Patient Reported and Clinical Outcomes of High Tibial Osteotomy and Distal Femoral Osteotomy in High Level Athletes: A Mean 5-Year Follow-up Study

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INTRODUCTION:

High-level athletes presenting with symptomatic chondral, ligamentous, or meniscal pathology in the presence of lower extremity coronal malalignment remain a difficult cohort to treat when the goal is to return to sport at their previous level. The purpose of this study is to present the outcomes after HTO or DFO in high-level athletes.

METHODS:

High-level athletic patients (defined as Tegner score $\geq$ 5) undergoing HTO/DFO from January 2010 to August 2023 were eligible for inclusion. Patients were excluded if they were less than 18 years old, had a Tegner score below 5 prior to symptom onset, or had less than 2 years of follow-up. Outcomes were assessed using follow-up questionnaires that consisted of symptom resolution, patient satisfaction, Tegner Activity Scale, International Knee Documentation Committee (IKDC) subjective score, Knee Injury and Osteoarthritis Outcome Score (KOOS), Lysholm score, and return to sport (RTS). Primary outcomes included RTS and patient-reported outcomes scores. Multiple sub-group analyses were performed, including "elite" level athletes (defined as Tegner score $\geq$7).

RESULTS:

Eighty (60 HTO, 20 DFO) patients met the inclusion criteria with a mean follow-up of 5.6 years (range, 2.3-12.6 years). The mean VAS satisfaction score at final follow-up was 77.4, and 76.0% patients would choose to undergo the operation again if given the option. Prior to symptom onset, the mean Tegner score was 6.6. There was a significant increase in Tegner score from pre-operative baseline of 3.1 to 4.6 at final follow-up ($p<0.001$). Following surgery, 86.3% of patients met the threshold for patient acceptable symptom state (PASS) for IKDC. The rate of RTS following surgery was 45.8% and, of the patients that returned to sport, 63.0% returned to their pre-injury level of activity. Eleven patients (12.1%) subsequently underwent total knee arthroplasty.

DISCUSSION AND CONCLUSION:

In high level-athletes, HTO and DFO procedures lead to high satisfaction rates and significant increases in Tegner scores following surgery compared to their symptomatic baseline, however return to previous level of activity is not guaranteed. Although high-level athletes may benefit from osteotomies, this procedure should be reserved for those that fail exhaustive non-surgical management.

Table 1. Overall Cohort Demographics

Demographics	N=80
Age (years)	38.7 ± 10.6 years
Sex	M: 73.8% F: 26.2%
BMI (kg/m^2)	28.6 ± 5.0
Peak Tegner Score	6.6 ± 1.5
Follow-up	5.6 ± 2.6 years (2.3-12.6 years)

Body Mass Index (BMI)

All data is reported as a mean +/- standard deviation.

Table 2. Concomitant Procedures

Procedure	
Meniscectomy	58.2%
Chondroplasty	40.7%
Osteochondral allograft transplantation	26.4%
ACL reconstruction	17.6%
Synovectomy	6.6%
Meniscus transplant	2.2%
Microfracture	2.2%

Anterior Cruciate Ligament (ACL)

All data is reported as a mean +/- standard deviation.

Table 3. Patient's Metting Criteria for Post-Operative PASS

Procedure	Mean value	Met PASS Threshold
IKDC	66.7 ± 20.0	86.3%
KOOS Symptom	64.4 ± 19.7	38.8%
KOOS Activities of Daily Living	86.3 ± 19.7	74.4%
KOOS Pain	80.7 ± 19.8	74.4%
KOOS QoL	54.9 ± 26.8	48.7%
KOOS Sports	58.4 ± 32.7	65.4%

International Knee Documentation Committee (IKDC); Knee Injury and Osteoarthritis Outcome Score (KOOS); Quality of Life (QoL)

All data is reported as a mean +/- standard deviation.

Table 4. Patient Reported Outcomes in Male Versus Female Patients Undergoing HTO/DFO

Procedure	Male	Female	P-value
IKDC	68.7 ± 19.9	61.0 ± 19.9	0.131
Lysholm	75.5 ± 22.3	71.8 ± 24.0	0.528
KOOS Symptom	65.5 ± 19.3	61.6 ± 20.7	0.439
KOOS Activities of Daily Living	87.2 ± 18.9	83.8 ± 21.7	0.504
KOOS Pain	81.7 ± 19.9	77.9 ± 19.7	0.459
KOOS QoL	56.9 ± 26.8	49.4 ± 29.7	0.275
KOOS Sports	61.9 ± 33.2	48.8 ± 29.7	0.116

International Knee Documentation Committee (IKDC); Knee Injury and Osteoarthritis Outcome Score (KOOS); Quality of Life (QoL)

All data is reported as a mean +/- standard deviation.