

Original Article

Windswept deformities – An indication to individualise valgus correction angle during total knee arthroplasty



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ABSTRACT

Purpose: We aimed to determine variation in femoral valgus correction angle (VCA) between the two limbs in a patient with windswept deformity undergoing total knee arthroplasty (TKA).

Methods: Femoral VCA was measured on full-length, hip-to-ankle, standing radiographs and was compared between the varus and the valgus limbs in 66 patients with windswept deformities.

Results: The mean VCA in varus knees was significantly higher compared to mean VCA in valgus knees ($p = 0.002$).

Conclusion: Significant difference in VCA is present between the varus and the valgus limbs in most patients with windswept deformity undergoing TKA.

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1. Introduction

'Windswept' deformity in a patient refers to a condition where one knee has a valgus deformity and the other knee has a varus deformity. Commonly associated with skeletal dysplasias and metabolic bone disorders,^{1,2} windswept deformities are rarely seen in severely arthritic knees which undergo total knee arthroplasty (TKA).³

Accurate limb and component alignment is one of the goals of TKA. Positioning the femoral component in coronal plane in relation to the mechanical axis of the femur is dependent on the valgus correction angle (VCA) during TKA.⁴ Although, it is recommended that a standard range of 5–7° VCA be used while performing the distal femoral cut, studies have reported significant variation in VCA among individual knees undergoing TKA when measured on full-length standing hip-to-ankle radiographs.^{4–7} Furthermore, individualising the VCA during TKA will result in more accurate restoration of the limb alignment and positioning of femoral component in the coronal plane, especially in the presence of severe varus or valgus deformities and significant femoral bowing.^{4–8} Hence, variation in VCA based on the type of knee deformity is more relevant in patients with windswept deformity undergoing TKA where VCA may be significantly different in varus

knee when compared to the valgus knee. There are very few studies which have analysed windswept deformities, especially in arthritic knees undergoing TKA.

Meding et al.,³ in the only study which analysed TKA in windswept deformities reported on postoperative knee alignment, joint line and patella position measured on short knee anteroposterior radiographs. To the best of our knowledge, this is the first study in the literature which has analysed VCA in windswept deformities in patients undergoing TKA. Hence the aim of our study was to measure and determine variation in VCA between the two limbs in a patient with windswept deformity on preoperative full-length, standing, hip-to-ankle radiographs. We hypothesised that there will be significant difference in VCA between the two limbs of a patient with arthritic windswept deformity and therefore it is necessary to individualise VCA for each limb preoperatively on full-length radiographs during TKA.

2. Patients and methods

We retrospectively reviewed the clinical and radiographic records of 4000 patients who underwent total knee arthroplasty (TKA) between 2005 and 2015 for arthritic knees. The inclusion criterion was patients who had windswept deformity as measured on a preoperative full-length, standing, hip-to-ankle radiographs. The exclusion criteria was incomplete radiographic records where the preoperative full length hip-to-ankle radiographs were incomplete or not available to valgus correction angle (VCA). Based on the above criteria, complete data of 66 patients with

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windswept deformity was available for analysis. Of these 66 patients, there were 9 male and 57 female patients and 34 patients underwent unilateral TKA whereas the remaining 32 patients underwent simultaneous bilateral TKA.

Standing full length, hip to ankle weight-bearing radiographs, weight-bearing anteroposterior knee radiographs and knee lateral radiographs were obtained in all patients pre- and postoperatively. The degree of knee deformity or hip–knee–ankle (HKA) angle was determined on the preoperative standing full-length radiographs as the angle between the mechanical axis of the femur (line connecting the femoral head centre to the centre of the knee joint) and the mechanical axis of the tibia (line connecting the centre of the knee joint to the centre of the ankle). The femoral valgus correction angle (VCA) was also measured on preoperative standing full-length radiographs for each limb as the angle between mechanical axis of the femur (line connecting the femoral head centre to the centre of the knee joint) and anatomical axis of the femur (line along the mid-medullary axis of the distal diaphysis of the femur).⁴ Varus deformity was defined as hip–knee–ankle (HKA) angle of $\leq 180^\circ$ and valgus deformity was defined as hip–knee–ankle (HKA) angle of $>180^\circ$.

Radiographic parameters in terms of mean VCA between the varus and valgus knees were compared using the *t* test whereas the percentage of knees with VCA $<5^\circ$, $5\text{--}7^\circ$ and $>7^\circ$ in the varus or valgus knees were compared using the Fisher's exact test. A *p* value of <0.05 was taken to be statistically significant.

3. Results

The incidence of windswept deformity in this study was 1.5%. In valgus knees, the mean preoperative HKA angle was $188 \pm 6^\circ$ (range, $181\text{--}207^\circ$) with a mean VCA of $5.4 \pm 2^\circ$ (range, $2\text{--}13^\circ$). In varus knees, the mean preoperative HKA angle was $171 \pm 7^\circ$ (range, $137\text{--}178^\circ$) with a mean VCA of $6.4 \pm 1.6^\circ$ (range, $3\text{--}12^\circ$).

The mean VCA in varus knees was significantly higher compared to mean VCA in valgus knees ($p = 0.002$). The VCA was $<5^\circ$ in 40% of valgus knees compared to 6% in varus knees ($p = 0.0001$) whereas VCA was $5\text{--}7^\circ$ in 73% of varus knees compared to 47% in valgus knees ($p = 0.0003$). There was no difference in the percentage of varus or valgus knees with VCA $>7^\circ$ ($p = 0.18$).

A difference in VCA of $<3^\circ$ between the two limbs was seen in 63% of patients, a difference of $\geq 3^\circ$ between the two limbs was seen in 18% of patients and 19% of patients had no difference in VCA between the two limbs.

4. Discussion

The aim of our study was to measure and determine variation in VCA between the two limbs in a patient with windswept deformity on preoperative full-length, standing, hip-to-ankle radiographs. The results of this study showed significant difference in VCA between the varus and the valgus limbs in most patients with windswept deformity undergoing TKA (Fig. 1) with only 19% of patients showing no difference in VCA between the varus and the valgus limbs. This study also showed wide variation in VCA among limbs based on the type and severity of knee deformity (Fig. 2), varying from 2° to 13° in valgus knees and from 3° to 12° in varus knees, greater number of valgus knees having VCA $<5^\circ$ with 22% of knees (29 out of 132 knees) having VCA $<5^\circ$, 22% of knees (29 out of 132 knees) having VCA $>7^\circ$.

Meding et al.,³ in the only study which analysed the results of TKA in patients with windswept deformities reported that TKA can give good clinical and radiographic results in both the knees if the surgeon pays proper attention to ligament release, tibia plateau preparation, and proper knee alignment intraoperatively.

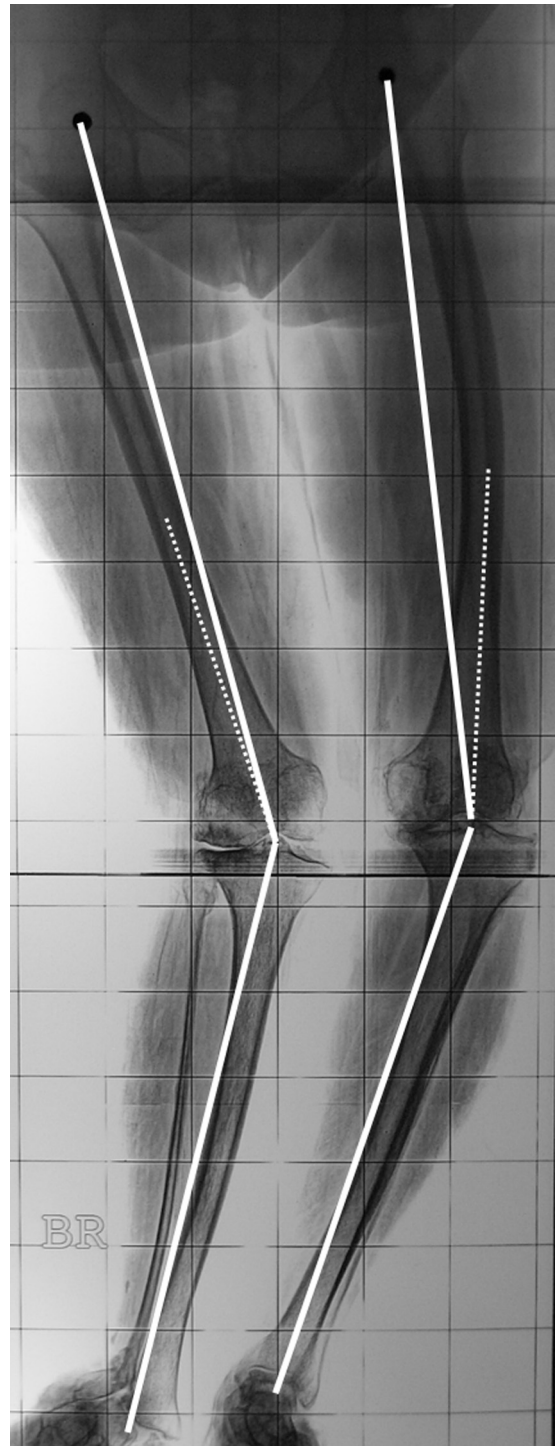


Fig. 1. Preoperative standing, full-length hip-to-ankle radiograph in a 76 year old female patient showing significant windswept deformity with a femoral valgus correction angle (VCA) of 4° for the right side with valgus deformity and VCA of 11° for the left side with varus deformity.

However, their study primarily focussed on knee alignment, joint line and patella position measured on short knee anteroposterior radiographs and did not analyse femoral VCA. Our results showing variation in VCA between the varus and valgus knee in windswept knees undergoing TKA is validated by similar studies done by other investigators in arthritic knees undergoing TKA. Mullaji et al.,⁴ in an analysis of 503 knees undergoing TKA reported that 56% of knees had VCA outside the usual range of $5\text{--}7^\circ$ whereas Palanisami et al.,⁵ in an analysis of 227 knees reported that 31% of knees had

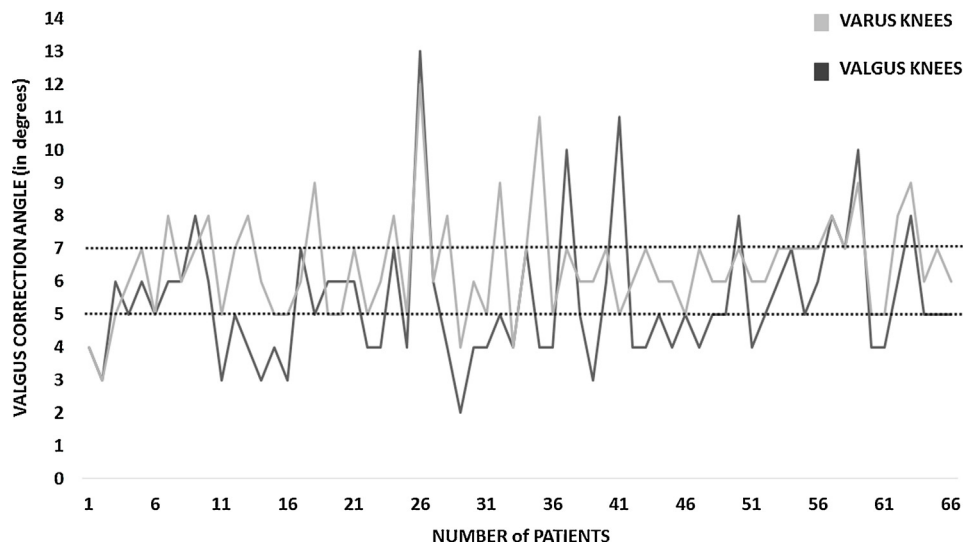


Fig. 2. Variation in the femoral valgus correction angle (VCA) among the varus and valgus knees in patients when compared to the standard VCA range of 5–7° (dotted lines).

VCA outside the usual range of 5–7°. This is similar to our study where 38% of knees had VCA outside the usual range of 5–7°.

Variations in VCA has been attributed to factors including type of deformity (varus or valgus), severity of deformity and presence of extra-articular deformities such as femoral or tibial bowing, coxa vara or valga and tibia vara.^{4–8} Individualising the VCA is crucial during TKA in order to achieve accurate limb and femoral component alignment and minimising errors especially in the presence of severe deformity or excessive femoral bowing of the femoral shaft.^{5,7} Hence, in view of the significant difference in mean VCA between the varus and the valgus knee, windswept deformities undergoing TKA is an indication for the surgeon to preoperatively measure femoral VCA on full-length hip-to-ankle radiographs in order to minimise error.

Limitations of this study include the retrospective nature of the study with its inherent drawbacks and biases and a relatively small number of study subjects considering the inherent rarity of windswept deformity in arthritic knees. However, to the best of our knowledge, this study is the first to analyse femoral valgus correction angle (VCA) in windswept arthritic knees undergoing TKA.

Conclusion

In conclusion, significant difference in VCA is present between the varus and the valgus limbs in most patients with windswept deformity undergoing TKA. It may be necessary to individualise VCA for each limb preoperatively on full-length radiographs in patients with windswept deformities in order to minimise error while performing the distal femoral cut during TKA.

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Conflicts of interest

The authors have none to declare.

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