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Evaluation Of The Effect Of Proximal Tibial Valgus Osteotomies On Knee Morphotype According To The Coronal Plane Alignment Of The Knee (CPAK) Classification

Orthopaedics / Knee & Lower Leg / Miscellaneous

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Background
High tibial osteotomy (HTO) is the primary joint-preserving surgery for patients with medial knee osteoarthritis and coronal plane deformities. Despite generally good outcomes, a subset of patients keeps experiencing early failure, prompting in the last few years a renewed interest in joint line orientation and its relationship to other alignment parameters as well as clinical outcomes. The recently developed coronal plane alignment of the knee (CPAK) classification integrates joint line obliquity and coronal alignment into nine phenotypes, offering a structured framework for characterizing knee alignment. Although originally designed for arthroplasty, CPAK may help stratify patients undergoing valgus osteotomy, but current evidence on its application in this context remains limited.

Objectives
This study aimed to analyze the pre-operative distribution of CPAK phenotypes in patients treated with HTO for genu varum and to assess how osteotomy influences CPAK changes.

Study Design & Methods
A retrospective review was conducted on patients who underwent HTO for genu varum at our institution. Inclusion criteria were a minimum of 6 months' follow-up and availability of pre- and post-operative long-leg weight-bearing radiographs. Patients with prior ipsilateral osteotomies or lower limb joint replacements were excluded. Radiographs were evaluated for hip-knee-ankle angle (HKA), medial proximal tibial angle (mMPTA), lateral distal femoral angle (mLDFA), arithmetic HKA (aHKA), joint line orientation (JLO), and CPAK morphotype. Descriptive statistics were used for demographic and radiographic data. Pre- and post-operative comparisons were made using the Student t-test for continuous variables and the Pearson Chi-square test for nominal variables. Statistical analysis was conducted using SPSS 25 (IBM, Armonk, NY, USA), with significance set at $p<0.05$.

Results
The study included 90 patients and 101 knees, with 72 undergoing medial opening wedge HTO and 29 lateral closing wedge HTO. Mean mHKA changed from 172.2° to 178.0°, MPTA from 84.3° to 90.7°, and LDFA varied by -0.2°. Preoperative aHKA showed 82.2% varus knees, shifting postoperatively to 41.6% neutral and 36.9% valgus. JLO changed from 77.2% distal apex to 54.5% neutral. CPAK type I (65.3%) predominated preoperatively, shifting mainly to types V (25.7%) and VI (21.8%) postoperatively.

Conclusions
This study analyzed changes in coronal alignment and CPAK knee morphotypes following high tibial osteotomy. CPAK classification patterns changed postoperatively, with type I knees most frequently

transitioning to type V and VI, while type IV showed a tendency to redistributing evenly between types VIII and IX.

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