REVIEW

Fetal station based on the trapezoidal plane and assessment of head descent during instrumental delivery

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The precise reporting of fetal station is important in the decision-making regarding whether instrumental vaginal delivery or cesarean section should be performed. However, accurate evaluation of fetal station is difficult because it is defined on the basis of a hypothetical vertical midline to the ischial spines. Moreover, during delivery, the fetal head descends anteriorly into the pelvis along the pelvic axis and not in the vertical direction. DeLee's concept of fetal station, first reported in 1924, has been revised by taking into account the fetal head descent along the pelvic axis, and this concept has been in clinical use at the University of Tokyo Hospital since the 1970s. In this review, we assess the problems associated with conventional fetal station and explain the new concept of fetal station based on the trapezoidal plane and assessment of head descent upon instrumental delivery.

Introduction

The concept of fetal station was initially described by DeLee in 1924 as the level of the presenting fetal part in the birth canal in relation to the ischial spines. Later, in 1988, the American College of Obstetricians and Gynecologists (ACOG) first reported on a station classification system wherein the pelvis above and below the ischial spines is divided into fifths. These divisions are represented in centimeters; if the leading part of the fetus descends at a level between the spines, the station is designated as 0. Below the ischial spines, the presenting part passes stations +1, +2, +3, +4, and +5 to delivery (Figure 1).

In order to assess the progress of labor, proper reporting of fetal station, as well as cervical dilation and effacement, is essential. In addition, precise reporting of fetal station is also important in the decision-making regarding whether instrumental vaginal delivery or cesarean section should be performed. However, accurate evaluation of fetal station is difficult due to the facts that it is defined on the basis of a hypothetical vertical midline to the spines and that the findings may vary between individuals. Moreover, during delivery, the fetal head descends anteriorly into the pelvis along the pelvic axis and not in the vertical direction. For these reasons, the definition of fetal station proposed by DeLee might not be suitable for the precise and objective assessment of fetal...
engagement and descent. In fact, several studies have shown that fetal head engagement and descent can be assessed more objectively and measured more precisely using ultrasonography or MRI compared to fetal station evaluation.\(^7\)\(^{-15}\)

DeLee’s original concept of fetal station has been revised by taking into account the fetal head descent along the pelvic axis, and this concept has been in clinical use at the University of Tokyo Hospital since the 1970s.\(^16\) Takeda and Kinoshita\(^17\) defined fetal station based on the triangular or trapezoidal plane consisting of the ischial spines and the lower edge of the pubic symphysis along the pelvic axis as the t-station, and this definition has been clinically used at Saitama Medical Center and Juntendo University Hospital since 1985 and 2001, respectively. Unfortunately, to date, this new concept of t-station has only been reported in textbooks of obstetrics written in Japanese\(^16,17\)

For this reason, in this brief review, we intend to explain the concept of t-station, which represents a more objective assessment metric for head descent.

**Definition of fetal station on the basis of the ischial spines**

DeLee defined fetal station as the vertical distance (in centimeters) from the line between the ischial spines (base level: 0) in Hodge’s parallel pelvic planes, to the presenting part. The stations above the line between the ischial spines are designated \(-1\) to \(-5\) and those below the line, \(+1\) to \(+5\) (Figure 1). However, when the fetal head is engaged and descends in the pelvis, the presenting part passes more anteriorly compared to the vertical axis on the line between the ischial spines, in accordance with the obstetric pelvic axis. Thus, estimation of fetal head

![Figure 2](image)

**Figure 2. New fetal station based on the trapezoidal plane (t-station).**
The definition of a new fetal station along the pelvic axis is based on the trapezoidal plane consisting of both ischial spines and the lower edge of the pubic symphysis. In the clinical setting, this t-station would be more useful for assessing the descent of the fetal head into the pelvic cavity after engagement.

(A) Oblique view
(B) Front-caudal view

![Figure 3](image)

**Figure 3. Direction of the fetal head descending anteriorly along the pelvic axis.**
This pelvic schema is copied as a precise reduced drawing from radiographic pelvimetry. A top fetal head is a real reduced-size fetal head but others are just moving to each station by itself. The fetal leading head descended anteriorly along the pelvic axis. With the descent of the head, a decrease in the degree of obliteration in the space between the posterior surface of the pubic symphysis and the fetal head is noted.

1. The true obstetric conjugate
2. The trapezoidal plane
station using this system does not accurately reflect on actual head descent and progression.

**Definition of fetal station on the basis of the trapezoidal plane (t-station)**

A revised definition of fetal station (t-station) has been previously proposed. This definition is based on the trapezoidal plane, which consists of both the ischial spines and the lower edge of the pubic symphysis along the pelvic axis. The t-station is defined as the shortest distance from the trapezoidal plane (base level: 0) to the presenting part (Figure 2). This revised definition is considered much easier to understand than DeLee’s original definition and can objectively estimate how the fetal head descends anteriorly along the pelvic axis as a curve (Figure 3). In fact, it is possible to measure the t-station between the trapezoidal plane and the leading portion of the fetal head with the breadth of each finger and the length of the space between the index finger and the middle finger. The distance from the upper edge of the index finger can directly measure t-station when the index finger is placed on the ischial spine, the upper edge of the index finger is set at the lower edge of the pubic conjugate during vaginal examination, and the descending fetal head is touched using the middle finger while bent (Figure 4). Thus, the descent of the fetal head can be objectively assessed, thereby aiding in the decision regarding whether instrumental vaginal delivery or cesarean delivery is most suitable.

**Estimation of the site of the largest fetal head circumference in the pelvis**

Appropriate vaginal examination is critical not only for observing the fetal position, flexion, and molding, but also for the accurate diagnosis of fetal descent into the pelvis in terms of fetal station. Moreover, the findings in each case must be explained and shared at clinical conferences for obstetricians involved in training and who practice instrumental delivery. In particular, it is important to estimate the site of the largest circumference, which is usually identical to the site of the suboccipitobregmatic diameter of the fetal head.

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**Figure 4. Vaginal examination to measure fetal descent.**

(A) Lateral view of the pelvis.

In vaginal examination, the physician touches the lateral ischial spine with the index finger-tip and places the upper edge of the index finger close to the lower edge of the pubic symphysis. Then, the bent middle finger can feel the leading portion of the fetal head. If the fetal head is floating, this bent middle finger cannot touch the fetal head. However, depending on the leading portion descending into the pelvic cavity, it can be touched by the bent middle finger. Consequently, the t-station can be recognized by measuring the distances between the upper edge of the index finger and the upper edge of the bent middle finger. For this, the physician needs to know the breadth of each finger at the distal or proximal interphalangeal joint and at the metacarpophalangeal joint as well as the length of the maximum space between the index and middle fingers.

This definition of the t-station is expected to be especially useful for instrumental delivery because of an objectively measurable station, being more objective and accurate than the DeLee’s station.

(B) Cephalad view of the pelvis.

It was possible to measure and estimate the t-station in centimeters, according to the length of the maximum space between the index and middle fingers.
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head at occiput anterior presentation (Figure 5), for the decision-making regarding whether instrumental vaginal delivery or cesarean delivery is indicated for cases of non-reassuring fetal status, arrested labor, etc. The site of the largest fetal head circumference, which corresponds to the site of the occipitofrontal diameter at the occiput posterior position, needs to be carefully estimated. The distance between the leading portion and the site of the largest circumference is obviously more in cases in which the infant is large, the head has extreme molding at occiput posterior presentation (Figure 6), or there is a large caput succedaneum, as well as in cases of prolonged labor, than in cases of normal smooth delivery and when the head is small or has less molding. In the former cases, it is extremely difficult to estimate the site of the largest fetal head circumference and to safely perform instrumental delivery if only fetal station and cervical dilatation.

To ensure safe and reliable vacuum extraction or forceps delivery, it is necessary to understand the positional relationship between the fetal head and pelvis. Thus, assessments of fetal station, the site of the largest fetal head circumference, rotation of the fetal head, and the degrees of head flexion are all important for safe instrumental delivery. Another important parameter is the palpable range of the posterior surface of the pubic symphysis, expressed as all, 2/3rd, 1/2nd, 1/3rd, or none. As the fetal head descends into the pelvis, the degree of obliteration of the space between the posterior surface of the pubic symphysis and the fetal head decreases;
The site of the largest fetal head circumference may be affected by several factors such as the size of the fetal head, size of the caput succedaneum, abnormal rotation, presentation and attitude, the degree of head extension, and asynclitism. Therefore, the site of the largest fetal head circumference is different in each case, even with the same fetal station. Both cases show the same t-station + 3.

(A) The occiput-anterior presentation.
In this presentation, the largest fetal head circumference is equal to the suboccipitobregmatic circumference.

(B) The occiput-posterior presentation.
In this presentation, the largest fetal head circumference is equal to the occipitofrontal circumference. In this abnormal presentation, the site of the largest head circumference is located much higher than that in the occiput-anterior presentation.

correspondingly, the palpable range of the posterior surface of the symphysis is gradually reduced (Figure 5, Table 1). During forceps or vacuum delivery, to determine the angle of the posterior surface of the pubic symphysis by vaginal examination, the fetal head must be pulled in the correct direction. Additionally, to assess the positional relationship between the head and the pelvic floor, such as the anterior space of the sacrum, it is important to
determine the degree of fetal head descent, expressed as wide, narrow, or none (Table 1).

**Criteria for types of forceps deliveries**

The ACOG criteria used to determine the type of forceps suitable for delivery are essentially based on the four-level pelvic plane. Accordingly, midforceps delivery is used for fetal head engagement above stations +2 cm, while low forceps delivery is used when the leading portion of the fetal head is at station ≥+2 cm but not on the pelvic floor. Outlet forceps delivery is employed when the fetal scalp is visible at the introitus without separating the labia, the fetal head has reached the pelvic floor, the sagittal suture is in the anteroposterior or right or left occiput anterior or posterior position, the fetal head is at or on the perineum, and the rotation does not exceed 45° (Table 1).

On the other hand, t-stations −1 cm to 0 cm, defined according to the trapezoidal plane, refer to when the site of the largest fetal head circumference is located at the pelvic inlet; whereas t-stations 0 cm to +1 cm, +2 cm to +3 cm, and +4 cm to +5 cm refer to when this site is located at the upper middle pelvis (midforceps delivery), the lower middle pelvis to the low pelvis (low forceps), and when the head is in the low outlet pelvis (outlet forceps delivery), respectively (Table 1). Correct estimation of the site of the maximum fetal head circumference is important for instrumental delivery, such as forceps delivery, which depends on the size of the fetal head and the axis of rotation of the fetus. The positions seem to be slightly higher for t-stations 0 cm to +2 cm than for the corresponding DeLee stations, although this difference is negligible in the case of the lower t-stations.

At Juntendo University, the prerequisite for successful application of forceps delivery is t-station ≥+3 cm. Only an expert may attempt forceps delivery at t-station ≥+2 cm, and preparation for a cesarean delivery must be made alongside. Several factors may affect the estimation of the site of the largest fetal head circumference, such as the size of the fetal head, size of the caput succedaneum, abnormal rotation, presentation and attitude, degree of head extension, and asynclitism. Full attention should be paid to cases in which the fetus is in the frontoanterior position because the fetal head may wrongfully appear descended, and the site of the largest head circumference is at a high position (Figure 6). This kind of misdiagnosis may require traction from a high level and can cause unexpected problems.

**Conclusion**

Accurate estimation of fetal station using vaginal examination is extremely important in cases in which forceps delivery is being considered, owing to the fact that this type of delivery cannot be applied on a trial basis. Therefore, the focus of training for forceps delivery should be on understanding the fetal head station at which safe and reliable delivery can be ensured. We believe that to effectively obtain objective and practical findings from internal examination, the presented concept of evaluating fetal head descent on the basis of the pelvic axis is better than the conventional station system proposed by DeLee. Further studies should be performed to demonstrate clinical evaluations and usefulness of t-station, compared with outcome of instrumental delivery by the conventional station.

**Conflict of interest**

None.

**References**


