

# Numerical Assessment of two Implants for Pubic Ramus Fracture of human Pelvis applying Normal Gait loading

PL. Ricci<sup>1</sup>, T. Gerich<sup>2</sup>, J. Kelm<sup>3</sup>, S. Kedziora<sup>1</sup>, A. Soliman<sup>1</sup>, S. Maas<sup>1</sup>  
ahmed.soliman@uni.lu



<sup>1</sup> Université du Luxembourg



<sup>2</sup> Centre Hospitalier de Luxembourg



<sup>3</sup> Universitätsklinikum des Saarlandes

## 1. INTRODUCTION

Pelvic instability impairs the load transfer to the lower extremity. Fractures of the anterior pelvic ring reduce patients' mobility, independence and increase mortality.

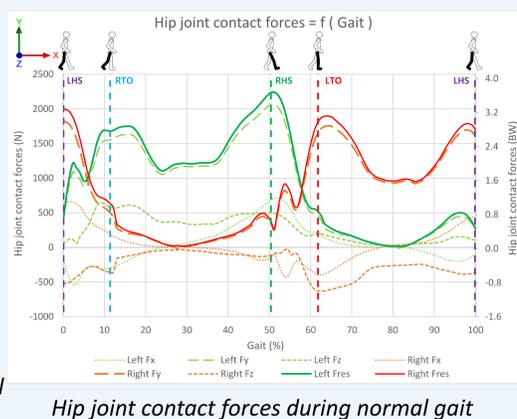
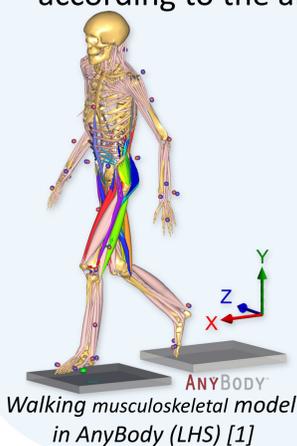
### Study Objectives

Investigating numerically the biomechanical stability of pelvic ring by two reconstructive devices : iliopubic Subcutaneous Plate (SP) innovative technique and the gold standard Supra-Acetabular External Fixator (SAFE).

## 2. Methods

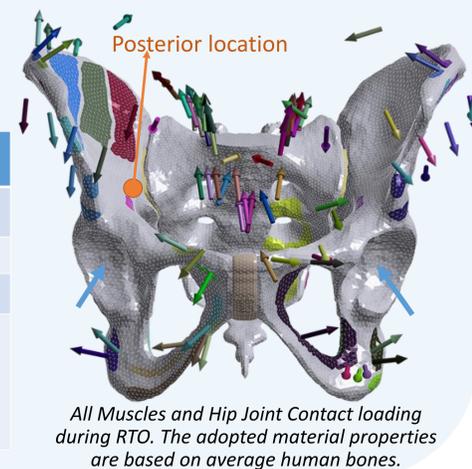
Physiological normal gait loading of all acting muscles and Hip Joint Contact (HJC) forces of the pelvis are calculated by means of inverse dynamics software for a healthy patient and considered in the numerical analysis.

Finite Element (FE) models were developed for a pelvis with superior and inferior rami fractures. Muscle forces are applied on surfaces according to the anatomical insertions and origins.



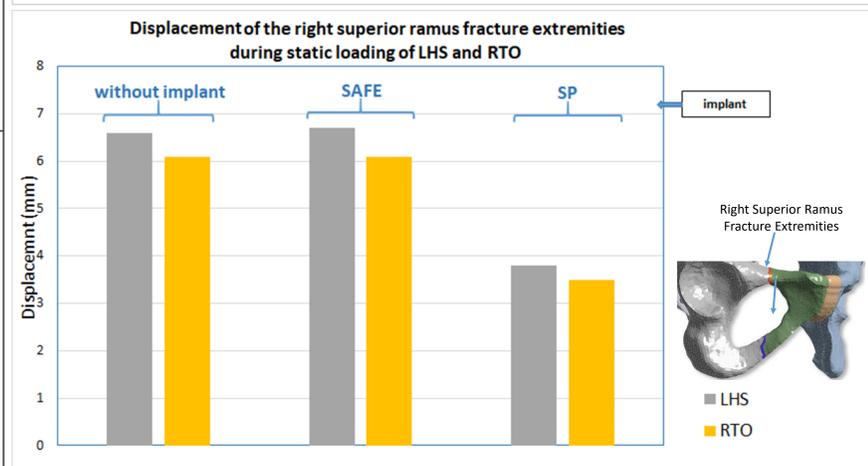
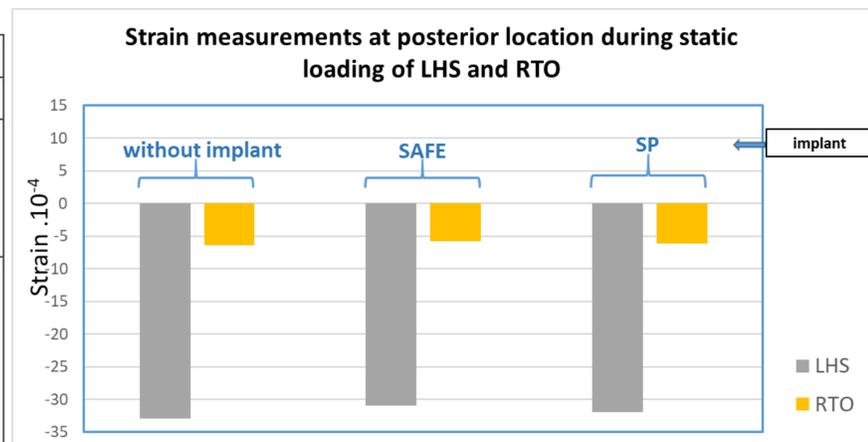
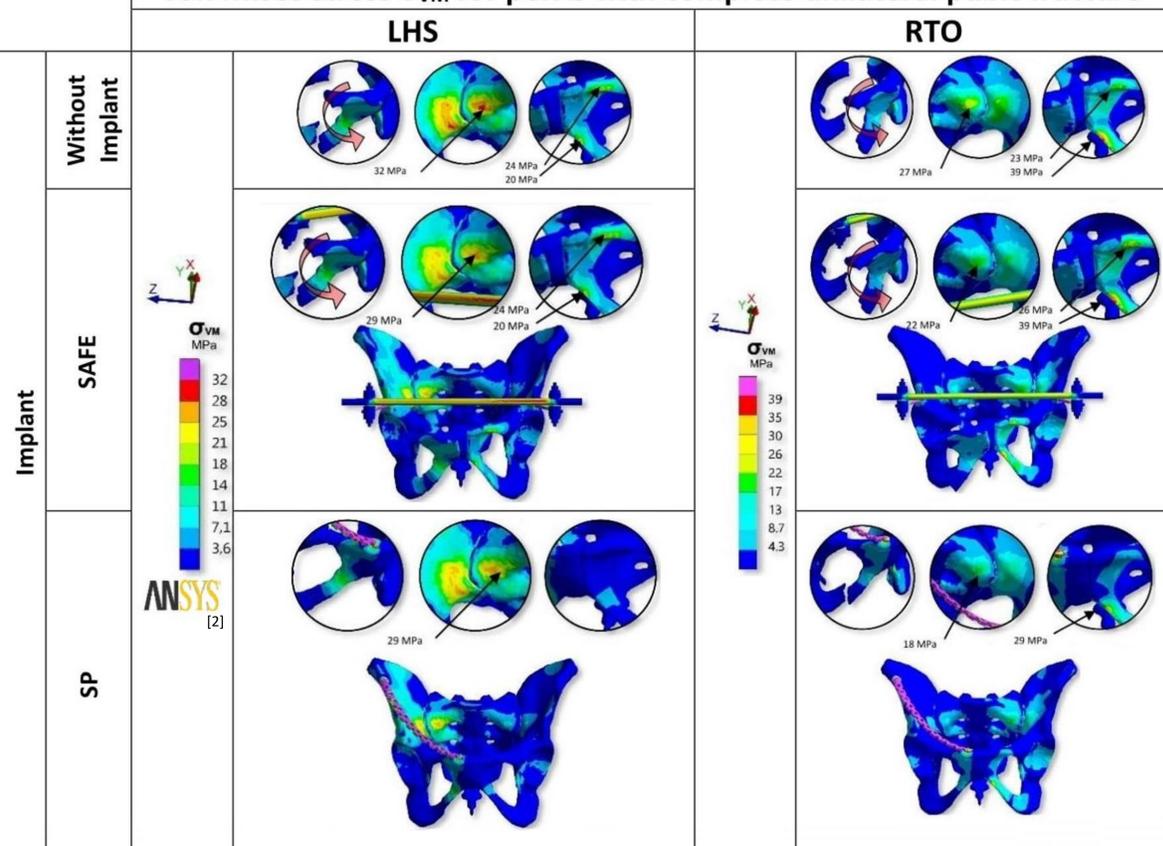
Muscle/Hip joint forces computed by inverse dynamics for Left Heel Strike (LHS) and Right Toe Off (RTO)

Joint / Muscle	Muscle forces - N [BW]			
	LHS - 0% Gait		RTO - 11,4% Gait	
	Left	Right	Left	Right
Hip joint	391	1998	1681	645
Algebraic Sum of Muscles forces ( 21 muscles: Adductor, Biceps femoris, Gluteus, Quadratus femoris,..etc)	723 [1,8]	2244 [7,0]	1661 [5,5]	1490 [3,5]



## 3. Results

### von Mises stress $\sigma_{VM}$ for pelvis with complete unilateral pubic fracture



## 4. DISCUSSION and CONCLUSION

- Both devices reduced stresses of the sacrum wing in LHS and RTO with slightly better results for SAFE.
- In case of superior and inferior pubic ramus fractures, SP technique reduced the frontal opening of the fractured right pubic bone. The SAFE did not provide any improvements compared to SP technique.

## References

- [1] AnyBody. The AnyBody Modeling System. Aalborg, Denmark: AnyBody Technology A/S; 2017.  
[2] ANSYS® Academic Research Mechanical, Release 19, Help System, Coupled Field Analysis Guide, ANSYS, Inc.

