll and Thompson^{8,9} discussed about to fix femoral shaft fractures that leaves most of the quadriceps mechanism separate from the patella. Judet's treatment for quadriceps contracture involved separating the vastus lateralis and medialis from the entire length of the femur^{10,11}. V-Y Quadricepsplasty was combined with a defined soft tissue procedure to relieve the knee stiffness with satisfactory outcome¹². Controlling pain after surgery and starting rehabilitation right away is the key to success in quadricepsplasty. Also this rehabilitation protocol should be done daily and regularly, and a good follow-up with the operated surgeon till good range of motion of knee is obtained for a successful outcome. If possible, rectus femoris tendon lengthening had to

be avoided because it can cause loss of active extension^{13,14}.

We were able to compare our results with other studies as mentioned below:

Name of the study	No of cases	Favorable outcome	Complications
Judet et al ¹⁵ in 1959	53	85%	Secondary infection of hematoma, DVT
Nicoll et al ¹⁶ in 1963	30	83%	Skin necrosis , fracture in post op mobilization
Ali et al ¹⁷ in 2003	33	90%	Infection, Hematoma formation
Wang et al ¹⁸ in 2006	22	95.5%	Superficial wound infection, Extensor lag
Our Study in 2023	40	92.5%	Skin necrosis and dehiscence, extensor lag

CONCLUSION

Quadricepsplasty/release is the standard operative treatment for the patients with resistant post-traumatic and post-surgical knee stiffness, step by step release and periodic regular institutional rehabilitation is required for a successful outcome.

The successful outcome of Quadricepsplasty depends upon the effective diagnosis of knee stiffness, proper evaluation of knee stiffness, sensitizing the patient for rehabilitation even before surgery and meticulous surgical technique.

CASE ILLUSTRATION

CASE 1



Fig. 1 – shows united Mullers C2 distal femur fracture at 6 months after surgery



Fig. 2- shows 20° knee flexion at 8 months



Fig 3. – 105° peroperative knee flexion



Fig. 4 - 90° knee flexion in immediate postop



Fig 5. - 120° knee flexion at 3 months' after
Quadriceps release

CASE 2

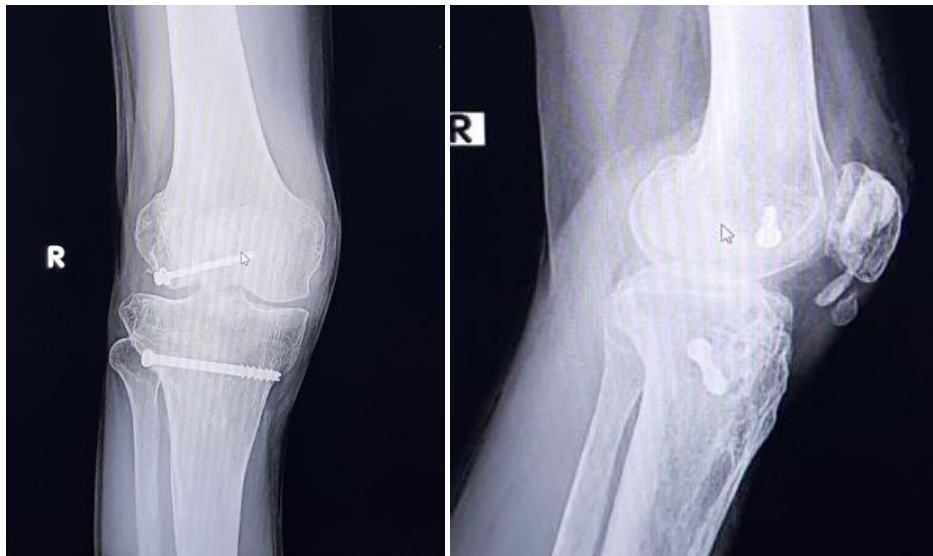


Fig. 6 – united lateral condyle femur and lateral tibial plateau



Fig. 7- shows 90° knee flexion under anaesthesia



Fig. 8 – peroperative knee flexion 110°



Fig. 9 - 100° knee flexion in immediate postop



Fig. 10 - 130° knee flexion at 4 months after Quadriceps release

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