

Table 1: Baseline Characteristics and Preoperative Alignment of Study Groups

Parameter	CPAK Group (n=25)	Mechanical Group (n=25)	p-value
Age (years, mean ± SD)	63.1 ± 7.3	63.8 ± 7.7	0.72
Female (%)	15 (60%)	16 (64%)	0.77
BMI (kg/m ² , mean ± SD)	27.6 ± 2.9	28.1 ± 3.1	0.51
KL Grade IV (%)	18 (72%)	17 (68%)	0.76
Comorbidities (≥1)	14 (56%)	15 (60%)	0.78
Pre-op HKA angle (°)	varus 7.2 ± 3.1	varus 6.8 ± 3.6	0.68
Joint line obliquity (°)	4.8 ± 2.1	4.6 ± 2.3	0.79
CPAK phenotype II (%)	9 (36%)	8 (32%)	--
CPAK phenotype III (%)	7 (28%)	6 (24%)	--

Values are presented as mean ± standard deviation or number (percentage), as appropriate. There were no statistically significant differences between the CPAK and mechanical alignment groups with respect to demographic variables, comorbidities, or preoperative radiographic parameters, indicating comparable baseline characteristics. CPAK phenotype distribution is presented descriptively.

Table 2: Comparison of Intraoperative Variables Between CPAK and Mechanical Alignment

Parameter	CPAK Group	Mechanical Group	p-value
Operative time (min)	79.4 ± 11.5	82.6 ± 12.2	0.32
Medial soft-tissue release (%)	3 (12%)	10 (40%)	0.02*
Lateral release (%)	1 (4%)	2 (8%)	0.55

Values are expressed as mean ± standard deviation or number (percentage). Operative time was comparable between groups. The CPAK group required significantly fewer medial soft-tissue releases compared to the mechanical alignment group ($p < 0.05$), while no significant difference was observed in lateral release rates.

Table 3: Postoperative Radiographic Alignment Outcomes

Parameter	CPAK Group	Mechanical Group	p-value
HKA angle deviation (°)	1.8 ± 1.2	3.9 ± 1.8	<0.001*
Joint line obliquity deviation (°)	1.2 ± 0.8	3.4 ± 1.5	<0.001*
Component varus/valgus error (°)	0.9 ± 0.6	1.6 ± 1.0	0.004*

Values are expressed as mean ± standard deviation. The CPAK group demonstrated significantly lower deviation from constitutional alignment compared to the mechanical alignment group across all parameters, including HKA deviation, joint line deviation, and component alignment error. Statistical significance was set at $p < 0.05$.

Table 4: Comparison of Clinical Outcomes, Pain Scores, and Complications Between CPAK and Mechanical Alignment Groups

Parameter	Timepoint	CPAK Group	Mechanical Group	p-value
Knee Society Score (KSS)	Preoperative	44.8 ± 6.4	45.2 ± 7.1	0.80
	3 Months	76.1 ± 8.2	69.5 ± 10.4	0.01*
	6 Months	89.4 ± 7.2	82.1 ± 9.0	0.004*
Oxford Knee Score (OKS)	Preoperative	22.6 ± 4.5	23.1 ± 4.9	0.72
	3 Months	35.8 ± 4.8	32.1 ± 5.1	0.01*
	6 Months	41.6 ± 4.1	37.9 ± 5.0	0.01*
VAS Pain Score	Preoperative	8.1 ± 1.2	8.0 ± 1.1	0.84
	3 Months	2.9 ± 1.0	3.8 ± 1.1	0.004*
	6 Months	1.4 ± 0.8	2.4 ± 1.0	0.002*
Complications, n(%)	Infection	0	1 (4%)	-
	Stiffness requiring physiotherapy	1 (4%)	4 (16%)	-
	Persistent pain	1 (4%)	5 (20%)	-
	Deep Vein Thrombosis	0	1 (4%)	-

Values are presented as mean ± standard deviation or number (percentage), as appropriate. Between-group comparisons were performed at each timepoint. The CPAK group demonstrated significantly better functional outcomes and lower pain scores at 3 and 6 months postoperatively compared to the mechanical alignment group ($p < 0.05$). Complication rates are presented descriptively without statistical comparison.

Table 5: Correlation Analysis Between Alignment Parameters and Functional Outcomes

Variable Comparison	Correlation (r)	p-value
CPAK phenotype vs. 6-month KSS	0.62	<0.001*
Joint line deviation vs. KSS	-0.48	0.004*
HKA deviation vs. OKS	-0.51	0.002*

Correlation coefficients (r) represent the strength and direction of association between radiographic parameters and functional outcomes. CPAK phenotype demonstrated a significant positive correlation with 6-month Knee Society Score (KSS), while joint line deviation and HKA deviation showed significant negative correlations with KSS and Oxford Knee Score (OKS), respectively. Statistical significance was set at $p < 0.05$.

Table 6: Multicentric Comparison of Clinical Outcomes and Alignment Distribution

Parameter	Center A (n=18)	Center B (n=16)	Center C (n=16)	p-value
Mean 6-month KSS	86.8 ± 8.2	84.6 ± 9.0	85.9 ± 8.4	0.79
CPAK alignment cases (%)	10 (55%)	8 (50%)	7 (44%)	0.71
Complication rate (%)	6%	9%	11%	0.63

Values are presented as mean ± standard deviation or percentage, as appropriate. No statistically significant differences were observed among the three centres with respect to 6-month Knee Society Scores, the proportion of CPAK alignment cases, and complication rates, indicating consistent outcomes across participating centres.