



## Extra articular arthroscopic release in post-traumatic stiff knees : a prospective study of endoscopic quadriceps and patellar release

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Knee stiffness due to mismanaged trauma is still common in underdeveloped countries. Many patients with distal femoral fractures, patellar injuries or other local trauma present with intra-articular and extra-articular adhesions between the quadriceps and anterior femur. Nineteen knees with post trauma stiffness due to combined intra- and extra- articular aetiology were taken up for arthroscopic aided release after failing an aggressive physiotherapy protocol. Ultrasound was used to identify the extra-articular adhesions. The intra-articular part of the release was done by a standard protocol involving the release of all infrapatellar, suprapatellar and gutter adhesions, and then the extra-articular proximal adhesions were released by using special long periosteal elevators and arthroscopic scissors. We were able to release the adhesions as high as 9 inches above the patella, and in one case bony ankylosis between the patella and the femur was arthroscopically osteotomised (after 11 years of stiffness). Delay before surgery averaged 2.7 years (6 months-11.3 years). Mean active flexion at one year follow-up improved from 27.3° to 119.3° (average increase : 92°). Mean preoperative extension lag reduced from 6° to 1° postoperatively. No CPM machine was available, and patients had to undergo daily manual and assisted therapy, with appropriate analgesia. Overall patient satisfaction was excellent ; one patient developed a supracondylar fracture (infected old fracture with bone loss and severe contracture) and was retrospectively a wrong case selection. Arthroscopic aided quadriceps adhesion release is a good option in cases of neglected trauma ; results are excellent even without sophisticated CPM machines,

and the periosteal elevators needed are cheap and indigenous.

### INTRODUCTION

Severely restricted knee motion is a recognized complication of operative procedures or trauma around the knee. This is a significant problem in underdeveloped countries where the initial management of many of these injuries is suboptimal. The reported rate (3, 6, 10, 13) of significant knee stiffness after various injuries and procedures around the knee is as high as 11% in the western literature, but may be much higher in underdeveloped countries, where ideal management of trauma

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is not readily available (2). A large percentage of these cases present with adhesions inside as well as outside the knee, and the management of these cases then becomes complex.

The goal of treatment in a stiff knee is restoration of normal motion without inflicting additional damage on the joint or adjacent structures. Forced manipulation of an extensively scarred knee may cause indiscriminate tearing of intra-articular tissue, excessive tibiofemoral and patellofemoral compression with the risk of chondral damage or fracture, rupture of the patellar ligament and even femoral fracture. Manipulation may also initiate complex regional pain syndrome (7). Open operative procedures are extensive, with considerable risk of morbidity, and often necessitate post surgical immobilisation which negates the concept of early rehabilitation efforts. Problems include superficial and deep wound infection, septic arthritis, sloughing of skin postoperatively, and decreased muscular strength, with no gain in motion (1, 3, 5, 8, 9, 10, 15).

With the advent of arthroscopic aided procedures, the problem of knee fixed flexion deformity was increasingly addressed (11, 16); Conti (4) developed controlled distension and manipulation under general anaesthesia. Sprague *et al* (13) recommended percutaneous release of adhesions under arthroscopic visualisation. Steinfeld *et al* (14) reported the first case of a percutaneous quadricepsplasty in a stiff knee after open reduction and internal fixation of a distal femur fracture, demonstrating the utility of arthroscopic aided percutaneous techniques in treating both intra and extra-articular pathology. In 2001, Rodriguez Blanco *et al* (12) from Cuba, presented a new surgical subperiosteal endoscopic technique for the release of fibrosis of the quadriceps to the femur, using periosteal elevators and arthroscopic scissors placed through medial and lateral superior knee portals to release adhesions and bands of scar tissue beneath the quadriceps mechanism.

At our Center, we routinely encountered cases with stiff knees which occurred after improperly managed trauma, and we identified cases with stiffness due to predominantly extra-articular causes. The previously reported technique was employed

by the first author (MSD) to do arthroscopically assisted intra articular release along with endoscopic quadricepsplasty; the results of our experience are presented.

## MATERIAL AND METHODS

The present prospective study was done in cases of posttraumatic or postoperative stiff knees which presented in the Departments of Orthopaedic Surgery, PGIMER, Chandigarh, India and Apollo Hospitals Colombo, Sri Lanka.

The study group consisted of 19 patients, all of whom had stiffness after trauma, and had failed a controlled non-operative regimen for a period of 3 months despite an intensive physiotherapy program. Preoperative clinical assessment, combined with ultrasound was used to confirm the quadriceps fibrotic adhesions to the femur. Patients with any of the following were excluded from the study: obvious frank joint instability, pathological ligamentous laxity, neurovascular injuries, deformities at hip and ankle and frank infections.

### Surgical technique

With the patient supine, spinal or epidural anaesthesia with tourniquet was used, without a standard leg holder to allow knee flexion and extra leg movements. By standard arthroscopic techniques, using the anterolateral portal for the telescope and the anteromedial portal for instruments the knee joint was inspected; often adequate distension was not achieved and gradual release of adhesions created space and allowed better visibility. Additional medial and lateral suprapatellar (and infrapatellar) portals were used for joint access, if adhesions caused a problem.

The intra-articular portion of the procedure included routine arthroscopic assessment and management of any existing intra-articular pathology. Arthroscopic lysis of adhesions was started in the infrapatellar area, extending into medial and lateral gutters, and then into the suprapatellar pouch till the patella was free. Determination was now made of the motion obtained by intra-articular release of adhesions. The extra-articular procedure was now started through the medial and lateral suprapatellar portals for access with the arthroscope and instrumentation in alternating manner. The superior aspect of the suprapatellar pouch was perforated with specially made long periosteal elevators and gradual subperiosteal release of adhesions was carried out on the medial, anterior and lateral femur, from distal to proximal. The fluid

pressure was minimized as much as possible to avoid excessive fluid extravasation, and gentle manipulation into knee flexion was carried out periodically to assess remaining adhesions. Any fibrous bands or scars connecting the anterior femur to the quadriceps mechanism were released using arthroscopic scissors or arthroscopic knives. Releases were continued until maximum flexion was attained or until the remaining limitation of motion was determined to be due to intrinsic contracture of the quadriceps – muscle tendon unit.

If the adhesions were deemed to be very high, percutaneous elevation of the quadriceps was carried out as a blind procedure using multiple stab incisions on the lateral thigh. The portals were closed over double suction drains.

### Post operative protocol

Immediate cryotherapy with ice-packs was started in the recovery room ; isometric exercises and active knee flexion were initiated as soon as possible after anaesthesia. Postoperative ambulation was encouraged with active assisted exercises being started within 48 hours of surgery. Special physiotherapy attention was paid to these patients 2 times a day for the first week. Resistive quadriceps exercises were started at one week postoperatively, and aggressive physical therapy was continued until maximum improvement was achieved.

### Data analysis

Range of flexion and any extension lag of the knee joint was measured preoperatively and postoperatively ; comparison of preoperative and postoperative values were done to see the effect of arthroscopic adhesion release and arthroscopic aided quadricepsplasty. Follow-up was done at 6 weeks, 6 months and finally 1 year after surgery, to calculate the degree of correction achieved, and whether the flexion achieved at surgery was maintained.

Subjective assessment of swelling, pain and walking ability was done on each visit. Objective assessment included range of flexion charting by using a hand held goniometer, assessment of extensor lag, knee effusion, as well as quadriceps and hamstring strength.

## RESULTS

Our study cohort consisted of 19 cases, with 4 females and 15 males. The age range of our patients was 22-60 years, with 13 cases being less

than 30 years of age. The causative factors were as follows : open distal femur fracture in 5, closed distal femur fracture in 4, open shaft of femur fracture in 4, open patellar fracture in 4 and proximal tibial fracture with ipsilateral injuries in 2. Seven cases had more than one injury around the knee. Various treatment modalities had been employed for treatment, ranging from external fixator in 9, ORIF with nails or plates or Rush nails in 5, tension band wiring of patella in 3 and patellectomy in 2. POP cast had been used as supplemental immobilisation in 8 cases. The period of knee immobilisation was more than 6 months in 12 cases, with no case having less than 2 months of postoperative immobilisation. All were thus labelled as having had improper rehabilitation in the postoperative period.

The interval between the injury/surgery and arthroscopic aided release was less than 2 years in 15 cases, and more than 2 years in 4 knees. Decreased patellofemoral glide was found in all, with additional wound or pin scars in the distal quadriceps in 14 cases. Ultrasound revealed adhesions in both intra as well as extra-articular sites in 13 cases, limited only to the area above the suprapatellar pouch in 4 cases, and only intra-articular adhesions in 2 cases, with one of these (of 11 years standing) having fusion of the patella to the anterior femur.

Arthroscopic findings correlated well with the ultrasound findings in all except one case which on ultrasound was labelled as only intra-articular adhesions, but at surgery, scar tissue had to be removed from areas proximal to the supra patellar pouch.

The mean preoperative extension lag/fixed flexion deformity was  $6^\circ$ , which improved to an average of  $1^\circ$  postoperatively ; one patient with patellar fusion to the femur and his knee fixed in  $15^\circ$  of flexion had worsening of the extension lag to  $20^\circ$  initially before recovering to  $5^\circ$  at 5 months.

The mean preoperative range of motion was  $27.33^\circ$ , which increased to  $119.33^\circ$ . Fourteen patients gained more than  $100^\circ$  of flexion (fig 1) ; patients with greater degrees of preoperative flexion, as well as those with more distal adhesions attained more knee flexion. Four cases needed manipulation under sedation/short GA within 2 weeks to regain the knee flexion achieved at



**Fig. 1.** — a, b) Radiographs (AP and lateral view) of a stiff knee with 2 Rush nails and screws in situ ; c) Clinical photograph showing preoperative range of active flexion ; d, e) Radiographs (AP and lateral view) of same case after Rush nail removal and arthroscopic quadriceps release ; f, g) Clinical photo showing post-operative extension and range of active flexion.

surgery, as they were not fully compliant with the aggressive physiotherapy protocol used by us. All patients had some degree of pain up to 2 months post arthroscopy, and at 6 months follow-up only 2 patients had residual pain. The average period of hospitalisation was 4 days postoperatively, after which all cases except one were discharged into outpatient physiotherapy.

One case with significant soft tissue adhesions and patellofemoral ankylosis needed osteotomy of the patellofemoral joint with an osteotome through the superolateral portal (fig 2).

Complications were noted in three patients. Two developed superficial wound infection which subsided with appropriate antibiotics ; both had previous history of infection either in the wound or in a



**Fig. 2.** — a) Radiograph (lateral view) of ankylosed patellofemoral joint ; b) Pre-operative clinical photograph showing passive knee flexion ; c) Intraoperative photograph showing arthroscope, shaver and osteotome in situ ; d) Same case after completion of arthroscopic osteotomy and quadriceps plasty.

**Fig. 3.** — a) Clinical photograph of stiff knee after open fracture and external fixator application ; b) Radiograph of same case showing weak areas where fracture occurred during manipulation.



pin tract. Another case with extensive quadriceps fibrosis and poor skin condition subsequent to chronic osteomyelitis (after being treated with Illizarov fixator for an infected non-union of an supra condylar fracture with ipsilateral fracture of the shaft of the femur) sustained a pathological fracture during attempted intra operative manipulation after arthroscopic release (fig 3). The limb was immobilised in a groin to toe POP Cast for 6 weeks, after which a hinged knee brace was used for 3 months. The patient did not gain any range of motion ( $5^\circ$ - $20^\circ$ ), and refused further treatment.

No patient had haemarthrosis significant enough to require a second arthroscopy.

## DISCUSSION

In spite of orthopaedic advances for fracture fixation and injury management, inadequate applica-

tion of these techniques, improper rehabilitation techniques, as well as non availability of expert medical help at the right time still leaves many people with stiff knees in underdeveloped countries. Loss of extension is labelled more debilitating in western cultures, with small extension deficits impeding normal walking ; restricted flexion however is a serious problem in the Asian countries, where social and religious mores make sitting on the ground a normal requirement of everyday life. Flexion loss is mostly due to intra-articular fibrosis and scarring in the quadriceps-femoral mechanism. Anterior adhesions involve the quadriceps expansion in the lateral and medial recesses, the suprapatellar bursa, muscle adhesions to the femur, patella infera, or even shortening of the rectus femoris (6).

With the advent of arthroscopic aided procedures, the problem of knee fixed flexion deformity

has been increasingly addressed ; Conti (4) developed controlled distension and manipulation under general anaesthesia. Sprague *et al* (13) recommended percutaneous release of adhesions under arthroscopic visualisation. In 1998, Steinfeld and Torchia (14) reported the first case of a percutaneous quadricepsplasty after open reduction and internal fixation of a distal femur fracture, demonstrating the utility of arthroscopic aided percutaneous techniques in treating both intra and extra-articular pathology. The possible disadvantages were the inability to lengthen the rectus femoris muscle and potential injury to the superficial femoral vessels at the adductor hiatus.

In 2001, Rodriguez Blanco *et al* (12) from Cuba presented a new surgical subperiosteal endoscopic technique for the release of fibrosis of the quadriceps to the femur. The technique used was a proximal endoscopic subperiosteal extension of the usual arthroscopic intra articular release of adhesions, using periosteal elevators and arthroscopic scissors placed through medial and lateral superior knee portals to release adhesions and bands of scar tissue beneath the quadriceps mechanism. The technique was used in stiff knees with clinically and ultrasonically documented extra articular fibrosis ; all patients obtained satisfactory results at 2 years follow-up.

In previous studies it was found that the time period between initiation of the inflammatory process and appropriate treatment was considered to be a major factor influencing improvement (6, 7). The ideal interval ranges from 3 to 9 months after the initial operation or injury. Operative treatment one year or more after initiation of the process has been less successful in improving the range of motion. In our social milieu, the desire of most patients was to gain as much of flexion as possible ; hence we started this procedure, in spite of significant delays, with a clear understanding that some quadriceps weakness may ensue due to delay.

With the advent of external fixators as a treatment modality for open fractures of the femur, an additional cause of adhesions may be the pin sites on the anterolateral femur. In our series although we used the protocols developed by previous authors, we extended the operative technique to

percutaneous sub-periosteal release of the adhesions at these sites, by making stab incisions and elevating the adherent vastus lateralis in some cases. Percutaneous technique was used when these sites could not be easily reached through arthroscopic aided technique through the suprapatellar pouch.

We had one case of distal femoral fracture through a weakened area of the femur, which was noted as an audible crack during attempted manipulations. Although adequate intra-articular and distal femoral adhesion release had been done, motion improvement was not significant, and manipulation caused a crack confirmed by intraoperative radiographs. This was a wrong case selection for two reasons ; firstly there was a large defect in the distal femur which would always have been an area of weakness for knee manipulation (fig 3). Secondly a retrospective review of radiographic films revealed proximal areas where the adhesions were probably significant. These could not have been tackled by arthroscopic aided quadriceps release. As this was taken up in the earlier part of our series, when we were in our learning curve, we admit this was not an ideal case for this procedure, and perhaps a combination of arthroscopic aided distal release and limited open proximal release may have been better.

The case with patellofemoral fusion was unique from two aspects ; firstly the period of delay between the primary injury (bomb splinter, which also caused ipsilateral foot drop due to peroneal nerve injury) was very significant. Secondly as the patient could walk unaided, we were somewhat apprehensive about the quadriceps weakness that would develop after patellar release as well as the potential for subsequent patello-femoral degenerative arthritis. The patient however was adamant about getting flexion at any cost. Although she has a slight extensor lag, she has maintained a flexion range of 100° at follow-up.

One major lacuna in our postoperative protocol was the absence of continuous passive motion exercises, which are perhaps the least painful form of rehabilitation exercises. We used indwelling epidural catheters in almost half of our cases to deliver analgesic drugs for postoperative pain

relief. These were continued for 24-48 hours as needed ; once the patients were comfortable with 70% of the motion range that had been achieved at surgery, analgesics requirements were significantly less. Local nerve blocks are another alternative, but we have no experience with them.

Our experience has prompted us to offer a few conclusions. With fractures or surgical procedures around the knee, there is always a combination of intra as well as extra-articular adhesions. The ones inside the knee can easily be released arthroscopically ; we have found that with proper case selection even extra-articular adhesions can be released with minimally invasive surgery, and with good postoperative rehabilitation techniques, the flexion range can be adequately maintained to allow local social practices. Proper case selection and adhesion identification is essential for success ; distal femoral adhesions, as well as pin tract problems give the best results. We have used additional percutaneous subperiosteal release for anterolateral adhesions which were slightly higher. We also project this procedure being used in a "hybrid form" in the future. Since the standard quadricepsplasty consists of a distal medial incision for intra articular release, and a lateral proximal one for quadriceps elevation, we think that an arthroscopic procedure for the distal aspect and a small limited release superolaterally (after identification of adhesion site by clinical judgment, ultrasound or even radiographs) could become a good alternative. One unique feature was the significant delay between the onset of knee stiffness and arthroscopic release. The biggest problem here is residual quadriceps weakness, and this can be tackled well by aggressive physiotherapy and a motivated patient.

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