Investigation of hamstring and quadriceps activation in the squatting position
-Examination of kyphosis at slope-

Hiroshi Shinohara [1)], Yukio Urabe [2)], Nobuaki Moriyama [2)]
Hironori Fujishita [2)]

1) Southern Clinic Orthopaedics and Internal Medicine, Hiroshima, Japan

2) Department of Sport Rehabilitation, Graduate School of Biomedical and Health Sciences, Hiroshima University, Hiroshima, Japan

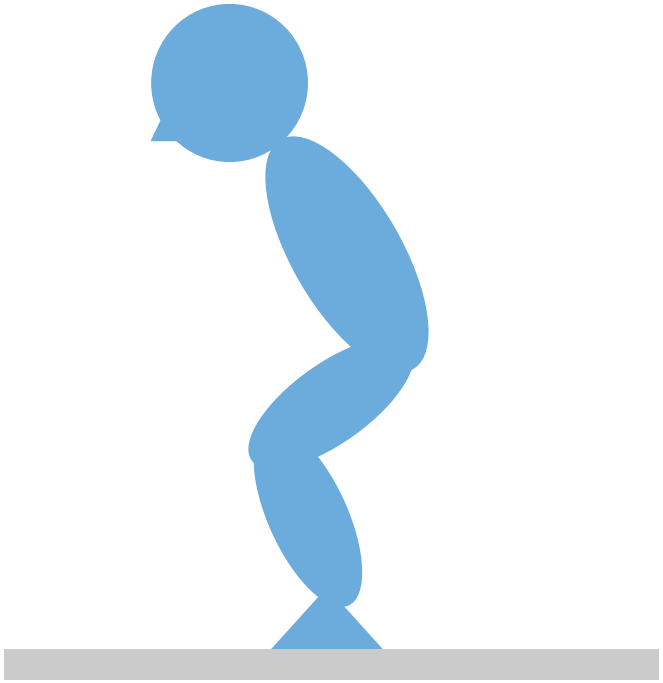
Introduction

- A squat exercise is incorporated for rehabilitation for various kinds of lower limbs disease.
- When many athletes return to the sport after injuries, it is essential to assume a squat position that imposes less stress on the knee joint.
- The squatting exercise is important for a skiing player because it is similar to posture of skiing.

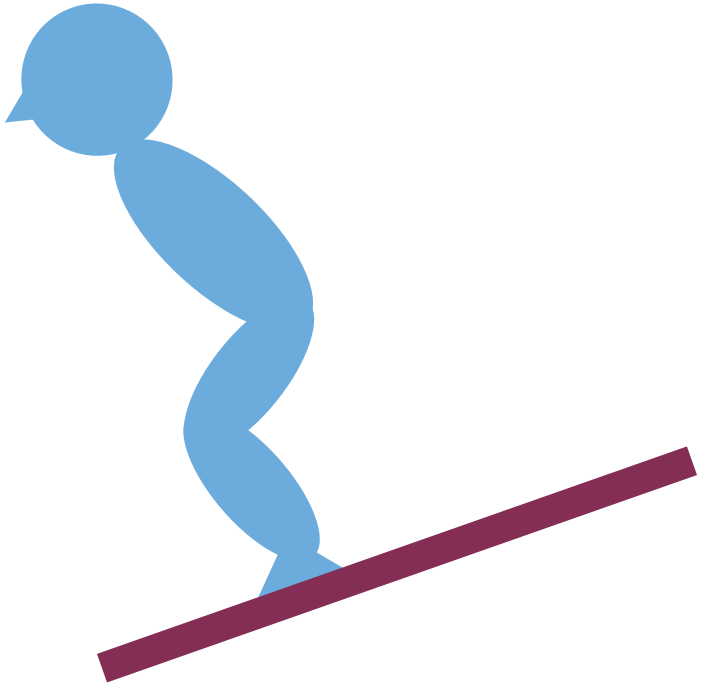
- The posture during squatting exercises influence activity of lower limb muscles.

- It is reported that the trunk angle, the pelvic angle of inclination, the hip joint angle, the knee joint angle, the ankle joint angle in case of the squatting posture influence it.

- In recent years, some studies have focused on muscle activation in the context of squatting on ski slopes (Kroll et al, 2010).

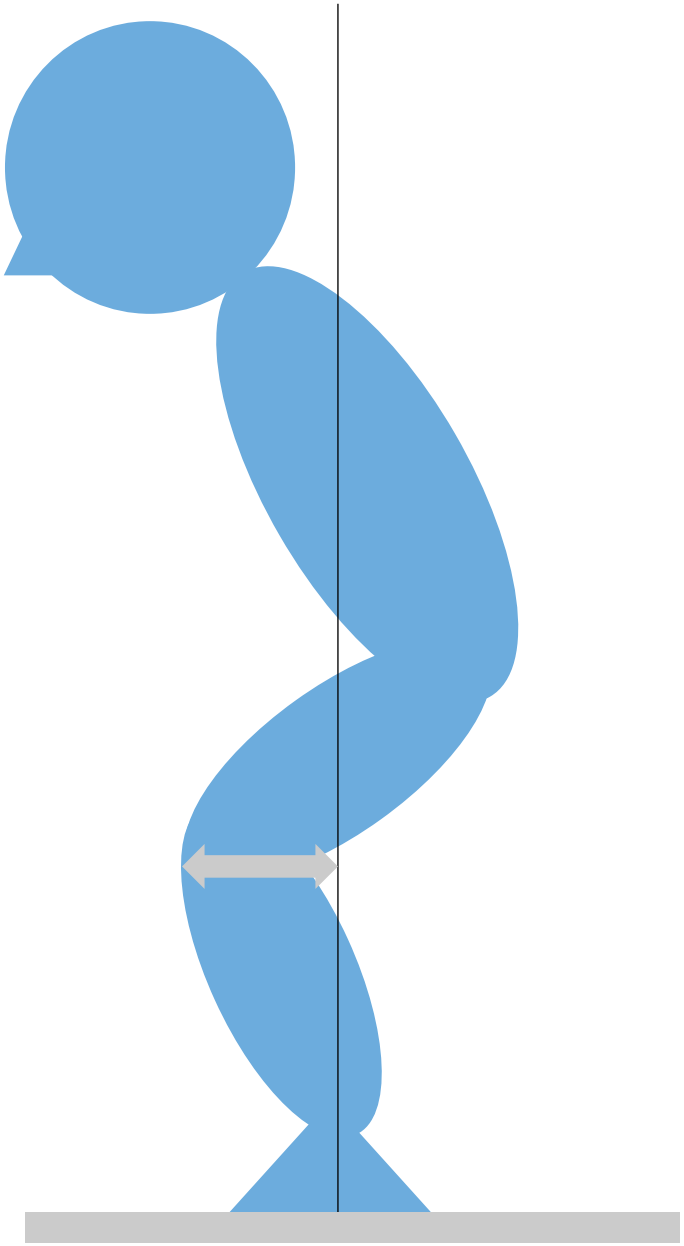


Squat without slope

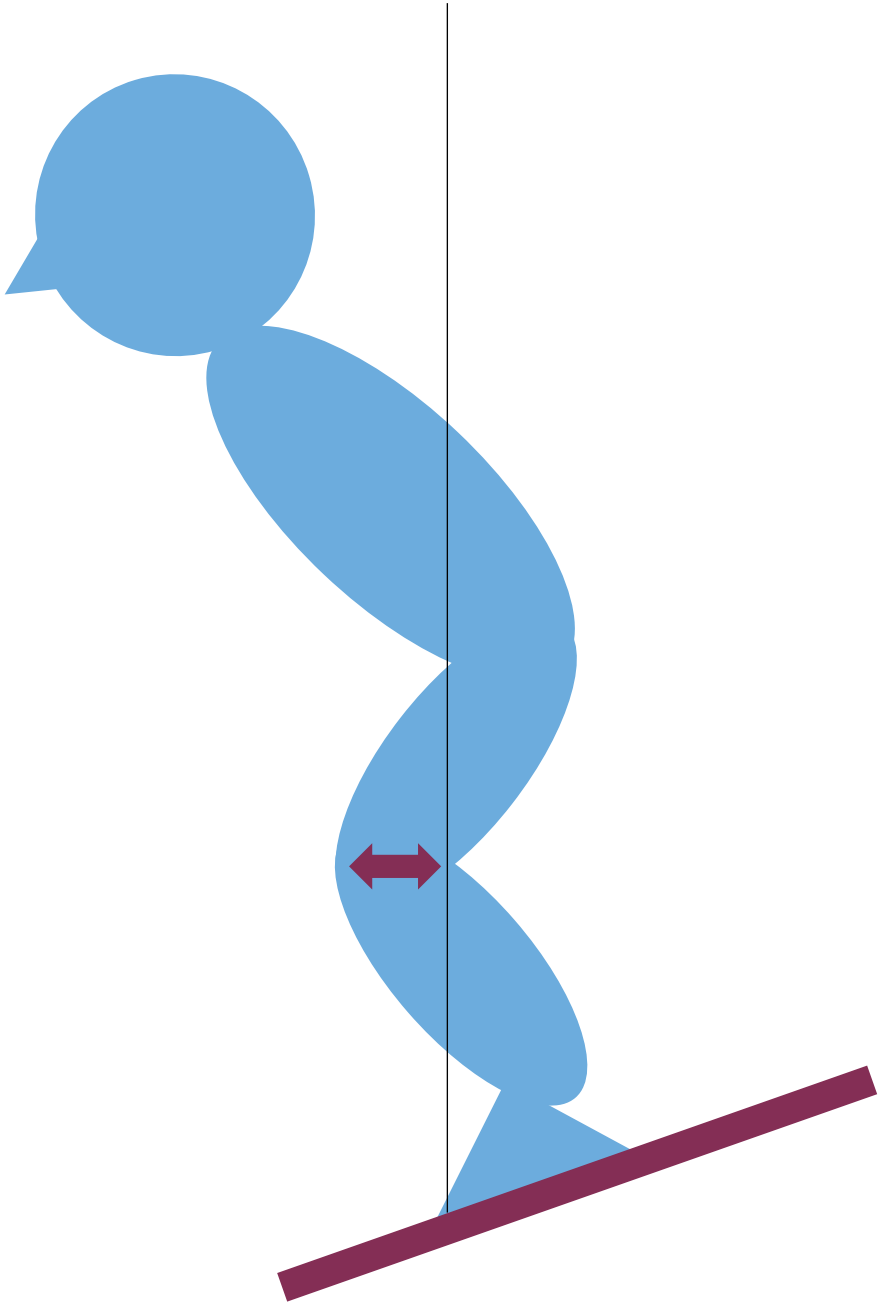


Squat with slope

Activation of quadriceps femoris muscle⇒



Squat without slope



Squat with slope

Purpose

To compare the activity of the thigh muscles during squatting on slopes with that on flat surfaces.

Hypothesis

The muscle activity of the quadriceps femoris muscle decreases during the squat with the slope.

Methods

Subjects

Six healthy men participated in this study.

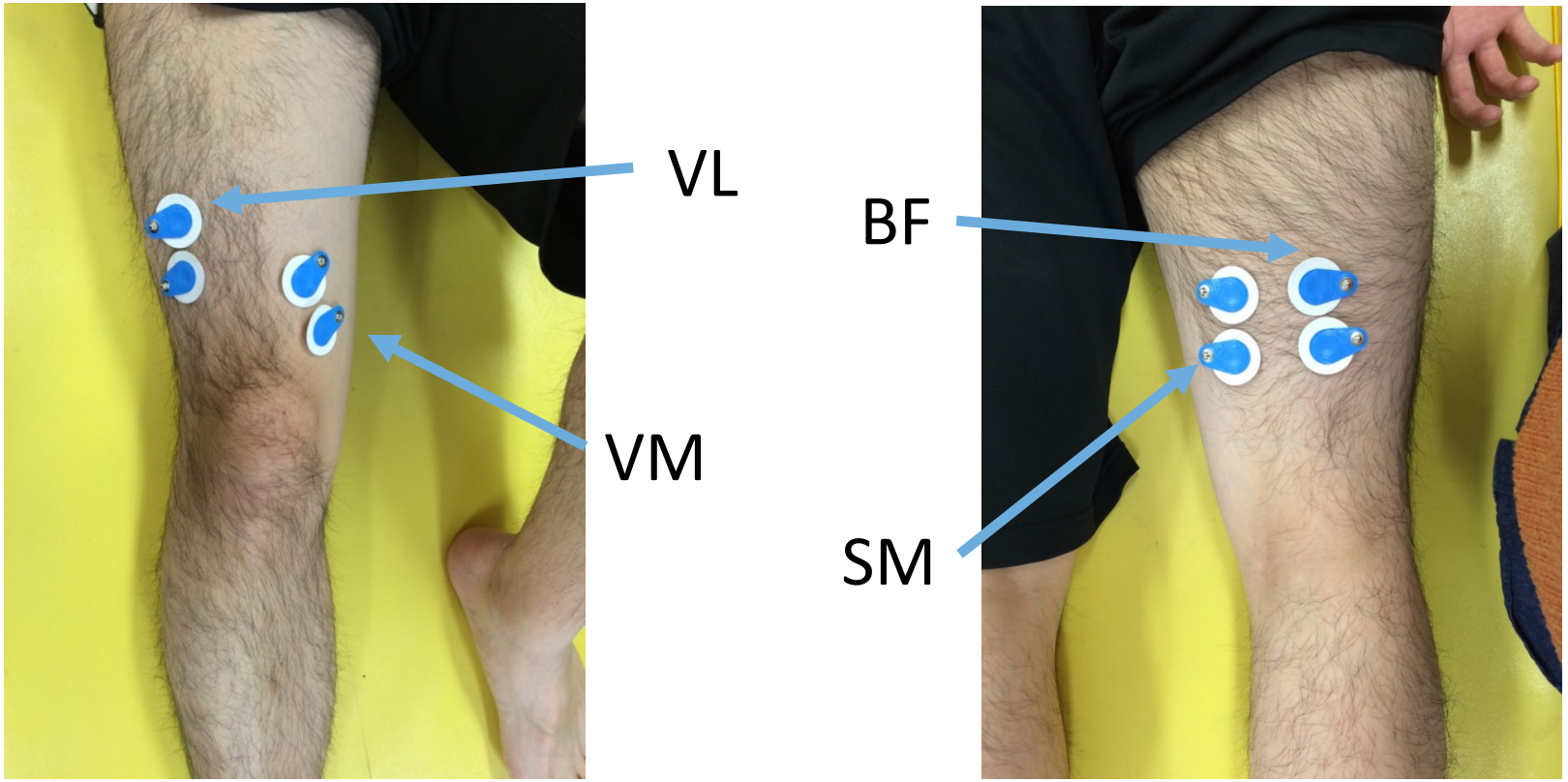
Age(yrs)	Height(cm)	Weight(kg)	BMI(kg/m^2)
23.2±2.4	172.5±5.4	61.8±5.5	20.7±0.9

Task

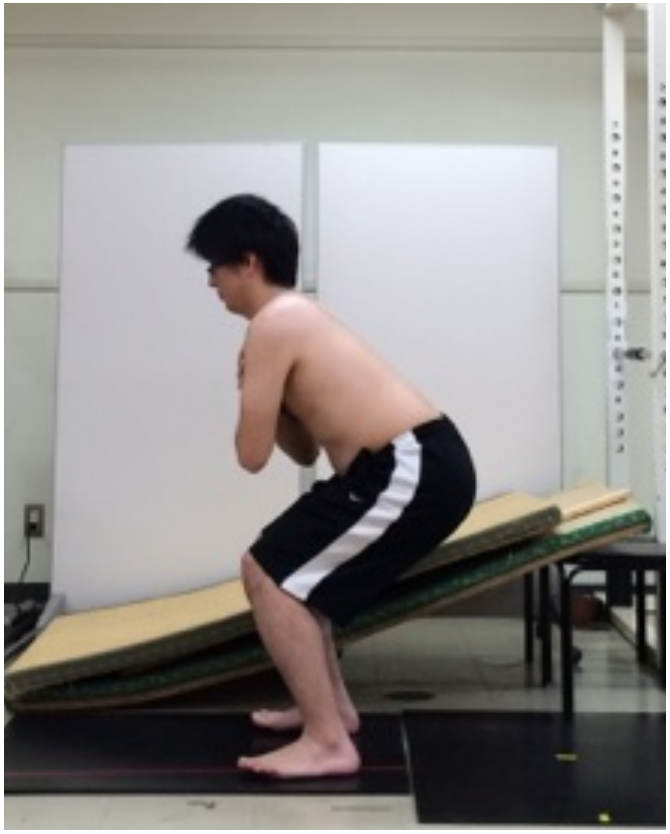
comparison

electromyography of Quadriceps and Hamstring in squat position **with slopes**

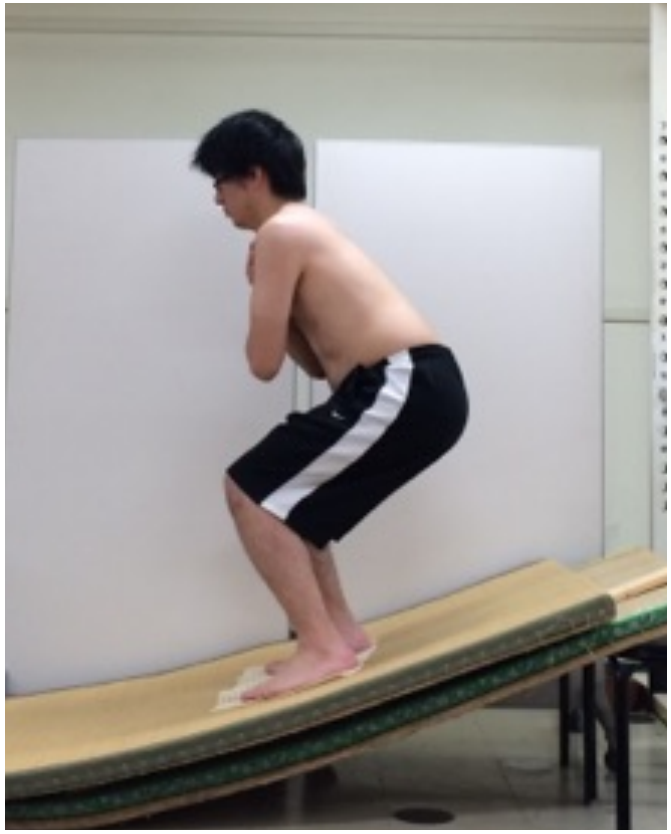
electromyography of Quadriceps and Hamstring in squat position **with flat surfaces**



We measured the activities of the right quadriceps femoris muscles (vastus medialis, vastus lateralis) and hamstring muscles (semitendinosus, biceps femoris) during squatting.



Squat without slope



Squat with slope

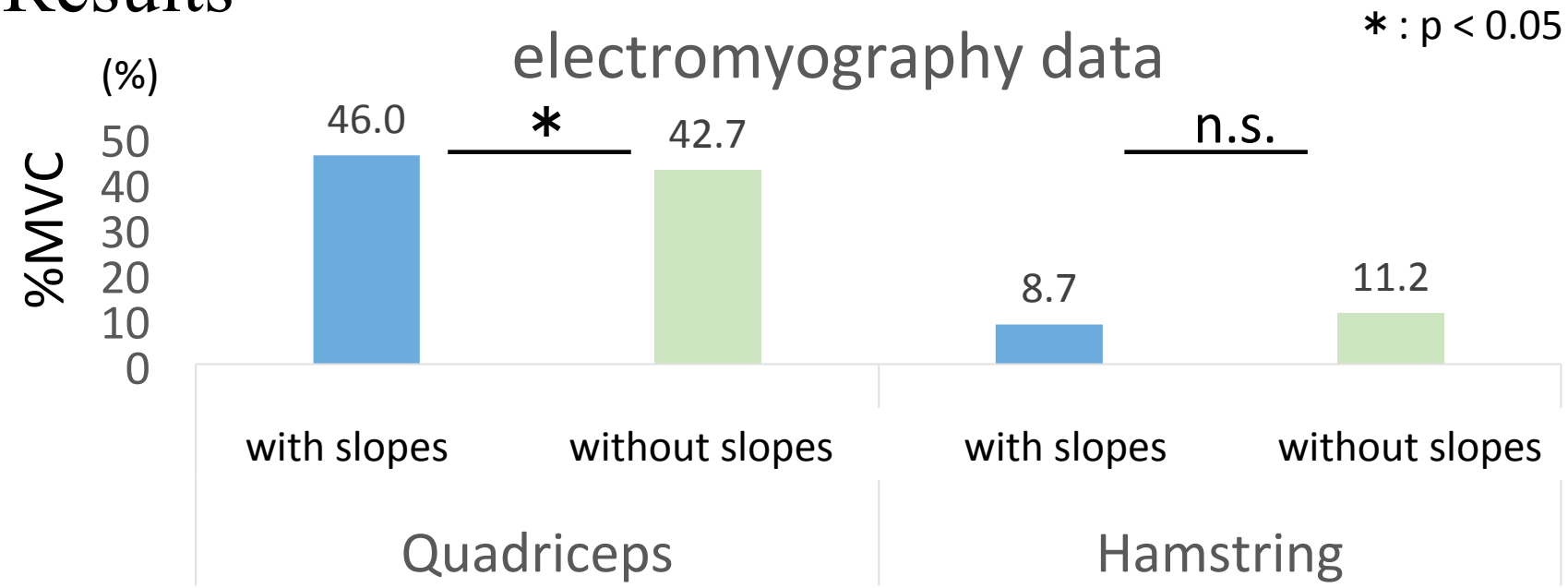
slope	20 degrees.
ankle joint	5-10 degrees.
knee joint	90 degrees.

The degree of muscle activation during squatting was divided by that during maximum voluntary contraction (MVC).

Statistical analysis

- A paired *t*-test was used for statistical analysis.
- A p-value < 0.05 was considered statistically significant.

Results



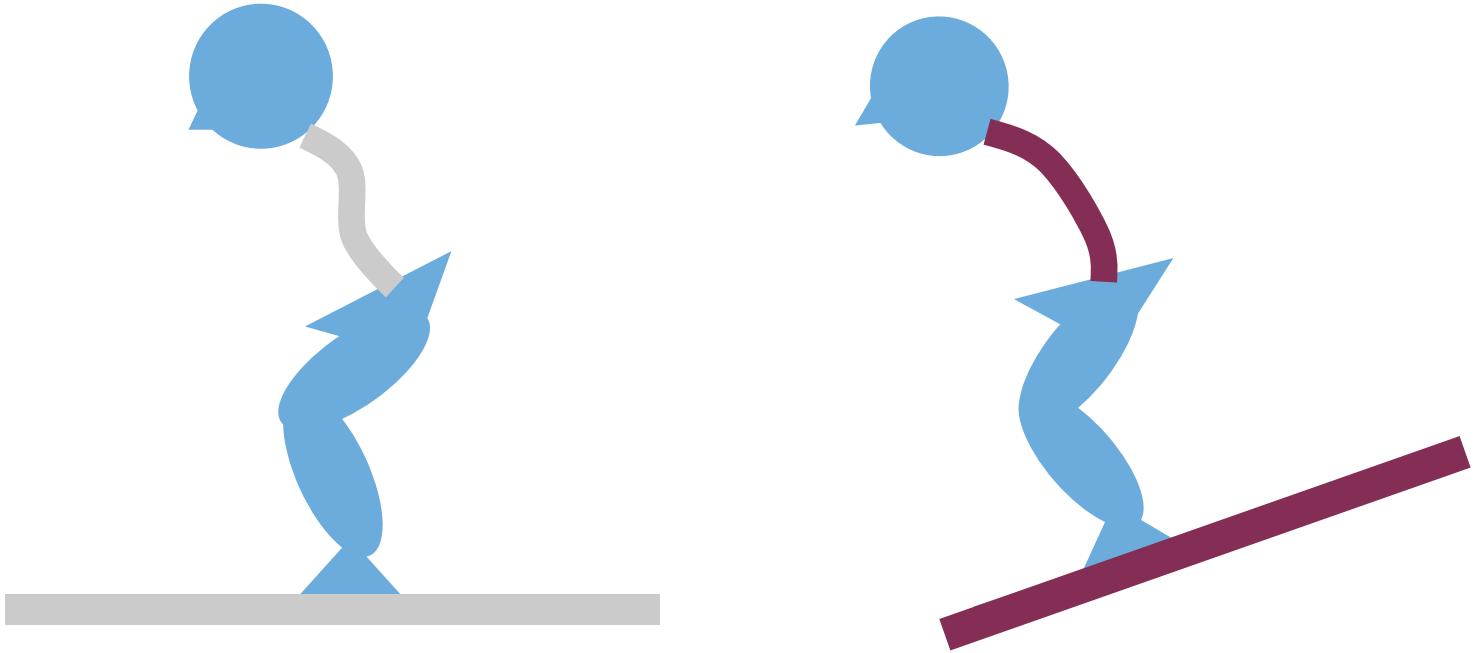
- The degree of activity in the quadriceps femoris muscles during squatting on a flat surface was lower than that on a slope ($p < 0.05$).
- The degree of activity in the hamstring muscles during squatting on a flat surface was not significant difference.

Discussion

electromyography

- Patellofemoral joint injury may be at increased risk for occurring the squatting posture with slopes.
- Slopes should be used because we know that the activity of the quadriceps femoris muscle becomes higher during squatting exercise on slopes.

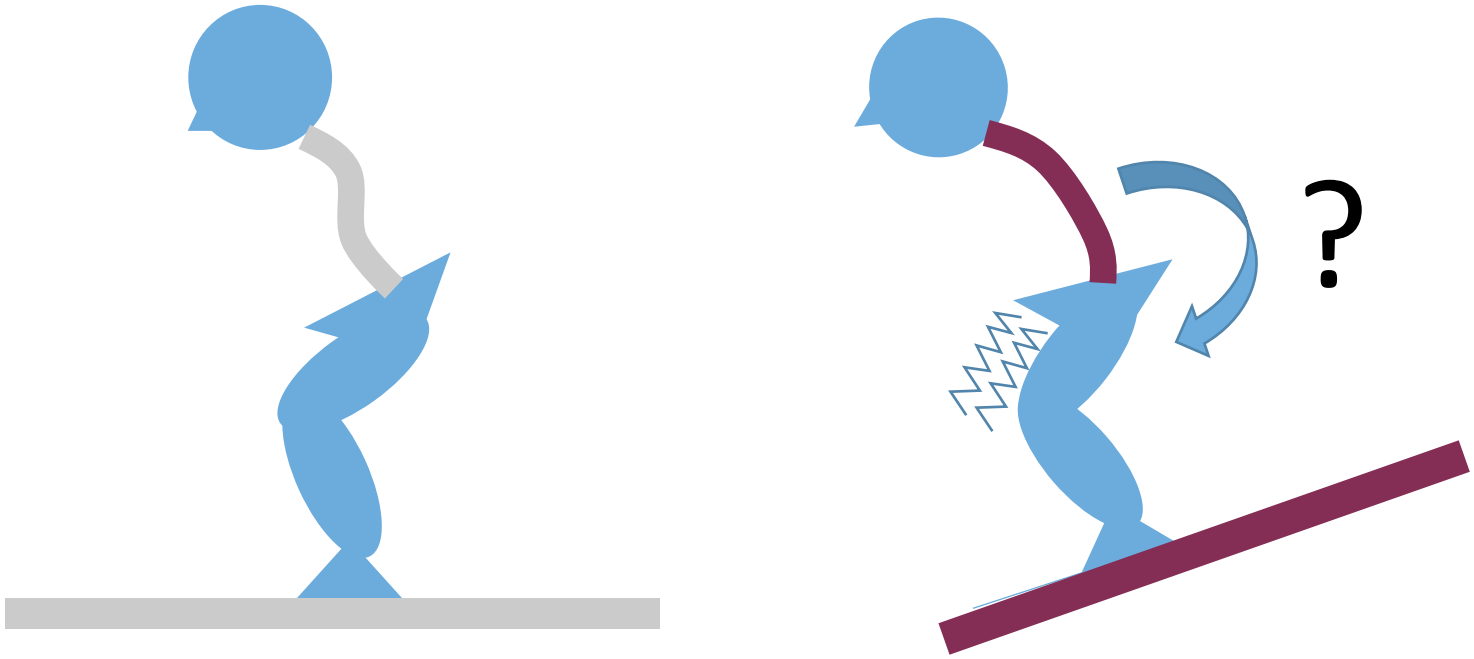
Why did this study turn out different from the hypothesis?



- This difference might be caused by pelvic retroversion in the squatting position on the slopes.
- As a result, the activity of the quadriceps femoris muscle might become higher.

Additional experiment

Does the pelvis become retroversion by the squatting position with the slope?



Purpose

To clarify whether change of the alignment of pelvic angle between squatting exercise with slopes and that without slopes.

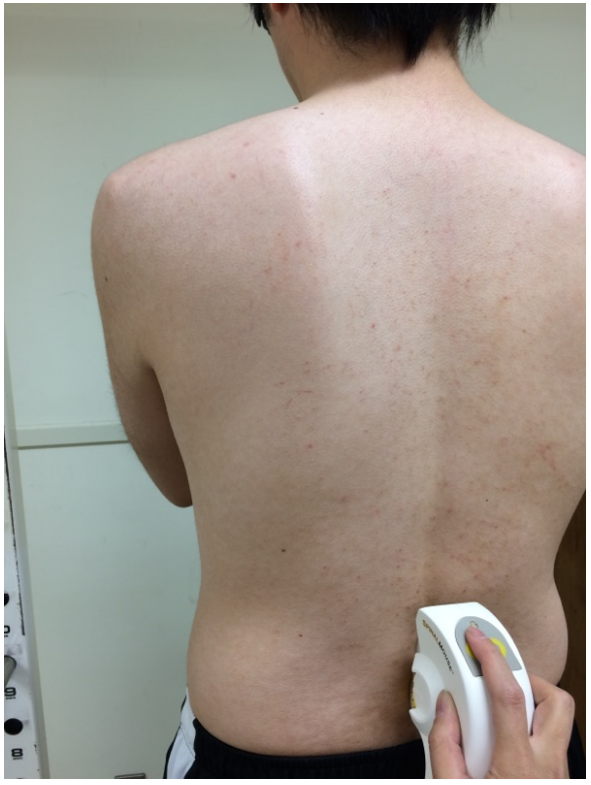
Hypothesis

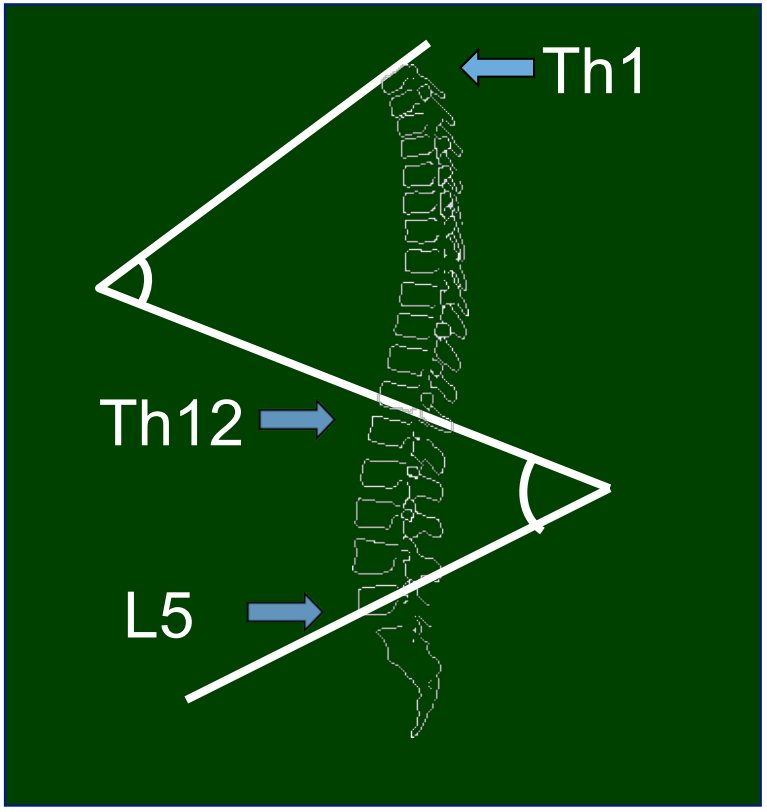
The squatting position using the slopes came to have a bigger lumbar kyphosis angle.

Methods

- Two healthy men participated in this study.
- Angle of ankle joint was defined of 5-10 degree of dorsal flexion, and knee joint was 90 degree with and without slope.
- We decided to measure a spinal column angle at squat posture with and without slopes.

- A spinal column alignment measured by SpinalMouse (Index)
- It is said that the pelvic angle correlates with a lumbar angle
- Thoracic angle = Th1-12
- Lumber angle = L1 - 5





Results

standing

	without slope	with slope	without slope	with slope
	Thoracic		Lumbar	(°)
A	36	29	-10	-4
B	28	28	-11	-11

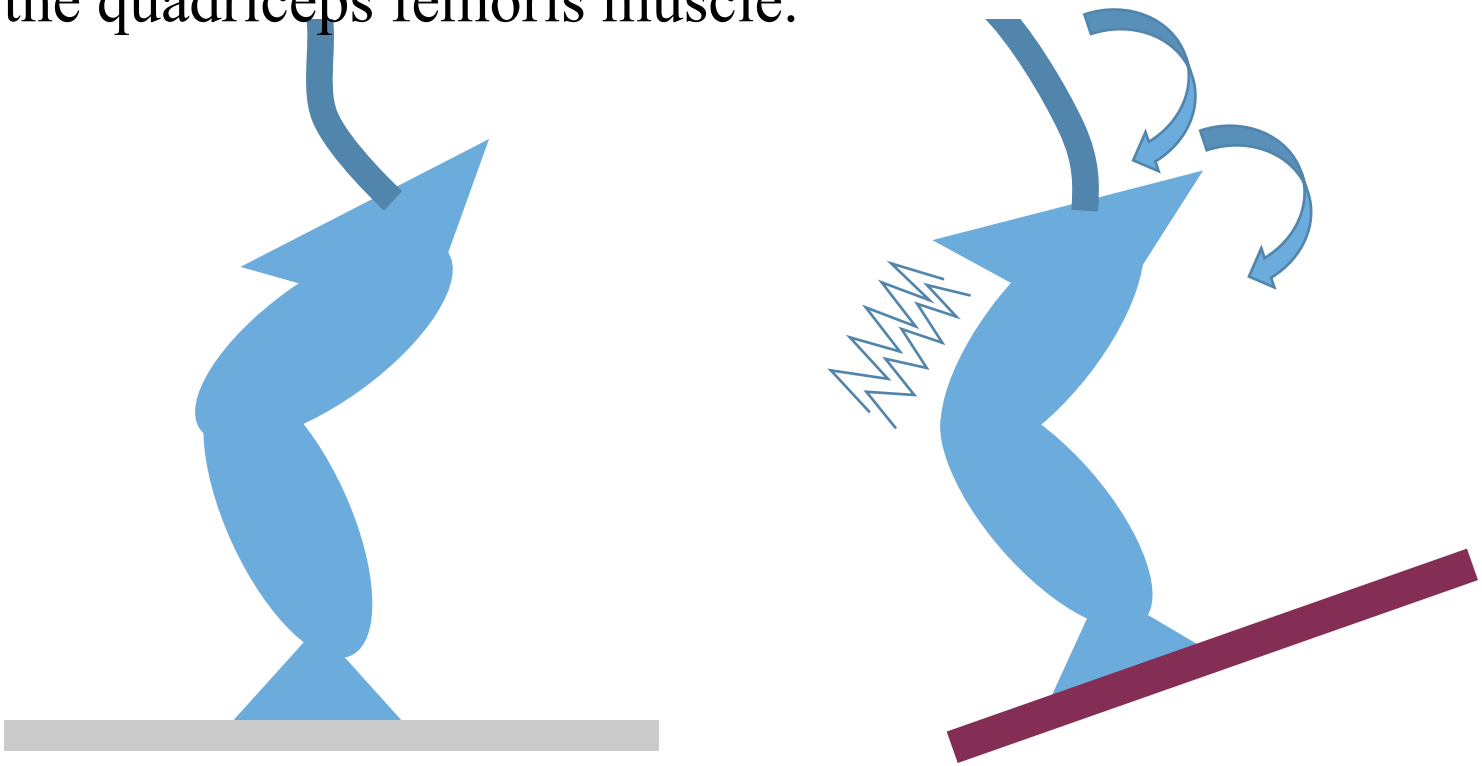
sqatting posture

	without slope	with slope	without slope	with slope
	Thoracic		Lumbar	(°)
A	18	16	-4	8
B	5	15	-9	-3

The degree of lumbar become kyphosis of the squtting posture with slopes than without.

Discussion

- During squatting exercise on slopes, change of posture might influence the angle of lumbar and pelvis and muscle activity of the quadriceps femoris muscle.



- It is necessary to instruct good posture when we provide rehabilitation exercise using the slopes.

Conclusions

- We tested whether muscle activities at the squatting posture were different between with and without slopes.
- Squatting posture with slopes became higher in the muscle activity of the quadriceps femoris muscle.
- The degree of lumbar became kyphosis of the squtting posture with slopes than without.
- It is necessary to instruct good posture when we provide rehabilitation exercise using the slope.