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Planning an intertrochanteric femoral osteotomy

A simple formula for calculating the displacement necessary to keep the hip-knee-ankle axis normal after intertrochanteric osteotomy is presented.

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Despite the advent of the total hip prosthesis, intertrochanteric femoral osteotomy still remains a valuable orthopaedic procedure. However, a varus osteotomy causes the weight-bearing hip-ankle joint axis to move medially from its normal position through the centre of the knee and so produce overloading of the medial compartment of the knee joint. Conversely, a valgus intertrochanteric osteotomy results in overloading of the lateral compartment of the knee. Unless these alterations in the axis of the leg are desired – for example, a valgus intertrochanteric osteotomy may have a beneficial effect on medial gonarthrosis – the osteotomy should be simultaneously displaced to maintain a normal hip-ankle axis. A simple formula for use with a pocket calculator has been derived to give the appropriate femoral shaft displacement which should accompany the chosen degree of varus or valgus of the osteotomy.

Derivation of the formula

A $\theta°$ varus-wedge excision osteotomy is planned (Figure 1) with medial displacement (D) of the femoral shaft necessary to maintain the normal hip-knee-ankle axis:

$$D = T'C - TC$$
$$TC = CA\cos\alpha$$
$$T'C = CA\cos(\alpha - \theta)$$
$$\therefore D = CA(\cos\alpha - \theta) - CA\cos\alpha$$
$$= CA(\cos(\alpha - \theta) - \cos\alpha)$$

The radiograph produces a magnification of 1.2 and so the actual displacement necessary during operation is:

$$D = \frac{CA.[\cos(\alpha - \theta) - \cos\alpha]}{1 \cdot 2}$$

The planned osteotomy wedge and the centre of the hip joint are marked on the radiograph (Figure 2). The line C A is drawn and measured.

As C T in Figure 1 is parallel to A M, the angle $T\hat{C}A$ (α) equals the angle $C\hat{A}M$. This angle is measured on the radiograph and, along with the desired varisation angle θ and the distance C A, is substituted in the formula to give the desired medial displacement of the femoral shaft.

When planning a valgus osteotomy, again the apex of the wedge is used as the reference point (Figure 3). For a valgus osteotomy θ must be added to α, resulting in a negative value for D, i.e. negative medialisation. That is to say, the femoral shaft must be displaced laterally by the calculated distance to restore the femoral axis.

With pre-operative knowledge of the necessary displacement, it is possible to remove an equally effective but smaller wedge than otherwise. This is particularly important in the case of a varus osteotomy in order to minimize associated shortening of the femur (Figure 4). The required true displacement D is calculated as before. However, on displacing and closing the osteotomy after excision of the small wedge, the lateral portion of the proximal osteotomy surface tilts upwards correspondingly through $\theta°$. Allowance must be made for this obliquity

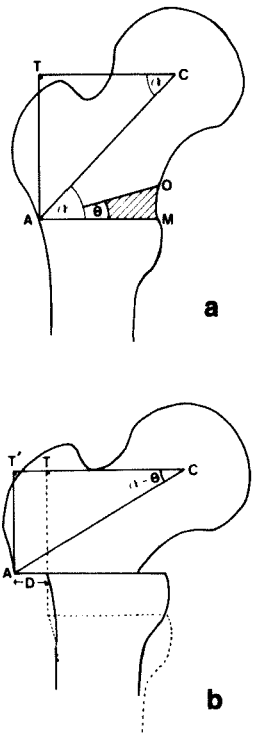

Figure 1. Planning a θ° varus osteotomy.
a before and b after the operation.
C = centre of femoral head.
A = apex of wedge O A M to be excised.
A M is perpendicular to the femoral shaft.
T C, parallel to A M, represents the horizontal distance between A and C. The dotted line shows the original position of the femoral shaft fragment. D, the medial displacement necessary to restore the femoral axis to its preoperative state, equals T'C – T C.

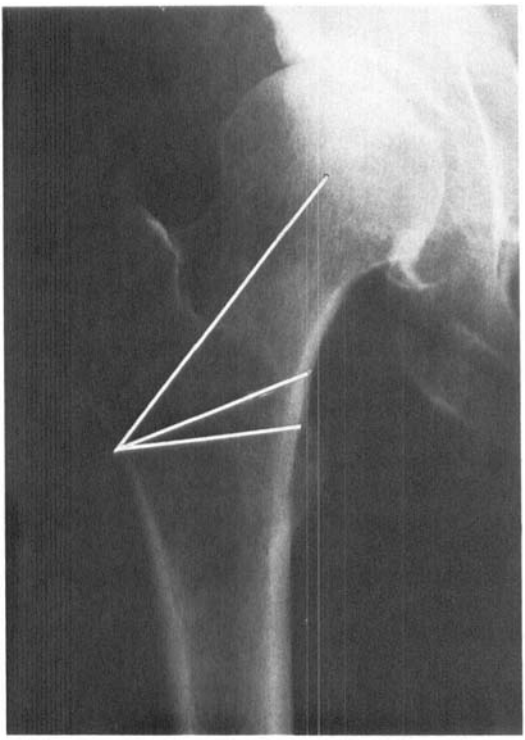

Figure 2. The clinical situation corresponding to Figure 1a. A θ varus osteotomy is required.
C A and the angle C Â M (α) are measured.

when calculating D', the distance between the lateral cortex and the apex of the small wedge.

$$D' = \frac{D}{\cos \theta}$$

Substituting this in the formula for D gives:

$$D' = \frac{CA}{1.2} \cdot \frac{\cos(\alpha - \theta) - \cos \alpha}{\cos \theta}$$

Discussion

Teinturier et al. (1981) have used the effect of upper femoral osteotomy advantageously to mitigate the effects of coexisting axial deformity of the knee. Unless such an effect is desirable, the normal hip-knee-ankle axis should be maintained during osteotomy by appropriate displacement of the femoral shaft. A method for measuring this displacement using rotated tracings of the hip radiographs has been devised by Müller (1975). However, the various tracings can be tedious and so the formula was devised to enable the required displacement to be calculated more easily.

During the osteotomy, excision of the wedge considerably distorts the femoral cortex at its base and so the displacement must be judged in each case at the apex A of the wedge, i.e. at the lateral cortex during a varus osteotomy and at the medial cortex during a valgus osteotomy.

During the last 2 years, this formula has been found useful when planning proximal femoral osteotomies. Perhaps more importantly, the drawings and the formula have been used in an attempt to impress on trainees

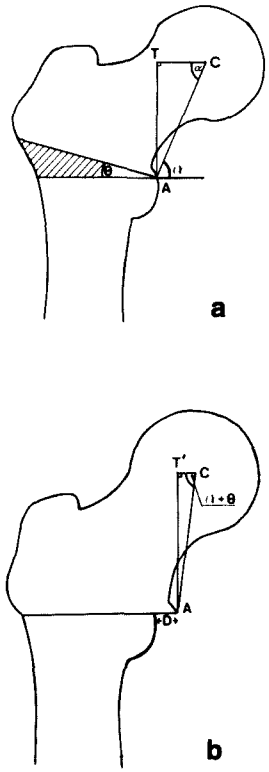

Figure 3. Planning a θ° valgus osteotomy. (See Figure 1, for explanations)

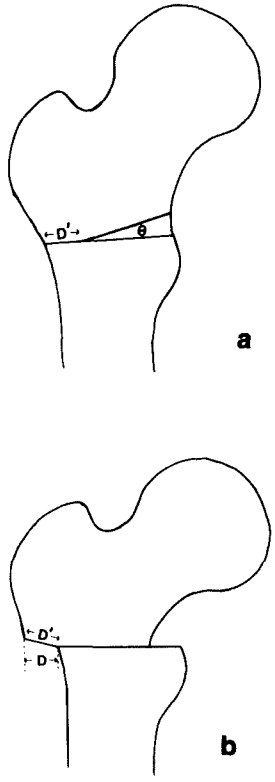

Figure 4. Varus osteotomy. Pre- (a) and postoperative (b) drawings illustrate how displacement of the apex of the wedge by D' (see text) allows excision of a smaller wedge. Compare with the full-size wedge in Figure 1.

the importance of considering the leg as a whole, and not only the hip, when planning a proximal femoral osteotomy.

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