Comparison of Core Stability and Knee Load During Forward and Backward Directional Changes Among Tennis Players of Different Age Groups

Chen-Yen Chien[1], Heng-Ju Lee[1]
[1]Department of Physical Education and Sport Sciences, National Taiwan Normal University, Taipei, Taiwan
Email: hjlee@ntnu.edu.tw

SUMMARY

This study investigated core stability and knee joint load during forward and backward directional changes in adult (20–35 years) and elderly (≥50 years) male tennis players. Elderly players exhibited significantly higher Directed Co-contraction Ratios (DCCR), particularly during backward Weight Acceptance (WA) (3.58 vs. 1.18), indicating a greater reliance on antagonist muscles for stability. Negative Peak Knee Abduction Moments (PKAM) during WA (-0.34 Nm) suggested knee instability, while adults maintained positive PKAM. Balanced DCCR (˜1) in adults reflected superior neuromuscular control. These findings underscore the importance of targeted stability and strength training in elderly athletes to mitigate deficits and reduce injury risk.

INTRODUCTION

This study examines aging-related declines in core stability and increased knee joint loads during directional changes in tennis players. By analyzing these differences, it provides insights into targeted training and injury prevention strategies for older athletes.

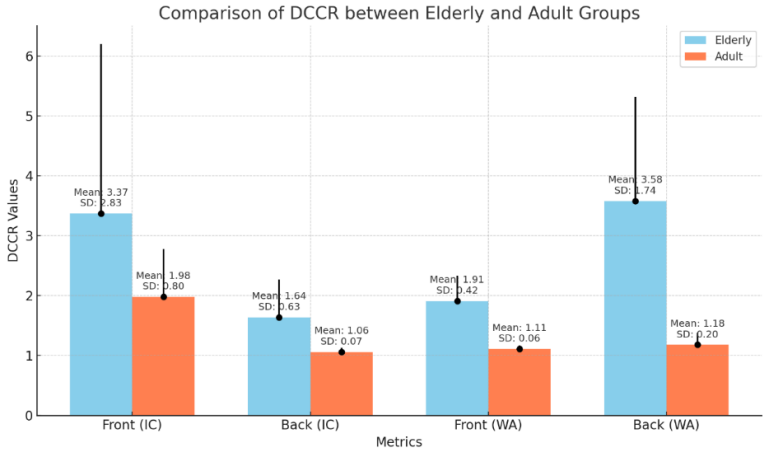
METHODS

The study recruited 20 male tennis players divided into two groups: elderly players aged 50 and above and adult players aged 20–35. All participants had over 10 years of tennis experience and no significant lower limb or core injuries in the past six months. Biomechanical and muscular responses during forward-backward directional changes were analyzed using a motion analysis system, force plates, and surface electromyography (EMG). Trials focused on two phases: Initial Contact (IC), when the force plate first received contact to initiate movement, and Weight Acceptance (WA), the second peak after IC, representing weight absorption.

Core stability was assessed using Directed Co-contraction Ratios (DCCR):

DCCR = (External Oblique + Rectus Abdominis + Erector Spinae) / (External Oblique + Rectus Abdominis).

Muscle activity values were normalized RMS (relative to MVIC) and measured from the right-side muscles. Peak Knee Abduction Moment (PKAM) was calculated as the peak external abduction moment of the knee joint during the IC and WA phases, using kinematic data and ground reaction forces through inverse dynamics. Statistical analysis was performed with independent t-tests, and



significance was set at $\alpha = 0.05$.

RESULTS AND DISCUSSION

The elderly group showed significantly higher Directed Co-contraction Ratios (DCCR) compared to the adult group, especially during the back WA phase (3.58 ± 1.74 vs. 1.18 ± 0.20) and front WA phase (1.91 ± 0.42 vs. 1.11 ± 0.06). Negative Peak Knee Abduction Moments (PKAM) observed in the elderly group during WA phases (e.g., back WA: -0.34 Nm) indicated reduced knee stability. Conversely, the adult group maintained lower DCCR values (˜1) and positive PKAM across all phases, reflecting better neuromuscular control and joint mechanics. These findings highlight the elderly players' reliance on antagonist muscle activation to compensate for reduced stability, increasing their risk of knee injuries. Stability and coordination-focused strengthening exercises are crucial for reducing injury risks in elderly tennis players.

CONCLUSIONS

Elderly tennis players show higher DCCR and negative PKAM, indicating reduced stability and increased injury risk. Improving core stability and knee mechanics through targeted training is crucial for performance and injury prevention.

REFRENCES

[1] Duchene Y et al. (2022). Influence of sidestepping expertise and core stability on knee joint loading during change of direction. *J. Sports Sci.*, **40**(9): 959-967.