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# ISOLATED POSTERIOR CRUCIATE LIGAMENT (PCL) LESION DRIVES TO INCREASED TIBIO-FEMORAL ACCELERATIONS AND LOWER-LIMB COMPENSATION STRATEGY: IN-VIVO KINEMATICAL ANALYSIS THROUGH WEARABLE INERTIAL SENSORS

**N. Pizza**, S. Di Paolo, A. Grassi, M. Viotto, L.  
Bragonzoni, S. Perelli, JC. Monllau, S. Zaffagnini





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# DISCLOSURES:

- **N.P., S.D.P, M.V., L.B.:** NOTHING TO DISCLOSE

- **S.P.:**

- SMITH & NEPHEW, CONMED-LINVATEC CONSULTANT

- **J.C.M.:**

- SMITH & NEPHEW, CONMED-LINVATEC CONSULTANT

- **S.Z.:**

- SMITH & NEPHEW, DEPUY CONSULTANT

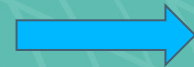
- MEDACTA, DEPUY RESEARCH SUPPORT



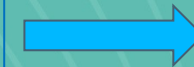
# INTRODUCTION

## DIAGNOSIS AND MANAGEMENT OF ISOLATED PCL LESIONS IS TRICKY

PERSISTENT POSTERIOR  
TIBIAL SUBLUXATION



ALTERED  
KINEMATICS



ALTERED  
CARTILAGE LOAD  
(OA CHANGES)

STATIC EVALUATION (CLINICAL EXPLORATION AND  
STRESS X-RAY)

RISK TO OVERLOOK INCREASED POSTERIOR LAXITY IN  
DAILY LIFE CONDITIONS.



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## AIM

TO INVESTIGATE THE IN-VIVO BIOMECHANICS OF ISOLATED PCL-INJURED PATIENTS IN ACTIVE EVERYDAY LIFE CONDITION USING WEARABLE INERTIAL SENSORS.

## HYPOTHESIS

- GLOBAL LOWER LIMB KINEMATICAL SIDE-TO-SIDE DIFFERENCES
- INCREASED LAXITY OF THE PCL-INJURED KNEE WOULD LED TO INCREASED TIBIO-FEMORAL ACCELERATIONS.



# METHODS

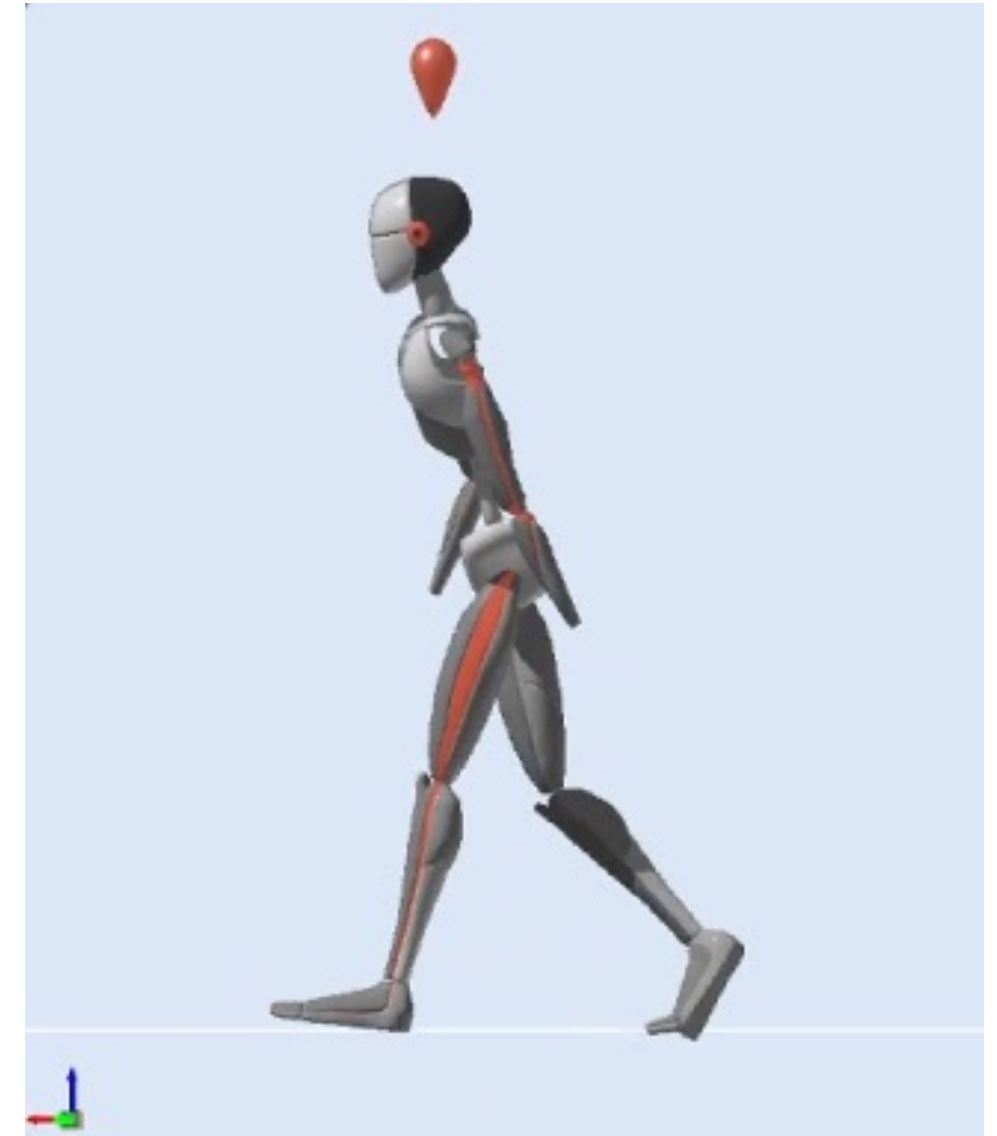
**8 PATIENTS** (6 MALES ; 2 FEMALES) WITH ISOLATED PCL GRADE I/II LESION

**GAIT OVER A 20M LINEAR PATH** (10M BACK AND FORTH) AT SELF-SELECTED SPEED.

**8 WEARABLE INERTIAL SENSORS** (*MTW AWINDA, XSENS*) BILATERALLY ON FEET, SHINS, AND THIGH, ONE ON THE PELVIS, ONE ON THE TRUNK.

**WAVEFORM KINEMATICS** (JOINT ANGLES IN THE THREE PLANES) OF HIP, KNEE, AND ANKLE  
**JOINTS KINETICS** (LINEAR ACCELERATION IN THE THREE PLANES) OF FEMUR, TIBIA, AND FOOT SEGMENTS WERE **NORMALIZED** OVER THE GAIT CYCLE AND **COMPARED** BETWEEN INJURED AND NON-INJURED LEG.

THE **STUDENT'S T-TEST** TO COMPARE THE WAVEFORMS DATA.



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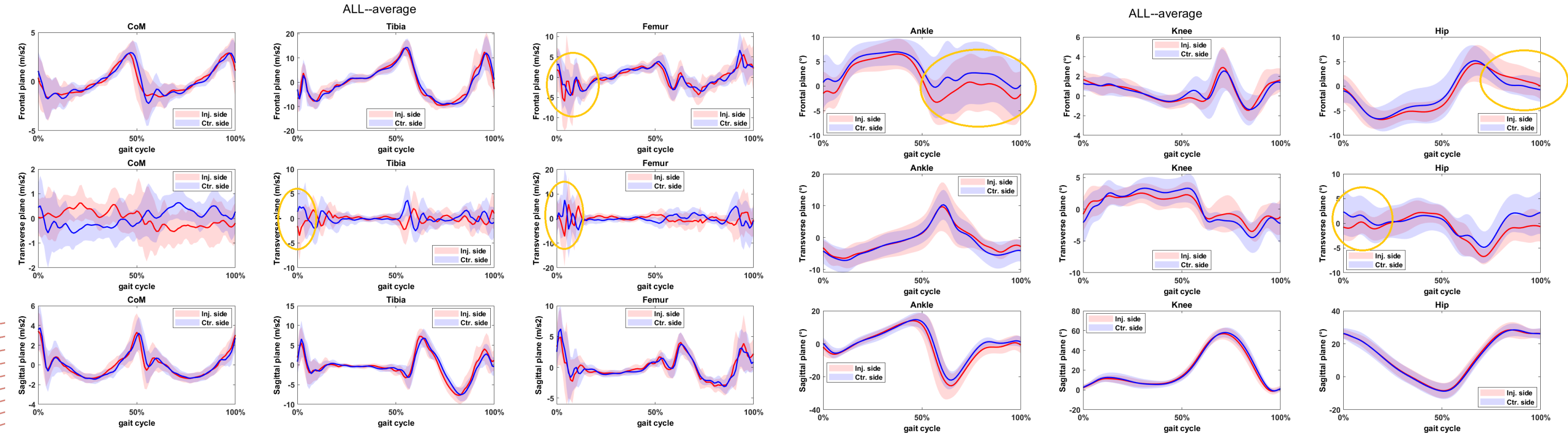
# RESULTS

## DURING SWING:

- INCREASED HIP ABDUCTION AND EXTERNAL ROTATION, INCREASED ANKLE EVERSION IN THE INJURED-LEG ( $p=0.035$ ).

## DURING INITIAL CONTACT:

- GREATER KNEE INTERNAL ROTATION AND HIP EXTERNAL ROTATION FOR THE INJURED-LEG
- GREATER ANTERIOR-POSTERIOR AND MEDIAL-LATERAL PEAK NEGATIVE ACCELERATIONS IN THE INJURED-LEG AT TIBIA AND FEMUR ( $p=0.021$ ).



# CONCLUSIONS

- SIGNIFICANT BIOMECHANICAL SIDE-TO-SIDE DIFFERENCES IN DIFFERENT STAGES OF GAIT:  
WHOLE LIMB COMPENSATION STRATEGY.
- INCREASED TIBIOFEMORAL ACCELERATION IN THE PCL-INJURED KNEE AT THE IMPACT PHASE.

# CLINICAL RELEVANCE

- KNEE AND LOWER LIMB ALTERATIONS CAN BE EFFECTIVELY DETECTED THROUGH NON-INVASIVE WEARABLE INERTIAL SENSORS
- NEED OF DYNAMIC ANALYSIS IN DAILY CLINICAL PRACTICE IN TRICKY INJURIES.



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