Validation of the Coronal Plane Alignment of the Knee Classification for Short-Leg Anteroposterior Weight-Bearing Radiograph with Use of Anatomic Axis Measurements

Thomas Bradbury[1], Anita "Alex" Bradham[1], Natalie Gresham[1], Charlotte Baker[1], Zachary Ricciardelli[1], Joseph Schwab[2]
[1] Total Joint Specialists, Cumming, GA, [2] University of Fribourg, Fribourg, Switzerland

Disclosures: Thomas Bradbury(1, 3B; Zimmer Biomet; Total Joint Orthopaedics, 9; Georgia Orthopaedic Society), Alex Bradham (N), Natalie Gresham (N), Charlotte Baker (N), Zachary Ricciardelli (N), Joseph Schwab (2; DePuySynthes. 9; Anterior Hip Foundation Board Member)

Introduction: Preoperative assessment of coronal knee alignment is critical for total knee arthroplasty (TKA) planning. Long-leg radiographs (LLRs) are the gold-standard for assessing mechanical axes but are time-consuming, costly, and involve more radiation exposure. Short-leg radiographs (SLRs) are more commonly used in clinical practice, but may lack the accuracy of LLRs. The Coronal Plane Alignment of the Knee (CPAK) classification, which uses joint line obliquity (JLO) and arithmetic hip-knee-ankle angle (aHKA), provides a standardized method of describing coronal alignment. This study evaluates whether applying a 5° correction to the short-leg lateral distal femoral angle (slLDFA) on SLRs can approximate CPAK classification derived from LLRs.

Methods: A retrospective review was conducted on 268 patients who underwent staged bilateral TKA by a single surgeon using a mechanical alignment technique. All patients had preoperative SLRs and LLRs. Two independent raters measured LDFA and MPTA to calculate aHKA and JLO, then assigned CPAK types using the MacDessi algorithm. Inter- and intra-rater reliability was assessed using intraclass correlation coefficients (ICCs). Agreement between CPAK classifications derived from LLRs and corrected-SLRs (with 5° slLDFA adjustment) was assessed per Kraus et al, 2025.

Results: We found a systematic difference between long-leg and short-leg LDFA measurements of 6.3°. Applying a 5° correction to the slLDFA yielded CPAK classifications that matched those derived from LLRs in 66% (177/268) of cases. The optimal correction threshold fell between 4.8° and 5.1°, yielding composite agreement rates exceeding 81.7%. Angle measurement ICCs ranged from 0.780 to 0.965.

Discussion: A 5° slLDFA correction applied to SLRs offers a valid approximation of CPAK classification compared to LLRs. This method provides a reliable, cost-effective alternative when long-leg imaging is unavailable, potentially enhancing preoperative planning while reducing patient burden.

Significance/Clinical Relevance: Corrected short-leg radiographs offer a cost-effective and less burdensome alternative to long-leg imaging while maintaining reliable CPAK classification. This approach provides a practical solution when long-leg radiographs are unavailable, streamlining preoperative planning without sacrificing accuracy.

Keywords: knee alignment, CPAK, short-leg radiographs, measurement reliability, lateral distal femoral angle

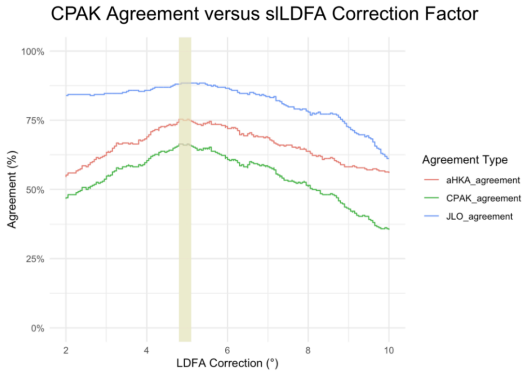

Figure 1: *Agreement between short-leg and long-leg radiographic classifications across a range of slLDFA correction factors. JLO, aHKA, and CPAK agreement are plotted as functions of slLDFA correction from 2° to 10°. The shaded region denotes the range of maximal composite agreement. Abbreviations: JLO, joint line obliquity; aHKA, arithmetic hip-knee-ankle angle; CPAK, coronal plane alignment of the knee; slLDFA, short-leg lateral distal femoral angle.*

Characteristic	Overall N = 268[1]	I N = 114[1]	II N = 60[1]	III N = 50[1]	IV N = 17[1]	V N = 7[1]	VI N = 19[1]	VII N = 1[1]
Short-Leg LDFA	81.4 (73.2-97.9)	82.6 (78.3-88.7)	80.8 (75.9-87.0)	79.0 (73.3-82.5)	84.3 (80.2-97.9)	81.1 (78.8-83.1)	80.3 (77.9-83.7)	86.2 (86.2-86.2)
Long-Leg LDFA	87.7 (78.1-96.3)	89.5 (85.5-94.3)	86.4 (80.1-88.9)	83.9 (78.1-86.8)	92.6 (90.0-96.3)	89.2 (88.0-90.2)	86.4 (82.5-88.4)	95.4 (95.4-95.4)
Delta LDFA	6.3 (2.9-9.3)	6.2 (2.9-9.3)	6.6 (3.9-9.0)	6.8 (4.6-9.0)	5.9 (3.9-8.7)	5.0 (3.8-7.9)	6.2 (4.4-8.0)	7.5 (7.5-7.5)

Table 1: *Descriptive Statistics of short-leg and long-leg LDFA measurements by corresponding CPAK classification, and the difference (delta) between them.*

[1]Mean(Min - Max)