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Variations of the "Grand Piano" Sign in Total Knee Arthroplasty

I have read with interest the recently published paper by Moyad and colleagues.[1] I should note, however, that the "grand piano sign" was first described by John N. Insall.[2,3] It would be fair to clarify this, not only for the sake of informing the readers of your Journal, but also as a tribute to this pioneer of knee replacement surgery.

It is also worthwhile mentioning the previous elaborate study on the same topic by Cui and colleagues,[3] who have employed computer tomography reconstructions and computer simulation in a larger sample size (n = 50). Their methodology was validated on 5 cadaver femora. Cui and colleagues[3] found that the medial to lateral (M:L) ratio was very close to 0.66, or $^2/_3$, when the anterior cut was performed parallel to the epicondylar axis. They, however, distinguished between what they termed the clinical and the surgical epicondylar axes, referencing them off of the most prominent point of the medial epicondyle and the deepest point of the sulcus of the medial epicondyle, respectively. Their findings, as described previously, referred to the surgical epicondylar axis, whereas use of the clinical epicondylar axis yielded an M:L ratio of approximately 0.5, or ½. Indeed, this is in agreement with what Moyad and colleagues[1] have reported.

Moyad and colleagues[1] did not describe how they defined the epicondylar axis. However, based on the above, I surmise they have used the most prominent point of the medial epicondyle as a reference. If this were not to be the case, then a discrepancy in the results of the 2 studies exists, which might be attributed to the different races (Caucasians[1] vs. Koreans[3]) of the patient populations in the 2 studies.

One last comment on the use of the anteroposterior (AP) axis in total knee replacement (TKR) in valgus knees: Moyad and colleagues[1] state in their introduction that "the [transepicondylar axis] EA and the AP axis are more accurate than the posterior condylar axis (PCA), particularly in the valgus knee," whereas, in the discussion, they go on to claim that "valgus deformity leads to reduced reliability of the TEA, the PCA, or the AP axis in terms of obtaining a symmetric flexion gap."[1] Interestingly, they have used the same paper[4] as reference in support of these 2 contradictory statements. Overall, there is literature to support the reliability of the anteroposterior axis in TKR in valgus knees.[5] My personal experience has been equally rewarding, as I use it routinely and, so far, have not encountered any problems with patellar tracking intra- or postoperatively.

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Author's Response

I appreciate the author's questions. Although John Insall was indeed a great pioneer and certainly may have used the term "grand piano sign," as far as the literature is concerned, I have seen nothing to support crediting him for studying its clinical use.

In the radiographic study by Cui and colleagues[1] in 2006, which used computed tomography imaging, the authors used imaging software to "simulate" bone cuts that are made during total knee arthroplasty. On the other hand, our original experiment performed in 2003 involved performing total knee replacements on cadaver knees in our laboratory. At that time, as well in a more recent follow-up literature search prior to publication, our search did not show that the grand piano sign was used previously in a *clinical* study. If you read our paper carefully, we state in the abstract that this has not been studied in vivo or in the lab. Although Cui and colleauges[1] used a few cadavers in their study, the majority of patients were scanned radiographically and simulated bone cuts were made to approximate a clinical bone cut. In our study however, we used fresh cadavers in *all* specimens and we actually made osteotomies with the cutting jigs and clinical instruments that are commonly used in arthroplasty today. Our study was not a radiologic study. Nevertheless, the author of the editorial is correct in stating that there has been another study performed fairly recently that also has studied the "grand piano sign" in the literature. I am glad to see this and I hope that there are more studies to support its use in the near future. Although our study was clinically relevant, I continue to stress that further clinical studies will be needed in the future to validate our findings.

In response to the question about valgus knees and the reliability of the posterior condylar axis (PCA), there is

literature to support that the PCA is the most unreliable axis, especially in valgus knees.[2] In Olcutt and Scott's paper,[2] the authors looked at obtaining a symmetric flexion gap by using the transepicondylar axis (TEA), PCA and anteroposterior (AP) axis. I disagree with the author of the editorial as there can actually be difficulty in obtaining a symmetric flexion gap with all 3 of these markers, especially in the valgus knee, compared with the varus knee. The author is correct that the AP axis is likely the most reliable marker in valgus knees for judging rotation. Nevertheless, with the goal of balancing the flexion gap, all 3 of these common axes do have significant error in valgus knees. It just so happens in the valgus knee, the PCA is the least reliable. The TEA and AP axis, although better than the PCA, still have clinically relevant error in obtaining a symmetric flexion gap.[2]

Lastly, the author of this letter implies that he does not know if we used the surgical epicondylar or clinical epicondylar axis. If you look at Figure 2 in our paper, there is an obvious red line that was place across the image purposefully to show that we use the clinical axis. To the untrained eye, this certainly could be confusing. However, for most surgeons who have experience with total knee arthroplasty, Figure 2 clearly shows that we used the prominent point on the medial epicondyle. Although we used a red line to demonstrate how we measured the TEA, in hindsight, describing which specific axis we used elsewhere in the body of our paper may have avoided any confusion.

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