

Difference in vertical ground
reaction force between dominant
leg and non-dominant leg at quick
stopping motion

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Introduction

©Anterior cruciate ligament (ACL) injury



Characteristics

- Non-contact injury is 70% of all ACL injury (Boden et al,2000)
- Incidence : Female > Male (Hewett et al,2007, Agel et al,2013)
- Laterality : Left > Right (Urabe et al, 2002)
- The sports return take 6 to 12 months (Kvist et al.,2004)

Introduction

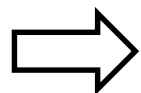
© Non-contact ACL injury

Cause

- Jump landing (Arendt et al,1995)
- **Stop movement** (Markolf et al,1995)
- Cutting maneuvers (Olsen et al,2004)
- • • • etc

Risk factors

- Knee joint valgus angle
- Valgus moment
- **Vertical ground reaction force(vGRF)**



It is the risk that these increases

vGRF and ACL injury

- Insufficient absorption of vGRF, pressure between the femur and the tibia is increased (Sheehan et al. 2012)
- When the pressure against is high, the tibia inclines to internal rotation and ACL rupture. (Meyer et al. 2008)

It is illustrated on the next page

Femur

patella

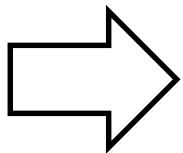
Tibia

fibula

② Pressure is increased

③ Tibia to internal rotation and ACL rupture

① Occurrence of vGRF



However, few studies that examined the GRF at the time of stop motion

Purpose

To clarify the difference of vGRF between dominant and non-dominant leg at the time of stop operation

Hypothesis

vGRF of the non-dominant leg is large, there is a high risk of ACL injury

Participant

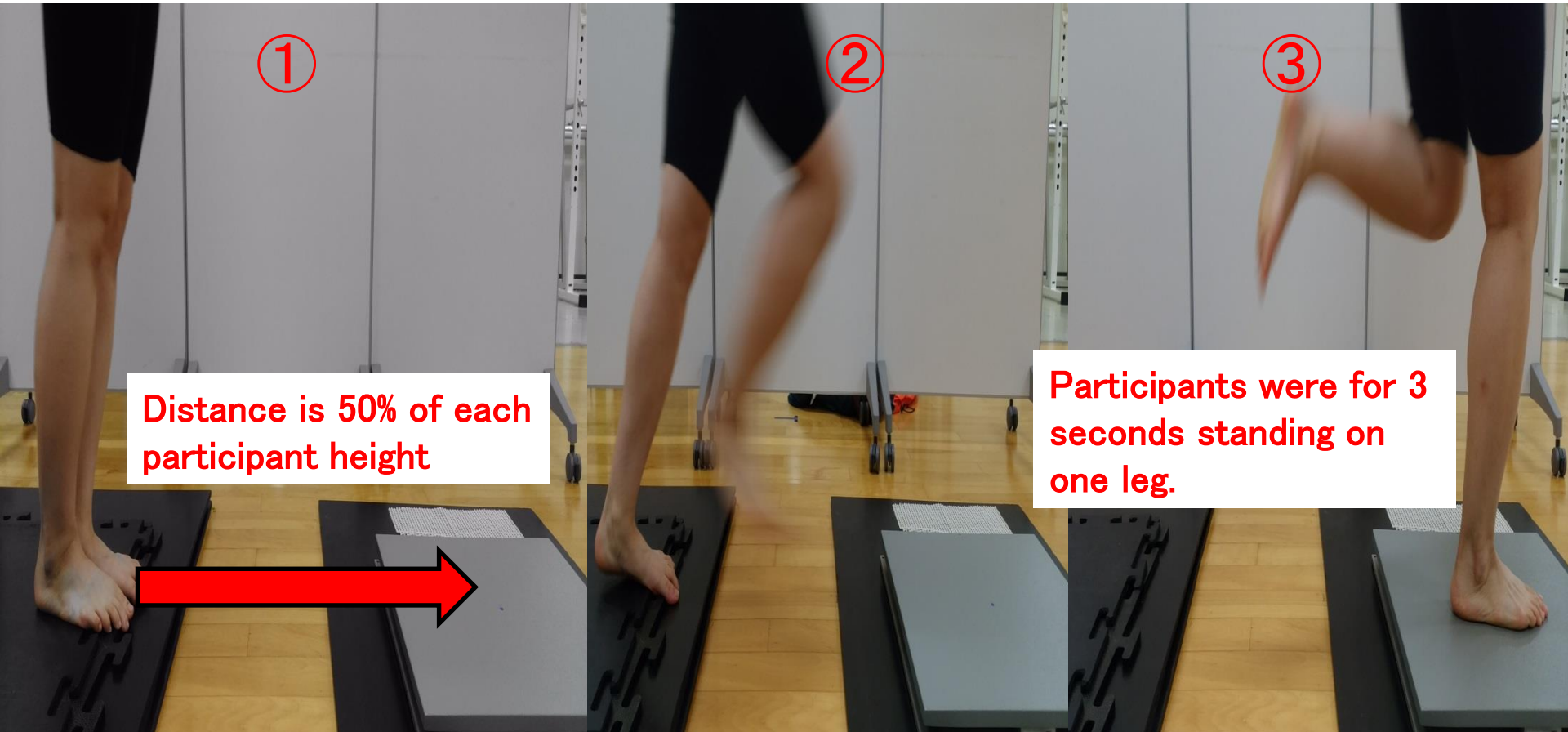
- Six healthy women (20.6 ± 1.2 years, 160.5 ± 7.1 cm, 51.0 ± 4.1 kg) without orthopedic diseases
- The dominant leg of participants was all the right
- Dominant leg was defined as the legs of those who kick the ball

Material and Method

Task : **Stop motion**

- ① Participant stand on the start line
- ② The participants tread with full force at a force plate (AMTI, Inc.)
- ③ Participant held the other leg stationary

This task was performed **10 times** in both legs.



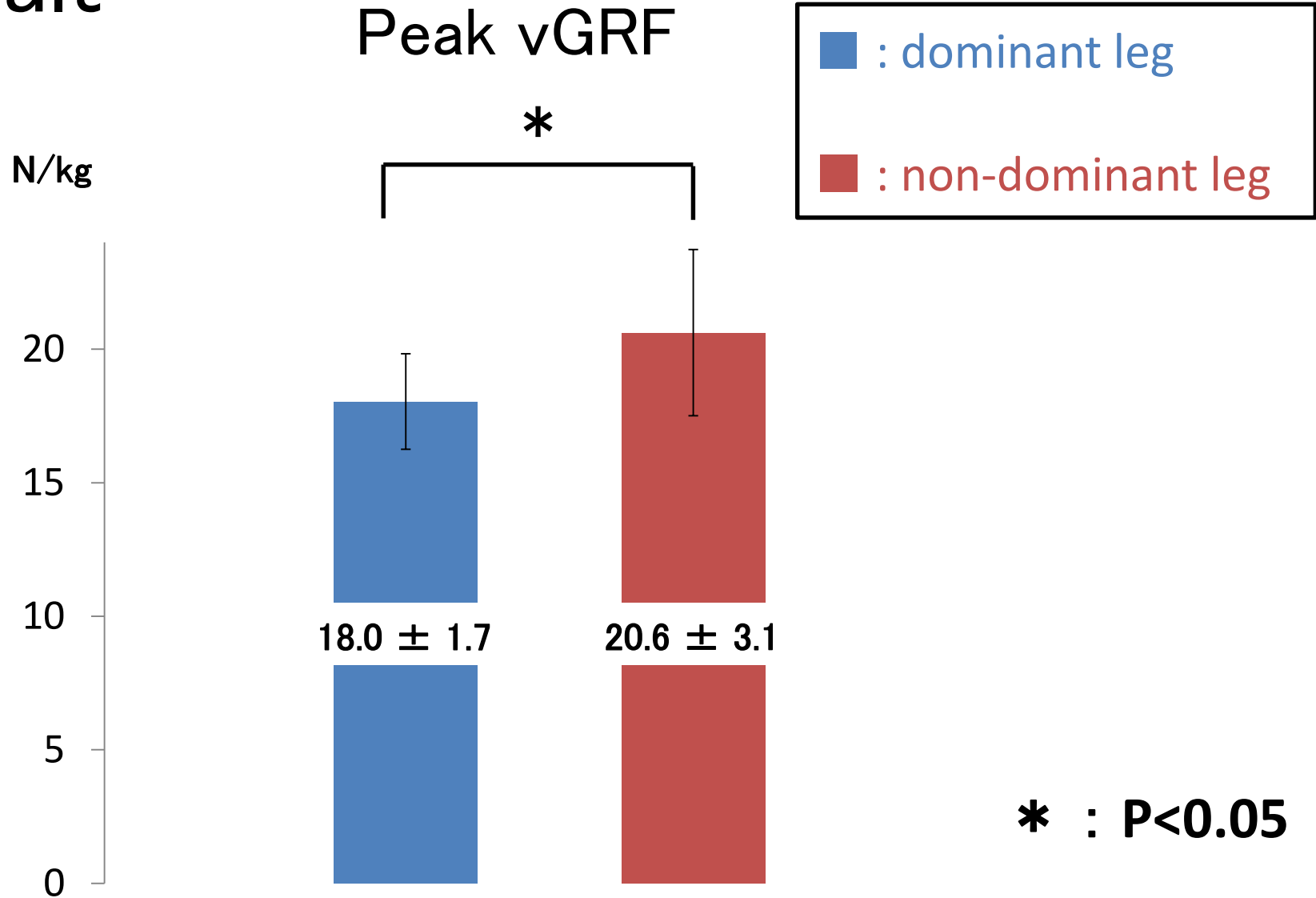
Measurement item

- Peak vGRF
 - Normalized by body weight (N/kg)
 - Calculated 10 times of the average value

Statistical analysis

- Dominant leg VS Non-dominant leg : T-test
 - The significance level was less than 5%
 - Excel Statistics 2010 for Windows (SSRI, Inc.) was used

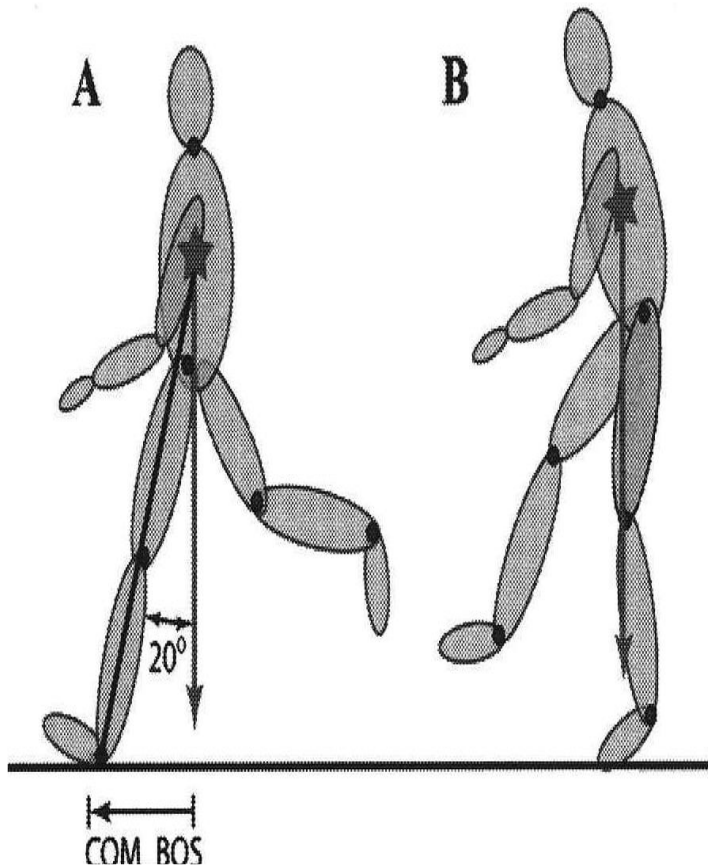
Result



Peak vGRF : Non-dominant leg > dominant leg

Discussion

vGRF was greater in the non-dominant leg than dominant leg



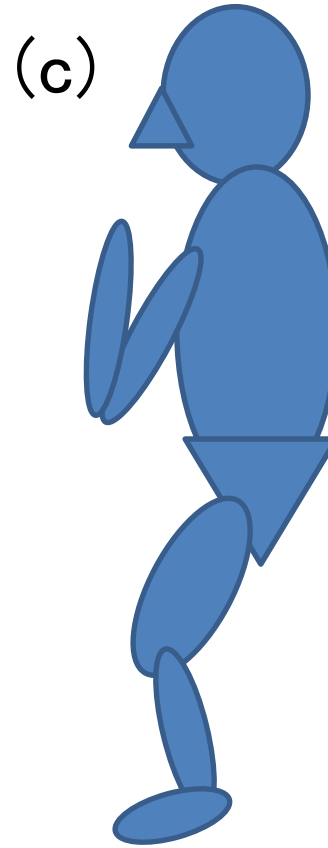
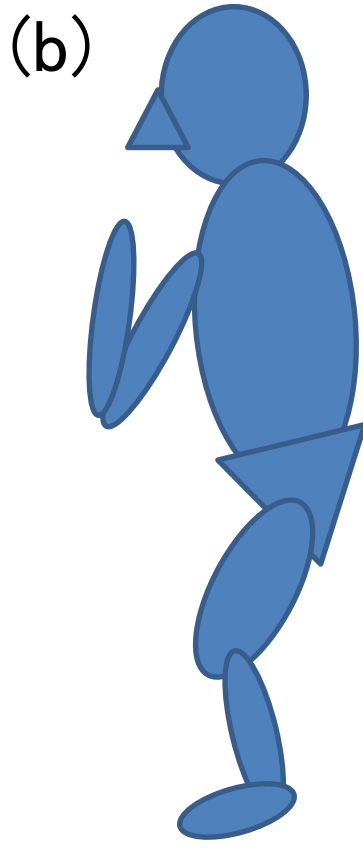
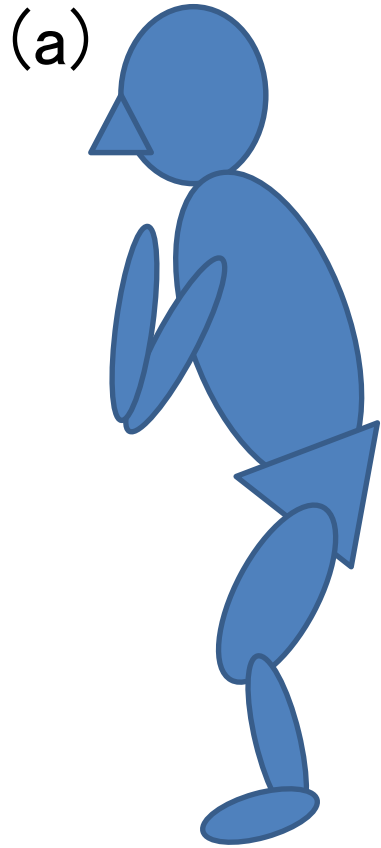
When the ACL injury has occurred, the trunk is upright
At that time, the GRF is estimated to be large

(Sheehan et al. 2012)

A : Landing pattern that ACL injury occurs

B : Normal landing

In fact, studies conducted three landing pattern, the **GRF is increased** in a pattern that upright the trunk
(Shimokochi et al. 2013)

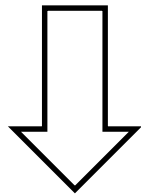


- (a) : leaning forward landing
- (b) : self-selected landing
- (c) : **upright landing**

Why the peak vGRF is increased in the non-dominant leg?

The absorption of the GRF

- Absorption of the GRF during jump landing are made at the knee joint and ankle joint
(Devita et al. 1992)



Possibility, bending of the non-dominant leg
knee joint was not enough

The video analysis during ACL injury in basketball, flexion angle of the knee joint has been reported that was not more than 30 degrees

(Teitz et al. 2001)

vGRF of the non-dominant leg was greater in this study

That is, the flexion of the knee joint is insufficient, there is a possibility that the risk of ACL injury was higher

One of the causes of ACL injury is often a non-dominant leg it may be the absorption of vGRF insufficient

Limitations

- Future prospective was measured in this study only the GRF
 - Therefore, it is not speculation about the joint exercise
 - In the future, it is necessary to examine the relationship between articulation

Conclusion

- 1 . This study was to measure the GRF during stop motion on a healthy woman
- 2 . As a result, it was found that the vGRF in the non-dominant leg is larger compared with that in dominant legs
- 3 . This might cause more ACL injuries, in non-dominant legs

Thank you

