MANAGEMENT FACTORIALS IN PRIMARY ARTHROPLASTY

Correcting deformity in total knee arthroplasty

TECHNIQUES TO AVOID THE RELEASE OF COLLATERAL LIGAMENTS IN SEVERELY DEFORMED KNEES

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Collateral ligament release is advocated in total knee arthroplasty (TKA) to deal with significant coronal plane deformities, but is also associated with significant disadvantages.

We describe steps to avoid release of the collateral (superficial medial and lateral collateral) ligaments during TKA in severely deformed knees, while correcting deformity and balancing the knee.

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Soft-tissue release plays an integral part in primary total knee arthroplasty (TKA) by ‘balancing’ the knee. ‘Static’ bony sagittal and coronal alignment in extension is achieved by bone cuts which ensure that components are positioned perpendicular to the mechanical axes of the femur and tibia. Although several techniques of soft-tissue release during TKA have been described, the sequence, timing (in relation to bone cuts) and the extent to which it should be done is unclear. Based on a literature review, Hunt et al concluded that there is insufficient evidence available to define the correct sequence, extent and magnitude of medial soft-tissue release in the varus knee undergoing TKA.

Arthritic knees with severe deformity and significant soft-tissue laxity or imbalance in the coronal plane (i.e. varus or valgus deformity) may require an extensive release during TKA including the release of the relevant collateral ligament (superficial medial collateral ligament (MCL) in the varus knee and lateral collateral ligament in the valgus knee). Some reports have advocated releasing the collateral ligament, either by pie-crusting or by detaching it from the distal attachment. However, releasing the collateral ligaments during TKA has unintended consequences such as the creation of significant mediolateral instability and a flexion gap which exceeds the extension gap: both of these may require a constrained prosthesis to achieve stability. Furthermore, instability from release of the collateral ligaments may lead to polyethylene wear and premature loosening of the tibial component.

We believe that soft-tissue balance can be achieved in cases of severe coronal plane deformity without performing a collateral ligament (superficial medial or lateral collateral) release during TKA and we describe steps to achieve this.

Extra-articular or intra-articular deformity

The first key step is to decide if the knee deformity is predominantly intra-articular or extra-articular. This can be determined by obtaining a full-length, weight-bearing, hip-to-ankle radiograph pre-operatively. Full-length radiographs will identify angular deformities of the femoral or tibial shaft which would otherwise be missed on a short anteroposterior radiograph of the knee. Furthermore, short films may underestimate the degree or severity of the deformity.

The existence of an extra-articular deformity in a knee undergoing TKA may warrant additional procedures such as an osteotomy of the medial condyle or lateral epicondyle, or a corrective osteotomy performed concurrently with the TKA. This will eliminate the need for release of a collateral ligament to achieve the necessary balance and correct the deformity.

Individualise valgus correction angle and resection depth

The valgus correction angle (VCA) or the angle of resection of the distal femur in the coronal plane may vary widely outside the conventional 5° to 7° range. In a study of 503 TKAs Mullaji et al showed that the VCA can vary from 2° to 12° depending on the type and severity of pre-operative hip-knee-ankle (HKA) angle. Choosing a fixed VCA for every case based on the conventional 5° to 7° range...
may lead to substantial error in positioning of the femoral component if the surgeon aims to place it perpendicular to the mechanical axis of the femur. Consequently, VCA should be individualised for each patient by measuring it pre-operatively on a full-length HKA radiograph.

The amount by which the distal femur and tibia are resected should also be individualised based on the type and severity of knee deformity and the severity of any medio-lateral soft-tissue imbalance. Thus, both tibial and femoral resections should be less than 8 mm (typically 5 mm to 6 mm) if there is severe deformity, subluxation of the tibia, indicating significant medio-lateral instability, and in knees with a recurvatum deformity.

Gap balancing without collateral ligament release

After resecting the distal femur and tibia, we prefer to create a well-balanced extension gap first and then fashion an identical flexion gap. Advanced osteoarthritis of the knee is associated with displacement of the MCL from the femoral and tibial condyles, usually by osteophyte, and may not be associated with contracture of the MCL. Excision of these osteophytes from both femur and tibia helps to increase the medial extension gap significantly without having to perform a soft-tissue release. A reduction osteotomy with or without undersizing of the tibial component may be undertaken to correct the deformity and balance the medio-lateral gap if these soft-tissue releases are inadequate. However, the posteromedial capsule of the knee joint may undergo significant contracture in the arthritic knee. Hence, resection of the contracted posteromedial capsule (Fig. 1) after release of the deep MCL and semimembranosus from the proximal tibia will further help to correct mediolateral imbalance.

Similarly, with a valgus deformity, release of the iliotibial band, posterolateral capsule and popliteofibular ligament helps to correct the deformity and establish balance without having to release the lateral collateral ligament. In knees with an associated severe flexion deformity, removal of posterior osteophytes and resection of the contracted posterior capsule will help to correct the flexion deformity. Once a well-balanced extension gap has been created, the flexion gap can be matched to it by altering the size and position of the femoral component.

Additional procedures for extra-articular deformity

The presence of an extra-articular deformity of the knee, as determined by a full-length HKA radiograph, adds to the complexity of the technique. In most patients, extensive soft-tissue release (except for the superficial MCL or LCL) and reduction osteotomy fail to achieve a rectangular extension gap, the proximal attachment of the collateral ligament may have to be moved distally using an osteotomy of the medial condyle or lateral epicondyle or a corrective osteotomy. When extensive soft-tissue release (except for the superficial MCL or LCL) and reduction osteotomy fail to achieve a rectangular extension gap, the proximal attachment of the collateral ligament may have to be moved distally using an osteotomy of the medial condyle or lateral epicondyle (Fig. 3).
advantage of advancing the collateral ligaments distally and achieving a rectangular extension gap without changing the flexion gap and avoiding imbalance because of overrelease: the bony fragment is stabilised with cancellous screws in the appropriate position. Similarly, a significant extra-articular deformity caused by a malunited fracture of the femur or proximal tibia may require corrective osteotomy so that TKA may be carried out without the need for collateral release (Fig. 3). This may be indicated if the extra-articular deformity is more than 20° or 30° and close to the knee joint.24

In conclusion, we believe that collateral release during TKA can be avoided in most cases of severe deformity by using steps such as determining whether the deformity is intra- or extra-articular, individualising the bone resection and VCA, balancing the extension gap first with judicious releases, and using additional procedures in the presence of extra-articular deformity.

Fig. 3a Fig. 3b Fig. 3c
Diagrams showing additional procedures (medial condylar osteotomy, lateral epicondylar osteotomy and corrective osteotomy) required in the presence of extra-articular deformities in order to achieve balance and deformity correction. The diagrams show a) medial condylar osteotomy in a varus knee with the condylar fragment (indicated by the arrow) shifted distally; b) distally displaced medial condylar bone block fixed with cancellous screws after cementing of implants; c) lateral epicondylar osteotomy done in a valgus knee with the condylar fragment (indicated by the arrow) shifted distally; d) distally displaced lateral epicondylar bone block fixed with cancellous screws after cementing of implants; e) lateral closed wedge corrective osteotomy done for an extra-articular varus deformity of the proximal tibia; and f) restored alignment after corrective osteotomy.

Fig. 3d Fig. 3e Fig. 3f

References

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