Does the Knee Kinematics during Static Lunge predict Knee Ligament Injury Risk in Single-Leg Landing?  
- A Comparative Study Among Three Different Toe Directions-

Kazuya Kaneda, Kengo Harato, Nobuyuki Fujita, Yutaro Morishige, Yu Iwama, Shu Kobayashi, Yasuo Niki, Takeo Nagura

Department of Orthopedic Surgery, Keio University School of Medicine
Kazuya Kaneda, MD
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Introductions

Single Leg Drop Landing (SLDL) is used as an indicator of risk assessment of anterior cruciate ligament (ACL) injury and evaluation after ACL reconstruction.  

Closed kinetic chain (CKC) exercise such as the static lunge (SL) is useful for rehabilitation to avoid overloading of ACL especially in the early postoperative period after ACL reconstruction.  

According to previous SLDL study, the athletes should avoid extreme toe-out foot rotation positions to minimize undesirable knee valgus loading associated with non-contact ACL injury when landing with one leg risks.  

Whether the knee joint dynamics of SLDL can be predicted from SL is unknown.
Purpose

To clarify the relationship between the knee joint kinematics in Static Lunge (SL) and Single Leg Drop Landing (SLDL) among different toe directions.
Subjects & Methods

- 23 healthy male volunteers belonging to university club activities. (Soccer 13, Ski 10)
- Age: 20.0±1.1 yrs.
- Each subject performed SL and SLDL.

- 30-cm high box
- Two force plates

46 retro-reflective markers

8 cameras
Methods

- SL and SLDL were performed under three different toe directions, including 0 degrees (Toe Neutral: TN), 20 degrees (Toe-In: TI), and -20 degrees (Toe-out: TO).
Methods

- 3D knee kinematics and kinetics at the timing of the knee flexion of 60 degrees were calculated using Visual 3D.
- As a statistical analysis, Pearson’s correlation was used to evaluate the relationship between SL and SLDL.
- The statistical significance level was set at $P<0.05$. 
Results (1)

Knee abduction angle

Fig: Correlation of knee abduction angle (°) between SL and SLDL in TN.

Knee abduction angle showed significant correlation between SL and SLL in three different directions.
Results (2)
Knee internal rotation

In terms of knee internal rotation, strong correlation was found in three different directions.

Fig: Correlation of tibial internal rotation angle (°) between SL and SLDL in TN.
Results (3)

External knee abduction moment

TI: r=0.574, TN: r=0.499, TO: r=0.469

Fig: Correlation of external knee abduction moment (Nm/kg) between SL and SLDL in TN.

External knee abduction moment presented significant correlation in all three different directions.
Discussion

- The occurrence of dynamic knee valgus when landing from a jump increases the risk of ACL (re)injury.

- Female athletes with increased knee abduction angle at initial contact, peak knee abduction angle, and peak knee abduction moment would be correlated with an increased risk of non-contact ACL injury during drop vertical jump.  

Therefore, knee abduction angle, external knee abduction moment and internal tibial rotation angle were extremely important for the assessment of non-contact ACL injury.
Discussion

- Significant correlation between SL and SLL was found in knee abduction angle, knee internal rotation, and external knee abduction moment under all three different directions.
- The knee kinematics during SL can predict knee ligament (re)injury risk during SLDL in male recreational level athletes.

Limitation

- All subjects in the present study were male soccer or skiing players.
- Stiffness of the ankle was not evaluated.
- the actual tension of ACL was unknown.
Conclusion

- Significant correlation between SL and SLDL was found in knee abduction angle, knee internal rotation, and external knee abduction moment under all three different directions including Toe-in, Toe-neutral, and Toe-out.

- The knee kinematics during the static lunge can predict knee ligament (re)injury risk during single-leg drop landing in male recreational level athletes.