Neutral Mechanical Alignment: A Requirement for Successful TKA: Opposes

JOHAN BELLEMANS, MD, PhD

abstract

There is increasing evidence that for a number of patients, neutral alignment is not normal. Patients with so-called constitutional varus have been in varus alignment since the end of their growth. Restoring neutral alignment in these cases may not be the best option for these patients since it is abnormal to them.

We recently performed a number of observational studies to find out how patients develop constitutional varus, how these patients can be recognized, and which factors contribute. A cohort of 800 young patients was analyzed to determine the influence of activity level on growth and the development of lower-leg alignment. At the same time, 250 asymptomatic adults between 20 and 27 years were analyzed to determine the incidence of constitutional varus. The results showed that 32% of adult men and 17% of adult women had constitutional varus knees with a natural mechanical alignment $\geq 3^\circ$ varus. Constitutional varus was associated with increased sports activity during growth and began to become apparent at the time of growth spurt.

Based on these data, we believe that an important fraction of the normal population has a natural alignment at the end of growth of $\geq 3^\circ$ varus. This may be a consequence of Hueter-Volkmann’s law. Restoration of mechanical alignment to neutral in these cases therefore may not be desirable and in fact unnatural for them.

Dr Bellemans is from the University Hospitals of the Catholic University, Leuven, Belgium.
Dr Bellemans has no relevant financial relationships to disclose.
Presented at Current Concepts in Joint Replacement 2010 Winter Meeting; December 8-11, 2010; Orlando, Florida.
Correspondence should be addressed to: Johan Bellemans, MD, PhD, Department of Orthopedic Surgery, University Hospital Pellenberg, Weligerveld 1, 3012 Pellenberg, Belgium (johan.bellemans@skynet.be).
doi: 10.3928/01477447-20110714-41
ne of the classical dogmas in total knee arthroplasty (TKA) reports that neutral mechanical alignment should be restored.\textsuperscript{1-5} Whether this is correct can be debated. Patients who have constitutional varus (ie, patients at the end of their growth when they have reached skeletal maturity) are in varus alignment and may not be helped in the best way by restoring neutral alignment, because this is not physiological and is abnormal for them.

There is evidence in the literature that the number of patients we are treating with constitutional varus is much greater than we expect. Virtually all studies on normal human alignment have shown that normal human alignment is not \(0^\circ\) mechanical, but rather around \(1^\circ\) varus.\textsuperscript{6-8} In addition, it has been shown that the standard deviation on this average is high, suggesting that a large number of outliers exist. To find what fraction of the normal population has constitutional varus, we examined 250 young adults just after they had reached skeletal maturity.\textsuperscript{9} We found that one-quarter of normal, healthy adults at the end of skeletal maturity have a natural mechanical alignment of \(\geqslant 3^\circ\) varus (1 in 3 men [32\%] and 1 in 6 women [17\%]).\textsuperscript{9}

We also analyzed potential factors contributing to the development of constitutional varus. An increased varus neck-shaft angle, increased femoral bowing, and increased angle between the mechanical and neutral axis of the femur were significant contributors, together with a history of increased physical activity during growth.\textsuperscript{9}

To investigate the effect of physical activity on the development of constitutional varus alignment, we performed a cross-sectional analysis among young patients with variable degrees of physical activity.\textsuperscript{10} A cohort of 800 growing children was studied. The cohort comprised one group of elite athletes who played soccer, a second group of elite athletes who played other types of impact sports, and a third group of controls who played no sports. Interestingly, we found that the youngsters from group 1 and 2 developed constitutional varus (Figure). Especially at the end of growth, aged approximately 14 to 16 years, the alignment of these children became significantly more in varus compared to the controls who did not play sports.\textsuperscript{10}

Based on these data, we conclude that an important fraction of the normal population has a natural alignment in varus. When these people, at a later stage in their life, present with osteoarthritis requiring TKA, it is potentially beneficial to restore their limb into their natural alignment of slight varus, as this is normal to them.

Unlike older reports in the literature, some recent studies have shown that the functional results and survivorship data of TKAs that were left in somewhat varus were not worse than the results of knees that were restored to \(0^\circ\) mechanical alignment.

Two recent reports came to the same conclusion: when using a modern implant and modern fixation techniques, the survivorship and functionality of the so-called outliers in varus were comparable to the neutral-aligned knees.\textsuperscript{11,12} In 1 of these studies, the TKA patients in varus had better survivorship than those restored to neutral.\textsuperscript{12}

It is legitimate to question the dogmatic approach of restoring every knee to \(0^\circ\) alignment. Instead, wouldn’t it be more logical to restore to the patient his own native baseline type of alignment?

**References**


