

There are 4, not 7, cardinal movements in labor



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The mechanics of labor describe the forces required for fetal descent and the movements the fetus must perform to overcome the resistance met by the maternal bony pelvis and soft tissue, mainly the levator ani muscle and the pelvic floor. The pelvic inlet is at a 90-degree angle to the pelvic outlet, forming a curved canal with varying diameters. The 3 sections of the birth canal are the inlet, the cavity, and the outlet. In the gynecoid pelvis, the inlet is widest in the transverse and the cavity more rounded, whereas the outlet is widest in the anterior-posterior diameter. The critical diameters in a human fetus are

The mechanics of labor describe the forces required for fetal descent, and the movements that the fetus must perform to overcome the resistance met by the maternal bony pelvis and soft tissue. The fetus negotiates the birth canal and rotational movements are necessary for descent. Anglo-American literature lists 7 cardinal movements, namely engagement, descent, flexion, internal rotation, extension, external rotation, and expulsion. German and older English literature lists only 4 rotational movements as the cardinal movements and excludes engagement, descent, and expulsion. We would argue that descent is the main purpose of the uterine powers and cardinal movements, a description of the rotational movements the fetal head and shoulders must perform to obtain descent. Ultrasound offers a historically unique opportunity for noninvasive, dynamic studies of the mechanics of labor. The information gathered by clinical examination and ultrasound should be integrated into clinical decision making.

Key words: cardinal movements, fetal attitude, fetal descent, fetal position, mechanics of labor, ultrasound

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EDITOR'S CHOICE

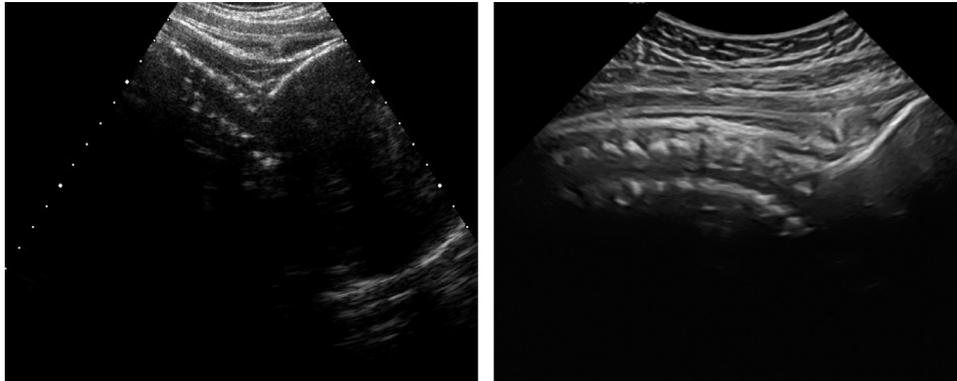
the head and the shoulders, and the fetus must rotate to negotiate the birth canal. These rotational movements of the fetal head and shoulders are often called the cardinal movements, but in earlier publications they are usually only referred to as movements.^{1–3} German and older English literature lists 4 movements as the cardinal movements.^{4–6}

In a gynecoid pelvis, the fetal head usually enters the pelvis in a transverse position, and the first rotational movement in the long axis of the fetus is flexion of the neck (Figure 1). The second movement is a transverse rotation of the occiput anteriorly (Figure 2), and the fetus is then facing the mother's back with the fetal head oriented in the anterior-posterior direction. This allows exit of the fetal head through the pelvic outlet, which is the largest in the anterior-posterior diameter. This second rotation allows the shoulders to enter the inlet of the pelvis in the transverse plane. When the nape of the fetal neck passes beneath the maternal symphysis, the resistance from the maternal soft tissue pushes the fetal head upwards, creating an extension of the head. This movement is called the third rotational movement (Figure 3,

Video). The fourth movement is the external rotation (Table). The fetal body and shoulders are now in the middle of the pelvis and can rotate into the largest anteroposterior plane of the outlet. As this happens, the fetal head rotates to face the mother's right or left thigh. (Figure 4).

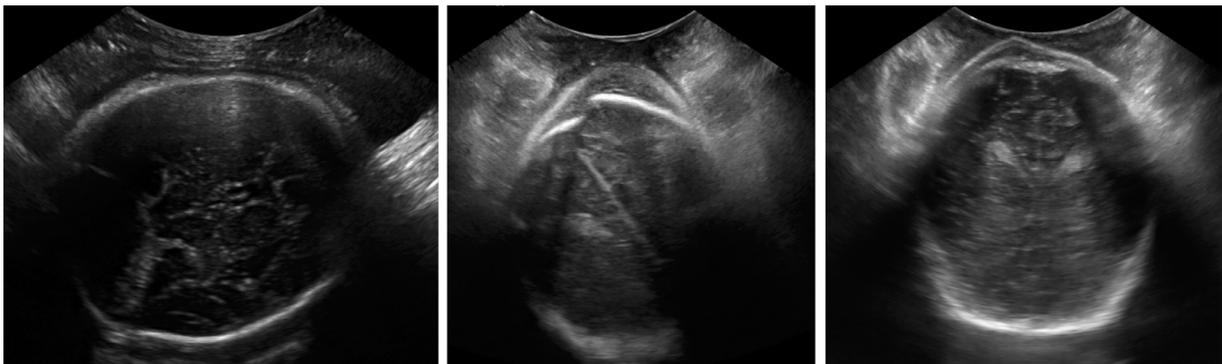
Understanding the cardinal movements of the fetal head is a relatively recent development in medicine. These are not described in ancient texts, which focus on lie and presentation,^{7,8} however, Soranus mentions that the birth is even more favorable when the fetus descends with its face turned downward.⁸ William Smellie in "A Treatise on the Theory and Practice of Midwifery" infers knowledge of the cardinal movements, but does not name them.⁹ In Alfred Galabin's "A Manual of Midwifery," the term "cardinal movements" appears⁴ and is adopted by later authors such as Munro Kerr.⁵ In the German tradition, Spiegelberg from Breslau lists the following 4 "movements" in 1878: flexion, internal rotation, extension, and external rotation, and in Pschyrembel's "Practische Geburtshilfe" from 1947, these 4 movements are called cardinal movements.^{3,6} In the United States, Shears' "Obstetrics,

FIGURE 1
Fetus with extended (left image) and flexed (right image) attitude



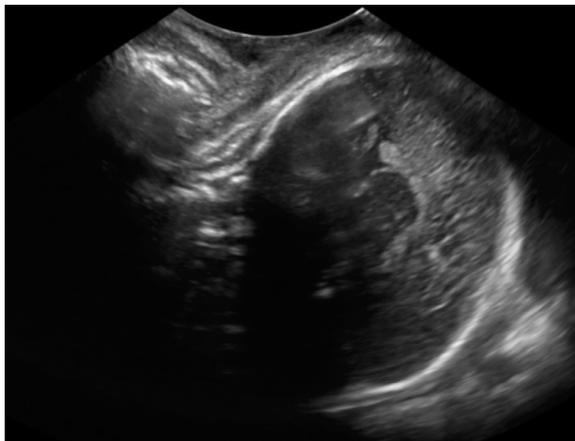
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FIGURE 2
Occiput at 8.30 (transabdominal scan), 10.30 and at 12 o'clock (transperineal scan) from left to right



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FIGURE 3
Head extension shown with sagittal transperineal scanning shortly before delivery



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Normal and Operative” talks of “movements of the head” and lists 5 movements, namely flexion, descent, rotation, extension, and external rotation.² In “Willams Obstetrics,” third edition, J. Whitridge Williams writes that the 3 true cardinal movements are

TABLE
The 4 classical cardinal rotational movements

1. Flexion of the fetal head
2. Internal rotation
3. Extension of the fetal head
4. External rotation for the shoulders

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FIGURE 4

The images show extension of the neck (third movement), followed by rotation of the shoulders (fourth movement), and expulsion of the fetus



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descent, internal rotation, and flexion, whereas extension and external rotation are only accessory movements,¹⁰ and in the 10th edition, editor J. Nicholson opines that the 3 cardinal movements are in fact descent, internal rotation, and extension, whereas flexion and external rotation are now considered accessory movements.¹¹ By the 1989 edition, edited by F. Cunningham, the list of cardinal movements had increased to 7.¹² Engagement is called the first movement. Descent is the gradual passage of the fetus through the birth canal and is called the second movement. The next 4 movements are the rotational movements described above and expulsion of the fetus is called the seventh movement.

The 3 extra movements listed in “Williams Obstetrics,” refer to fetal descent. Engagement is simply a stage of descent when the largest diameter of the fetal head has passed the pelvic inlet and expulsion the ultimate result of the descent. One could argue that descent of the fetal head is an obligatory movement without which the fetus cannot be born, as “Williams Obstetrics” and some earlier authors do.^{10–13} However, we would argue that descent is the main purpose of the uterine powers, and the cardinal movements are a description of the rotational movements the fetal head and shoulders must perform to obtain descent. This is a descriptive discussion without any direct clinical value,

but understanding the rotational movements is of clinical importance.

The 4 classic rotational movements listed above only occur with the fetus delivering in an occiput anterior (OA) position in a gynecoid pelvis. An anthropoid pelvis has a pelvic inlet that is widest in the anterior-posterior diameter. The rotational movements in the anthropoid pelvis must be different from that of a gynecoid pelvis, however, the labor mechanics in pelvic forms other than in the gynecoid pelvis is vastly understudied.

The cardinal movements vary with fetal head position and attitude (degree of flexion). If the internal rotation (second cardinal movement) leads to an occiput posterior (OP) position, the third cardinal movement is maximal flexion followed by an extension to a neutral attitude after the head is born. Even if maximally flexed, the fetus in OP position can never follow the curve of the birth canal as optimally as the fetus in OA position does through extension. This is of vital importance for the clinicians to understand, because traction used in assisted deliveries must differ from that used in OA position. As the head reaches the pelvic floor, the fetus in OP position must continue straight forward for longer before upwards traction is possible when compared with the fetus in OA position.¹⁴ If the clinician, instead of continuing straight forward, overcorrects with downwards traction, the risk of an anal

sphincter tear greatly increases.^{5,15} OP deliveries are associated with more failed deliveries. This may, in part, be because the OP fetus goes undiagnosed, but also because the OP fetus generally presents less flexed throughout the delivery than a fetus in OA position and because clinicians are not well versed in the differences in labor mechanics. If an OP position can be corrected to an OA position through rotational vacuum, forceps, or manual rotation, it is advantageous for ease of delivery. Manual rotation is currently gaining popularity, but a randomized study was underpowered to show reduced operative delivery rates.¹⁶ Another randomized clinical trial found reduced risk of operative delivery after prophylactic manual rotation of OP or occiput transverse positions during the early second stage of labor.¹⁷ To successfully perform instrumental or manual rotations, precise diagnostics of fetal head station, position, and flexion is necessary.

Fetal attitude and position are difficult to assess with clinical examinations in the early phase of labor, but easy to see with ultrasound. Therefore, ultrasound can increase the understanding of labor mechanics and help clinicians in decision making.

Fetal rotation has recently been described longitudinally with ultrasound in nulliparous women with a spontaneous onset of labor, and 85% followed the 4 classical movements, but with the varying length of the internal

rotation (second movement) depending on the initial position.¹⁸ Fetal attitude can be measured (Figure 1),^{19–21} and fetal position can be described like a clock face with 12 or 24 divisions (Figure 2).²² The “head up sign” means that the fetal neck is extended and the head is directed upward in the pelvic outlet.²³ Figure 3 shows a fetus with an extended neck shortly before delivery. Ultrasound is redundant to assess the fourth movement (Figure 4).

Ultrasound has the potential to add clinically important information, but information alone is not enough to improve outcomes.²⁴ Understanding how to use the information is essential.^{25,26} To translate the information gathered by clinical examination and ultrasound into clinical decision making, a deeper understanding of labor mechanics is required. Unfortunately, this knowledge is not easily accessible anymore, because the topic is reduced to superficial sections in most modern textbooks. Most research on labor mechanics is more than 50 years old, and we believe a revival is long overdue, because there are still unanswered questions. Ultrasound offers a historically unique opportunity for noninvasive, dynamic studies of the mechanics of labor to answer those questions. ■

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Supplementary materials

Supplementary material associated with this article can be found, in the online

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