Introduction

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Definition:

Normally, when the legs are parallel to the midline of the body , the line joining the anterior superior iliac spines is perpendicular to the midline of the body and the pelvis is said to be leveled or square . As defined in the glossary complied by the terminology committee of the Scoliosis Research Society, pelvic obliquity is a deviation of the pelvis from horizontal in the frontal plane, but this definition seems to be insufficient, however, because pelvic obliquity, in fact, is a three dimensional structural deformity, and its treatment requires correction in the three planes.

(Lotfi etal. , 1997)

The definition of pelvic obliquity lies in three major concepts ; ***firstly*** , the pelvic unit must be considered one unique vertebra . The sacrum and iliac bones are united by the sacroiliac and symphysis pubis, where a little motion occurs . Therefore, it can be considered as one unique vertebra that can be displaced in three dimensions. ***Secondary***, the pelvic unit must be considered an intercalary bone between the trunk and lower limbs with six degrees of freedom at the lumbosacral junction as well as on both hip joints . This position is of great importance regardless of posture, but mainly for standing and sitting . ***Thirdly*** , the pelvic unit is a plastic bone and may be distorted with growth , particularly if there is muscle imbalance .

With these concepts in mind, one can understand that the pelvis can be displaced in a three dimensional planes, as well as distorted by the various forces in three dimensions . This leads directly to the etiology of pelvic obliquity where it is possible to find causes for its existence above the pelvis " spine and trunk disorders " and below the pelvis " lower limbs and hip disorders ".

(Dubousset , 1991)

And , it was apparent in the majority of cases that the body of the fifth lumbar vertebra sat square on the pelvis . This is because the iliolumbar ligaments maintain that vertebra in a fairly constant relationship to the sacrum , as the pelvis tilts the body of the fifth lumbar vertebra moves with it .

(O'Brien , 1975)

The iliolumbar ligament may have an important role in maintaining lumbosacral stability in patients with pelvic obliquity secondary to neuromuscular scoliosis and it is one of the three vertebropelvic ligaments , the others being the sacrotuberous and the sacrospinous ligaments. They help stabilize the lumbosacral spine on the pelvis . The iliolumbar ligament is described as being attached to the tip and the lower anterior part of the transverse process of the fifth lumbar vertebra with , occasionally , a weak attachment to the transverse process of the fourth lumbar vertebra . The ligament is stated to run laterally and slightly posteriorly and to insert into the top of the iliac crest . A lower band of the ligament is also described , often termed the lumbosacral ligament , which runs from the inferior aspect of the fifth lumbar transverse process to the anterior part of the ala of the sacrum .

The arrangement of the two bands of the ligament suggests that it may serve two functions . The anterior band may be mainly responsible for " squaring " the tilting of the vertebra in the coronal plane . The direction of the posterior band suggests that this band may serve to prevent anterior slipping of the fifth lumbar vertebra on the sacrum during weight-bearing . Together with the strong fifth intervertebral disc this ligament stabilizes the lumbosacral junction .

So , it may therefore have an important clinical and biomechanical role in stabilizing the lumbosacral junction .

(Lukeetal ., 1986)

Biomechanics and pathomechanics:

To understand the deformities , disabilities that may occur in pelvic obliquity patient , and methods of its treatment ; it is required to focus on the biomechanical aspects of normal balanced skeleton during walking , pathomechanics when hip abductors are contracted and normal ranges for the pelvic angle in the three planes .

As stated by Irwin (1947) , during normal walking the abductors of the hip on the weight – bearing side pull downward on the pelvis and the lateral trunk muscles on the contralateral side pull upward , these two sets of muscles hold the pelvis at a right angle to the longitudinal axis of the trunk . The femoral head on the weight – bearing side serves as the fulcrum . The different muscle groups , bone levers , and weight bearing thrusts have a symmetric and triangular relationship as shown in the **fig (1-A)**, the line BC represents the abductor muscles of the hip , the line AB represents the femoral head , neck , and trochanter , which provide a lever for the abductor muscles , the line AC represents the weight-bearing thrust on the femoral head , the lines DF and CF represents the lateral trunk muscles , the line CE represents the bone lever of the pelvis through which the trunk muscles act , and the line FE represents the weight bearing thrust through the midline of the pelvis from above. When the body is balanced , the triangles above and below the pelvis are symmetric . During the normal walking , when the DF elevates the pelvis , CF must provide counter fixation ; CF in turn depends on the abductors of the hip , BC , for counter fixation .

Thus with each step the femur on the weight – bearing side is the central point of action for this coordinated system of fixation and counter fixation and each part of the system is dependent on the others for proper pelvic balance during walking .

When there is a patholgic contracture of one abductor or illiotibial band as **fig (1-B,C)** , the line BC is shortened , as the affected extremity is placed in the weight – bearing position , the femur , acting through the contracted abductor group , BC , depresses the pelvis on that side .

During this motion the affected extremity and the pelvis act as a unit; the pelvis is displaced by the lateral thrust toward the opposite side , and thus the normal symmetry of the pelvis in relation to the weight–bearing thrust from above is altered . This thrust from above , FE , now closely approaches the affected hip , and the pelvis is tilted obliquity .

The adducted position of the unaffected hip elongates the abductor muscle , DG , to about the same extent that the abductor on the affected side , BC , have been shortened so that even when the abductors , DG , are normal , their contractility and efficiency are diminished . Moreover , the demand on these weakened muscles is increased by the increase in the length of the line DE . The trunk muscles are also affected by this asymmetry . The lateral trunk muscles , CF, become elongated , and their efficiency is impaired .

The elongation of the abductors , DG , alters their interrelation with the lateral trunk muscles , DF , is providing a fixed point for contracture of the lateral trunk muscles , CF , which normally elevate the pelvis on that side , but their position now prevent efficient function . Shortening of the lever, EC , places the trunk muscles , CF at a further disadvantage.

All these alteration in function and structure disrupt the mechanics of walking . When the contracted lateral trunk muscles , DF , and contracted hip abductors , BC , hold the pelvis in this deformed position for long , its obliquity become fixed through adaptive changes in the spine .

The normal ranges for the pelvic angles in the three planes ; sagittal plane , frontal plane , and transverse plane are **as fig (2) :**

Sagittal plane motion can be seen during normal gait , the pelvis has an anterior tilt of around 8^0 , noted that the exact value depends on how the horizontal plane of the pelvis is defined , usually this is done from the anterior superior iliac spines " ASIS " and the spinous process of the second sacral vertebra " S_2 " . If other land marks are used to define the horizontal , the normal tilt may be more or less than 8^0.

In frontal plane motion , it can be seen that each hemipelvis rises in stance and drops down during the swing phase of the corresponding leg . This called physiological trendlenberg , and is due to the slight collapse of the hemipelvis when its supporting leg is unloaded . This drop is not large " around 4^0 " in normal gait , this motion is increases the effective leg length at toe-off and heel strike .

In the transverse plane , each hemipelvis rotates in wards on the side of the leading leg, and of course, as one side of the pelvis rotates internally in this way , the other hemipelvis must rotate externally as the contra lateral side approaches its contact .

(Winter , 1994)