Physical therapists who examine and treat patients with low back pain recognize that the sacroiliac joint (SIJ) is a possible source of low back pain or dysfunction. Various methods of visually assessing the relative position of the innominate bones to the sacrum have been used to evaluate SIJ dysfunction. In a preliminary investigation to determine the degree of pelvic tilt in the standing position, we found a potential source of geometric measurement error when using visual assessment and bony landmarks to determine whether one innominate bone is rotated anteriorly or posteriorly relative to the other innominate in the sagittal plane. The source of error occurs when a leg-length difference exists or when a heel lift alters a functional leg-length difference (Figs. 1, 2). The purpose of this special communication is to describe how a false-positive interpretation of innominate rotation may occur when a leg-length difference exists and visual assessment is used. A method commonly used to detect innominate rotation in the frontal plane is visual assessment of the relative height of the left and right superior iliac spines (PSISs) and anterior superior iliac spines (ASISs) with the patient standing. When the left PSIS is inferior to the right PSIS and the left ASIS is superior to the right ASIS, for example, we may hypothesize that the left innominate is rotated posteriorly relative to the right innominate (or, conversely, the right innominate is rotated anteriorly relative to the left innominate). We propose that this assessment may produce a false-positive interpretation of innominate rotation with as slight as a 15-mm leg-length difference or heel lift.

In Figure 2, the left lower limb is longer than the right lower limb, causing the pelvis to tilt superiorly on the left in the frontal plane. The error occurs because the left ASIS is farther from the axis of rotation, the right femoral head, than is the left PSIS as represented by lines C and D, respectively. Because the ASIS moves at the end of a longer lever arm, it moves farther from the axis than does the PSIS when the pelvis is elevated. The effect of this error is very important when visually comparing the heights of the innominate landmarks (ie, ASIS vs PSIS) to determine relative rotation of the left and right innominates.

We tested our hypothesis using an articulated adult spine and pelvis. We measured the pelvic tilt in the sagittal plane with the pelvis level in the frontal plane (Fig. 1) and with a 15-mm lift under one side of the pelvis (Fig. 2). The articulated spine and pelvis were suspended from a display stand with the pelvis on a level surface. The pelvis was kept in a vertical position to simulate pelvic position in a normal standing posture defined by Solonen. This procedure involved positioning the pelvis so that the left and right ASISs were in the same transverse plane and in the same vertical plane as the anterocranial margin of the pubic symphysis. This positioning ensured that no innominate rotation occurred in either the level or the elevated position. We made small ink dots on the most prominent aspect of the ASIS and the PSIS for measurement purposes. When we raised the left lower limb 15 mm, the ASIS moved 5.5 mm vertically (line B), although the PSIS moved only 1 mm (line A) as measured from the level surface with a metric ruler. The elevation of ASIS by 5.5 mm and PSIS by 1 mm could be interpreted as a posteriorly rotated innominate on the left. These measurements confirmed our hypothesis that an incorrect impression of innominate rotation may result from the illusion created by the geometry of the pelvis and pelvic movement when a leg-length discrepancy exists. The greater the leg-length difference, the greater the possibility of interpreting a false-positive posterior rotation.

This article is directed to the clinician who uses heel lifts and visual assessment for patients with apparent leg-length differences or SIJ dysfunctions. We do not intend to discount the concept that a leg-length difference may have various biomechanical effects on the relative position of the innominate on the sacrum. Additionally, the relative position of the innominates may affect measurement of leg-length difference in the supine or standing position.

Sanders and Stavarakas proposed an alternative method to visual and palpatory assessment for determining innominate rotation or pelvic tilt. Their method involves measurement of the relative distances from the floor of the ASIS and the PSIS and the distance from the ASIS to the PSIS in the hori-
Fig. 1. The pelvis is positioned to represent equal leg lengths. Lines A and B represent vertical distances from a level surface to the left posterior superior iliac spine (PSIS) and the left anterior superior iliac spine (ASIS), respectively. Lines C and D represent the distances of the PSIS and the ASIS from the axis of rotation at the right femoral head. (Note: Same scale as Fig. 2.)

Fig. 2. The left acetabulum is elevated 15 mm to simulate a leg-length difference. The left anterior superior iliac spine (ASIS) (line B) elevated 5.5 mm, whereas the left posterior iliac spine (PSIS) (line A) elevated only 1 mm as a result of the 15-mm lift. Lines C and D represent the distances of the PSIS and the ASIS from the axis of rotation at the right femoral head.

horizontal plane, and incorporates these data into a trigonometric formula to determine the degree of ipsilateral pelvic tilt (i.e., the degree of innominate rotation in the sagittal plane) in standing. The measurement error we described previously also threatens the internal validity of this assessment method, because the relative height from the floor of the PSIS and the ASIS is used to compute pelvic tilt. To estimate the magnitude of the error, we used Sanders and Stavrakas's method to calculate the apparent innominate rotation caused by a 15-mm lift in our model (in which no real rotation was allowed). The error was less than 0.02 degrees compared with the level pelvis. Because this error is much less than can be expected from visual assessment, it does not appear to preclude clinical use of Sanders and Stavrakas's method. Use of their method may produce fewer false-positive interpretations than visual assessment when determining innominate rotation.

Gajdosik et al reported good to high intratester reliability for Sanders and Stavrakas's method. The intertester reliability of the method, however, has not been validated. Further intertester reliability and validity studies of Sanders and Stavrakas's method are needed.

CONCLUSION

Physical therapists who evaluate and treat patients with SIJ dysfunction should not claim to assess or change innominate positions without reliable and valid measurements. Potter and Rothstein reported extremely poor intertester reliability of visual assessment for the PSIS and the ASIS in the standing position. The implication of using visual assessment to determine innominate rotation and to obtain a false positive interpretation for pretreatment and posttreatment effects on pelvic tilt and in the use of heel lifts is obvious. Based on our observations, Sanders and Stavrakas's method appears to be more accurate than visual assessment to evaluate, treat, and make objective claims about patients with SIJ dysfunctions. Their method, however, may be too time-consuming for use in the average clinical setting. Research is needed to develop a tool for more time-efficient measurement of innominate rotation.

REFERENCES