

ABSTRACT

Author: Bc. Michaela Lupačová

Supervisor: Mgr. Jitka Marenčáková, Ph.D.

Consultants: prof. Ing. František Zahálka, Ph.D., PhDr. Mikuláš Hank, Ph.D.

Title: Functional relationships of lower limb segments in floorball players with a focus on predictors of lower limb injuries

Objectives:

The main objective of the thesis was to determine the magnitude of differences in knee joint torque levels depending on specific knee flexion positions and lower extremity preference in elite female floorball players. Another objective was to assess the occurrence of knee valgus during the maximum vertical drop jump and to compare the level of isokinetic strength abilities in specific knee flexion angles between groups of players with and without valgus

Methods:

This is a retrospective observational analytical study. Data were obtained within the framework of the professional scientific activity of the Sport Research Center, Faculty of Physical Education and Sport, Charles University during the years 2019-2023. Measurements were carried out under standard laboratory conditions and under the conditions of the Declaration of Helsinki. The 37 elite female floorball players in the age range of 18-33 years (mean age = $21,01 \pm 3,60$) playing in the top Czech women's floorball league were monitored. The Cybex Humac Norm dynamometer (Cybex NORM®, Humac, CA, USA) was used to test the isokinetic strength of the knee flexors and extensors. The angular velocity of the test was set at 60°/s, and the range of motion was 0 to 90° of knee flexion. 2D video analysis of recordings taken during jump measurements was used to evaluate the appearance of the knee valgus during a vertical drop jump. The criterion for the occurrence of dynamic knee valgus was one of the elements of the valid and reliable Landing Error Scoring System protocol. The medial knee displacement, where the center of the patella is at the level of or exceeds the first metatarsus, was considered a knee valgus. Descriptive statistics were used for statistical analysis, as well as the Shapiro-Wilk test to determine the normal distribution of the data, Student's paired t-test and the two-sample t-test. The significance level was established at $\alpha = 0,05$.

Results:

Adult elite female floorball players demonstrated significant muscle asymmetries between knee flexor and extensor strength of both dominant and nondominant lower extremities. The knee extensors of the dominant lower limb had significantly higher peak torque ($p = 0,028$) than the extensors of the nondominant lower limb. Knee flexors also had significantly higher maximum torque ($p = 0,006$) in the dominant lower extremity. The normalized maximum torque of both the knee extensors ($p = 0,041$) and the flexors ($p = 0,012$) was also significantly higher in the dominant lower limb compared to the non-dominant lower limb. The angle of maximum torque of the knee extensors was reached at 57° - 58° of bilateral knee flexion. The angle-specific torque of the knee extensors differed over almost the entire range of motion, but at angles approaching full extension (10° of knee flexion), the torque of the extensors equalized and at this angle, no statistically significant differences ($p = 0,484$) were found between the angle-specific torque of the knee extensors of the dominant and non-dominant lower extremities. The angle-specific torque of the knee extensors gradually decreased as the knee extension approached. The percentage decrease in knee extensor torque between 58° - 45° , 45° - 30° , 30° - 20° , and 20° - 10° were 13 %, 23 %, 22 %, and 31 % for the dominant lower limb, and 13 %, 22 %, 21 %, and 27 % for the nondominant lower limb. The angle-specific torque of the knee extensors in the midrange of motion that reached the maximum torque was still greater than half the maximum torque (67 % of the maximum torque of the knee extensors at 30° of knee flexion). The field play positions (defenders and forwards) did not differ significantly in their strength abilities, but the knee flexor strength of the goalkeepers was lower than the knee flexor strength of the defenders and forwards bilaterally. According to our findings, the angle-specific torque of the knee extensors in positions close to the full extension of the knee does not affect the knee valgus. Players with valgus knee ($n = 31$) had a higher normalized maximum torque of the knee flexors of the dominant ($p = 0,040$) and non-dominant ($p = 0,034$) lower extremities than players without valgus.

Conclusion:

The unilateral loading of the floorball was fully reflected in the degree of muscle strength asymmetry between the dominant and the nondominant limbs. The dominant lower extremity had higher peak torques in both the knee extensors and the flexors. This lateral asymmetry between the knee extensors was present throughout almost the entire range of motion studied, but at angles close to full extension, there was none. We also found that goalkeepers showed a significant deficit in bilaterally normalized knee flexor peak torque relative to other players. No relationship was found between angle-specific torque of knee extensors and the incidence

of knee valgus. Statistical analysis of the results regarding positions and valgus is weak, as there were only 4 goalkeepers and knee valgus was not present in 6 players. The results highlight the level of asymmetry in the unilaterally loading sport, which only emphasizes the importance of compensation to offset these asymmetries. The isokinetic testing is recommended to show the strength abilities throughout the tested range of motion and to show angle-specific torque deficits individually. Insufficient lower extremity muscle strength in positions close to full extension can predict lower limb injury, thus it is important to identify and correct them. Our results may help to create compensatory exercises or preventive programs for female floorball players, as well as to evaluate female floorball players performances or to draw information and compare with other research.

Keywords:

floorball, women, isokinetic strength, injury predictors, knee joint, dynamic knee valgus, muscle asymmetry, strength asymmetry, knee extensors, knee flexors