

## The fundamentals: **BIOMECHANICS and STABILITY of the SIJ & PELVIS**

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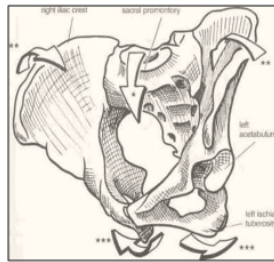
## Introduction to sacroiliac motion

- In order to discuss the mechanisms of pelvic stability one needs to begin with a study of the biomechanics
- **The biomechanics are underpinned by the anatomy**
- It has often been the study and discussion of the SIJ biomechanics that has generated much of the controversy surrounding SIJ or pelvic motion
- Much of the so-called research from the early & mid-20<sup>th</sup> century into SIJ biomechanics comes from clinical observation
- **AND clinicians should be wary of hypotheses that have not been tested and verified experimentally**

## SIJ Biomechanics

- The physiological movements occurring at the SIJ are described in relation to either the sacrum or the innominate

- The main movements of the sacrum are:
  - **nutation and**
  - **counternutation**



- **Nutation and counternutation describe how the sacrum moves relative to the innominates**

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## Biomechanics

- **Motion of the pelvis occurs in all 3 body planes:**

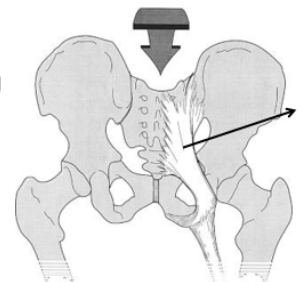
1. Flexion/extension in the **sagittal** plane during forward and backward bending
2. Side flexion in the **coronal** plane during lateral bending and
3. Axial rotation in the **transverse** plane during twisting of the trunk

- A combination of all these motions occurs during the normal gait cycle and other habitual movements

## Sacral nutation

- Bilateral sacral nutation occurs during the initial stages of forward bending of the trunk

- **Unilateral sacral nutation occurs during flexion of the lower extremity**

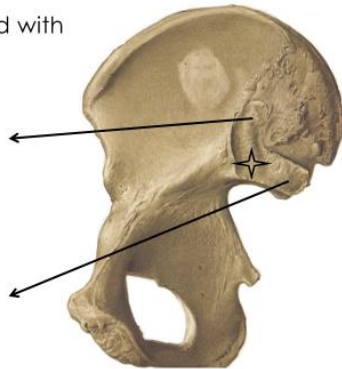


**This motion is resisted by the interosseous and sacrotuberous ligaments**

## The primary SIJ axis

The SIJ is roughly L-shaped with 2 arms at 90°

1. A **short arm or vertical arm** at the level of S1
2. The **longer arm or AP arm** at S2,3,4



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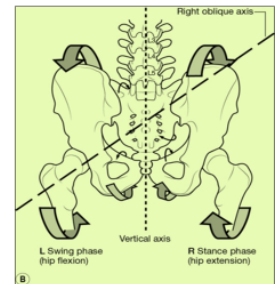
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## The controversy: Multiple versus fixed axes of motion

- The number of potential axes for pelvic motion tends to confuse and complicate pelvic/sacral mechanics
- **Mitchell et al (1979) describes 6-fixed axes:**
  - 1 axis through the pubic symphysis
  - 3 transverse axes
  - And right and left diagonal sacral axes
- The axes are dependant on whether the loading occurs from the spine (sacroiliac) or lower extremities (ilio-sacral)
- Helped name osteopathic SIJ dysfunctions

## Controversy: An 'oblique axes' of motion

- Magoun (1940) proposed that the sacrum rotates about an oblique axis running from the upper pole on one side to the lower pole on the opposite side
- **Postulated: a degree of sacral rotation/torsion needs to take place to explain for the complex nature of gait biomechanics**



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## Introducing PELVIC STABILITY

## The Pelvis

### Fundamental point:

#### Primary function:

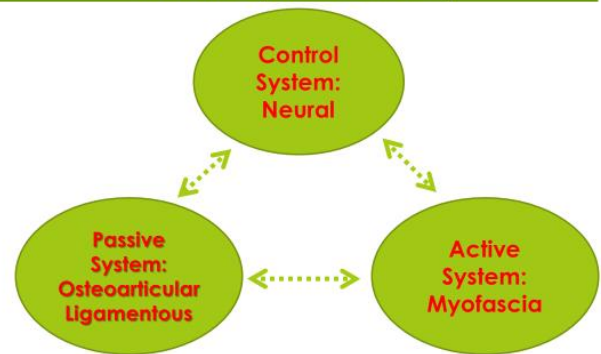
- The joints of the pelvis
  - the pubic symphysis
  - the sacroiliac joints

Must be able to absorb and transmit forces efficiently for optimal function



## Panjabi (1992) Stability Model

-Static & Dynamic Stability



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## So how does the SIJ maintain its stability within the pelvic girdle?

## A model for pelvic stability

- A conceptual model has been proposed in which **form and force closure** are used to describe how:
  - **Effective load is transferred through the pelvic girdle**
  - **Snijders & Vleeming (1993)**

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# What is form-force closure & why is it important to the pelvis?

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## SIJ Stability & function

### Vertical shear in the SIJ is prevented by:

1. The combination of the specific anatomical features of **form closure**
2. And the compression generated by muscles and ligaments that can be accommodated to the specific loading situation of **force closure**

## Load transfer through the pelvic girdle is dynamic process

### Depends on a number of factors:

1. Optimal function of bones, joints and ligaments to ensure joint congruency
2. Optimal function of the muscle and fascia
3. And appropriate neuromuscular control

Vleeming et al (1990a, 1990b, 1993)

## Other points to consider: SIJ & the role in gait

The principal function of the SIJ's is:

- To act as a stress reliever ensuring that the pelvic girdle is not a solid ring of bone that would crack under the stresses to which it is subjected

### The SIJ's in humans serve a purpose:

- to economise gait
- to allow shock & shear absorption

Bogduk 1997, Adams et al 2002

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