Knees with anteromedial osteoarthritis show a substantial variability in Coronal Plane Alignment of the Knee (CPAK) phenotypes: prevalence and phenotypic changes following medial unicompartmental knee arthroplasty

G.V. ten Noever de Brauw[1,2], T. Bayoumi[1,2], L.V. Ruderman[1], G.M.M.J. Kerkhoffs[2], A.D. Pearle[1], H.A. Zuiderbaan[3]

[1] **Hospital for Special Surgery, New York, United States**

[2] Amsterdam UMC, Location Univeristy of Amsterdam, Amsterdam, The Netherlands

[3] Medische Kliniek Velsen, Velsen-Noord, The Netherlands

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Dr. Andrew D. Pearle is a paid consultant for Smith & Nephew Inc and DePuy Synthes

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Background and Objectives

- To evaluate the phenotypic variation using the Coronal Plane Alignment of the Knee (CPAK) classification[1] among knees with anteromedial osteoarthritis (OA) both prior to and following medial unicompartmental knee arthroplasty (UKA).

- To investigate whether knees maintained their preoperative CPAK phenotype and to evaluate the phenotypic alterations in the coronal plane that occur following medial UKA.

Methods

- This study comprised of 1000 knees of 835 patients undergoing robotic-arm assisted medial UKA for isolated anteromedial OA.
- Radiographic measurements included the lateral distal femoral angle (LDFA) and medial proximal tibial angle (MPTA).
- Knees were categorized into nine distinct CPAK phenotypes (Fig. 1) based on their arithmetic hip-knee-ankle angle (aHKA: MPTA - LDFA), which estimates the pre-arthritic alignment, and their joint line obliquity (JLO: MPTA + LDFA), both pre- and postoperatively.
- Phenotypic variation was analyzed by sex and the phenotypic alterations following medial UKA were evaluated by phenotype.

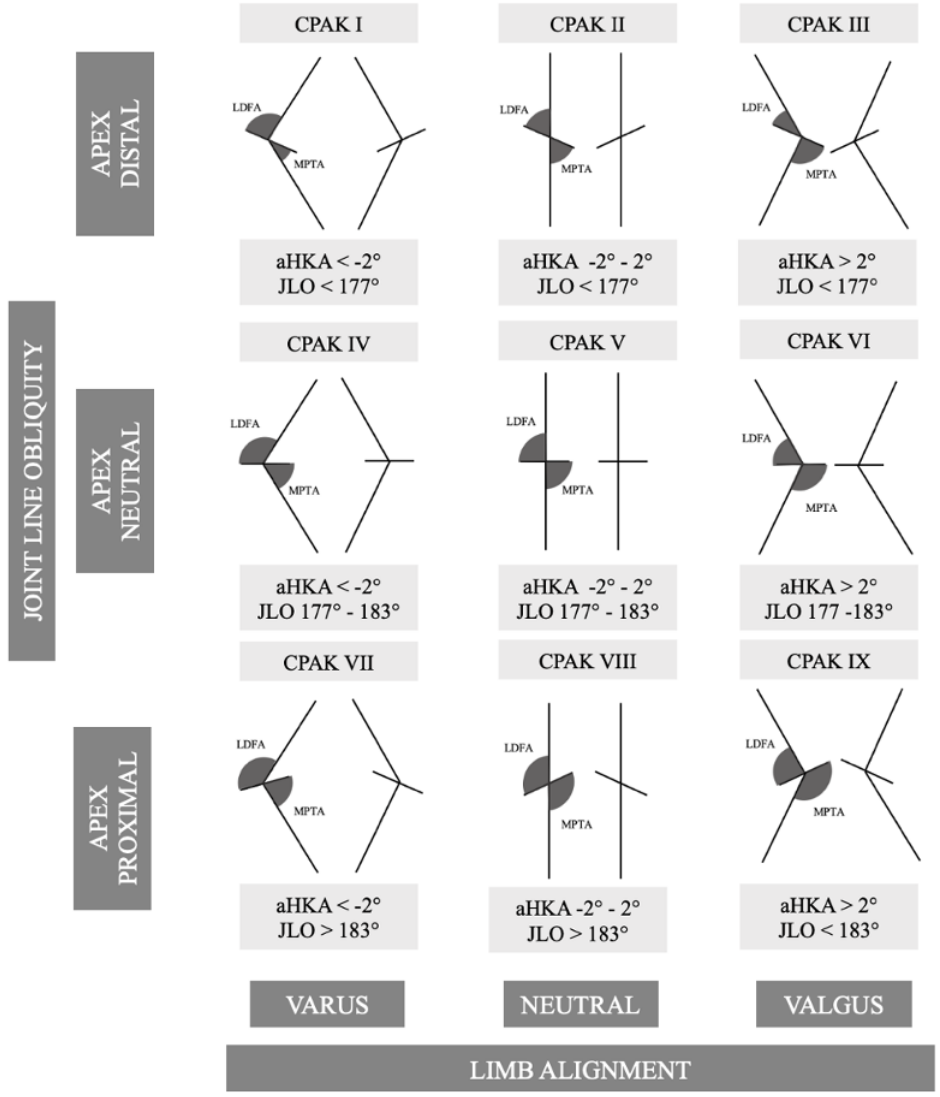

Figure 1. Coronal Plane Alignment of the Knee (CPAK) classification with nine identified CPAK phenotypes

Results

- Preoperatively, CPAK phenotype I and II exhibited the highest prevalence (45% and 34%, respectively), whereas postoperatively there was a noticeable shift towards a more neutral alignment (Fig.2).

- Pre- and postoperatively, the majority of patients exhibited with an apex distal oriented joint line (82.5% and 83.8%, respectively).

- Among males, the preoperative prevalence of CPAK phenotype I was significantly higher compared to females (53% vs. 35%, respectively; p = <.001), while females exhibited a significantly higher occurrence of CPAK V compared to males (10% vs. 4%, respectively; p = .015).

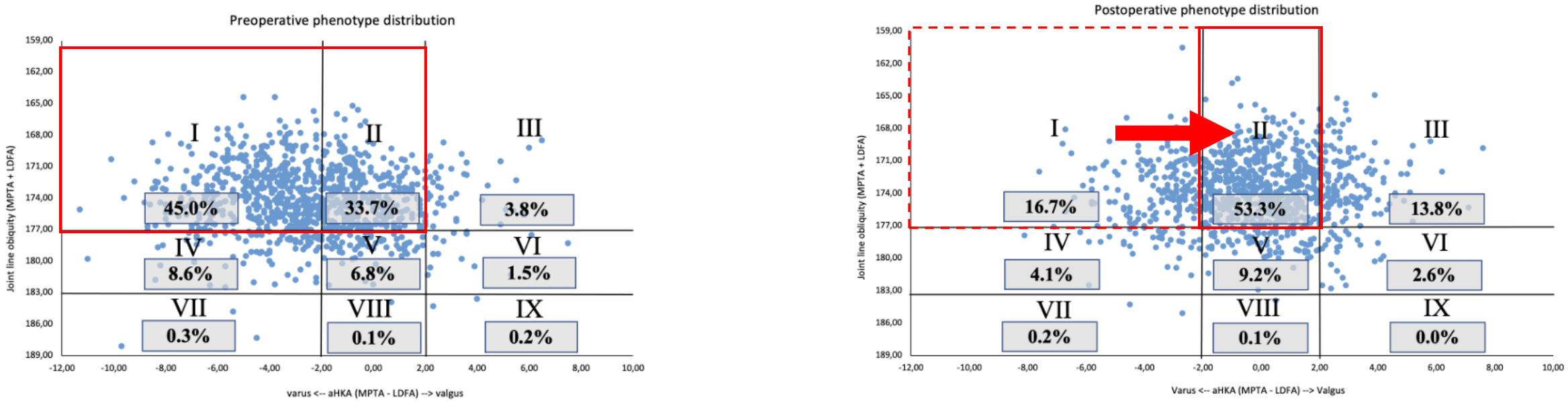

Figure 2. Scatterplots of the preoperative (left) and postoperative (right) phenotype distribution in knees with anteromedial OA and following medial UKA.

Results

- Overall, 45% of knees maintained their preoperative CPAK phenotype following medial UKA (Table 1).

Table 1. Distribution of CPAK phenotype restoration

Preoperative CPAK phenotype	Number of knees	Maintained CPAK phenotype	Not Maintained CPAK phenotype
I	450 (45.0%)	143 (31.8%)	307 (68.2%)
II	337 (33.7%)	228 (67.6%)	109 (32.4%)
III	38 (3.8%)	25 (65.8%)	13 (34.2%)
IV	86 (8.6%)	21 (24.4%)	65 (75.6%)
V	68 (6.8%)	27 (39.7%)	41 (60.3%)
VI	15 (1.5%)	5 (33.3%)	10 (66.7%)
VII	3 (0.3%)	2 (66.7%)	1 (33.3%)
VIII	1 (0.1%)	0 (0.0%)	1 (100.0%)
IX	2 (0.2%)	0 (0.0%)	2 (100.0%)
Total	1000 (100.0%)	451 (45.1%)	549 (54.9%)

Conclusions

- There is a substantial variation in CPAK phenotypes among knees with anteromedial OA, as well as following medial UKA.
- The variability in phenotypic expressions challenges the assumption of uniform characteristics among knees with an identical wear pattern associated with anteromedial OA and emphasizes the complexity and variability of this specific form of OA.
- CPAK phenotypes characterized by varus alignment were more common in males, whereas phenotypes characterized by a neutral or valgus alignment were more frequently observed in females.
- Future studies should investigate the specific advantages of maintaining the preoperative CPAK phenotype and identify the acceptable limits for pre- to postoperative alterations in CPAK phenotypes during medial UKA in relation to functional outcomes

References

[1] MacDessi SJ, Griffiths-Jones W, Harris IA, Bellemans J, Chen DB (2021) Coronal Plane Alignment of the Knee (CPAK) classification. Bone Joint J 103-b:329-337

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