



Do Functional Knee Braces Protect Critical Knee Structures in the ACL Deficient Knee?

Sebastian Tomescu MD, Ryan Bakker MSc, David Wasserstein MD,
Jas Chahal MD, Naveen Chandrashekar PhD, Paul Marks MD

SUNNYBROOK HEALTH SCIENCES CENTRE, UNIVERSITY OF TORONTO, CANADA
ORTHOPAEDIC BIOMECHANICS LABORATORY, UNIVERSITY OF WATERLOO, CANADA

ISAKOS 2015, LYON, FRANCE

Disclosures

- ▶ No financial disclosures declared by the co-authors

Introduction

- ▶ Many ACL injured patients elect not to undergo reconstruction
- ▶ Natural history of ACL deficient knees is repeated instability which leads to meniscal injury and eventually arthritis
- ▶ Functional Knee Braces are a common treatment for ACL deficient patients to facilitate return to sport or for those awaiting surgery
- ▶ Braces known to reduce subjective instability, but no data to show they prevent further meniscal and articular injury

Study Objective

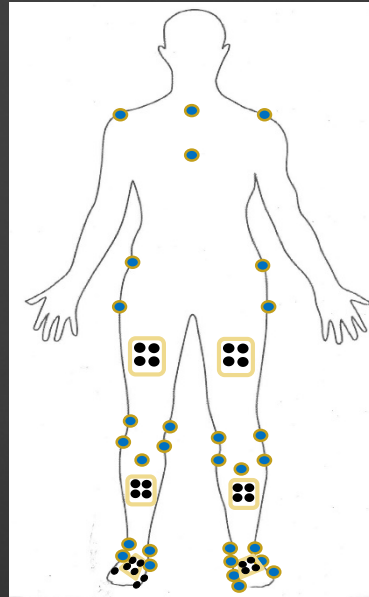
- ▶ Determine if Functional Knee Braces are effective in decreasing medial meniscal strain and articular contact pressure in an ACL Deficient knee during a common athletic maneuver – double leg landing

Methods

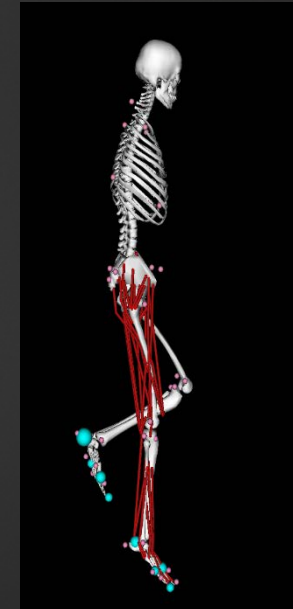
- ▶ Combined in vivo/in vitro approach to simulate athletic maneuver
 - ▶ In vivo – motion capture and analysis of a double leg landing; one subject



Motion Capture
Optotrak system



Marker Setup



Joint kinematics and
muscle forces calculated
in OpenSim software

Methods

- ▶ Combined in vivo/in vitro approach to simulate athletic maneuver
 - ▶ In vitro – one cadaver dissected, instrumented, and placed in soft tissue mould



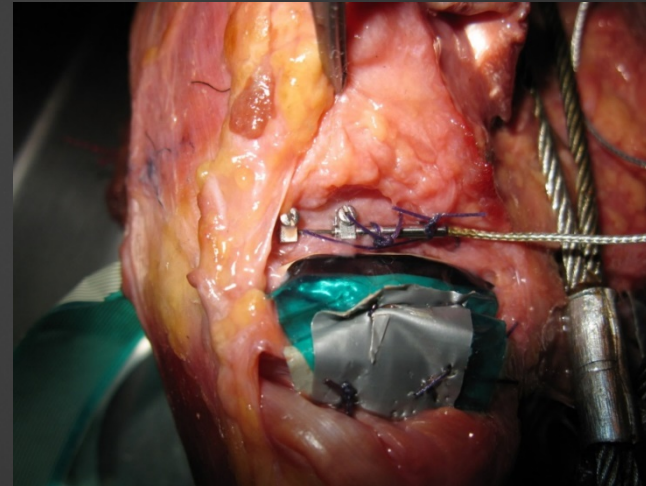
Intact Specimen



Cast mould



Dissected



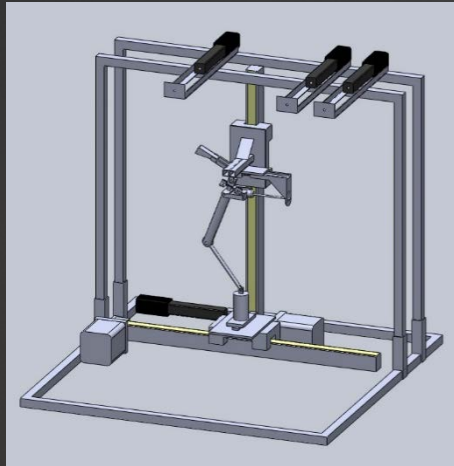
Instrumented specimen
(Tekscan pressure sensor,
meniscal DVRT, muscle
cables)



Soft tissue foam
mould with specimen
inside

Methods

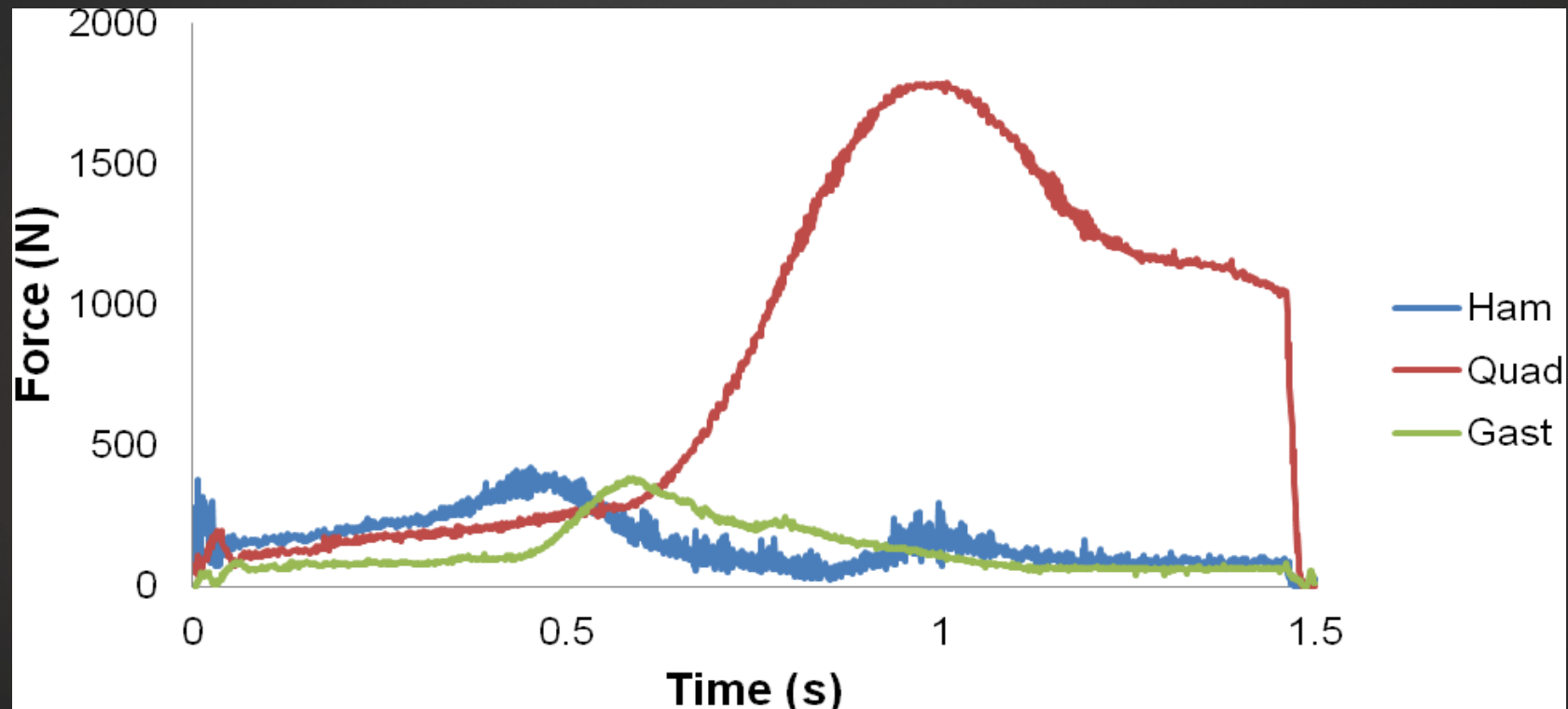
- ▶ Combined in vivo/in vitro approach to simulate athletic maneuver
 - ▶ In vitro – motion (knee), dynamic muscle forces (quads, hamstrings, gastrocnemius), and hip moment applied to cadaver



- ▶ 3 Testing Conditions
 - ▶ ACL Intact; No Brace
 - ▶ ACL Deficient, No Brace (ACL sectioned)
 - ▶ ACL Deficient, Braced (Ossur CTi Custom Brace)

Results

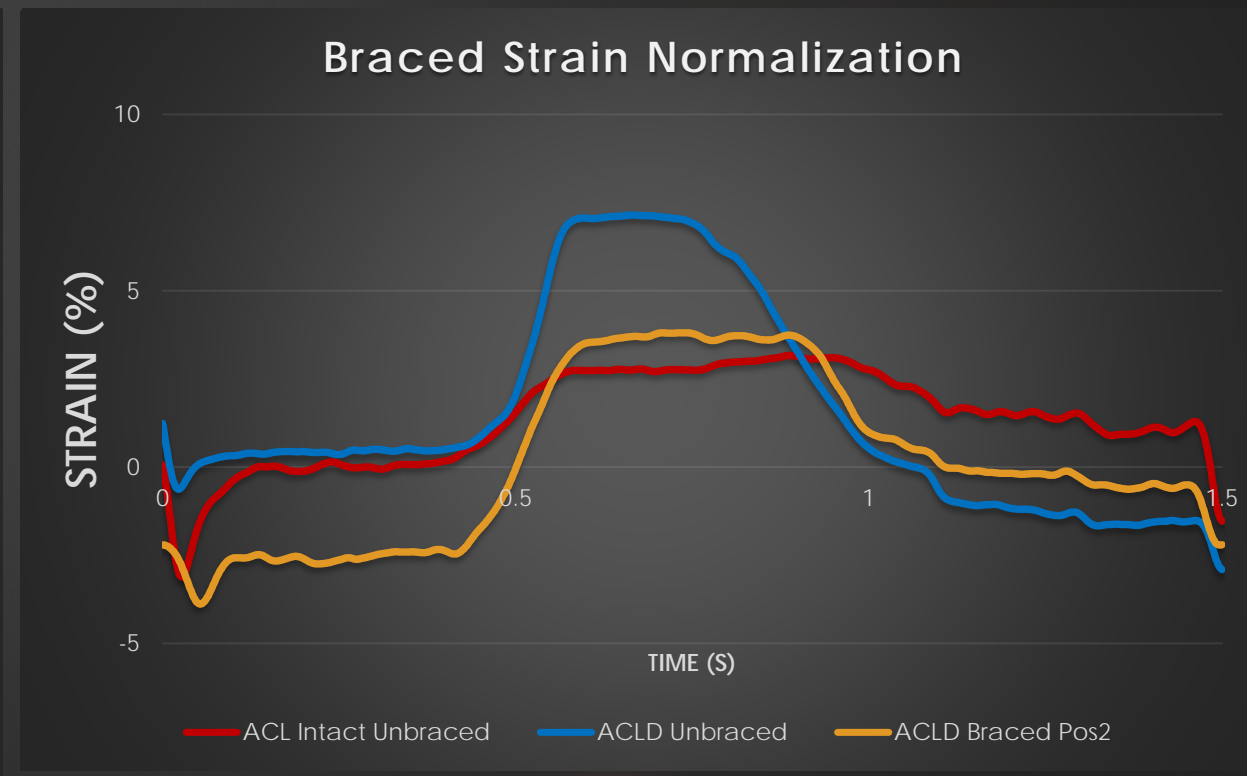
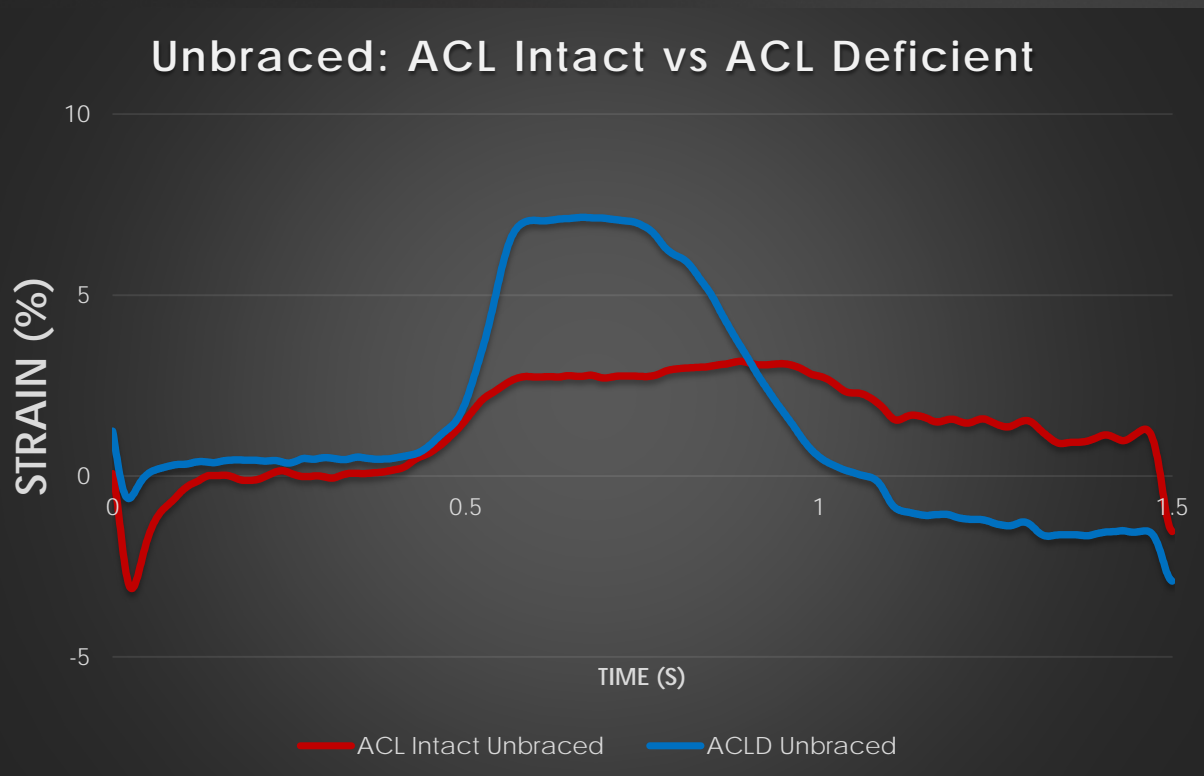
- ▶ Muscle Forces derived from OpenSim simulation and applied to cadaver specimen; landing occurred 0.5s



Results

- ▶ Peak strain in the medial meniscus increased from 3.17% to 7.81% after the ACL was transected

- ▶ After bracing, the strain decreased to 3.81%, nearly normalizing the strain compared to the ACL Intact condition



Results

- ▶ Peak contact pressure in the medial compartment was 13.3% lower after applying the brace in the ACL Deficient knee
- ▶ The tibia translated 2 mm further anteriorly without the brace than with the brace (based on Centre of Force measurements)

Discussion

- ▶ These preliminary results show that a custom, functional knee brace can decrease articular contact pressure and meniscal strain in an ACL deficient knee
- ▶ Decreased tissue loads suggest that braces have a protective effect on these critical knee structures
- ▶ Findings limited for use of a single cadaver; further testing planned with a larger sample size

References

- ▶ Beynnon BD, Johnson RJ, Abate JA, Fleming BC, Nichols CE. Treatment of anterior cruciate ligament injuries, part 1. *Am J Sports Med.* 2005; 33(10):1579-602.
- ▶ Cassidy K, Hangalur G, Sabharwal P, Chandrashekar N. Combined In Vivo/In Vitro Method to Study Anteromedial Bundle Strain in the Anterior Cruciate Ligament Using a Dynamic Knee Simulator. *J Biomech Eng,* 2013, 135(3), 035001
- ▶ Frobell RB, Roos EM, Roos HP, Ranstam J, Lohmander LS. A Randomized Trial of Treatment for Acute Anterior Cruciate Ligament Tears. *N Engl J Med.* 2010; 363:331-342.
- ▶ Laughlin WA, Weinhandl JT, Kernozek TW, Cobb SC, Keenan KG, O'Connor KM. The effects of single-leg landing technique on ACL loading. *J Biomech.* 2011 Jul 7;44(10):1845-51
- ▶ Najibi S, Albright JP. The use of knee braces, part 1: Prophylactic knee braces in contact sports. *Am J Sports Med.* 2005; 33(4):602-11.