Influence of pubic symphysis stiffness on pelvis stress distribution during single leg stance

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1 - INTRODUCTION

**Pelvis** ➔ complex circular structure:
- 3 bones:
  - Left/right hipbones,
  - Sacrum,
- 3 joints:
  - Left/right Sacroiliac joints (SI joints),
  - Pubic Symphysis (PS).

**Stability** is essential to prevent lower back pain and further complications.
**Aim of the study:** to assess the influence of Pubic Symphysis (PS) stiffness on the integrity of the bony structures and joints.

Numerical single leg stance model with loads from muscles and hips ➔ Soft PS / Normal PS / Stiff PS ➔ Changes in stress distribution

2 - METHODS

Load distribution in pelvis under physiological loading conditions

**Inverse dynamics:**
- Joints reaction forces,
- Muscles forces.

Musculoskeletal model from AnyBody experimentally validated applied to right single leg stance:

**Fz** from Fz shearing & Pectineus increases

**Changes in stress:**
- Muscles: Symphysis leg to the pelvis left Abdominis 17 Fz physiological = Spinae Soft springs at lower ischial Congress of the European Society of Biomechanics stresses on the sacrum. conditions to = compression Symphysis Rectus = 7000 1692 Gemellus Rasmussen, (2007) World Congress of Biomechanics Fy 50 Fy more 3 Fy applied Gracilis, right Fy Earl Quadratus Pectineus = 350 forces Sartorius Adductor stance 1.5 experiencing 0.5 Psoas bones:
- AnyBody / right hip (distribution in pelvis decreases Sacrum, Right SI joint. 3 joints:
  - Left SI joint, Right SI joint.
- 50 E 22 [N]
- 25% of pubic symphysis ramus increases.
- **AnyBody**

**Finite Element Analysis:** load distribution in pelvis

**Bones** (averaged mechanical properties from cancellous and spongyous bones, Eps = 7000 MPa, Eps = 0.3 [1]):
- **Left** / **right** hip bones, sacrum
- **Sacroiliac joints** (Eps = 350 MPa, Eps = 0.695 [1]):
  - Left SI joint,
  - Right SI joint.

**Pubic Symphysis** (single component, Eps = 0.495 [1]):
- Eps = 0.5 MPa (Soft),
- Eps = 5 MPa (Normal) [1],
- Eps = 50 MPa (Stiff).

**Boundary conditions:**
- Spherical joint at the lumbosacral joint,
- Physiological forces from inverse-dynamics simulation (AnyBody),
- Soft springs at lower ischial tuber ossities for numerical convergence.

3 - RESULTS

![Sections at PS, Right SI joint, and Left SI joint with different PS stiffness](attachment:image)

**Section moment** at PS and SI joints: Normal PS (5 MPa) ➔ Stiff PS (50 MPa)

4 - DISCUSSION and CONCLUSION

**Normal PS:**
- higher stresses at the superior ramus
  - decreases stresses at the superior ramus,
  - increases stresses on the sacrum,
- e.g.: increased laxity, pregnant women, etc. ➔ lower back pain and problems on the back?

**Soft PS:**
- decreases stresses at the superior ramus,
- decreases stresses on the sacrum.

**Stiff PS:**
- increases stresses at the superior ramus,
- decreases stresses on the sacrum.

- e.g.: elderly people, bridging of the PS, etc. ➔ superior ramus more prone to fracture?

**PS**, experiencing more compression forces than shearing forces. ➔ **essential role** on the load distribution, ➔ **key element** of the biomechanics of the pelvis.

5 - REFERENCES