18. Instability of the sacroiliac joint and the consequences for gait

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INTRODUCTION

Instability occurs when the functional integrity of a system that provides stability is lost. In the pelvic girdle, two systems contribute to stability: the osteoarticularligamentous and the myofascial. Together they provide a self-locking mechanism. The osteoarticularligamentous system provides form closure, and the myofascial system provides force closure (Snijders et al 1993, Vleeming et al 1990a) (see Chapters 3 and 6 in this volume).

Loss of the ligamentous support (form closure) will lead to instability of the sacroiliac joint (SIJ). Form closure can be evaluated clinically with specific stability tests that evaluate the ability of the SIJ to resist vertical and horizontal translation forces (shear) that are applied passively to the non-weight-bearing joint. These tests are described in detail elsewhere (see Chapter 37 in this volume). Loss of muscle strength and control (force closure) will lead to myofascial instability through the pelvic girdle. Force closure can be evaluated clinically with specific muscle tests (see Chapter 37).

During gait, the integrated function of the trunk and lower extremity muscles assist in load transference during the weight-bearing phase by increasing intra-articular compression (see Chapter 3 in this volume). Weakness, or non-synergistic recruitment of these muscle groups, reduces the force closure mechanism through the SIJ and leads to myofascial instability. The patient then adopts compensatory movement strategies to accommodate the weakness. These strategies can be observed during gait. Over time, they can lead to decompensation of the lower back, hip, and knee.

NORMAL GAIT

During the swing phase of the right leg, the right innominate bone rotates posteriorly relative to the sacrum (unilateral right sacral nutation or flexion) (Greenman 1992, Vleeming et al 1995a). This motion increases the tension of the sacrotuberous and interosseus ligament and prepares the joint for heel strike (Fig. 18.1). The increase in tension contributes to the force closure mechanism, augments the form closure mechanism, and therefore increases stability. Inman et al (1981) have shown that the hamstrings become active just

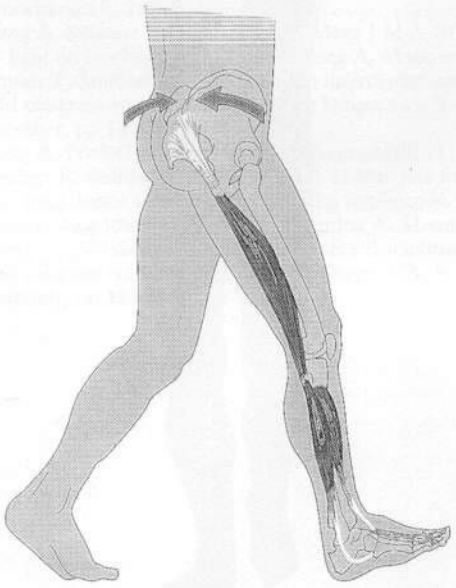

Fig. 18.1 At heel strike, the biceps femoris contracts and increases tension in the sacrotuberus ligament (Vleeming et al 1995a). This mechanism facilitates force closure of the SIJ. (Redrawn from Vleeming et al 1995a.)

before heel strike. Contraction of the biceps femoris increases the tension in the sacrotuberous ligament, further contributing to the force closure mechanism.

During the single-leg stance phase of the right leg, the right innominate begins to rotate anteriorly relative to the sacrum (unilateral right sacral counternutation or extension). This motion is resisted by the long dorsal sacroiliac (SI) ligament (Vleeming et al 1995b). The hamstrings relax and the gluteus maximus becomes more active (Inman et al 1981) (Fig. 18.2). This occurs in conjunction with a counter-rotation of the trunk. The contralateral latissimus dorsi can be felt to fire during this motion. Together, these two muscles tense the thoracodorsal fascia and facilitate the force closure mechanism through the SIJ. The superincumbent body weight is thereby transferred to the lower extremity through a system that is stabilized through ligamentous and myofascial tension. From heel strike through midstance, the ipsilateral gluteus medius, minimus, and tensor fascia latae, and contralateral adductors are active to stabilize the pelvic girdle on the femoral head.

Fig. 18.2 Through midstance, the gluteus maximus contracts and facilitates the transmission of force through the thoracodorsal fascia.

Muscle activity is much less in all groups during the double support phase since both legs receive the body weight.

In optimal gait, the center of gravity travels along a smooth sinusoidal curve both vertically and laterally. The displacement in both planes should be no more than 5 cm (Inman et al 1981).

UNSTABLE GAIT

The displacement of the center of gravity is exaggerated when the SIJ is unstable (insufficient in either form or force closure). The patient attempts to compensate for the lack of stability by reducing the shear forces through the SIJ. In a fully compensated gait, the patient transfers his or her weight laterally over the involved limb (compensated Trendelenburg sign), thus reducing the vertical shear forces through the joint (Fig. 18.3).

In a non-compensated gait pattern, the patient tends to demonstrate a true Trendelenburg sign. The pelvic girdle adducts excessively (on the weight-bearing leg) (Fig. 18.4). The femur abducts relative to the foot, thus bringing the center of

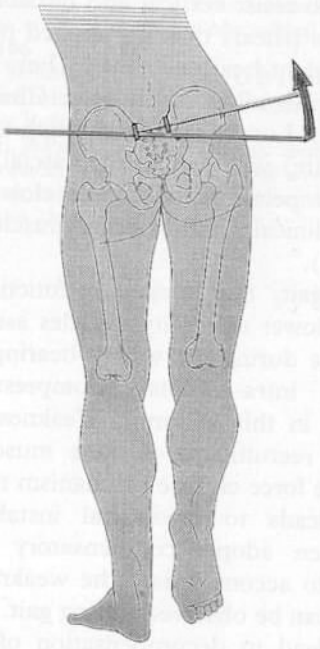

Fig. 18.3 Compensated Trendelenburg sign.

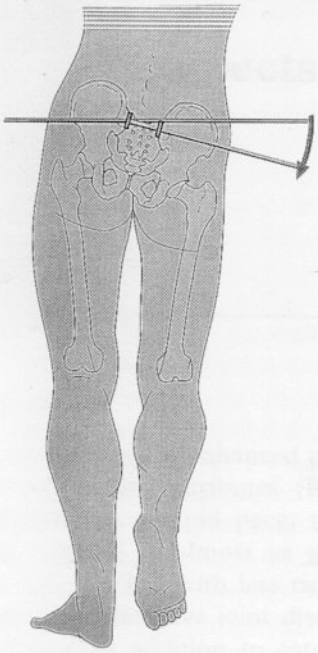

Fig. 18.4 Non-compensated Trendelenburg sign.

gravity closer to the SIJ, which reduces the vertical shear force. This gait pattern is also seen when the SIJ is stable and the gluteus medius weak or poorly recruited.

Clinically, the gluteus maximus appears to become inhibited whenever the SIJ is irritated or in dysfunction. The consequences to gait can be catastrophic when the gluteus maximus is weak. The stride length shortens and the hamstrings are overused to compensate for the loss of hip extensor power. The hamstrings are not ideally situated to provide a force closure mechanism and, in time, the SIJ can become hypermobile. This is often seen in athletes with repetitive hamstring strains. The hamstrings remain overused and vulnerable to intramuscular tears.

CONCLUSIONS

1. Instability of the pelvic girdle can become an extremely debilitating condition.
2. Instability of the pelvic girdle is reflected in the gait pattern.
3. Early identification can prevent the excessive loss of muscle power and the subsequent breakdown of the force closure mechanism.

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