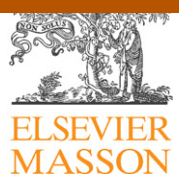

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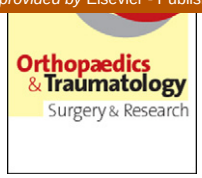

WORKSHOPS OF THE SOTO (2009 RENNES). TECHNICAL NOTE

Total knee arthroplasty in valgus knee

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KEYWORDS
Gonarthrosis;
Valgus knee;
Total knee arthroplasty;
Ligaments

Summary Total knee arthroplasty (TKA) in valgus knee has the reputation of being more difficult than in well aligned or varus knee, and there is no management consensus. Results on a continuous series of 100 TKAs on valgus knee were compared to the literature data, to define surgical strategy adapted to the various types of valgus knee.

Introduction

The SOO classification (Western France Orthopedics Society: Société d'orthopédie de l'Ouest) established in 2003 (Fig. 1) distinguishes four types of valgus knee, of increasing surgical difficulty:

- type I, can be completely reduced, without medial laxity, and poses no particular problem and a medial approach is possible; but in case of patellar dislocation, we recommend a lateral approach;
- type II is totally or partially irreducible, but without medial laxity, and is the most frequent; lateral release is required;
- type III is reducible, but with medial distension laxity, and may require management of the medial laxity;
- type IV is irreducible, with medial distension laxity, combining the problems of types II and III.

Revision of tibial valgization osteotomy with hypercorrection is a case apart, requiring specific precautions.

Material and methods

To understand the ''typical'' operative procedure in valgus knee, it should be borne in mind that the lateral stabilizers, which may hinder reduction, are of two types:

- those inserting near the flexion-extension axis (lateral collateral ligament (LCL) and popliteal tendon), acting in both extension and flexion of the knee;
- those inserting remotely with respect to the axis (fascia lata, postero-external articular capsule, biceps and external gastrocnemius muscles), acting only in extension.

The sequencing of lateral release is controversial, with many and various protocols of progressive step-wise release. Anatomic studies, on mainly well-aligned knees cadavers, are numerous and often contradictory [18,20,22,28,33]. One result, however, appears consistently, and notably in Krackow's study [22]: lateral release, performed in whatever order, finally induces a much greater femoro-tibial gap in flexion than in extension. From this fundamental principle, it follows that:

- the essential point is precise release in extension;
- it is exceptional for a knee released correctly in extension to be insufficiently released in flexion;

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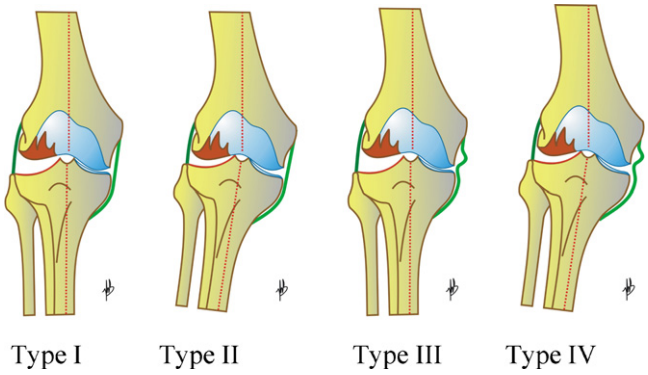

Figure 1 Société d'orthopédie de l'Ouest (SOO) valgus knee classification.

- on the contrary, while lateral release is required for realignment in extension, consequent laxity in flexion is the pitfall to be avoided.

Thus, in extension:

- isolated fascia lata, popliteal muscle tendon or LCL sectioning increases the lateral femoro-tibial gap very little;
- LCL sectioning associated to popliteal tendon sectioning increases this gap only moderately, so long as the fascia lata is conserved, but very considerably if the fascia lata is sectioned;
- If only the fascia lata and LCL are sectioned, the conserved popliteal prevents any considerable increase in femoro-tibial gap.

Fascia lata release is effective in extension. It may be total, by transverse section above the joint line [25,33] or by release from the Gerdy tubercle, or modulated, by section of the Kaplan fibers [36], by Z or VY plasty [4], ''pie crusting'' [2,12,32], or release from the Gerdy tubercle in continuity with the tibial aponeurosis to create a digastrics muscle. Isolated fascia lata release may prove sufficient in small deviations.

On the basis of these principles, our departmental experience and a series of 100 TKRs in valgus knee, the following operative strategy is recommended in ''classic'' valgus knee: i.e.,

Type II congenital valgus knee on the Société d'orthopédie de l'Ouest classification

The approach is lateral following Keblish [21]

Tibial tubercle eversion osteotomy seems the most reliable (with better exposure and no risk to the patellar tendon), and has never had adverse consequences in our experience. After freeing the lateral edge of the patella, it enables controlled release of the fascia lata by release from the Gerdy tubercle. This may be enough to correct the valgus, with conserved continuity between fascia lata and tibial aponeurosis. This is a ''safeguard'' in case larger release of other obstacles to reduction has to be performed. The one drawback of this approach is that it does not allow (or at least greatly complicates) restoration of medial tension, although resort to this technique seems to be very rare.

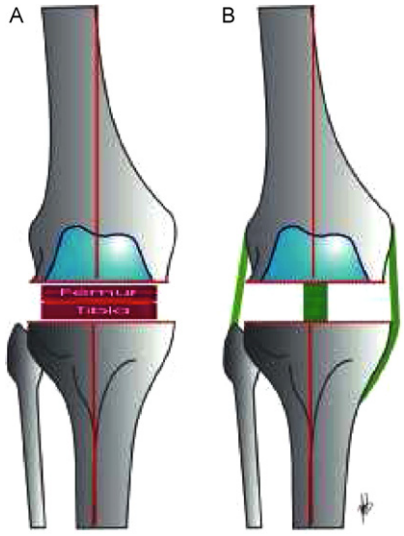

Figure 2 Control of femorotibial space in extension. A. Rectangular. B. PCL can be conserved.

Osteophyte resection

Osteophyte resection is performed not so much on the femur, where they are forward of the LCL-popliteal complex, forming a kind of bridge (exeresis should be cautious in case of condyle sliding osteotomy), as at the posterolateral angle of the tibia, where they constitute a significant bridge effect.

Distal tibial and femoral cuts

The order is not important, since distal cuts should be independent, perpendicular to the mechanical axes of the femur and tibia, without regard for the degree or reducibility of the deformity. In valgus knee, they should be made with reference to the medial compartment. If made with reference to the lateral compartment, they would certainly avoid lateral release but would induce or increase medial laxity. The one exception, in our view, is in case of revision of tibial valgization osteotomy.

Control of femoro-tibial space in extension

If the femoro-tibial space is rectangular, ligamentary balance is terminated, and the posterior cruciate ligament (PCL) may be conserved (Fig. 2).

If it is trapezoid with too short a lateral side, lateral release is required, and PCL conservation is debatable (Fig. 3).

Frontal femoral cuts

Frontal femoral sectioning should use the technique and landmarks the operator is used to. The femoral component can be positioned in rotation on the bi-epicondylar line [1,13,17], the Whiteside line [3,4,16,34] or the posterior condylar line [23]. The choice depends on how one sees the lateral condyle in valgus knee: most authors speak of a hypoplastic lateral condyle to account for the inclination of the joint line with respect to the anatomic axis of the femur; we, however, like others [7,31], consider the lateral condyle to be not hypoplastic but too proximally implanted

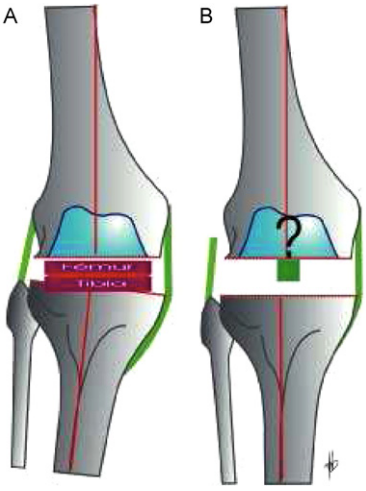

Figure 3 Control of femorotibial space in extension. A. Trapezoid with too short lateral side. B. Lateral release is required. PCL conservation is debatable (PCL: posterior cruciate ligament).

(with normal height and anteroposterior length) and that it is the flexion-extension axis of the knee that is in valgus [6,8,9]. This means that the posterior condyle line is a reliable landmark for determining femoral component rotation.

Control of femoro-tibial space in flexion

If the femoro-tibial space is rectangular, lateral release should be in extension only. Only lateral condyle sliding osteotomy enables this (by purely distal translation of the bone block).

If it is trapezoid with too short lateral side, lateral release should be in flexion and extension. Either LCL-popliteal release or lateral condyle sliding osteotomy may be used.

LCL-popliteal release is performed by lancet, seeking to conserve continuity with the femoral periosteum: according to the anatomic factors mentioned above, it would seem logical to begin by releasing the first obstacle, the LCL. In our experience, this is an all-or-nothing situation: release must be total to have any effect. In this situation, if fascia lata release has been cautious, the fascia lata will be able to act as a safety.

Lateral condyle sliding osteotomy [5,7,11] has the advantage of enabling the degree of release to be modulated, to avoid onset of laxity, to choose the sector (extension only or extension-flexion), to avoid flexion contracture with the lateral condyle shell sectioning that is always associated, and finally to allow the usual postoperative course.

Complementary procedures

Superior release of the gastrocnemius at the same time as the condyle shell is seldom necessary, and biceps release even less so unless for persistent flexion contracture.

Lateral popliteal sciatic neurolysis is discussed in the literature [14,24,29], and we have occasionally resorted to this. We consider it necessary in severe deviation with associated flexion contracture and when extensive lateral release has been performed.

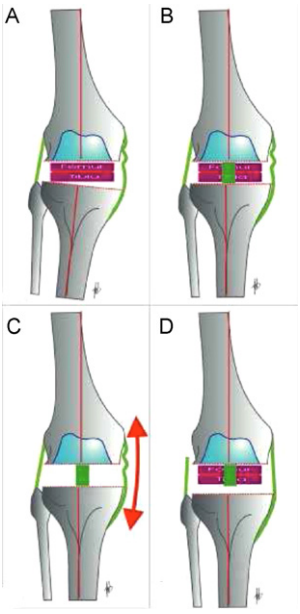

Figure 4 Control of femorotibial space in extension. A. Trapezoid with too long a medial side. B. Abstention: preferable to conserve PCL? C. MCL tension restoration: preferable to conserve PCL? D. Lateral release to enlarge gap and restore tension from within. PCL must be sacrificed. (PCL: posterior cruciate ligament; MCL: medial collateral ligament).

Type III and IV valgus knee

Type III and IV valgus knee (with associated medial laxity) raise the question of medial tension restoration procedures, to which we have rarely resorted.

When medial laxity is found on controlling the femorotibial space in extension, and bone cut error can be ruled out, there are three options (Fig. 4):

- abstention, if the laxity is moderate and it is preferable to conserve the LCL;
- restoration of medial capsuloligamentary tension, preferably without endangering the PCL for safety. We described

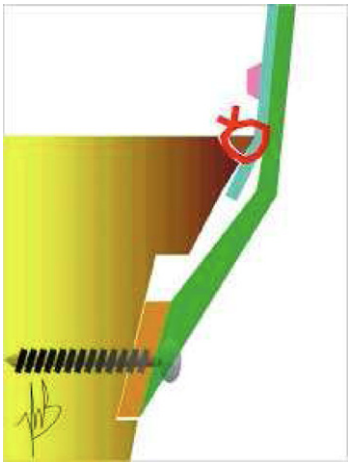

Figure 5 Downward restoration of medial collateral ligament tension.

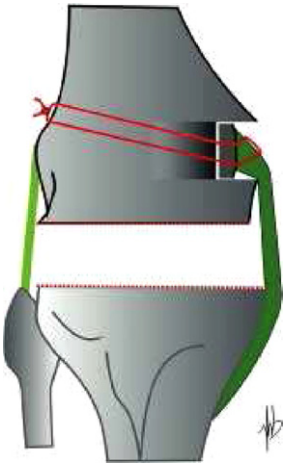

Figure 6 Upward restoration of medial collateral ligament tension, following Healy.

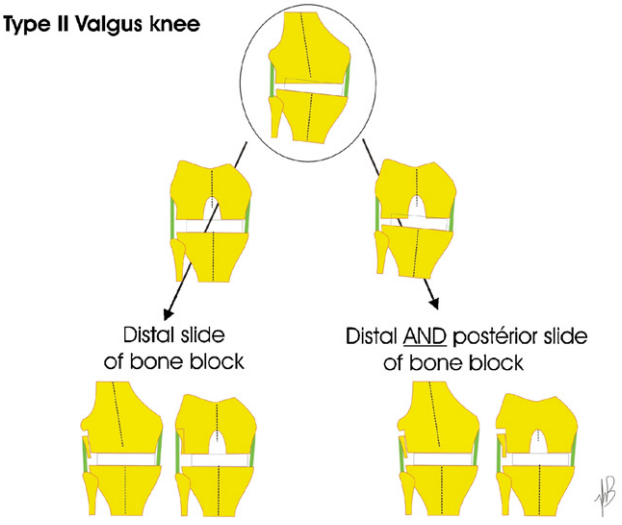

Figure 7 Type II valgus knee decision tree.

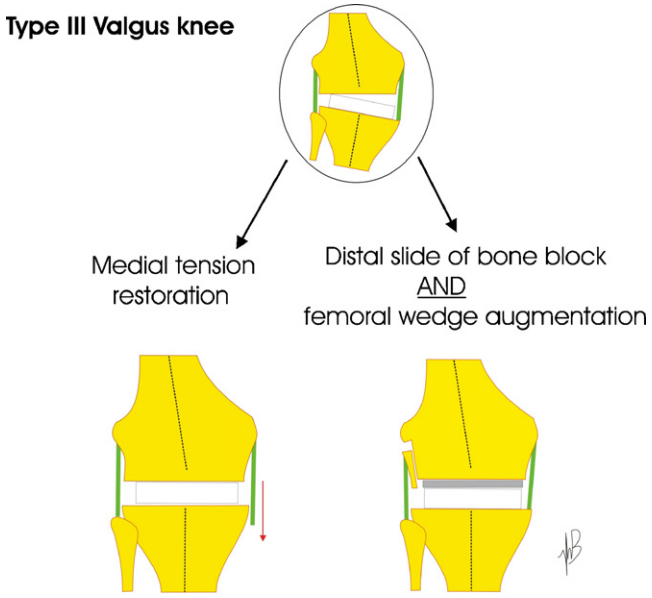

Figure 8 Type III valgus knee decision tree.

a technique of tension restoration from below [10] (Fig. 5); our experience with it remains limited, but laxity effects have been much less than with condyle sliding osteotomy. Healy [19], in1998, described a technique of tension restoration from above (Fig. 6) which seems interesting, although we have no experience of it;

- further lateral release to increase the femorotibial gap, thus restoring internal tension; this requires sacrificing the PCL. The increased femorotibial gap may be filled using prosthetic wedges.

Decision trees according to type of valgus knee, with the various peroperative options (Figs. 7—9).

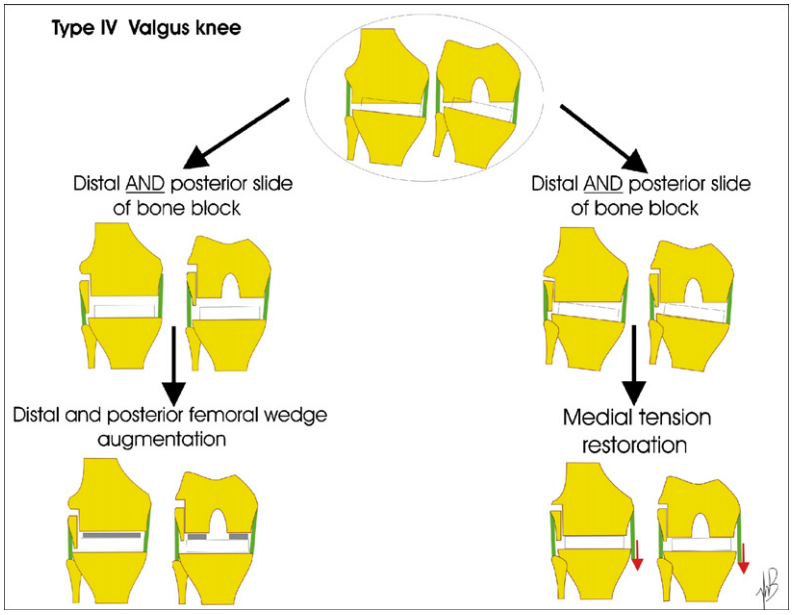

Figure 9 Type IV valgus knee decision tree.

Remarks

Type of implant

In valgus knee, it is important to adapt the level of strain, so as to avoid residual laxity. For this we recommend hinged implants in first intention, but only in elderly patients with severe irreducible valgus. It is certainly wise to use an implant with which the same ancillary enables varying degrees of intrinsic stability, and to have augmentation wedges available.

Valgus knee secondary to tibial valgization osteotomy

In tibial valgization osteotomy (TVO) revision, unlike other cases of valgus knee, the landmark is the lateral compartment, which is initially ''normal''. The height of tibial and distal femoral sectioning should take account of lateral wear, avoiding lateral laxity and minimizing medial laxity.

In TVO revision without particular hypercorrection, the total knee arthroplasty (TKA) can be inserted without undoing the osteotomy. If, however, the hypercorrection is greater, the risk of medial ''resection'' laxity due to the tibial bone cut increases. This may be aggravated if the tibial cut weakens the tibial insertion of the deep bundle of the LCL, which is the only check on medial laxity, since the superior bundle is weakened by the TVO. To avoid severe medial laxity (and correct malunion) closing wedge osteotomy may be associated in the same step [26,27]. Certain authors [15,30,35] have detailed strict preconditions for this, but we do not consider that any threshold angle can be specified. In our view, it may be envisaged as of 8° to 10° valgus as measured on the main axes, but also very much depends on knee ligament status.

Conclusion

For ''classic'' type II congenital valgus knee (the most frequent case), we recommend:

- an anterolateral approach, with tubercle osteotomy and systematic fascia lata release from the Gerdy tubercle in continuity with the anterior tibial aponeurosis;
- independent tibial and distal femoral bone cuts, with reference to the medial compartment;
- posterior condyle cut with reference to the posterior condyle plane;
- lateral femoral condyle sliding osteotomy, if the need for ligament balancing appears after bone cuts;
- insertion of a semiconstrained implant with possibility of adapted intrinsic stability.

Conflict of interest statement

None.

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