

# Does the severity of preoperative varus deformity influence postoperative alignment in computer-assisted total knee arthroplasty? A five-to-eight year follow-up study

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**Introduction:** The accuracy of conventional total knee arthroplasty (TKA) using an intramedullary or extramedullary guide was thought to be compromised by the severity of the preoperative deformity.<sup>1</sup> However, the effect of the preoperative deformity on the postoperative accuracy and alignment in TKA using computer-assisted navigation system (CAS) is still debated.<sup>2,3</sup> The purpose of study was to evaluate the postoperative alignment according to the severity of preoperative deformity in computer-assisted total knee arthroplasty (CAS-TKA).

**Materials & Methods:** One hundred twenty consecutive CAS-TKAs were retrospectively reviewed. All TKAs were performed using the Vector Vision® 1.1 (BrainLAB, Heimstetten, Germany) navigation system. The average age at the time of TKA was 66.1 (range, 44–80) years. The average follow-up period was 6.7 years. The pre- and postoperative mechanical axes (MA) were defined as the angle between the femoral and tibial mechanical axes. Detailed analyses of the radiographs were conducted to determine  $\alpha$ ,  $\beta$ ,  $\gamma$ , and  $\delta$  angles, using the Knee Society X-ray evaluation method.<sup>4</sup> According to the preoperative MA, 78 knees with varus deformity  $\leq 15^\circ$  were classified as group A and 42 knees with varus deformity  $> 15^\circ$  were classified as group B. The postoperative MA and position of the component were compared between group A and B.

The Knee Society knee and function scores were used to evaluate pain and function, including range of motion (ROM), preoperatively and at the latest follow-up assessment.

**Results:** The MA was  $6.3 \pm 9.9^\circ$  varus preoperatively and  $0.7 \pm 2.9^\circ$  varus at the latest follow-up assessment in group A and  $21.7 \pm 5.2^\circ$  varus and  $2.8 \pm 3.4^\circ$  varus, respectively, in group B. The difference in postoperative MA between groups A and B was significant ( $p < 0.001$ ). The MA was within  $3^\circ$  in 78.4% of group A and 61.9% of group B. Using the Knee Society radiographic evaluation method, the position of the component was determined to be accurate and within the permissible range. The position of the component did not differ significantly between group A and B (Table 1).

The preoperative knee score was  $52.1 \pm 9.0$  and increased significantly ( $p < 0.001$ ) to  $96.6 \pm 7.1$  at the last follow-up examination. The preoperative function score was  $45.0 \pm 7.4$  and increased significantly ( $p < 0.001$ ) to  $91.4 \pm 11.4$  at the last follow-up examination. The ROM increased from  $121.8 \pm 22.0^\circ$  preoperatively to  $123.5 \pm 17.7^\circ$  at the last follow-up examination ( $p < 0.001$ ). The clinical results at the last follow-up examination did not differ between group A and B ( $p = 0.208$ ).

**Discussion:** The most important finding of this study was that the severity of preoperative varus deformity influenced postoperative alignment despite using CAS. We could not definitively explain why a more severe preoperative deformity resulted in more residual varus postoperative alignment. However, several explanations are possible. One concern is the effect of weight bearing.<sup>5</sup> The second concern is the potential source of registration error with a severely deformed knee and distorted anatomical landmarks. In addition, the application of a database that reflects Western anatomical features to Asian patients with different anatomical features and deformity patterns can make it difficult to morph the anatomy to a best-fit model and may create problems in imageless navigation system. Another concern is that the center of the resected surface does not coincide with the point of the shaft axis passing through the cut surface in some knees. In Asian populations, this finding has

been explained as the medial offset, shift angle, or bowing angle. This discrepancy is more apparent in knees with severe varus deformity and lateral bowing of the femoral or tibial shaft.

In conclusion, the severity of preoperative varus deformity influenced postoperative alignment despite using CAS. More careful attention to ensure an accurate alignment is required, especially in TKA in patients with a greater varus deformity, to avoid insufficient correction. The mid-term clinical results of CAS-TKA were satisfactory without major complications.

|                                  | Group A                   | Group B                    | P      |
|----------------------------------|---------------------------|----------------------------|--------|
| <b>Preoperative MA</b>           | Varus $6.3 \pm 9.9^\circ$ | Varus $21.7 \pm 5.2^\circ$ | <0.001 |
| <b>Postoperative MA</b>          | Varus $0.7 \pm 2.9^\circ$ | Varus $2.8 \pm 3.4^\circ$  | <0.001 |
| <b><math>\alpha</math> angle</b> | $96.1 \pm 2.0^\circ$      | $95.7 \pm 2.7^\circ$       | 0.374  |
| <b><math>\beta</math> angle</b>  | $90.0 \pm 1.5^\circ$      | $89.4 \pm 1.8^\circ$       | 0.238  |
| <b><math>\gamma</math> angle</b> | $1.9 \pm 2.5^\circ$       | $1.4 \pm 2.8^\circ$        | 0.103  |
| <b><math>\delta</math> angle</b> | $85.9 \pm 2.7^\circ$      | $85.8 \pm 2.7^\circ$       | 0.935  |

**Table 1.** Clinical results according to the underlying disease Group A, knees with preoperative varus deformity  $\leq 15^\circ$ ; Group B, knees with preoperative varus deformity  $> 15^\circ$ ; MA, mechanical axis;  $\alpha$ ,  $\beta$ ,  $\gamma$ , and  $\delta$  angles indicate the coronal or sagittal position of the femoral or tibial component using the Knee Society X-ray evaluation method.

## References

1. Teeny SM, Krackow KA, Hungerford DS, Jones M. Primary total knee arthroplasty in patients with severe varus deformity. A comparative study. *Clin Orthop Relat Res* 1991;273:19-31.
2. Yau WP, Chiu KY, Zuo JL, Tang WM, Ng TP. Computer navigation did not improve alignment in a lower-volume total knee practice. *Clin Orthop Relat Res* 2008;466-4:935-45.
3. Hsu WH, Hsu RW, Weng YJ. Effect of preoperative deformity on postoperative leg axis in total knee arthroplasty: a prospective randomized study. *Knee Surg Sports Traumatol Arthrosc*;2010;18-10:1323-7.
4. Ewald FC. The Knee Society total knee arthroplasty roentgenographic evaluation and scoring system. *Clin Orthop Relat Res* 1989;248:9-12.
5. Specogna AV, Birmingham TB, Hunt MA, Jones IC, Jenkyn TR, Fowler PJ, Giffin JR. Radiographic measures of knee alignment in patients with varus gonarthrosis: effect of weightbearing status and associations with dynamic joint load. *Am J Sports Med* 2007;35:65-70.