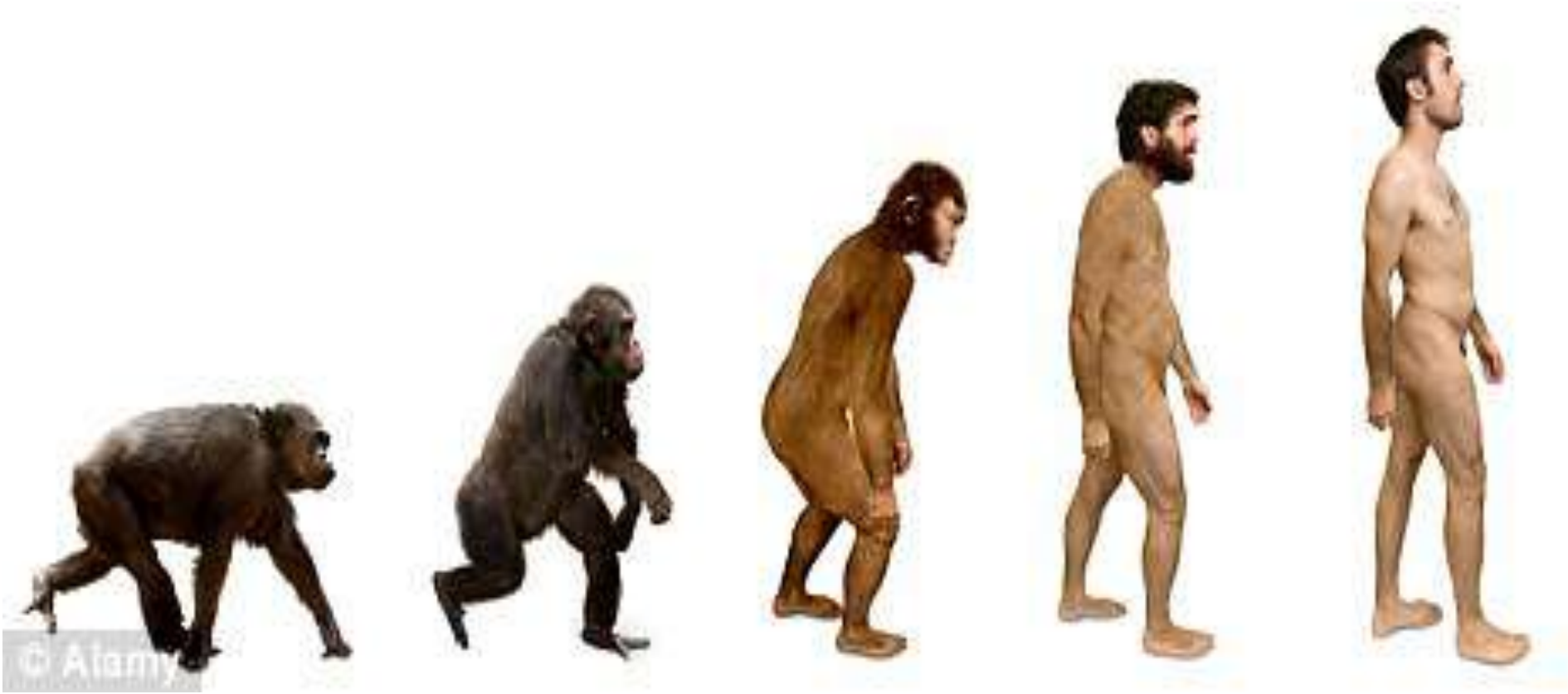
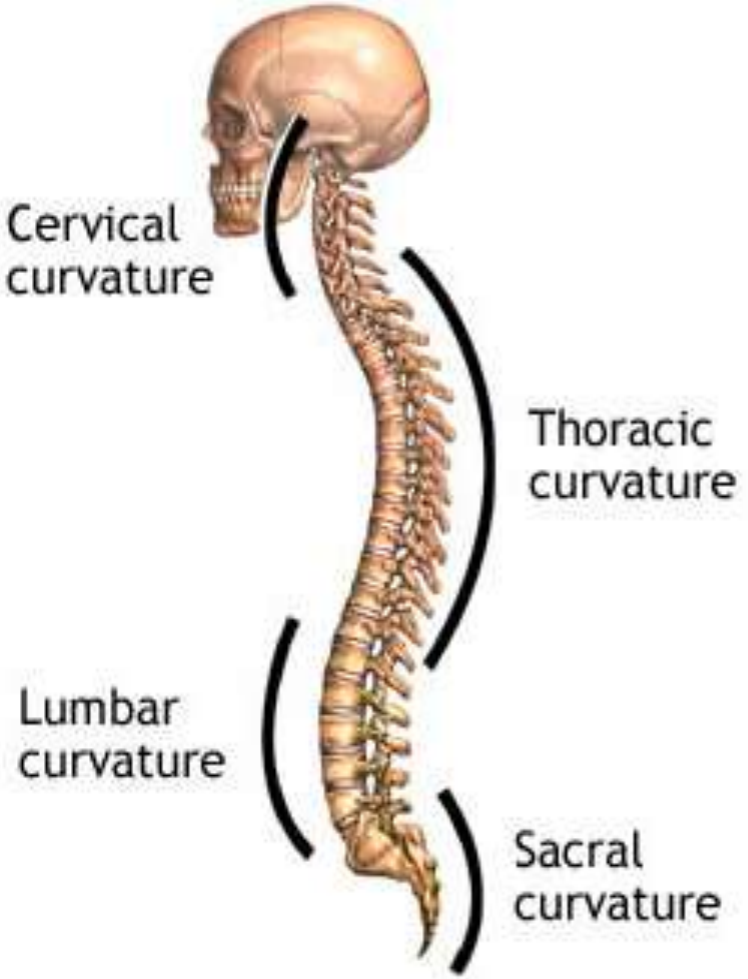
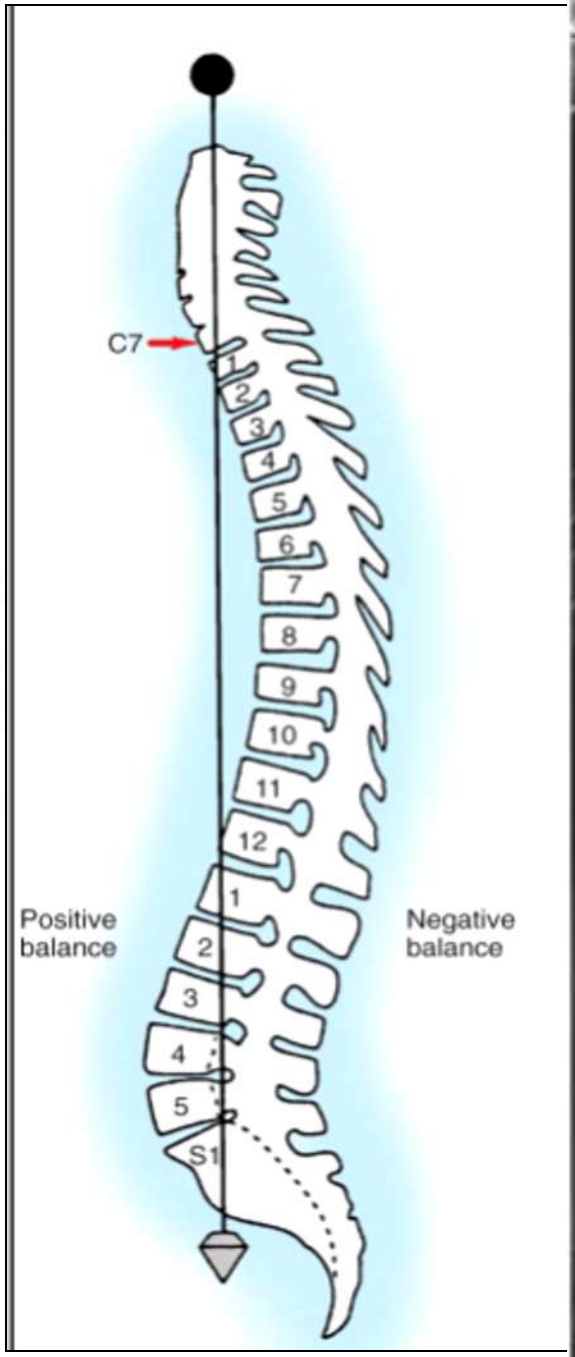
Understanding sagittal balance of spine and its implications in various spinal pathologies

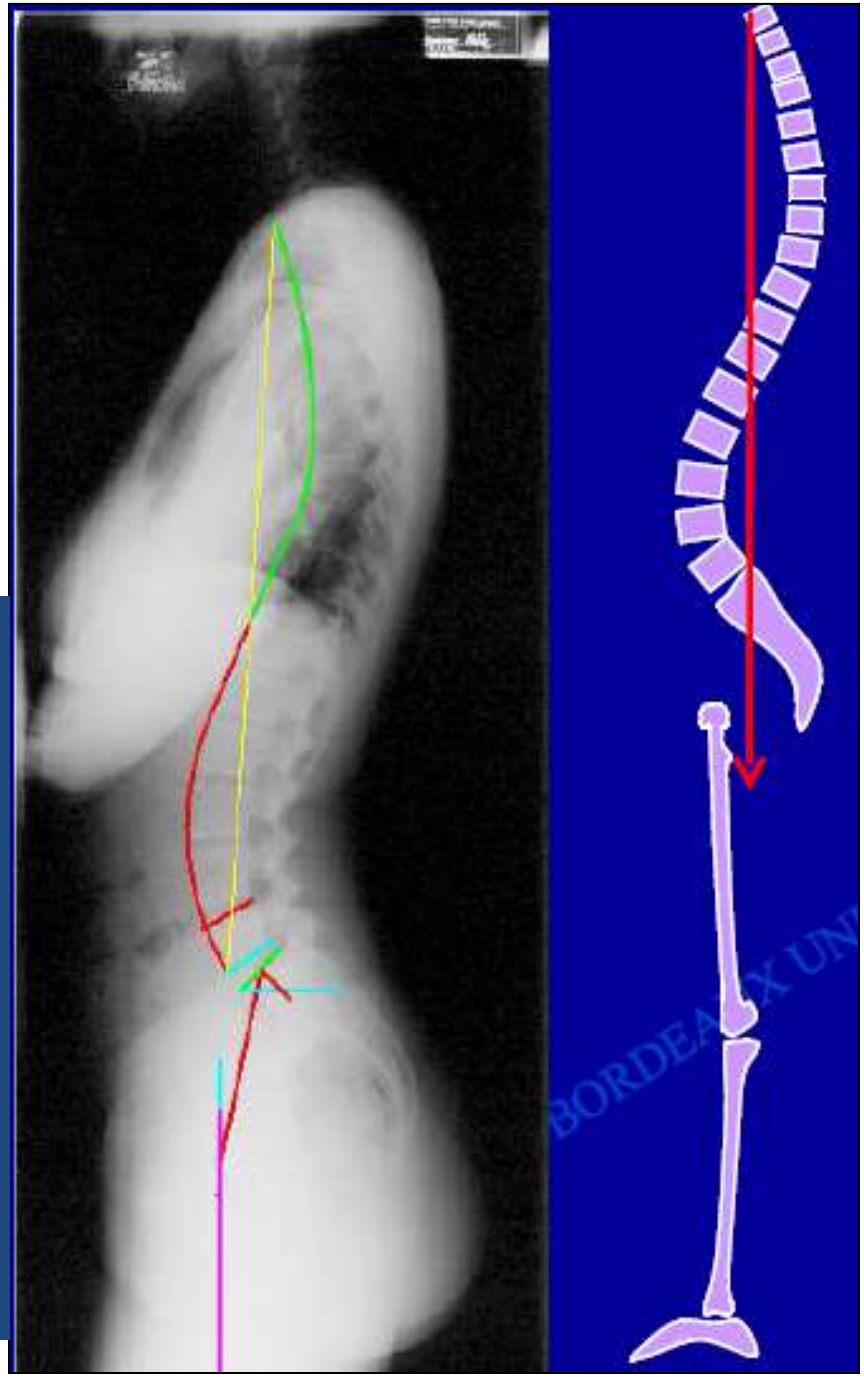
Why erect position ?







How to measure sagittal balance ?
C7 plumb line



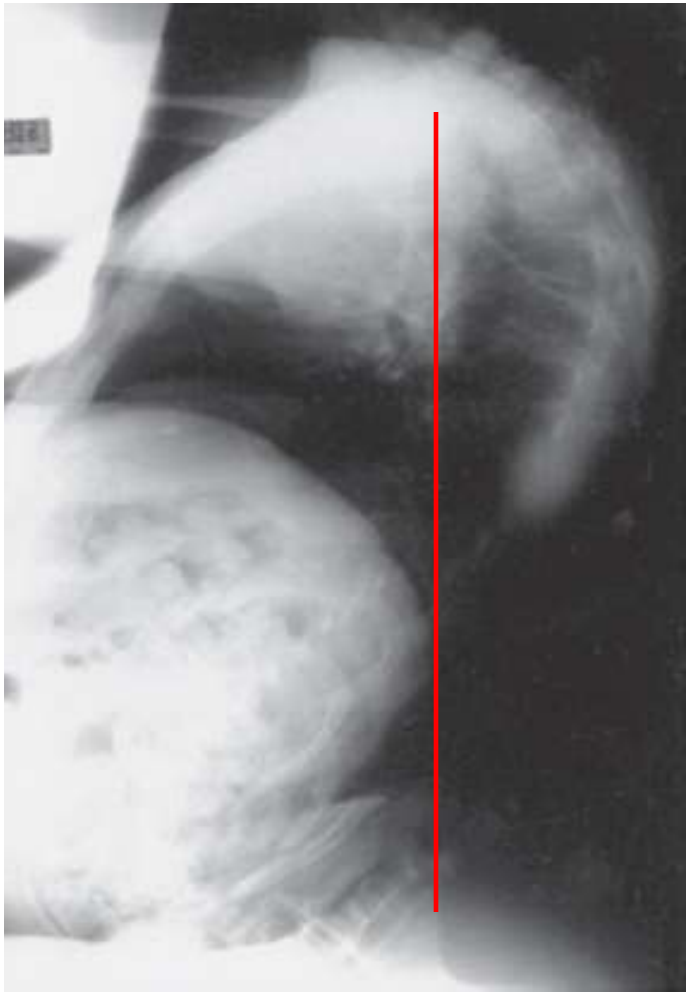
- Sagittal balance is the alignment of C7 to the posterior superior aspect of the sacrum on an upright radiograph.

- Should be plus or minus 2 centimeters from the posterior superior aspect of the sacrum.

Positive Sagittal imbalance

- ***Positive sagittal imbalance*** - truncal muscles, hips, knees, and thighs under continual strain to keep the patient's head in line with the shoulders and hips and over the feet.

Negative Sagittal imbalance

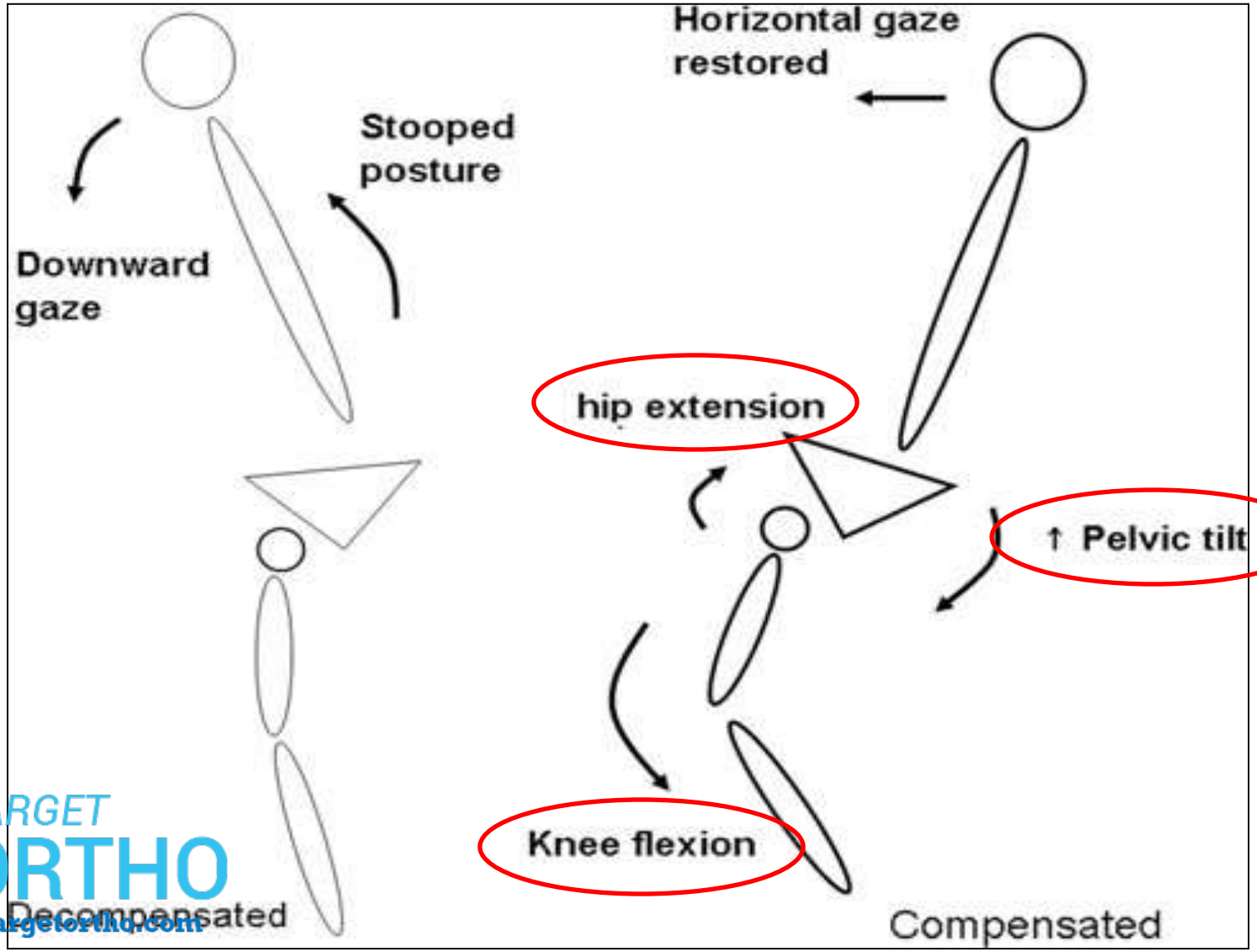


Balancing mechanism for positive sagittal imbalance

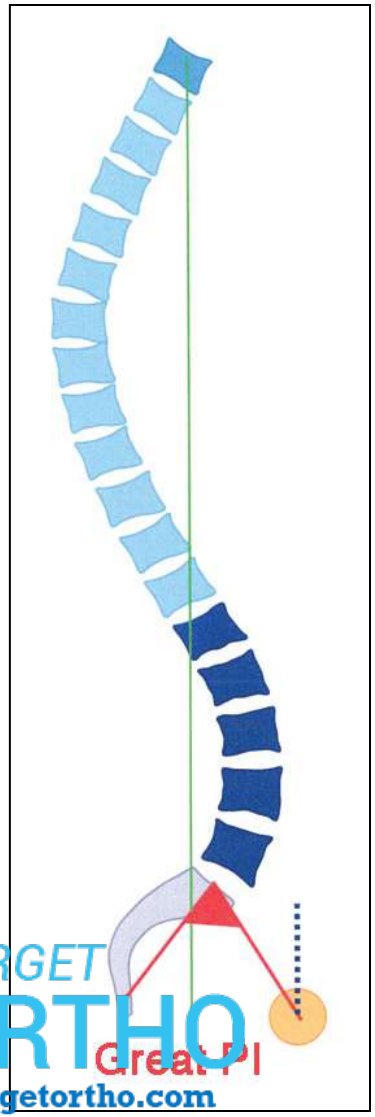
To bring the centre of gravity back:

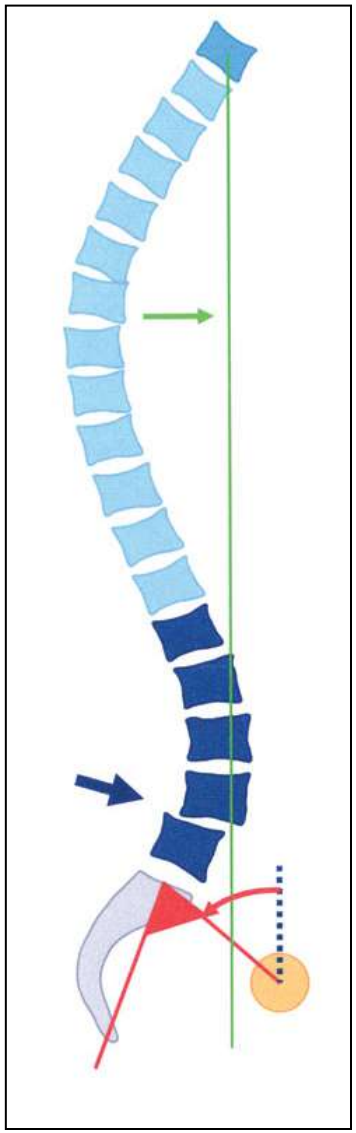
1. Increasing the lumbar lordosis
2. Pelvis retroversion
3. Hip extension and Knee flexion

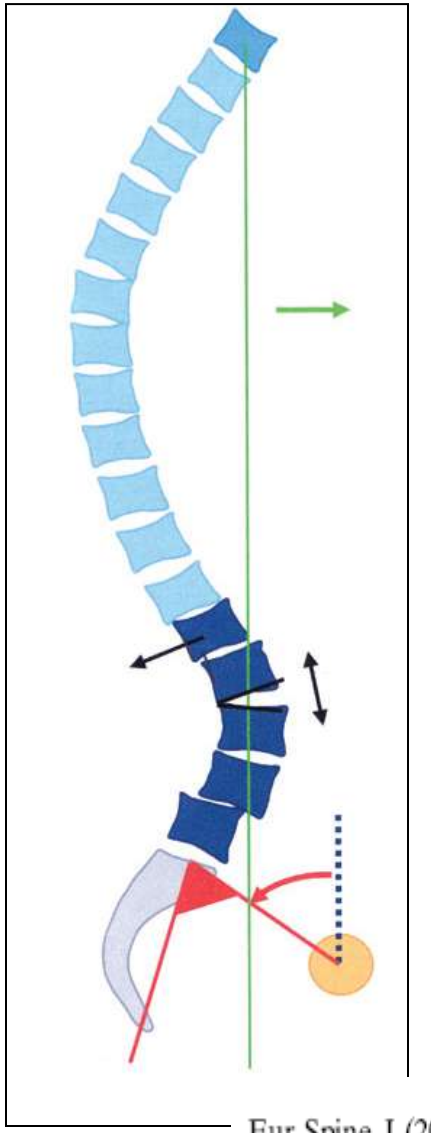
Balancing mechanism
Hip and knee



Balancing mechanism
Lumbar lordosis





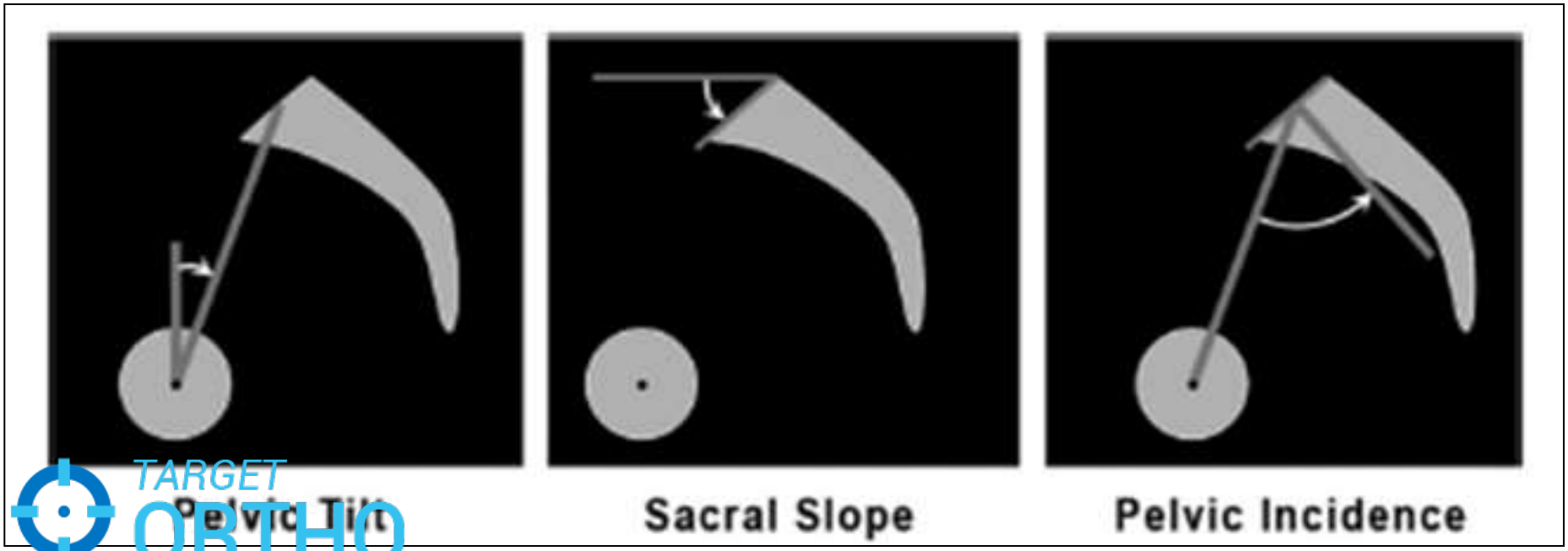


Eur Spine J (2007) 16:1459–1467

Balancing mechanism
Spinopelvic parameters

- The relation of the pelvis to the spine, spinopelvic balance - contributes to overall sagittal balance.

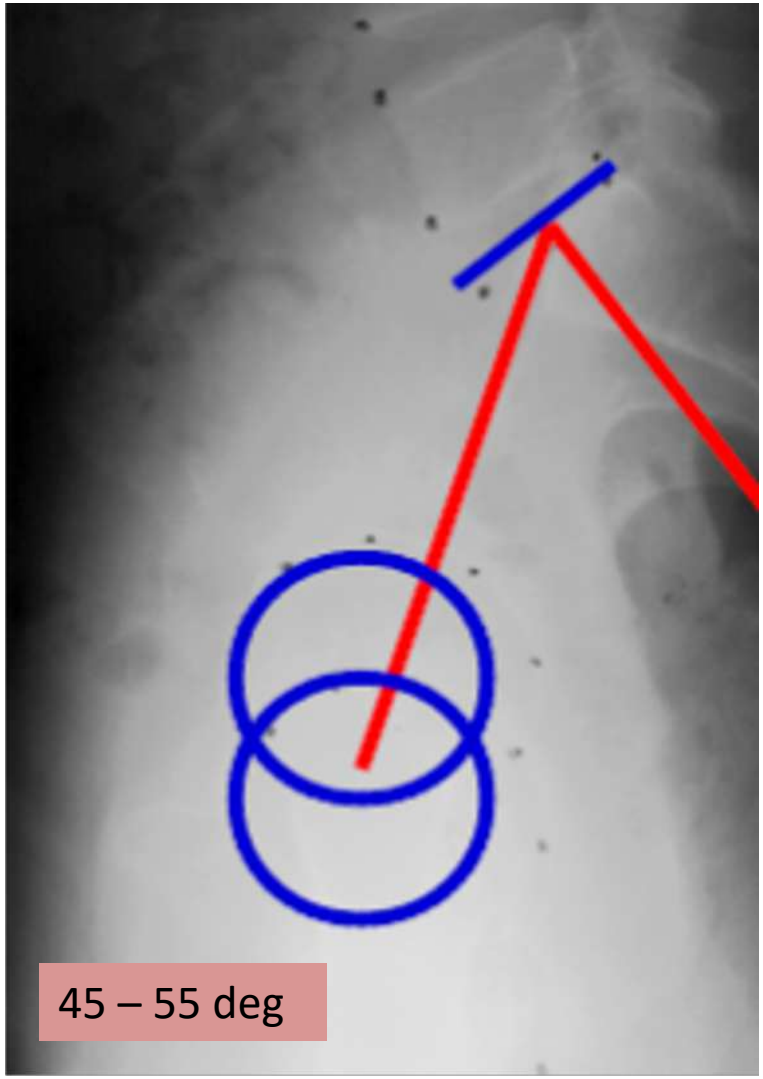
- Defined by 3 different set of parameters



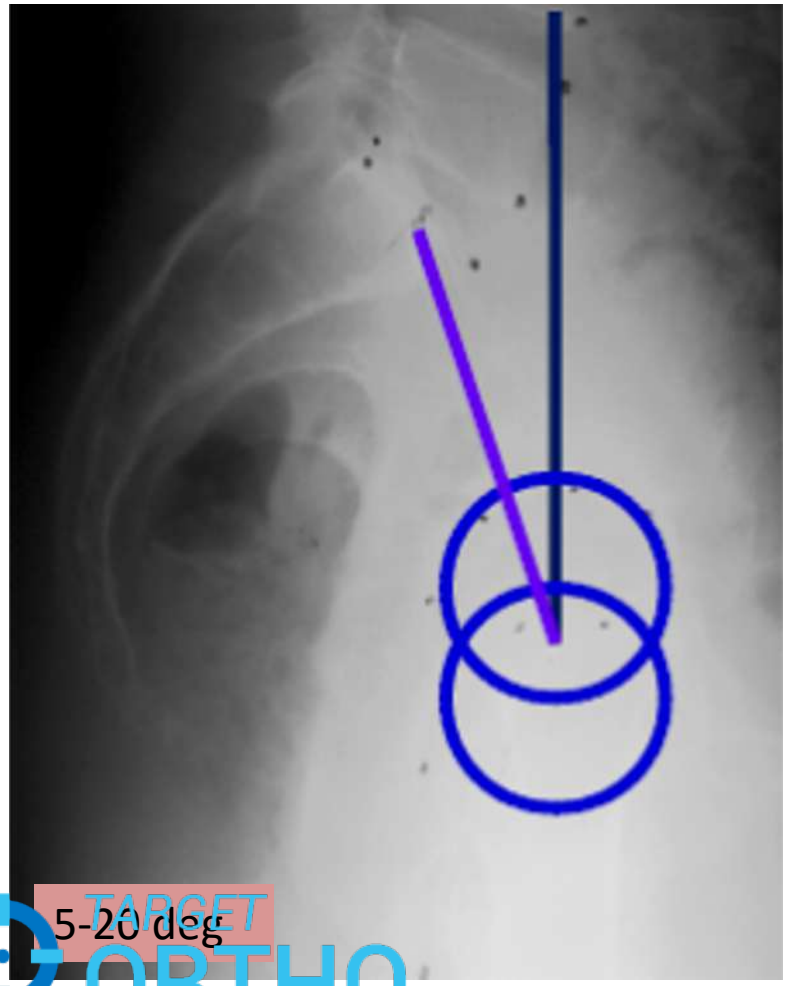
Duval-Beaupe`re et al-1992

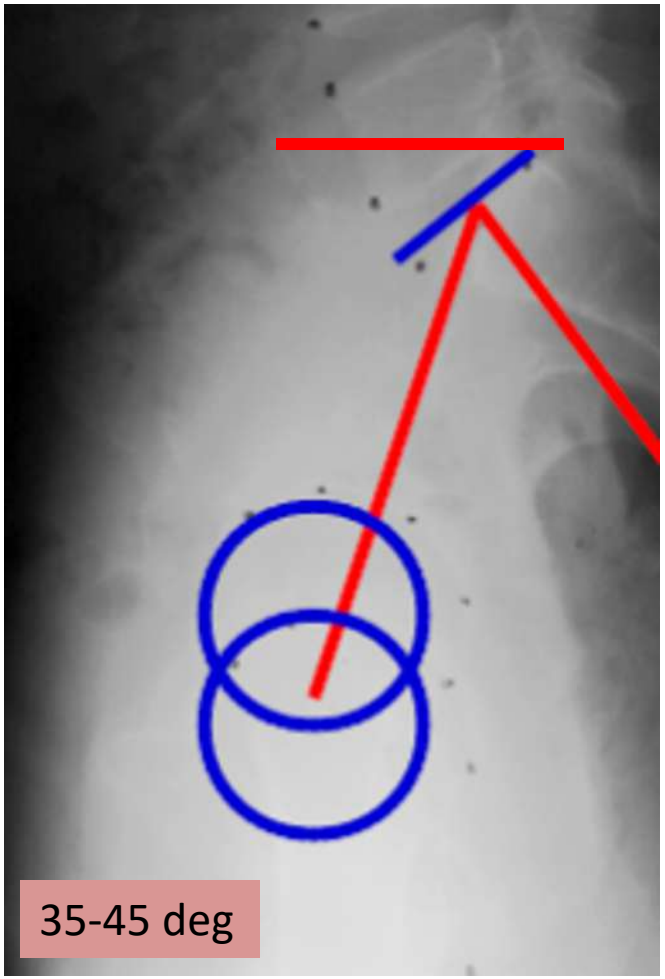
Pelvic incidence

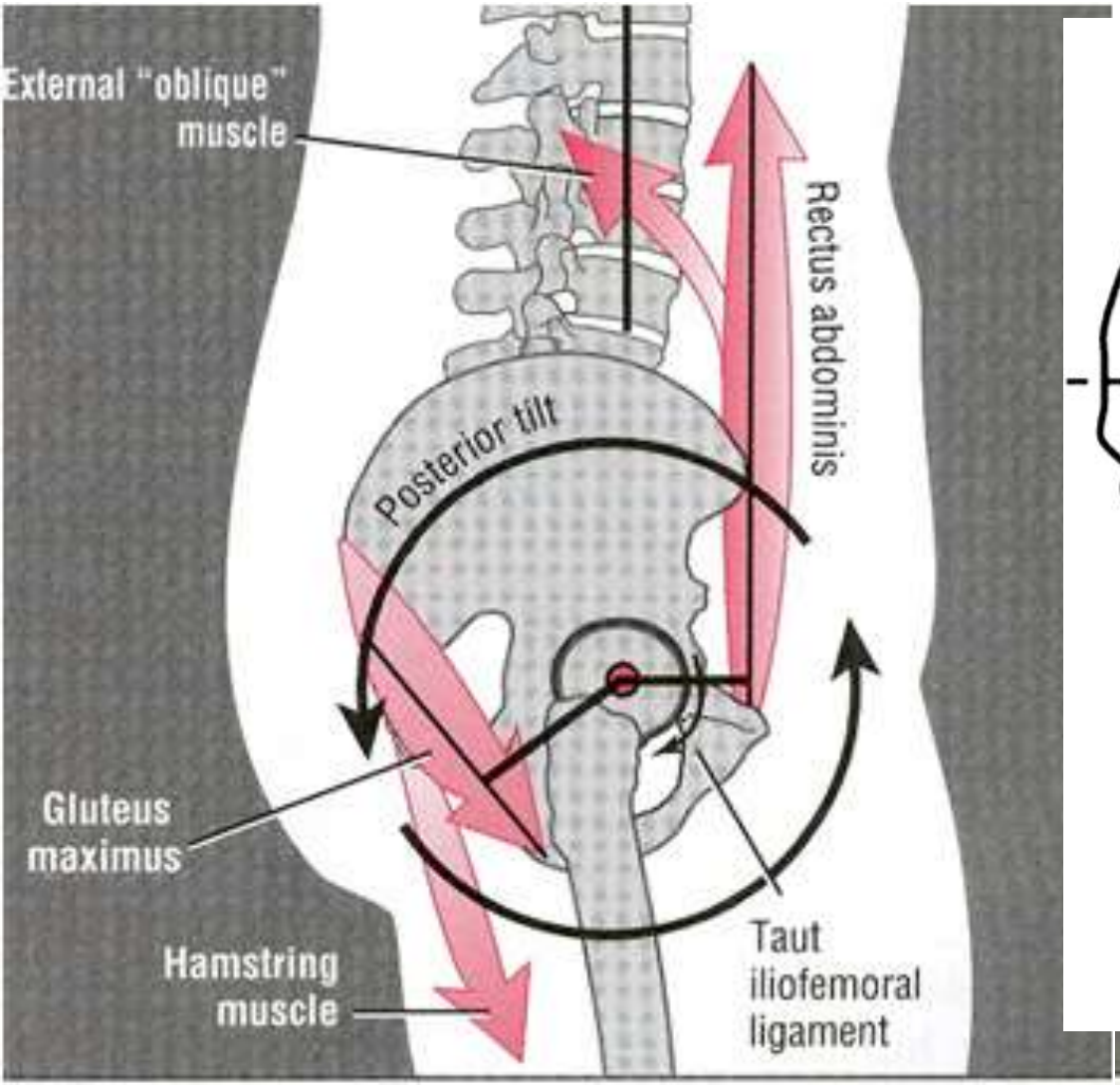
- Relation between sacral plate and the femoral heads.
- Constant morphological parameter for one person.
- Not posture dependant
- Linear correlation between age and PI
- PI stabilizes in early adolescence
- Does not change after skeletal maturity

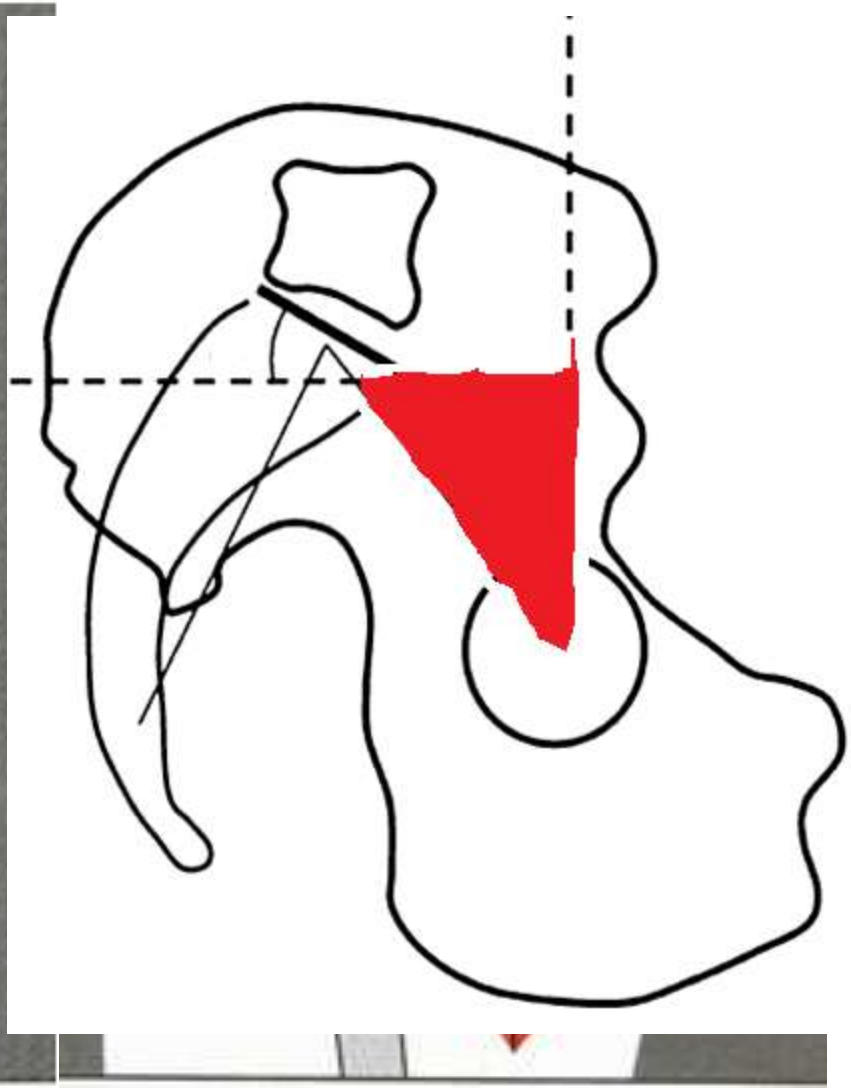


Pelvic tilt & Sacral slope

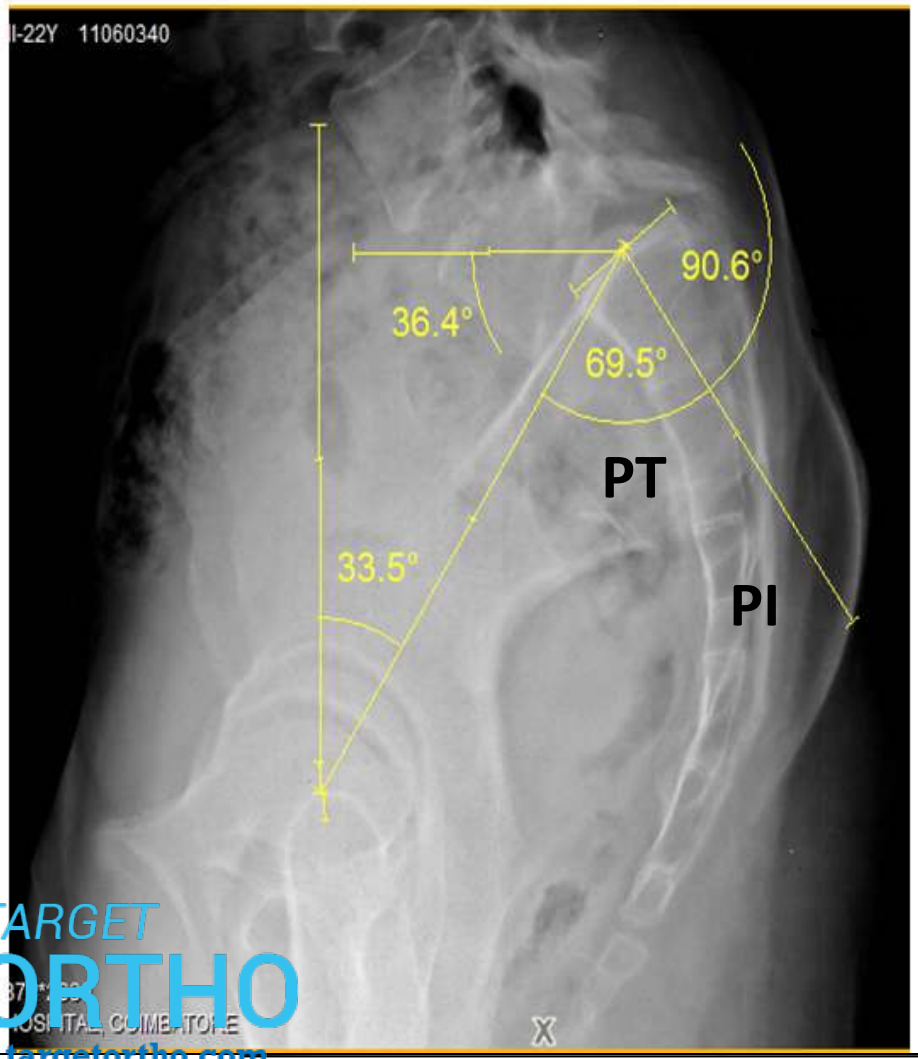








PI = PT+SS



Pelvic incidence - 69.5 degrees

Pelvic tilt – 33.5 degrees.

Sacral slope – 36.4 degrees.

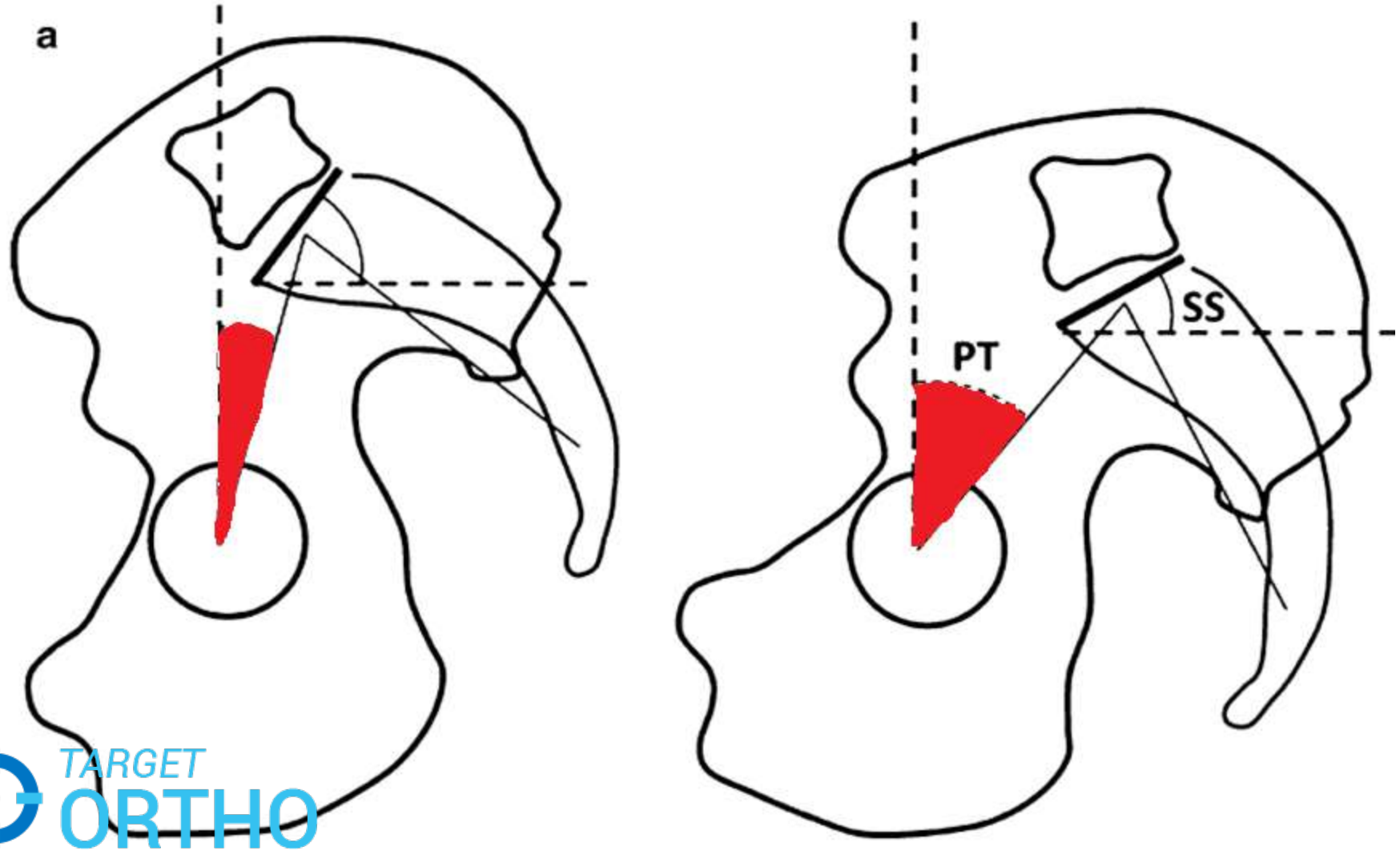
Pelvic incidence =

sacral slope + pelvic tilt.

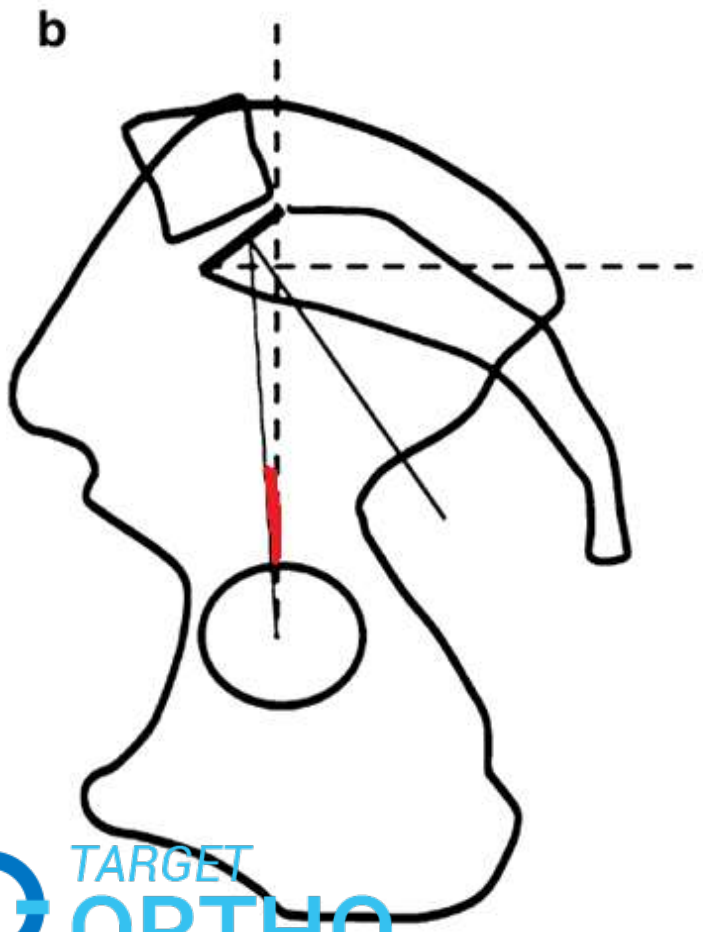
Spinopelvic parameters

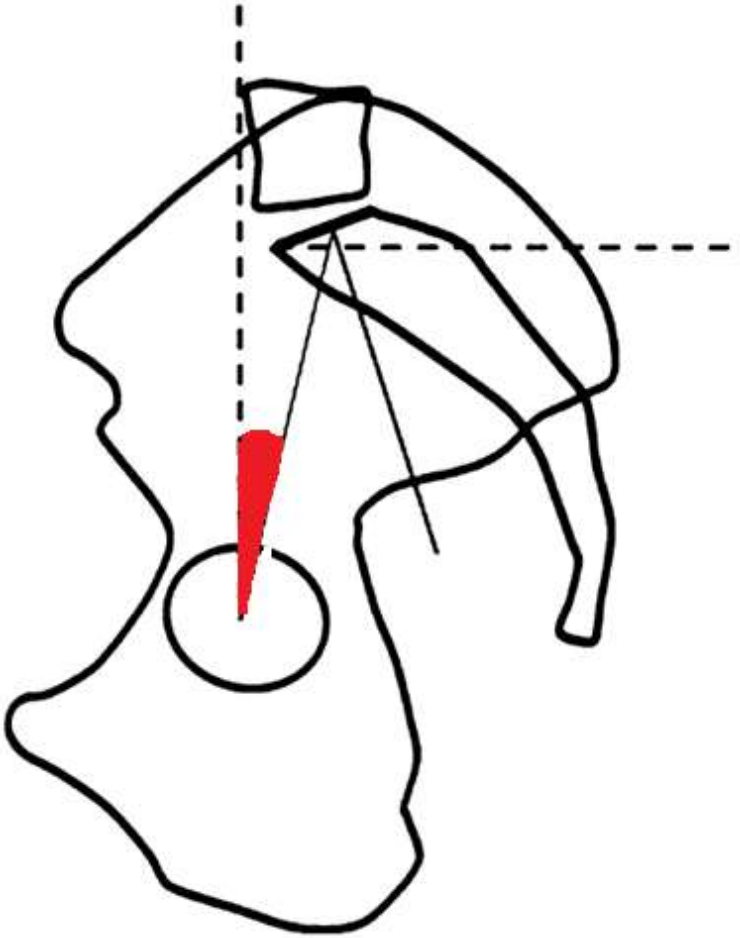
Pelvic Parameters	Caucasian Boulay et al –ESJ 2006	Korean Chong suh lee-Spine2011	Indian Ganga hospital
PI	53.2° +/- 10.3°	47.8° +/- 7.3°	46.1° +/- 8.3°
PT	14.0° +/- 6°	11.5° +/- 5.3°	9.8° +/- 7.3°
SS	40.7° +/- 7°	36.3° +/- 7.8°	36.3° +/- 7.7°

Balancing mechanism in patients with high PI
Spinopelvic parameters

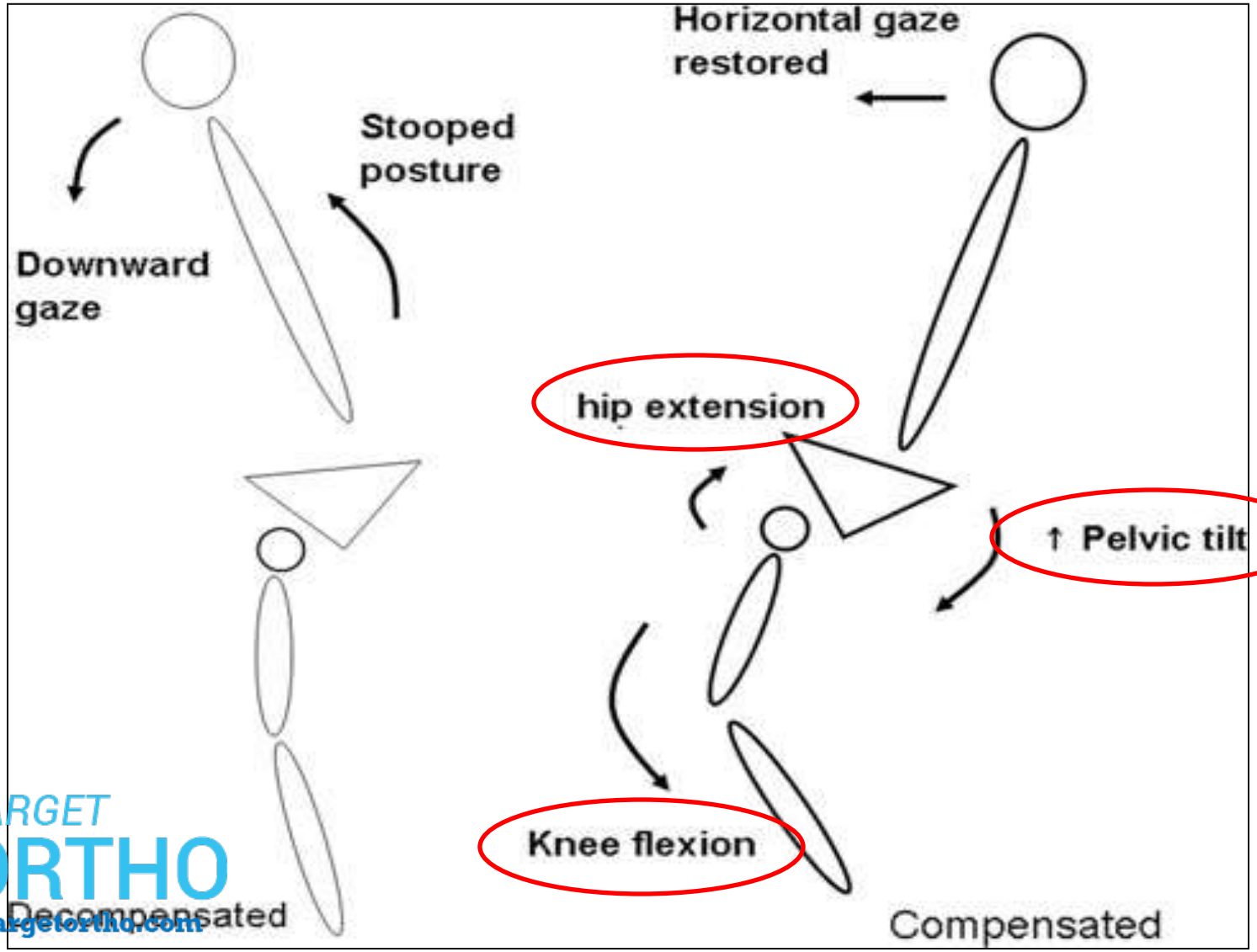


Balancing mechanism in patients with low PI
Spinopelvic parameters

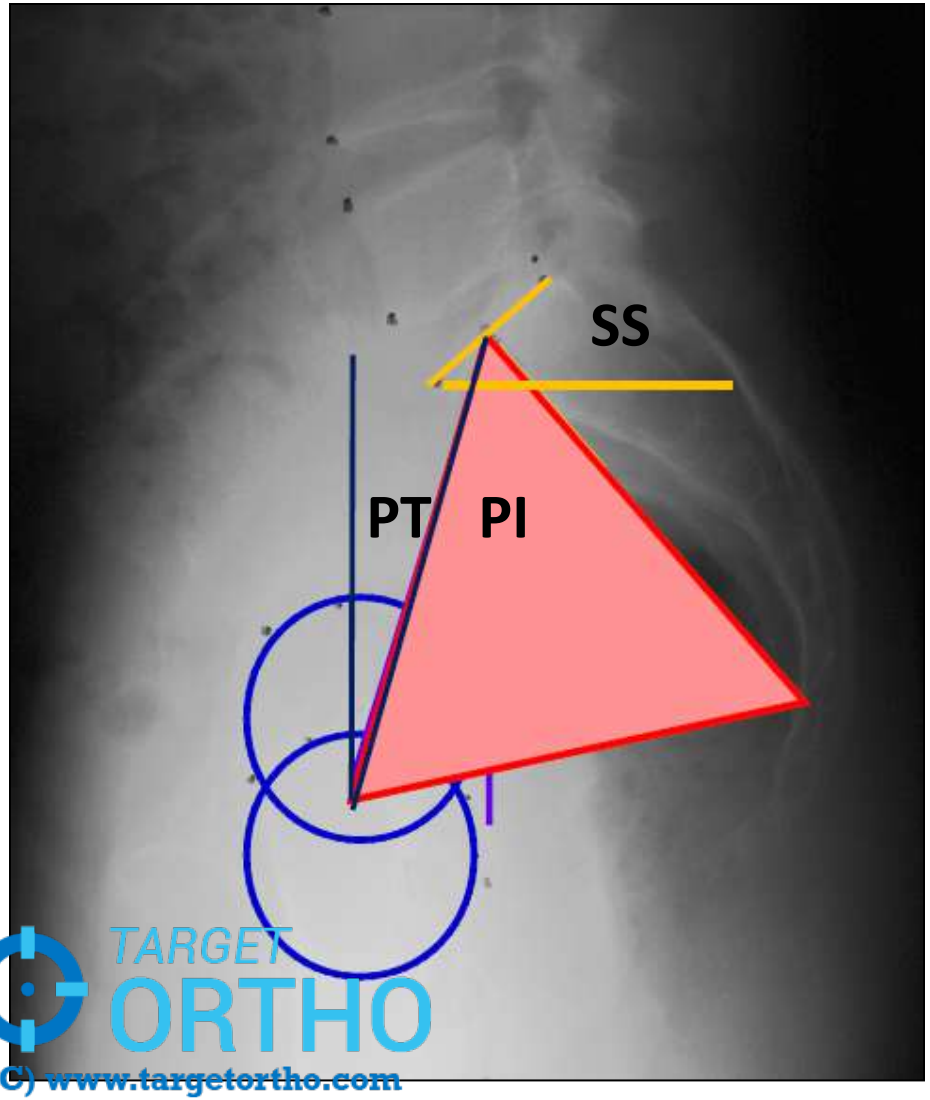




Balancing mechanism
Hip and knee

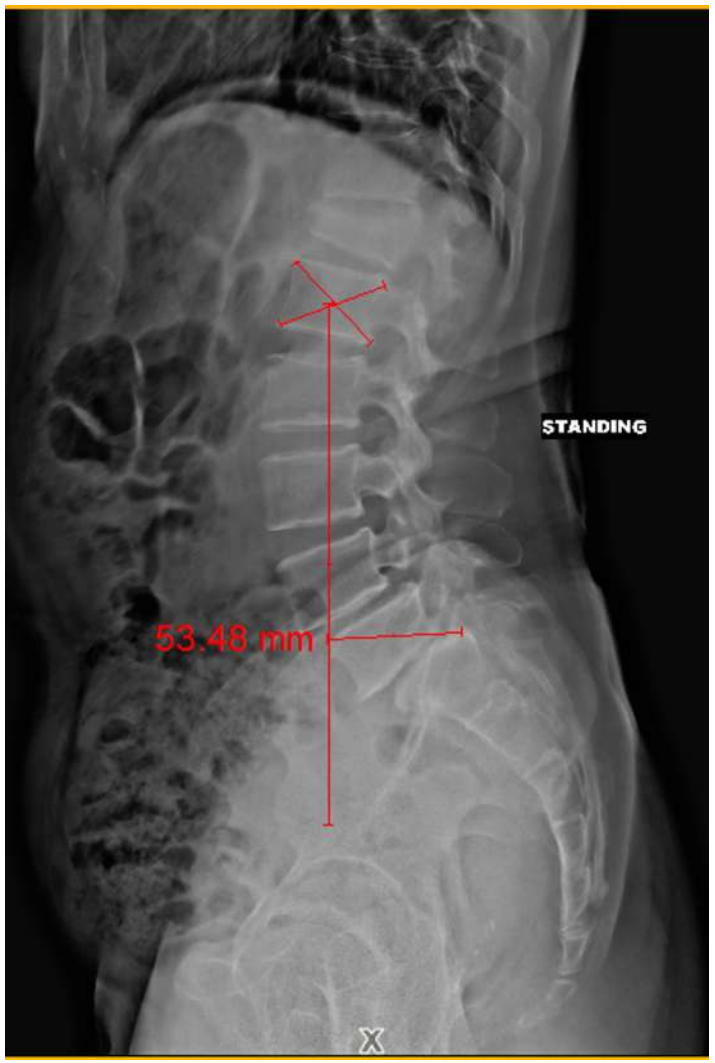


PI = PT+SS



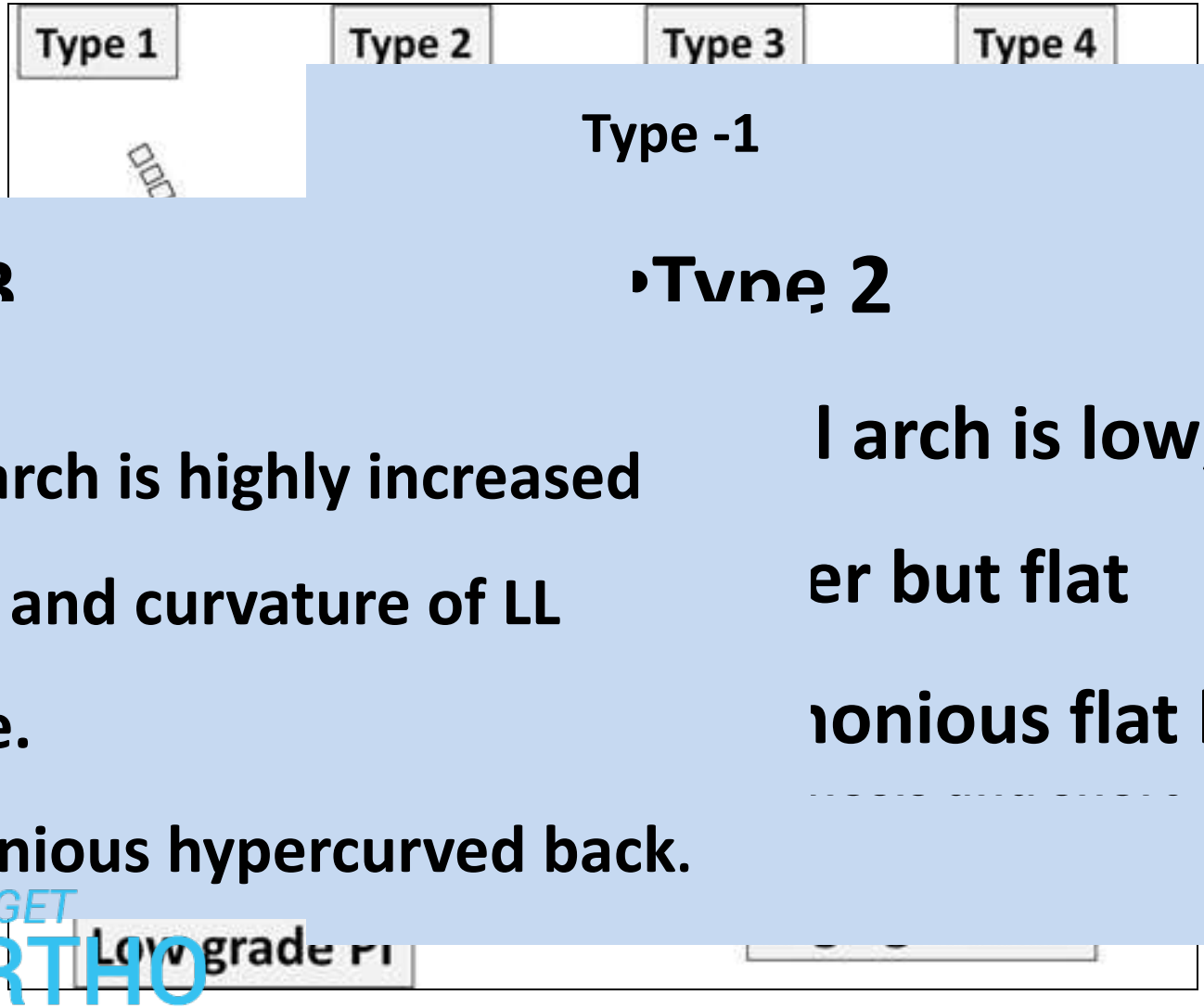
PI = PT(< 50%)+SS(> 50%)

Failure of compensatory mechanism



Failure of compensatory mechanism

Roussouly- types



Type -1

•Type 3

Type 4

•Distal arch is highly increased

•Length and curvature of LL increase.

•Harmonious hypercurved back.

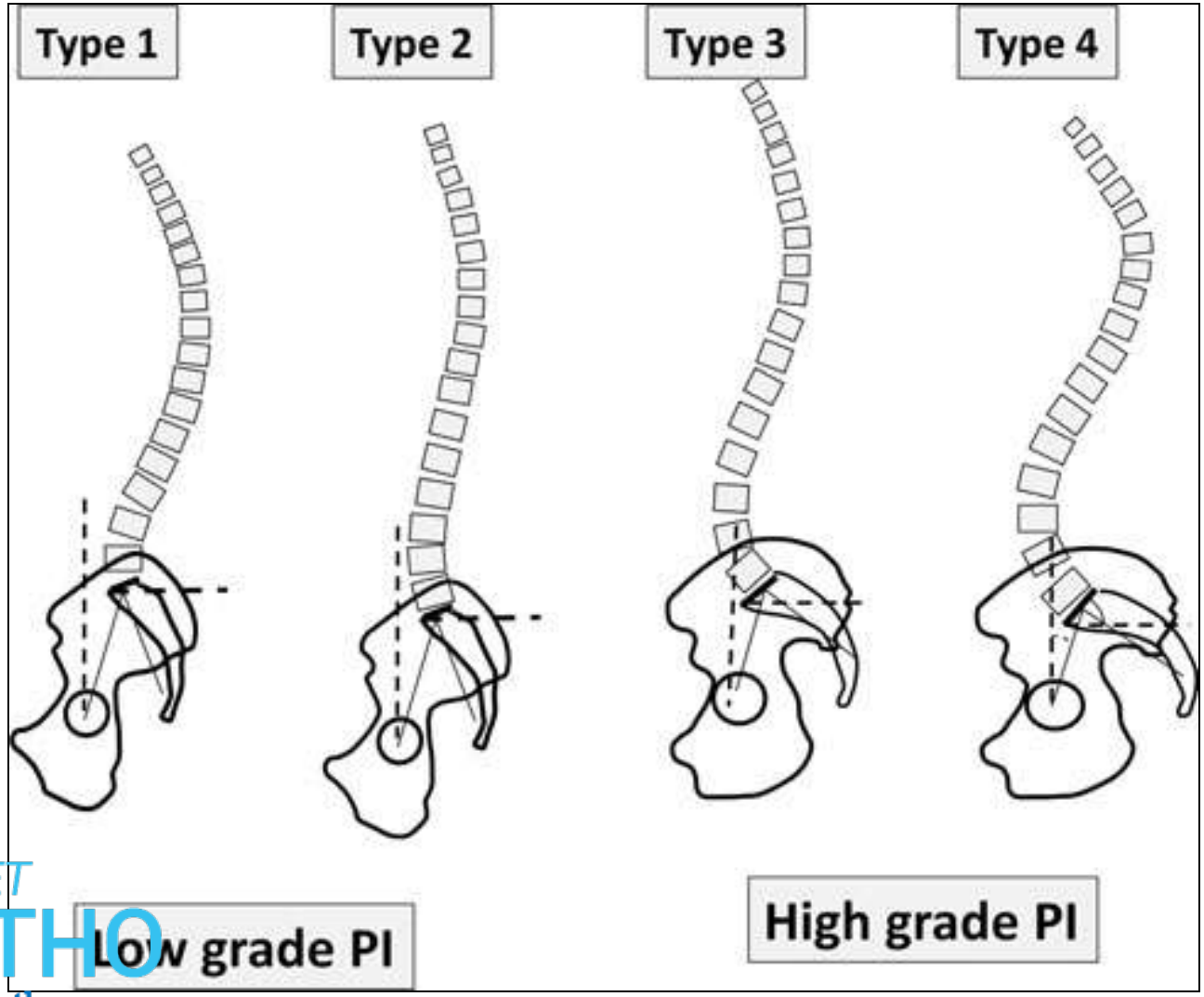
•Type 2

l arch is low;

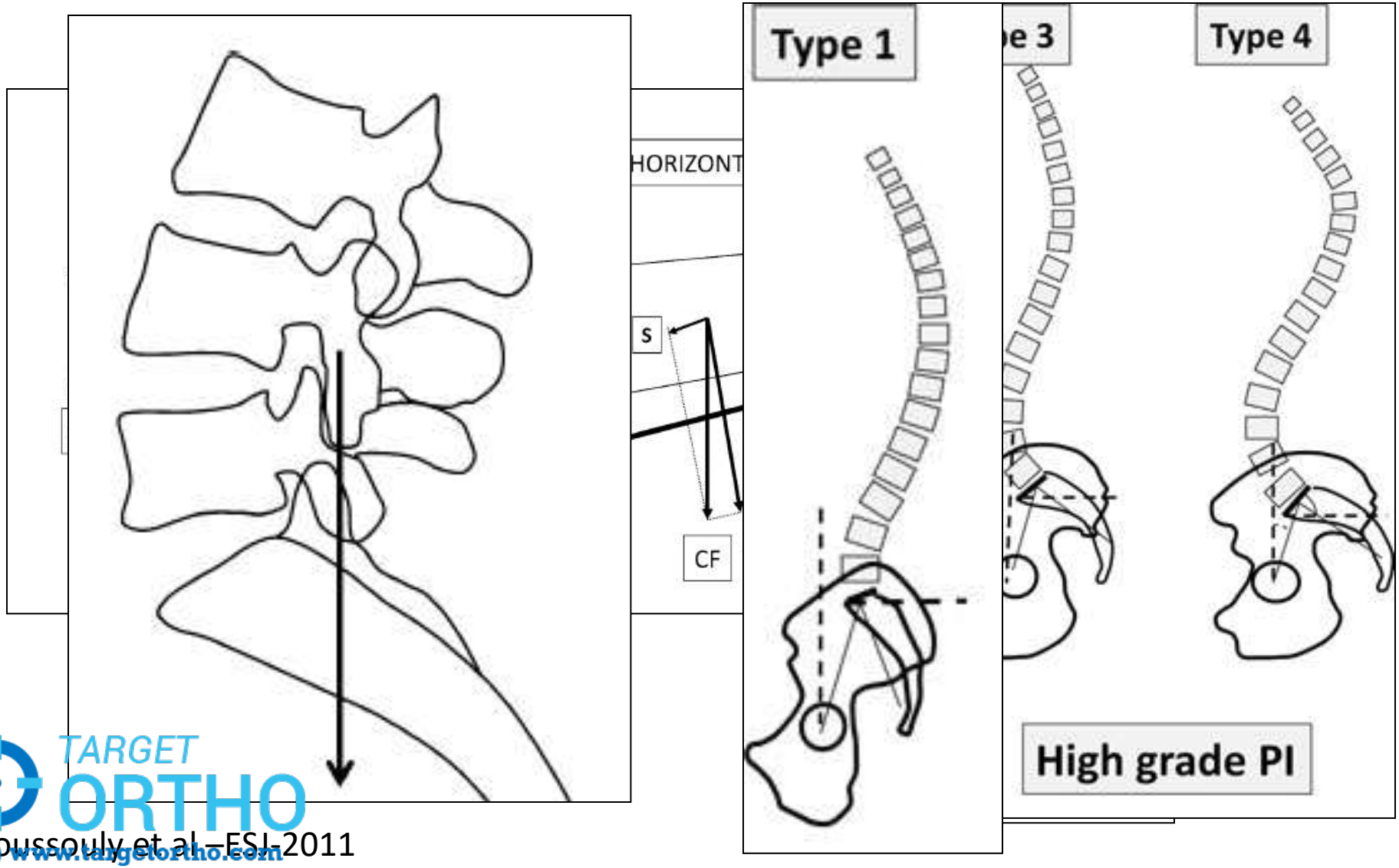
er but flat

ıonious flat back

Who compensates better ?



The contact force
Who is predisposed to Degeneration?



Roussouly et al – ESJ-2011

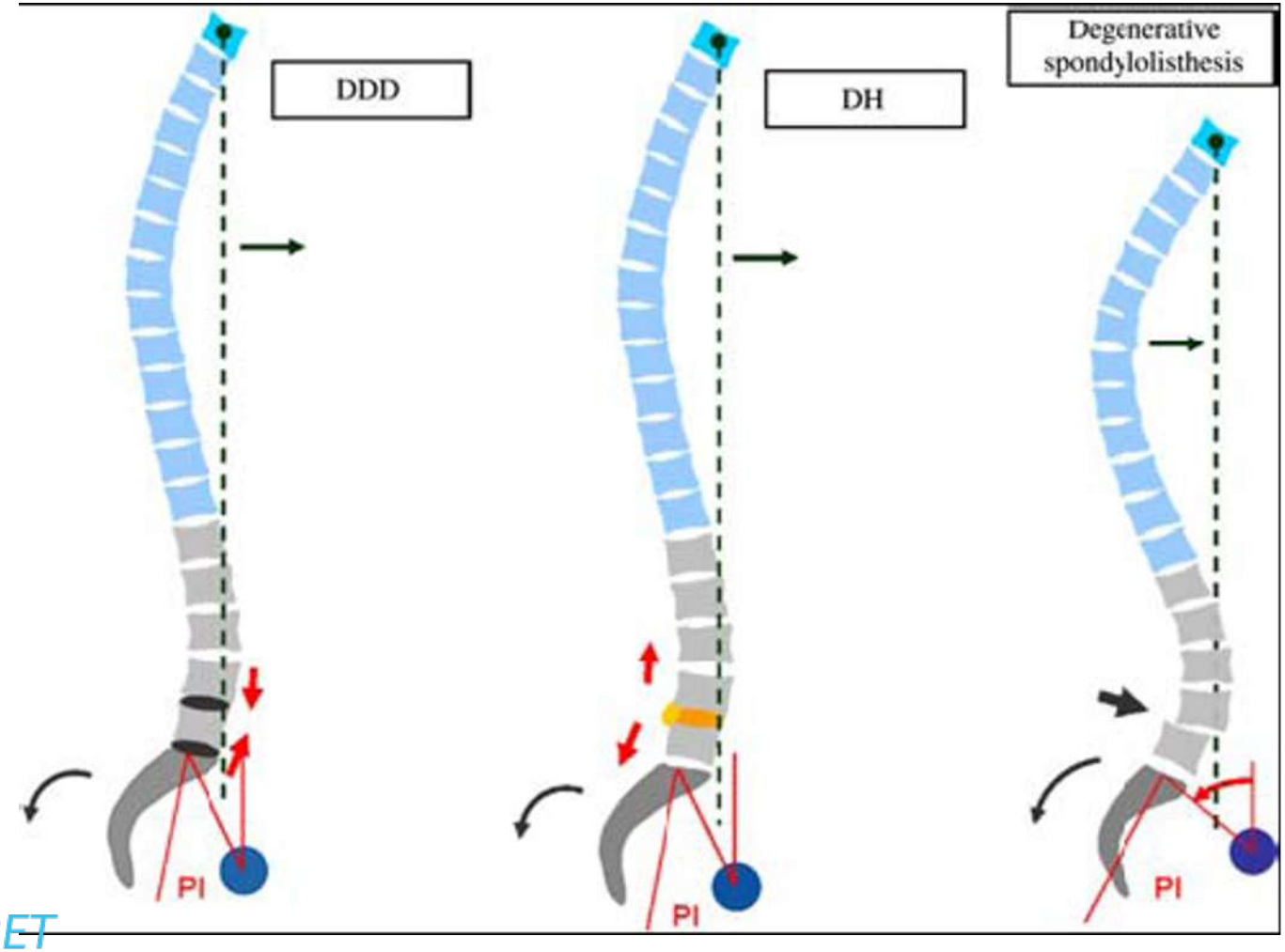
Who is predisposed to Degeneration?

- **No difference in pelvic incidence** between **DDD and Disc prolapse** patients and healthy volunteers

- But **loss of Lumbar lordosis and Sacral slope** observed in patients with **Low back ache ,DDD and Disc prolapse.**

Barrey et al – Neurosurgery-2011
Mehta et al – Neurosurgery-2012

Who is predisposed to Degeneration?

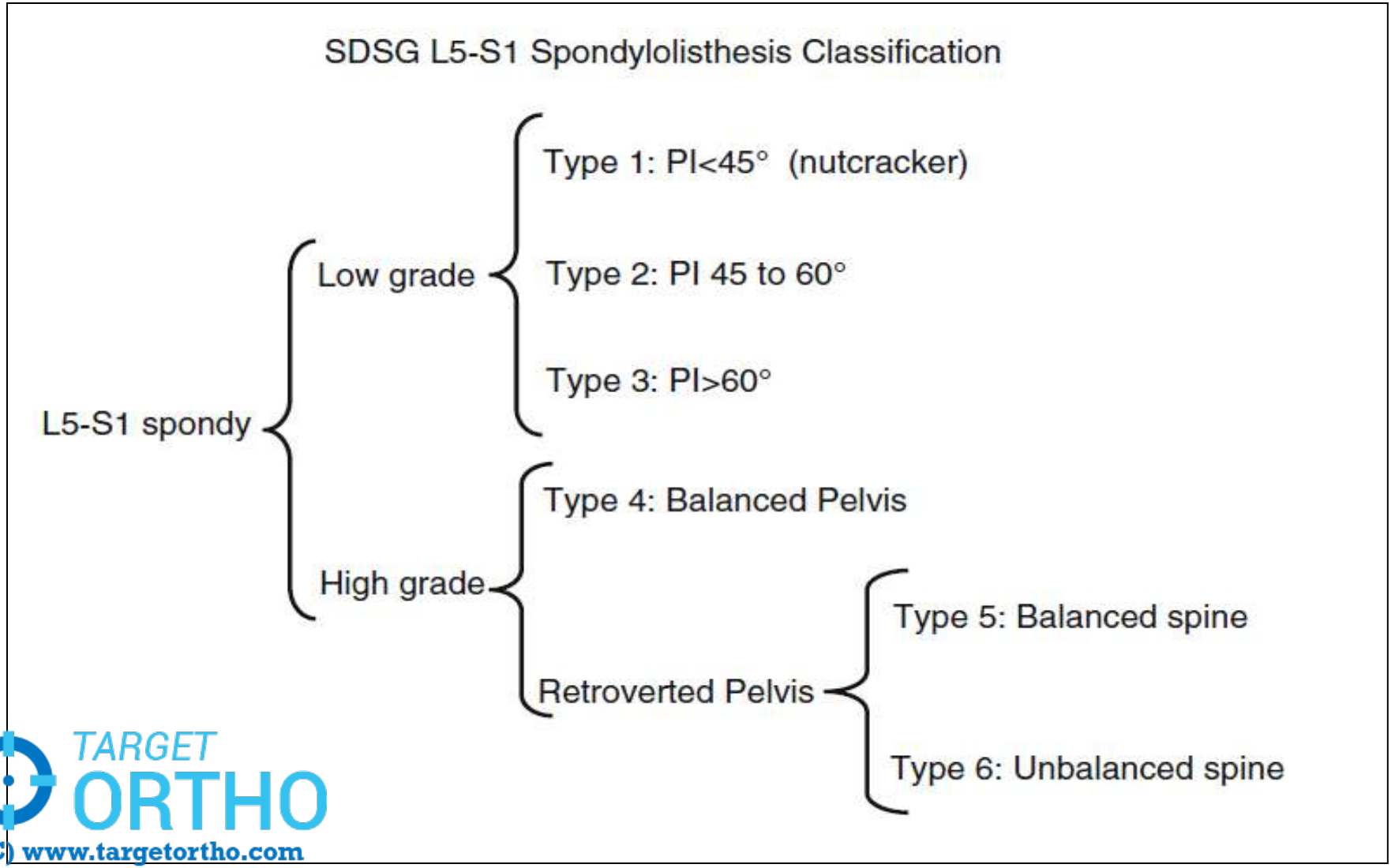


ur Spin J (2007) 16:1459–1467 1465

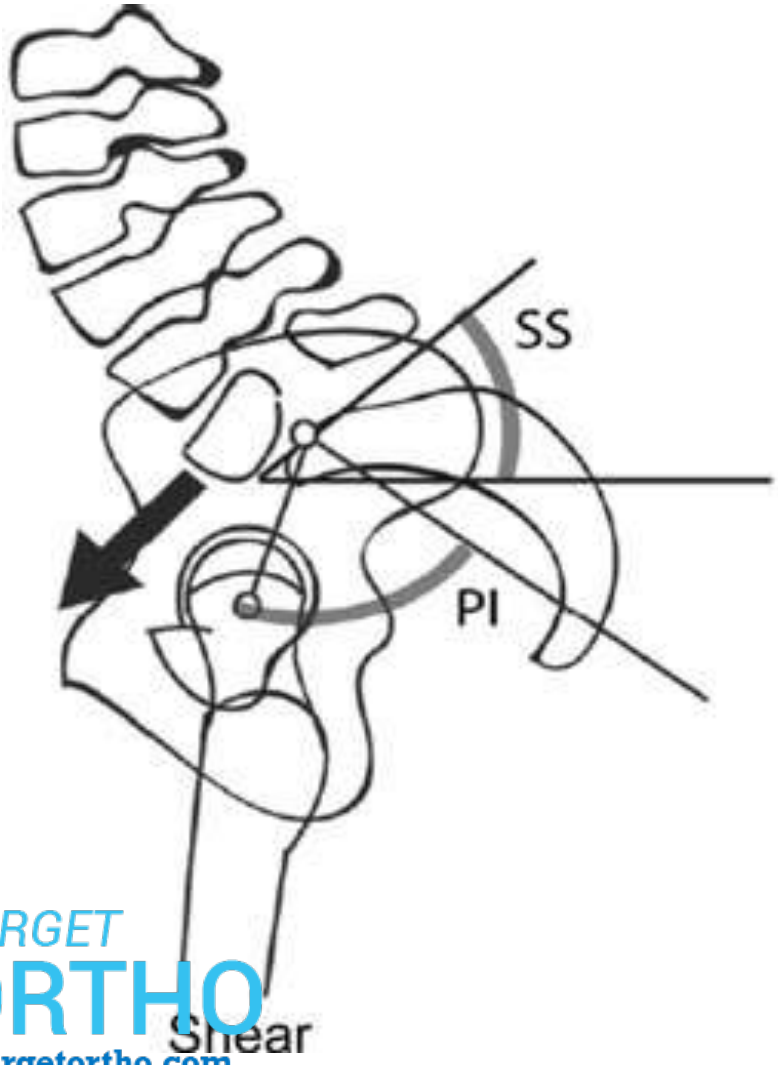
Lytic lysthesis
High grade listhesis

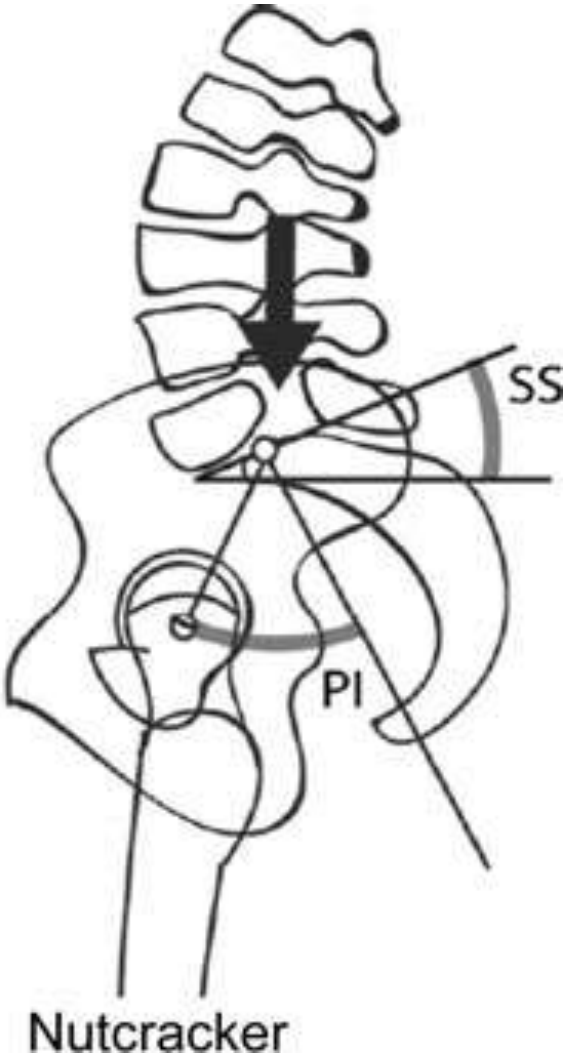
- Reduction
- Partial reduction
- Insitu fusion

Spino-pelvic sagittal balance of spondylolisthesis

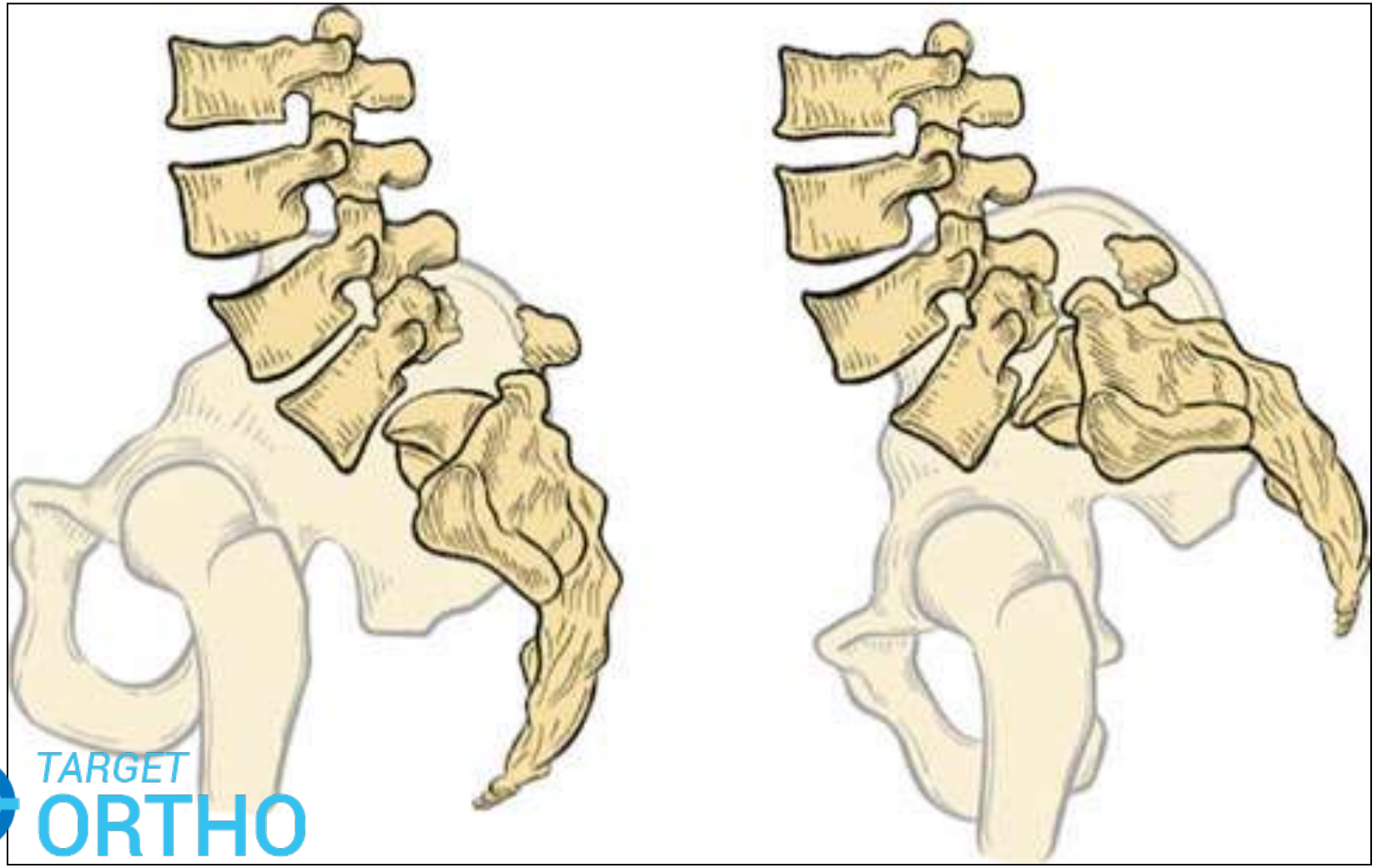


Who will progress ?

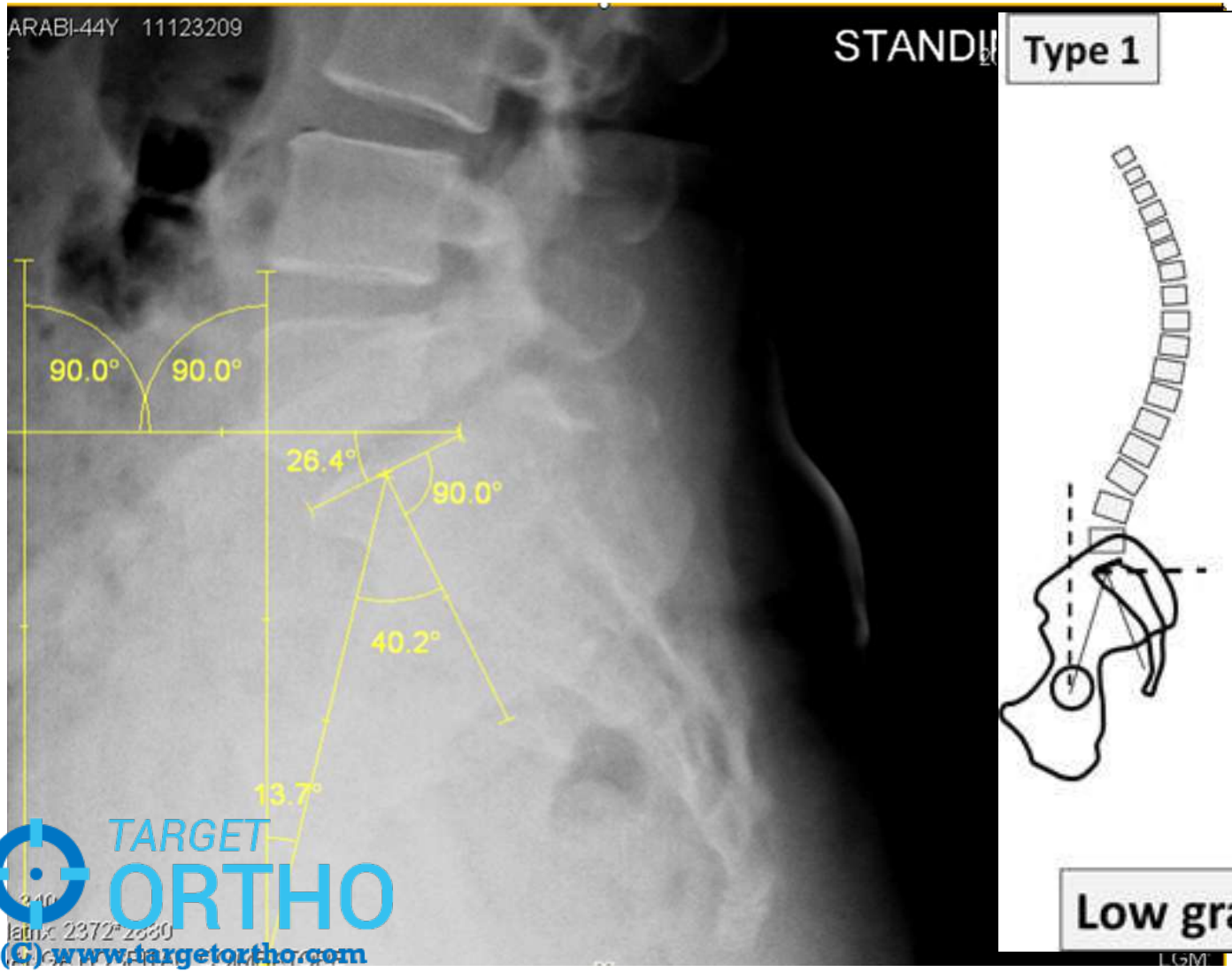


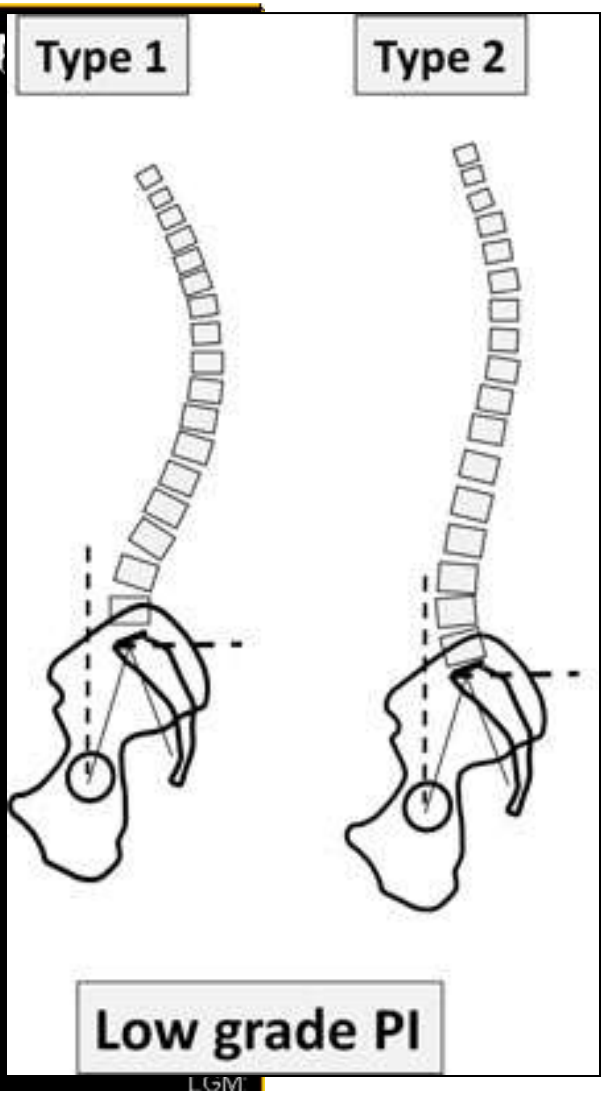


Who needs reduction?

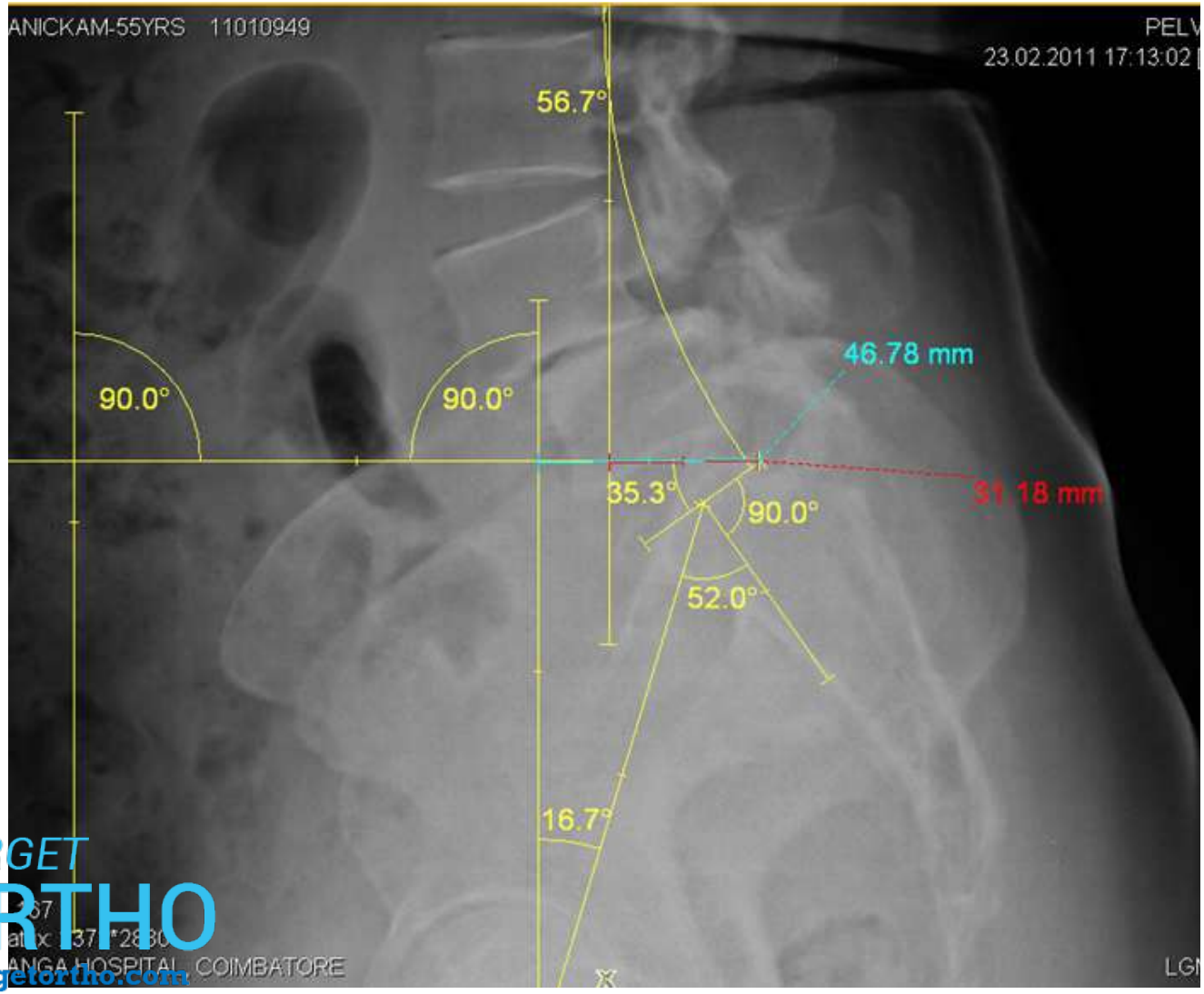


Nut cracker

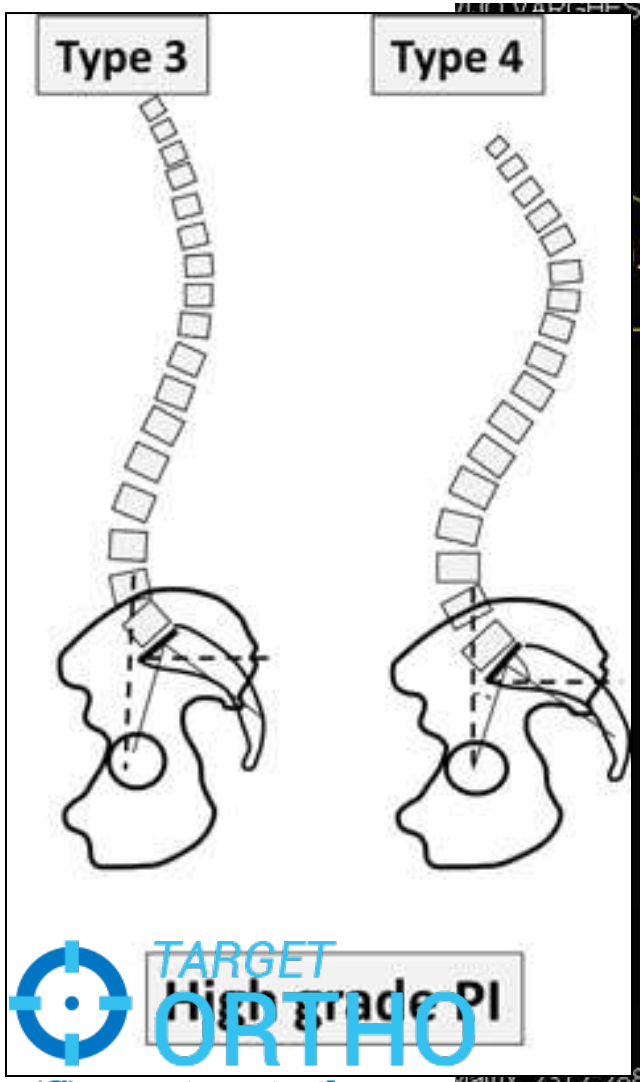

ARABI-44Y 11123209
90.0°
90.0°
26.4°
90.0°
40.2°
13.7°
TARGET
ORTHO
(C) www.targetortho.com

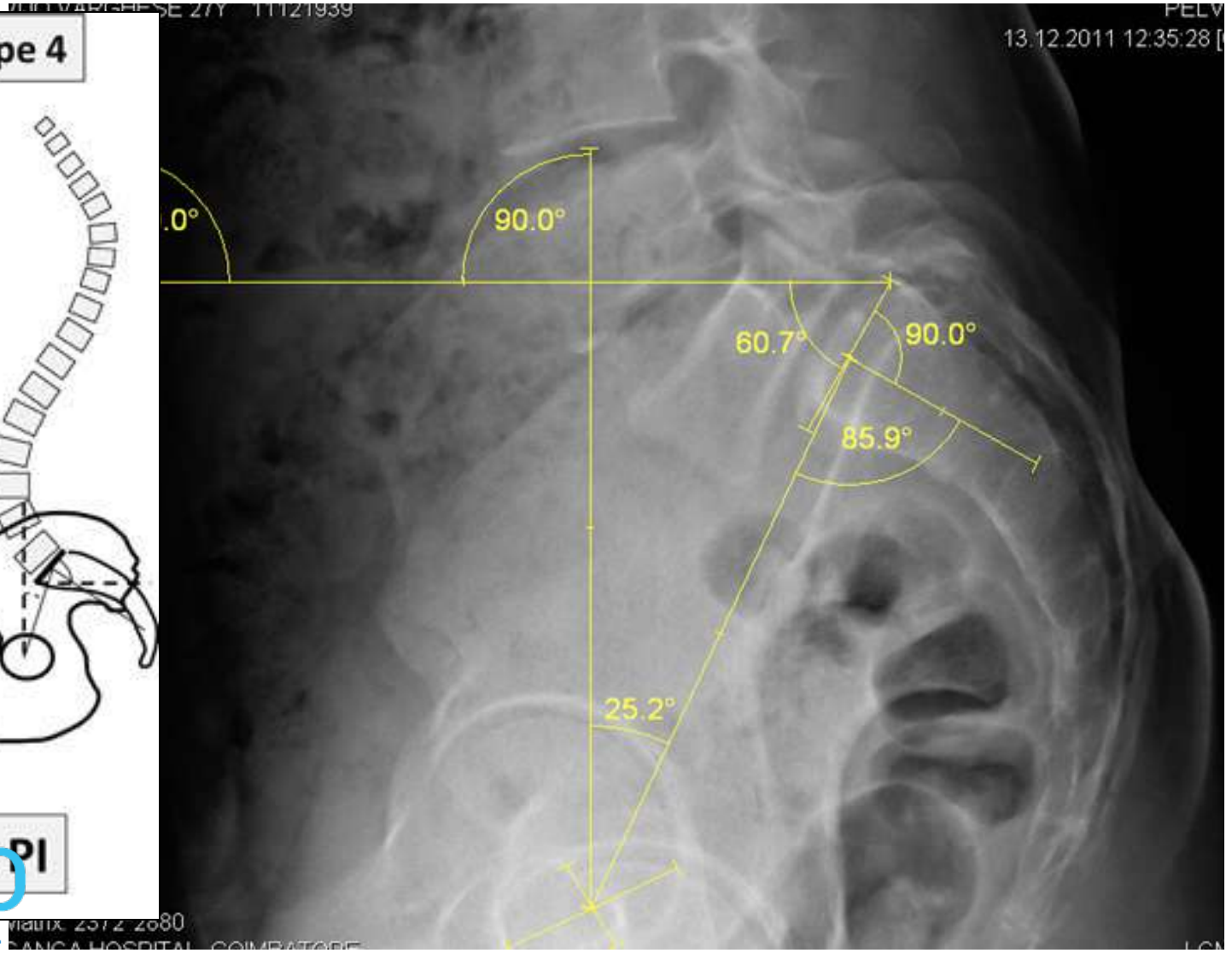

Type 1
Type 2
Low grade PI

Normal PI



Shear type





Conclusion

- Sagittal balance and pelvic parameters play an important role in different spinal pathologies

- Understanding and applying it during surgery is important in good surgical outcome .

Thank you