INFLUENCE OF FUNCTIONAL KNEE BRACES ON LOWER LIMB MECHANICS DURING STAIR LOCOMOTION IN PATIENTS WITH ANTERIOR CRUCIATE LIGAMENT DEFICIENCY

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INTRODUCTION

Anterior curciate ligament (ACL) provides passive stability of the knee and involves in the guidance of the joint motion. Injury of the ACL would lead to the degradation of stability and/or mobility of the joint. Functional knee braces have been suggested to provide necessary stability for ACL injured individuals and to be a factor causing the change of the kinetics of the lower limb during gait [1]. But, knee braces only resulted in minor kinematic changes in the ACL deficient (ACLD) knees during single leg hops [2]. The efficacy of knee braces may be different for different activities. The efficacy of braces on ACLD subjects during stair locomotion, one of the most common daily activities, has not been reported. The purpose of this study was to examine the immediate effects of functional knee bracing on the mechanics of the lower limb joints in ACLD individuals during stair locomotion.

METHODS

Ten ACLD subjects (26.1±7.3 years) were asked to perform stair ascent and descent in a gait laboratory first without and then with knee braces (DonJoy Goldpoint, Smith & Nephew DonJoy Inc.). The kinematic data were measured with a seven-camera motion analysis system (VICON 370, Oxford Metrics, U.K.) and the kinetic data with a force platform (AMTI, Mass., U.S.A.) that served as the second step of a three-step stairs. Joint angles, moments and angular impulses were calculated during the stance phase of the stair activities from the measured kinematic and kinetic data with a 3-D lower limb model. Peak joint angles, joint moments and angular impulses at the hip, knee and ankle joints in three dimensions were calculated and compared between bracing conditions and between affected and unaffected knees using paired *t*-test. Data from ten normal controls without bracing were also obtained.

RESULTS AND DISCUSSION

The affected knees adopted quite similar movement patterns to the normal ones (Figure 1) while significant alterations at the affected hip and in the unaffected limb were noticed during stair activities. Bracing did not affect the biomechanics of the lower limb during stair locomotion except for minor changes in the flexion angle and flexor impulse at the affected hip and in the internal rotation angle and external rotator moment at the unaffected knee during stair ascent, Table 1. The adaptations of the locomotor system to ACL deficiency were evident although there had no significant mechanical changes at the affected knees. The bracing did not result in any significant alteration of the mechanics of the affected knees. These results suggest that the mechanical condition at the ACLD knees remained relatively unchanged mainly because of the adaptations at the other joints instead of knee bracing.

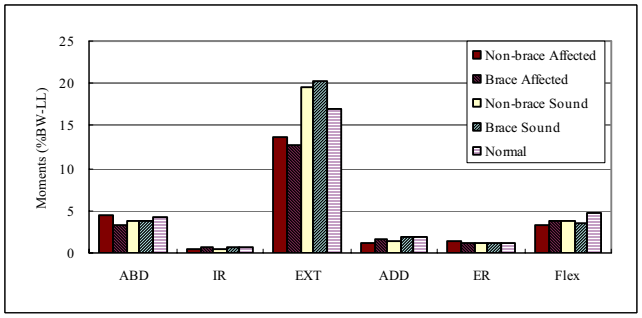

Figure 1: Peak joint moments at the knee during stair ascent.

CONCLUSIONS

The influence of knee bracing on the lower limb mechanics was not significant in ACLD subjects during stair locomotion. Bracing may not be used as a device to improve the performance of stair locomotion in these subjects.

REFERENCES

1. DeVita P, et al. *J Biomech* **29**, 583-588, 1996.
2. Ramsey DK, et al. *Clin Biomech* **16**, 61-70, 2001.

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Table 1: Variables affected by functional knee bracing for the ACLD subjects during stair ascent.

	Normal		Affected				Unaffected			
	Non-brace		Non-brace		Brace		Non-brace		Brace	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Hip extension (deg)	3.35	5.17	0.05	5.34 *	3.36	5.72	1.64	5.24	0.47	3.99
Hip flexor impulse (%)	0.41	0.39	0.15	0.16 *	0.11	0.15	0.33	0.28	0.32	0.32
Knee IR (deg)	0.42	8.50	2.62	10.45	0.87	4.64	-6.34	4.04 *	-3.37	3.39
Knee ER moment (%)	1.30	0.57	1.52	1.31	1.08	0.42	1.19	0.53 *	1.11	0.52

* $p<0.05$ between brace conditions using paired *t*-test