Intra-Uterine Fracture of the Infant's Skull*

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EXPERIENCE with six infants showing depression of the skull at the time of birth prompted a further study of this matter. In each instance the depression was found to have occurred in utero, not during the process of delivery. It was assumed that this was a common problem, frequently reported, but such does not prove to be the case if one can judge from the paucity of reports found in an extensive review of the medical literature. Various authors have referred to the mechanism by which intra-uterine fracture may occur.

Potter\textsuperscript{13} indicated that depressed fracture of the skull in infants may be the result of pressure against the maternal symphysis pubis or the promontory of the sacrum. Under such circumstances, “a several centimeter portion of one parietal bone may become depressed in which is usually known as a depressed fracture.”

Watson-Jones\textsuperscript{20} stated that if a fracture is sustained as a result of injury to the mother, the parietal bones are usually involved and the injury arises from pressure of the head on the bones of the pelvic inlet, particularly the promontory of the sacrum. He emphasized that this sometimes occurs through a slightly contracted pelvis.

Tkacz\textsuperscript{19} made a similar statement. He noted that skull fractures of this sort are comparable to greenstick fractures of the long bones in childhood and may result from pressure against the maternal symphysis pubis or pressure against the promontory of the sacrum, as well as from other injuries which may take place during the process of delivery.

Review of Older Medical Papers

Although the medical literature of the last 50 years has only scant reference to intra-uterine depressed fracture of the skull, a number of older accounts are briefly summarized below. These references have been taken directly from the journals in which they were published. In several instances there are secondary references to journals in the 19th century. So far, it has not been possible to substantiate these further. The intra-uterine position of the head was not recorded in any of this older series of cases.

Our report is not concerned with the rationale or technique for elevation of depressed fractures of the skull, nor the depressions which are produced during traumatic delivery.

Case Reports

In 1884, Brinton\textsuperscript{2} referred to the following cases, all of which had been shown to have depressions of the skull. He referred to many other cases of fractures of other bones, but these are those in which fractures of the skull were found. Brinton cited Gurilt\textsuperscript{8} in nine of his cases (Cases 18 through 26) and he added a tenth case (Case 42) which was reported by Hecken (sic).\textsuperscript{6}

Case 18, Brinton. Schmitt, W. J., Vienna, reported the case of a woman aged 20, in the eighth month of her fifth pregnancy, who had received a severe blow. The child was born at full term with a fracture of the crown of the head.

Case 19, Brinton. Schnuhr’s patient, a 38-year-old mother, fell in the eighth month of pregnancy. A full-term child was delivered with a deep depression in the right frontal bone. He noted that the bone gradually became elevated, and at the end of 3 months the depression had disappeared.

Case 20, Brinton. Wittzack delivered the child of a mother who had fallen from a cherry tree during her pregnancy, the time not indicated. There was a depression 3 inch-
es long and \( \frac{1}{2} \) inch broad upon the left frontal and parietal bones of the child, who was delivered by turning for a breech presentation.

**Case 21, Brinton.** Albert (Wiesentheid) had a patient, a healthy peasant woman aged 20, who had fallen and struck the right side of her abdomen on a boundary stone 8 days before the expected date of confinement. A dead male child was delivered with a fracture of the left parietal bone, separated from its neighboring bones, and greatly depressed along the sagittal suture.

**Case 22, Brinton.** Heyfelder examined a woman in her eighth month of pregnancy who had violently struck her abdomen against the projecting angle of a bedstead. Spontaneous movements of the child ceased, and there was bleeding from the vagina. After forceps delivery at full term, the child showed depression upon the left frontal bone and died several days later in convulsions.

**Case 23, Brinton.** C. G. Carus, Dresden, examined the second child of a rachitic woman. There was a deep depression of the right frontal bone \( \frac{1}{2} \) inch long caused, according to Carus, by pressure of the head against the last lumbar vertebra.

**Case 24, Brinton.** F. B. Osianter delivered this child without the use of forceps. There was a marked depression of the child’s skull attributed to the pressure of the head against the lumbar vertebrae.

**Case 25, Brinton.** d’Outrepont reported a patient who had an exostosis projecting from the fourth or fifth lumbar vertebra. A child was delivered with a depression of the frontal bone, presumably caused by compression against the exostosis. The child died 4 weeks after birth, and the brain was found to be compressed by the depressed bone. He referred to another patient of a similar sort in whom there was a depression of the parietal bone.

**Case 26, Brinton.** Düntzer (Cologne) delivered the child of a woman with rickets who was in her fourth pregnancy; the child had a depression in the left frontal bone extending to the sagittal suture. He examined the woman and found an oval exostosis the size of a pigeon’s egg between the fourth and fifth lumbar vertebrae. He assumed that the depression of the skull came from pressure against the exostosis.

**Case 22, Brinton.** Hecken (sic)\(^3\) had a patient, a powerful woman in her sixth month of pregnancy, who had fallen down stairs. She delivered at full term a normal living child and a second product of pregnancy that was a disorganized 6-month-old fetus with the bones of the calvarium separated and sharp projecting bone coming through the scalp.

In 1913, Smith\(^1\) made a similar review of the literature and added four cases to the 10 of Brinton.

**Case 36, Smith.** Lumley (sic)\(^10\) reported that a pregnant woman slipped within 10 days of term while going through a doorway and struck the left portion of her abdomen against the edge of the door. Movements of the child ceased, and a dead fetus was delivered 8 days later, with a fracture of the left frontal and parietal bones of the skull.

**Case 37, Smith.** Gorham (sic)\(^7\) reported the case of a woman about 6 months pregnant who was involved in a severe quarrel with her sister-in-law, thrown to the ground, and stamped upon. A dead fetus was born 2 months later with “a fissure of both parietal bones.”

**Case 41, Smith.** Crosland\(^6\) reported that a pregnant woman fell down the cellar stairs, striking and severely bruising her back in the sacral region. Labor pains set in 4 days later. The child was delivered spontaneously with the mother in the kneeling position. The child was a dead female infant, somewhat macerated, but there was in the left parietal region a separation of the left parietal and temporal bones from the rest of the skull. These bones were displaced and tilted outward and the lower jaw was fractured. Dr. Crosland believed that the injury had occurred as the result of the head being forcibly jammed against the sacral promontory.

**Case 42, Smith.** Pugliese\(^14\) examined a 12-month-old child whose mother in the last month of pregnancy had severe seizures dur-
ing one of which she fell from her bed to the floor. He noticed a separation of the frontal bones just to the left of the midline, extending from the fontanel to the root of the nose. He considered this to be a traumatic defect, occurring as the result of the mother's seizures and fall.

Since at the time of these reports it was not common practice to ascertain the position of the fetus before delivery, it is not possible to reconstruct the exact mechanism by which depression of the infants' skulls occurred.

**Review of Recent Medical Papers**

Since the advent of the x-ray and the recording of the position of the fetal head, reports of the last 25 years have presented a more logical interpretation of some of the mechanical forces involved. Only eight confirmed cases have been uncovered; in each of these, from the accounts in the publication or from direct correspondence with the author, it has been possible to reconstruct the position of the fetal head in the pelvis and the forces which must have been responsible for the injury. These are shown in Fig. 1.

**Case 1.** Jones and O'Nan\(^6\) reported the case of a 39-year-old woman near term who was involved in a truck accident. She was pinned beneath the truck with the cab door open on her side. Roentgenograms of the mother's pelvis disclosed a fracture of both rami of the right pubis, in good position. There was a depressed fracture of the parietal bone of the fetus (Fig. 1 A).

On the day of the accident, a 5 lb, 13 oz, male infant was delivered by caesarean section. A depression of the right parietal bone was present which "disappeared over the following several weeks." No further details are available concerning the position of the baby's head in the pelvis since neither author can recall information beyond that published in the paper.

**Case 2.** Flew\(^6\) observed the delivery of twins by a skilled midwife. The breech presentation of the first child resulted in some difficulty in which the head was arrested at the pelvic brim. Suprapubic pressure was exerted; at birth there was a large depressed fracture of the skull in the right temporoparietal region. The child was referred to Pennybacker\(^1\) who elevated the depressed fracture following which the child made a good recovery (Fig. 1 B).

**Case 3.** Barr\(^1\) referred to a 26-year-old mother in her first pregnancy. The fetus had presented as a vertex in the 30th week. At the 37th week the head was high and free, and a pelvic examination disclosed that it had been forced out of the pelvis because of a fibroid tumor on the posterior wall of the uterus. The child, delivered by caesarean section 10 days before the expected date of delivery, had a large depression in the left parietal bone. The author considered the depression to be secondary to the fibroid of the uterus. The depression was said to have come out spontaneously over the next 15 days, but the child was retarded at 13 months of age (Fig. 1 C).

**Case 4.** Seear and Woeppe\(^1\) admitted a 21-year-old woman following an automobile accident approximately 5 weeks before the expected date of delivery. X-ray films of the pelvis showed fractures of the right sacroiliac joint and of the left pubic ischium, with the symphysis separated 2 cm and displaced downward. The head of the fetus was in a cephalic presentation, left occiput transverse (Fig. 1 D). There was a mobile fracture, 11 cm in length, of the right side of the skull. It was felt that the mechanics of the skull fracture involved direct depression of the loose fragments of the maternal pelvis against the uterus and secondarily against the fetal head.

**Case 5.** Pike\(^1\) reported the case of a 31-year-old woman, weighing 91 lbs, who was pregnant for the fifth time. The head of the infant was in the right occiput anterior position. The patient fell forward against a step on April 11, 1957. The child was delivered normally with outlet forceps on April 24, 1957; a 3.5 cm, rounded depression of the right frontal bone was present at the time of delivery (Fig. 1 F). The depression was elevated by Dr. Giles Bertrand on April 26, 1957; the child was normal. The author commented that the fracture of the infant's skull had occurred against the sacral promontory.
Intra-Uterine Fracture of Infant’s Skull

Fig. 1. Artist’s drawings of the eight cases from the contemporary literature in which the position of the fetal head was reported.  
B. (Flew) Twin delivery, strong suprapubic pressure; right side of first infant depressed against promontory of sacrum.  
C. (Barr) Fibroid tumor of uterus. Caesarean section. Left parietal depression.  
D. (Seear and Woeppe) Fracture maternal pelvis. Direct impingement of fragments of pelvis against right side of head.  
E. (Rawl) Contracted pelvis. Radiographic evidence of depression of right parietal region against promontory of sacrum.  
F. (Pike) Mother fell forward against step 13 days before delivery. Depression of infant skull occurred against sacral promontory.  
G. (Dyer and Barclay) Comminuted fractures of maternal pelvis. Head in left occiput posterior. Fracture of right parietal bone occurred as result of fragmentation of pubic rami.  
Case 6. Dyer and Barclay reported the case of a 22-year-old woman injured approximately at term of her fourth pregnancy. She was involved in an automobile accident approximately 5 hours before admission. X-ray films of the pelvis showed comminuted fractures involving the pubic ramus on the right which was markedly displaced, plus a left sacroiliac displacement. The head of the fetus was in the left occiput transverse position. An 8 lb, 3 oz, infant was delivered by caesarean section. A depressed fracture, 3 cm in diameter, was present on the right side of the skull (Fig. 1 G).

Case 7. Theurer and Kaiser reported an infant born at term by caesarean section to a mother who was in a sports-car accident shortly before admission to the hospital. The mother had pelvic fractures. X-ray films of the child showed a fracture of the right parietal bone and multiple other fractures of the skull. There was laceration of the dura mater, extensive subdural and subarachnoid hemorrhage, and bilateral laceration of the tentorium cerebelli. The position of the head was not stated (Fig. 1 H).

It is evident from this series that in those instances in which one could be sure of the position of the head in the pelvis, with the exception of those cases in which the maternal pelvis was shattered by injury or in the single case with a uterine fibroid, the depressed fracture of the skull occurred against the promontory of the sacrum.

North Carolina Baptist Hospital Cases

NCBH Case 1. On October 18, 1951, a 6 lb, 9 oz, male infant was delivered whose head at birth showed a 2½ cm depressed fracture of the right frontal bone (Fig. 2 A). The mother gave a history of having several miscarriages; she had been delivered of a stillborn fetus in September, 1950.

She was in labor for 7 hr, 15 min, and examination before delivery showed the head to be in the right occiput posterior position, rotated to the right occiput transverse position. The child was delivered by low forceps and no forceps marks were on the scalp. The depression of the skull had been palpated by the obstetrician before application of the forceps, and it was considered to have been produced by compression of the head against the sacral promontory.

The fracture of the skull was elevated on the day of delivery. The child made a good recovery, showing normal development thereafter.

NCBH Case 2. A 5 lb, 2 oz, infant was delivered by caesarean section without the use of forceps on June 10, 1959. The young mother had been in an automobile accident on June 9, 1959, in which the right side of her pelvis was fractured, involving the right acetabulum and displacing the lateral border of the symphysis pubis medially (Figs. 2 B and 3 left). There was destruction in the continuity of the right acetabulum, the posterior lip being displaced superiorly.

The infant's head was in the left occiput transverse position. When the baby was delivered, a 3 by 3½ cm, smooth depression was present in the left temporoparietal region (Fig. 3 right). This was easily elevated on the sixth day after birth, although the bone was well fixed in this position and had to be comminuted in order to set it into the normal position. The underlying brain was normal. The child made an uneventful recovery and developed normally.

NCBH Case 3. A 7-day-old infant was admitted to the Neurosurgical Service with a depressed skull fracture (Fig. 2 C). The 25-year-old mother had gone into labor on March 28, 1962. Labor was mild at first but became more severe. Anteroposterior and lateral x-ray films were made of the pelvis 2 hours after the onset of labor. The films (Fig. 4 left) showed the head fixed in the inlet and a marked depression of the left temporoparietal region against the promontory of the sacrum. The head was in the left occiput transverse position.

The child was delivered by caesarean section without forceps. He behaved normally after birth. The depression (Fig. 4 right), which was fairly well fixed, was elevated by rongeur ing away bone and replacing the fragments until the depression was completely elevated. The child has developed normally since that time.

NCBH Case 4. A 4-day-old female infant was admitted to the hospital with a de-
pressed fracture of the skull (Fig. 2 D). The child was the product of a normal pregnancy after 3 hours of labor. The head had been in the right occiput transverse position, but just before delivery it was in the right occiput anterior position.

At the time of delivery, which was not considered to be traumatic, with no forceps marks on the head, the child was found to have a depression in the right frontal region of the skull. This measured 5 by 4 cm and was depressed about 1 to 1 ½ cm. The fracture was elevated by rongeuring bone so that the depression could be broken out into its previously normal position. The bone was fairly well fixed in this position, indicating that it had been present for several days.

The child did well, made a satisfactory recovery, and returned home. At the age of 3 months paroxysmal auricular tachycardia developed which proved to be fatal. At post-mortem examination no depression of the skull remained. Some minor adhesions were present between the dura mater and the cortex in the right frontal region, but the brain was normal otherwise.

NCBH Case 5. A 7-week-old infant was being rolled down a flight of stairs in a carriage when the carriage slipped and the child fell out. He was not rendered unconscious but did suffer a head injury with a fracture in the right occipitoparietal region (Fig. 2 E).

A history was given that at the time of birth the child had a small depression in the left frontal region near the hairline. This had persisted unchanged until the time of admission.

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**Fig. 2.** Artist's drawings of the five North Carolina Baptist Hospital cases as detailed in the text.
A review of the history revealed that the mother was 22 years old and had a normal pregnancy and delivery. The first stage of labor lasted 15 hours, the second stage 52 minutes, and the third stage 2 minutes. The presentation of the head was vertex at first. The head was rotated to the left occiput anterior and then to the occiput anterior position, and the child was delivered by low forceps. The depression of the skull was believed to have occurred as the result of compression against the promontory of the mother's sacrum. The depression was not sufficiently severe to require elevation.

NCBH Case 6. Since the study of the foregoing five cases, an additional patient has been admitted and an operation performed. This child, admitted at 7 weeks of age with a depression of the right frontal bone, was considered to have sustained the fracture by pressure against the sacral promontory of the mother as in the previous cases. However, the obstetrician did apply forceps to the head at the outlet. He was certain that just before delivery the infant's head was in the left occiput anterior position in the pelvis. Hence, the fracture of the skull could not have come as a result of contact with the promontory of the sacrum. The pelvis of the mother was described as borderline of the gynecoid type. This case, which must be accepted as an intra-uterine fracture of the skull, therefore must be considered to be an exception to the rule observed in all the other cases of this series.

Discussion

The demonstration in NCBH Case 3 of the depression in the right parietal bone directly in contact with the sacral promontory documents the mechanism as well as might be desired. The fracture of the left parietal bone of the infant in NCBH Case 2 whose mother's pelvis was broken in an accident just before a caesarean section is another clearly documented substantiation of the contention that most fractures do occur as a result of contact between the mother's sacral promontory and the infant's head in the pelvis. In this patient, the direction of force was against the right anterior pelvis and the pelvis was actually fractured inward, yet the fracture of the infant's skull was on the side of the head in contact with the posterior pelvis of the mother.

It was surprising to learn of the relatively rare reports of intra-uterine depressions of the skull in infants. Although a number of reports were found in the older literature, the position of the head of the infant is recorded in none and it is not possible in most of these cases to offer any theory as to the mechanism by which the depression occurred. In some cases the authors indicated that the promontory of the sacrum, a
Intra-Uterine Fracture of Infant’s Skull

Fig. 4. NCBH Case 3. *Left:* Lateral x-ray film of maternal pelvis showing head with left parietal bone depressed by sacral promontory. Caesarean section. *Right:* Anteroposterior view of infant’s skull after birth.

fibroma of the uterus, or an exostosis of the lumbar vertebrae had been responsible for the depression of the infant’s skull.

However, in a review of the relatively small number of cases reported in which it is possible to know the position of the infant’s head, most have occurred as a result of compression of the skull against the promontory of the sacrum. This is true of the reports by Pike, Barr, Flew and Pennybacker, and Rawl; in the report by Theurer and Kaiser the position of the head in utero is not given.

In the case reported by Seear and Woeppel there was severe fragmentation of the left pubis and ischium directly over the area of the infant’s skull found to be fractured at postmortem examination.

Only in the case of Dyer and Barclay in which the position of the head was given before delivery did the fracture of the skull not occur from the compression against the promontory of the sacrum. The mother had multiple fractures of the pelvis at the time of injury and this may have been responsible for the position of the fracture.

When the position of the fetal head is documented, the depressed fracture of the infant’s skull has been found to occur as the result of contact of the skull against the promontory of the sacrum in all except one of the cases reported in this series. This was true in spite of the fact that extensive trauma to the pelvis occurred in one patient.

Summary and Conclusions

1. Although intra-uterine depressed fractures of the infant’s skull have been reported infrequently, such injuries occur, and six cases have been reported in detail.

2. A survey of the medical literature has disclosed eight cases in which the intra-uterine position of the fetal head was known.

3. A study of all documented cases has shown that in the majority of patients with intra-uterine fractures of the skull, including most of those resulting from trauma to the maternal pelvis, the depression has come as
a result of pressure against the promontory of the maternal sacrum.

4. Other less frequent causes of depressed fractures in utero include severe comminuted fractures of the maternal pelvis, fibroid tumors of the uterus, and tumors and deformities of the pelvis.

5. The treatment is elevation of the depression. In most instances, the depression has been present at the time of birth for a sufficient length of time to have healed and become more solidly fixed in the position of depression than the usual acute depressed fracture of the skull in infants.

References
8. Gurtt, E. (Cited by Brinton, J. H., see ref. 2.)
11. Pennybacker, J. Personal communication.