The Obstetrical Forceps and the Vacuum Extractor: An Assessment of their Compressive Force

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OVER 250 YEARS AGO, attempts were first made to aid delivery by means of a suction cup applied to the scalp of the fetus.[13] Since that time occasional trials with such a device have been reported.[5, 10, 11] It was not until recently, however, that this method of operative vaginal delivery has achieved any significant popularity. Within the past 5 years there have been over 50 published reports on delivery with the vacuum extractor, almost all of them favorable.[2] These articles ascribe several important advantages to this instrument, including its safety for the mother, the feasibility of employment at high stations of the vertex or through an incompletely dilated cervix, and its applicability with only local anesthesia.

If the vacuum extractor is to gain acceptance as a method of operative delivery, proof of its safety for the baby is imperative. In an evaluation of fetal safety, one important aspect involves the amount of cerebral compression exerted by the instruments used for delivery, be they obstetric forceps or vacuum extractor. Holland's classic work has demonstrated the mechanism by which increasing cerebral compression induces rises in intracranial pressure which may result in cerebral hemorrhage and brain damage. If the degree of cerebral compression could be determined, this would provide one index for selection of the instrument which might be safest for the fetus.

Theoretical estimations of the compressive force of obstetric forceps and the vacuum extractor have been determined mathematically.[9]

Instrument	*Theoretical compressive force (gm./sq. cm.)*
Simpson forceps	1500
Vacuum extractor	75

It will be noted that, when a pull of 22 lb. is exerted, the calculated compressive force is 20 times greater with forceps than with the vacuum extractor.

Unfortunately, confirmation of these theoretical calculations by actual measurement of this compressive force is difficult. Attempts with rubber balloons[3] or strain gauges[6] on a few cases with forceps have yielded only fragmentary results. Specific proof awaits the development of more refined and sensitive technics. However, it is known that the compressive force on the fetal head is proportional to the amount of pull exerted by the obstetrician.[1, 4] Therefore, an indirect determination of the compressive force exerted by the forceps or the vacuum extractor could be obtained by measuring the total pull required for delivery with each instrument.

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Employing this method we designed the following study in an effort to determine which operative technique might be safer for the fetus in regard to one aspect of fetal safety, that of cerebral compression.

METHOD AND MATERIAL

It was proposed to measure the amount of traction required to achieve vaginal delivery in 50 women, 25 to be delivered by obstetric forceps and 25 by the vacuum extractor.

The forceps used were the Luikart-Simpson type. Malmström's vacuum extractor was used with the 50-mm. suction cup; an average vacuum of 0.7 kg. of negative pressure per square centimeter was produced.[8] The amount of pull was determined by a spring gauge calibrated in pounds which was built into the body of a conventional Bill axis-traction handle.[12] This instrument was provided with a scale from which the amount of pull in pounds could be read directly. The Bill axis-traction handle was used for each delivery by attaching it to the forceps or vacuum extractor and employing intermittent pulls of approximately 15-sec. duration each. The maximum amount of traction force in pounds was recorded for each pull.

In an effort to make the 2 groups of patients as homogeneous as possible and to reduce the number of variables, certain criteria were established for selection of the women:

1. The patients were to be primigravida so as to equalize as much as possible the resistance of the vaginal outlet.
2. The women were to be at term by date and by fetal size estimation.
3. There were to be no maternal or fetal complications.
4. Conduction anesthesia was to be used routinely in an effort to avoid any expulsive efforts by the patients.
5. In every case the vertex was to be presenting in an occiput anterior position and located at a plus 4 to plus 5 station.
6. Mediolateral episiotomies were to be done on all patients prior to the initiation of traction.

RESULTS

The results are presented in Table 1. It will be noted that both the sizes of the babies and the number of pulls were similar in the 2 groups of patients. However, the average single pull was greater when forceps were used. This resulted in a total traction force for delivery by forceps approximately 40 per cent greater than by vacuum extractor.

DISCUSSION

There are two possible explanations of why less traction was required with the vacuum extractor. First, this instrument does not affect the diameter of the presenting vertex, whereas with forceps, the thickness of the blades increases the transverse diameter by 8 per cent. More pull is thus required to overcome the resultant additional resistance. Second, by virtue of its scalp traction, the vacuum extractor may be mechanically more efficient than the obstetric forceps and its malar eminence traction.

Thus, since cerebral compression is proportional to the amount of traction, this aspect of fetal safety would seem to be best served by the vacuum extractor.

However, that aspect of fetal safety involving skin trauma warrants careful scrutiny. The incidence of such complications in this study are listed on Table 2. The pro-

TABLE 1. AVERAGE TRACTION REQUIRED WITH FORCEPS OR VACUUM EXTRACTOR

Instrument	*No. of patients*	*Infant weight (gm.)*	*No. of pulls*	*Single pull (lb.)*	*Total traction (lb.)*
Simpson forceps	25	2977	2.5	27.2	67.5
Vacuum extractor	25	3232	2.3	17.0	38.8

TABLE 2. INCIDENCE OF SKIN TRAUMA

	Obstetric forceps	*Vacuum extractor*
Scalp ecchymoses	3 (12%)	25 (100%)
Scalp abrasions	0 (0%)	4 (16%)
Cephalic hematoma	1 (4%)	2 (8%)
Permanent small scalp mark	0 (0%)	1 (4%)

clivity of the vacuum extractor to injure the fetal scalp is well known. The frequencies of skin traumata in our series are consistent with those reported in the literature. The abrasions inflicted serve as a potential site for infection of the newborn. As a result, this implied threat to fetal safety by the vacuum extractor may possibly balance or even outweigh its suggested advantage of reduced cerebral compression. The final answer to the question of which facet of fetal safety is most important may be provided only by long-term follow-up of comparable groups of children delivered by these instruments.

SUMMARY

The amount of total traction force required for delivery with either the obstretic forceps or the vacuum extractor has been measured in 2 similar groups of 25 women. The fact that 40 per cent less pull was required with the vacuum extractor suggests that the aspect of fetal safety involving cerebral compression is best served by this instrument. However, this possible advantage of the vacuum extractor may be offset by the potentially dangerous traumata which it may inflict on the fetal scalp.

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