Chapter

Management of Flexion Contracture in Total Knee Arthroplasty

Kavin Khatri, Deepak Bansal and Karan Rajpal

Abstract

Fixed flexion deformity at knee is common in osteoarthritic knee and is a combination of bony deformity, capsular and ligamentous deformity. It affects knee biomechanics in terms of increased forces at the patellofemoral and tibiofemoral joint. This in turn makes carrying out of routine daily activities like walking or use of staircase very difficult. Therefore, it is essential to correct this deformity at the time of operative intervention. Major interventions like posterior capsular release and removal of osteophytes and adequate bony resection helps in correcting the deformity. Post operatively, use of extension night splints and adequate physiotherapy can help in correcting the residual deformity left over at the time of knee arthroplasty.

Keywords: total knee arthroplasty, fixed flexion deformity, range of motion, flexion contracture

1. Introduction

Flexion deformity at knee in osteoarthritis or rheumatoid arthritis is due to synovial inflammation leading to fluid in joint subsequently resulting in assuming of position maximum accommodation i.e. flexion. Posterior femoral and tibal osteophytes tent upon the capsule resulting in further flexion at the knee and sometimes mechanical block to extension. Other factors like hamstring shortening and ligament contracture also contribute to flexion at the knee. There is increase in energy expenditure while walking or standing along with decreased endurance and inability to stand for long period of time [1–2]. Fixed flexion at single knee increases abnormal forces on other knee resulting in abnormal gait. There is limb length discrepancy and short stride length. There is associated increase in extension and adduction. In severe flexion deformities, there is alteration of kinematics of spine. There are increased chances of lumbar spondylosis and accelerated degeneration of contralateral knee in cases of long standing flexion deformity at knee. Isolated flexion deformity is very rare and generally associated with either varus or valgus deformity at knee [3]. Some authors have reported incidence of flexion deformity up to 60° in cases of osteoarthritis knee [4]. To achieve complete range of movement at knee, full surgical correction should be achieved during surgical correction.

2. Prevalence and risk factors

Ritter et al. [5] had described that residual flexion contracture by more than 10 degree can result in poor functional outcome in patients who undergo knee replacement. The risk factors for persistence of deformity were male gender, higher age and preoperative flexion contracture of more than five or more degrees [6]. Among these the single most important factor predictive of residual flexion contracture was preoperative flexion deformity at knee. Body mass index has no role in persistence of flexion deformity after surgical correction [7]. Surgical technique factor like overstuffing of extension gap and flexion of femoral component also determines the post-operative flexion deformity. The femoral component placed in flexion can result in limitation of arc of motion due to constraints in articulation.

3. Pathoanatomy

Long standing cases of arthritis have intercondylar osteophytes, which acts as mechanical block to extension [4]. The posterior osteophytes in addition impinge upon posterior capsule further increasing flexion contracture. Subsequently, it leads to contraction of soft tissues over the posterior aspect of knee adding to the deformity.

There is erosion of the posterior aspect of the tibia and reduction in the strength of quadriceps resulting in extension lag even after correction of deformity. Lombardi et al. [8] had classified flexion deformity into three grades depending upon the severity of deformity. Grade I is mild contracture with deformity limited to less than 15°. Grade II is moderate contracture with deformity between 15° and 30°. Grade III is severe contracture with deformity greater than 30°.

4. Preoperative preparation

A patient with knee flexion contracture undergoing knee replacement should be evaluated for coronal plane deformities, grade of flexion deformity, extensor lag and preoperative range of motion is recorded. The assessment of these variables helps a surgeon to decide regarding the clinical expectations, surgical technique, associated risks and complications. The next important step is to grade the flexion contracture. The standard radiographs should be evaluated to determine the disturbances in the bony anatomy especially posterior condylar deficiencies, coronal deformities and prominent osteophytes. The posterior condylar deficiency affects the rotation of femoral component when posterior referencing system or measured resection technique is used. Sometimes large bony defects would require augments in the form of allografts or modular inserts.

5. Preoperative measures to treat flexion deformity

In patients suffering from inflammatory arthritis, there is minimal or no osteophyte formation associated with fixed flexion deformity hence preoperative manipulation is sometimes helpful in selected cases. In cases with bilateral hip and knee deformity, the preoperative manipulation is carried out after hip replacement with the aid of serial casting over the knee in maximal stretch [9]. The cast should be adequately padded to avoid pressure sores over the anterior

aspect of knee. Epidural anesthesia can be very helpful in these cases as serial casting becomes relatively pain free and fruitful.

6. Surgical technique

After all preoperative preparations, tourniquet is applied over the limb to operated and activated just before incision. The operative leg is examined again under anesthesia to ascertain the degree of deformities. Limb is draped and prepared with betadine or chlorhexidine solution as per the hospital infection control protocols. A midline skin incision is given extending approximately 5 cm proximal to suprapatellar pouch to a point just medial to tibial tubercle. Medial parapatellar osteotomy is performed with eversion of patella exposing both lateral and medial femoral condyle. Next step is to correction of coronal deformities with removal of osteophytes and soft tissue contractures. All efforts should be concentrated to correct the flexion deformity intraoperatively while maintaining soft tissue and adequate stability. The classical approach described by Insall [10] is to resect the posterior femoral condyle and releasing the soft tissues in order to achieve a rectangular flexion gap. Another technique of balancing is to measure the resected pieces of bones from femoral and tibial condyle and replacing the same with components of same size.

The primary focus in case of fixed flexion deformity is over the posterior femoral recess. The posterior capsule should be released as far as possible. The posterior capsule release makes the extension gap equivalent to flexion gap. It also avoids excessive resection of distal femur which can lead to elevation of joint line and mid flexion instability there by altering the patellofemoral kinematics.

7. Grade 1 flexion contracture

Tibial and femoral cuts are carried out in usual manner as in primary uncomplicated arthroplasty. The flexion contracture is due to posterior recess and posterior osteophytes indenting upon the capsule. After the bony cuts, the osteophytes can easily be visualized and removed with the help of ¾ inch osteotome (**Figure 1**). A intramedullary rod may be used to elevate the distal femur or lamina spreaders can be used for better visualization of posterior capsule. There is clear dividing line between the osteophytes and femoral condyle. The loose osteophytes can be removed with the help of curette. The posterior obliterated posterior recess can be then be created with osteotome. The osteophytes from posterior aspect of tibia are visible clearly at this stage and can be removed with the help of curette and osteotome. The osteophytes attached to the posterior capsule is pulled forward and removed with the help of electrocautery. In case extension gap is less than flexion

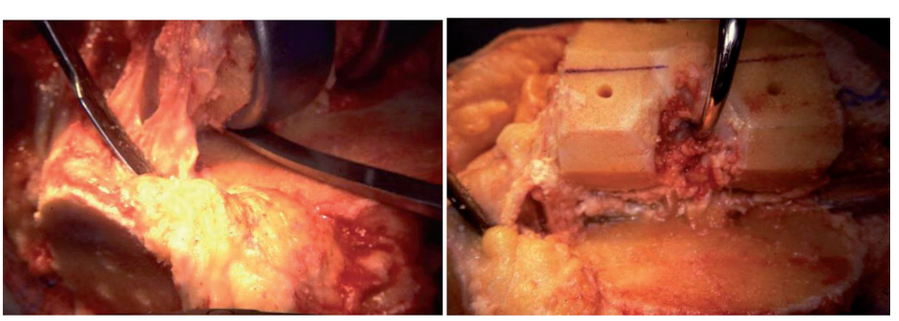

Figure 1.
Posterior osteophytes are removed with the help of osteotome.

gap further release of posterior recess is carried out. However, if extension gap is more than flexion gap, the posterior slope of tibia is evaluated. The slope can be increased up to 8° in order to balance the knee. Tight flexion gap can result in poor roll back of femoral component and lift off of tibia tray.

In majority of the cases, the flexion contracture is corrected with these simple maneuvers. The type of knee prosthesis i.e. cruciate retaining or cruciate sacrificing depends upon the choice of surgeon in mild flexion contracture. Laskin [11] described a test to assess the correction of flexion deformity intraoperatively. The operated limb is lifted from the table and foot is dorsiflexed at ankle subsequently axial pressure is applied along the long axis of the limb. The sudden flexion at knee suggests residual flexion deformity. If there is no bending at knee due to axial pressure then it suggests achievement of adequate correction at the knee joint.

8. Grade II flexion contracture

In addition to release of posterior recess and removal of osteophytes as described in management of grade I flexion, the posterior cruciate ligament is released from the femoral end first and subsequently from the tibial end as per the requirement. Medial and lateral perforations of posterior cruciate ligament can also result in fractional lengthening. With this technique, the cruciate retaining components can be used. In other cases where posterior cruciate ligament is significantly weakened, one should opt for posterior stabilized components.

At the end of all the above releases, if extension gap is smaller than flexion gap, the distal femur is resected by 2 mm. However, if surgeon decides to go ahead with cruciate retaining knee components then distal femur should be resected by more than 4 mm as it can lead to posterior cruciate ligament dysfunction due to elevation of joint line.

9. Grade III flexion contracture

In case of flexion contracture is more than 30°, sequential release is carried out as described in management of grade I and II flexion contracture. The posterior cruciate ligament should be released from its proximal and distal attachment to balance flexion and extension gap at this stage. The choice of implant should preferably be posterior stabilized rather than cruciate retaining. It is important to release posterior capsule and gastrocnemius heads from the posterior aspect of distal femur. In majority of the cases the balanced flexion and extension gap is achieved, however, if there is valgus-varus instability due to laxity of medial or lateral collateral ligament then constrained prosthesis should preferably be used. The lax extensor mechanism can be countered by distal and lateral advancement of vastus medialis and medial capsular structures.

Sequential correction of fixed flexion deformity in total knee replacement (**Figure 2**).

1. Correct coronal deformity with mediolateral balancing and removal of all visible osteophytes. Perform all bony tibial and femoral cuts in the usual manner. In majority of mild flexion contractures, the deformity shall be corrected.

2. The posterior recess should be established with help of osteotome and periosteal elevator. If required the medial and lateral head of gastrocnemius should

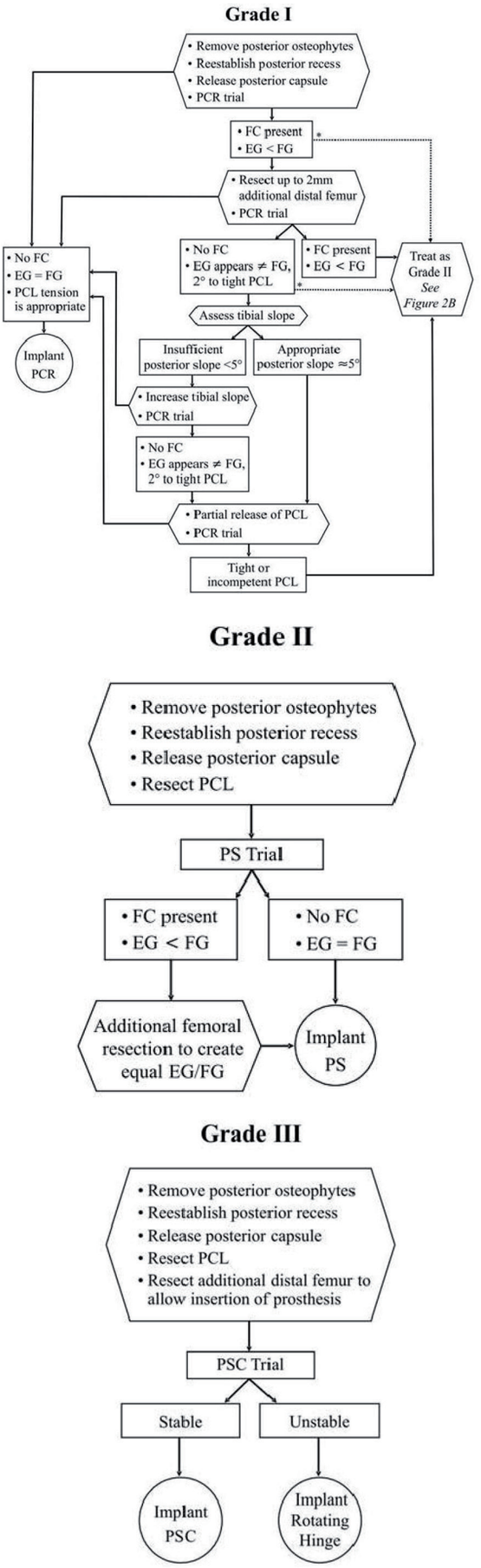

Figure 2.
Treating algorithms for grade I, II and III deformity (EG, extension gap; FC, flexion contracture; FG, flexion gap; PCL, posterior cruciate ligament; PCR, posterior cruciate retaining; PS, posterior stabilized; PSC, posterior stabilized constrained). Reproduced from [12].

also be raised from the posterior and distal end of femur. Sometimes transverse capsulotomy is carried out starting medially and moving laterally. The collaterals are carefully separated from the capsule by longitudinal incisions.

3. In cases of severe flexion deformity, distal femoral resection of up to 4 mm in increments of 2 mm is carried out and gap mismatch is checked. It is advisable to resect minimal bone from the distal femur in order to prevent problem of patellofemoral kinematics, patella baja and elevation of joint line. Sometimes it results in mediolateral instability necessitating the need for constrained prosthesis.

4. Medial and lateral hamstrings are tenotomised in order to achieve full correction in rare cases. Biceps femoris should be clearly identified and separated under vision in order to avoid injury to common peroneal nerve. In cases with flexion deformity of more than 60 degrees, it is advisable to undergo serial casting prior to total knee arthroplasty.

10. Postoperative management

The patients are encouraged to do quadriceps exercises at regular intervals. In cases of mild residual flexion deformity, patients are advised to wear night splints. Stretching exercises play a vital role in the rehabilitation of these cases. It is advised to avoid pillow below the knee and sitting on recliner chairs for a long time as there is tendency towards flexion. The patients should be closely followed in the postoperative period to look for recurrence of deformity. Sometimes patient require manipulation under anesthesia to achieve range of motion similar to that attained in immediate post-operative period. Excessive force should be avoided during manipulation as it might lead to fracture of distal femur.

11. Complications

1. Recurrence of flexion contracture and loss of movement

As stated earlier, the aim should be full correction of flexion deformity intraoperatively. However, at the end of 1 year few cases experience recurrence of deformity.

2. Flexion extension imbalance

Flexion extension instability in case of flexion extension mismatch might require restraint with rotating hinge prostheses.

3. Peroneal nerve injury

Peroneal nerve injury sometimes occurs in cases of fixed flexion with valgus deformity at knee. There could be associated lengthening of the lower limb.

12. Summary

The complexity of surgical procedure increases with increasing flexion deformity of knee. The less complex deformities correct with usual bony resections and removal of osteophytes. Special attention should be paid to creation of posterior capsule. The bony resection especially distal femur should be reserved in cases where soft tissue release achieves inadequate flexion-extension gap match. Postoperatively, the patients should be followed up closely to prevent recurrence of deformity. The patients need monitoring of neurovascular status to miss on an untoward complication.

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