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Exploring the newborn head diameters in relation to current obstetric forceps' dimensions: A systematic review

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ABSTRACT

Objective: The aim of this study was to systematically search the literature for studies that reported term neonate head size and shape, in an attempt to determine the most appropriate dimensions for the obstetric forceps.
Study design: We searched the Ovid Medline, Ovid Embase and Ebscohost CINAHL databases from inception to February 2016. We predefined inclusion criteria to identify studies in which head width and length of asymptomatic, term neonates were measured soon after birth using direct, non-photographic methods A bespoke quality assessment score was used to evaluate the identified studies.
Results: Seven studies were identified which measured head width (biparietal diameter) in 551 neonates; giving a mean value of 94.0 mm (range 90.7 mm–95.5 mm). We identified one study which measured head length (mentovertical diameter) in 38 neonates; which gave a mean value of 134.5 mm (range 129 mm–139 mm).
Conclusion: This data, in conjunction with measurements of Neville Barnes' and Wrigley's forceps from our previous study, indicates current obstetric forceps' blades are too long, and close together. Potentially, this could be contributing to neonatal and maternal injuries associated with operational vaginal deliveries.

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Introduction

The Chamberlen family invented obstetric forceps in the 1600's, and since then there have been several hundred versions. Currently, the two most commonly used types in the UK are Neville Barnes' (NBF) and Wrigley's forceps (WF). The latter tends to be used to assist extraction of the head during caesarean section, while NBF (similar in design to the later produced Simpson forceps; more commonly used in the U.S.A.) are reserved for operative vaginal deliveries (OVD). Despite increasing rates of caesarean section and use of vacuum extraction devices, forceps still account for ~7% (1 in 14) of deliveries in England [1].

There are specific situations where OVD tends to be associated with better overall outcomes than caesarean section. A 1996 meta-analysis found that compared to caesarean section, women who delivered vaginally (with or without instrumental assistance) had lower anxiety and increased interaction with their babies, and were more likely to breastfeed [2]. These women also had shorter hospital stay and fewer readmissions [3,4]. Moreover, women who've avoided a previous caesarean section due to forceps assisted delivery are more likely to deliver vaginally, and also have reduced risk of intrapartum complications in future pregnancies [5,6]. Indeed, repeat caesarean section is one of the major factors implicated in the increasing rates of surgical delivery [7].

OVD is associated with several maternal and fetal complications. Compared to forceps, vacuum extraction devices are associated with less vaginal and perineal trauma, post-partum haemorrhage and 3rd and 4th degree tears (even in the presence of an episiotomy) [8–11], however results in higher rates of retinal haemorrhage, cephalhaematoma and subgaleal haemorrhage (incidence of 16/10,000 deliveries) [12–14]. Forceps have been linked to scalp lacerations, facial nerve palsy, corneal injury, skull fracture and cervical spine injury, however are also associated with less failure and quicker delivery than vacuum extraction, and hence still regularly used in several countries, e.g. the UK [15]. Nonetheless, given the above, many obstetricians prefer to use vacuum extraction devices than forceps, or perform caesarean

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sections rather than OVD deliveries in general, in fear of litigation, and the belief that these are safer options [14,16]. In the UK, according to the UK National Health Service Litigation Authority report, the total value of claims between 1st April 2000 and 31st March 2010 for OVD was £93,659,223 (approximately £10,000,000 annually) [12].

While some of the aforementioned complications might be inherent to the very process of OVD, or the fetal and maternal circumstances for which OVD was performed; we believe that in the case of forceps deliveries, some of these could be contributed to by their absolute dimensions (the interblade distance corresponds to biparietal diameter at 29–31 weeks' gestation), as well as the lack of standardisation in such dimensions between different pairs of forceps, which we have previously reported [17–19]. Therefore, the aim of this study was to systematically search the literature for studies that reported term neonate head size and shape, in an attempt to determine the most appropriate dimensions for the obstetric forceps.

Methods

We searched the Ovid Medline, Ovid Embase and Ebscohost CINAHL databases from inception to February 2016. A search of the Cochrane Database of Systematic Reviews yielded no relevant articles.

The search was designed to capture all articles relating to the measurement of the size or shape of the skull or cranium of the neonate regardless of population, gender, viability or morbidity. No limits in relation to study or publication type, language or date of publication were applied at the database searching stage.

We searched for the subject heading of Cephalometry (selecting the exploded subject) and combined this with a free text search of the terms; Cephalometry, Craniometry, Cephalometric analysis, head circumference measurement or cranial dimension in multiple database fields (including but not limited to) article title, abstract and keywords. We also searched subject headings relating to Anthropometry of the Skull or Head and combined this free text searches for Morphometrics or Morphometry (again combined with the subject headings for skull or head). Finally; subject headings for Infant; Newborn were searched and combined with free text term searches for Newborn or Neonate. These were added to the search to create a set of search results relevant to the research question.

The Medline search was adapted for use with other database (Appendix A: Supplementary Table 1). All references and available abstracts were downloaded into EndNote to allow for identification and removal of duplicate References

We were particularly interested in two dimensions; head width, or biparietal diameter – BPD (which should correspond to the interblade distance in the closed position), and head length (which should correspond to blade length). The most commonly used dimension for this was the mentovertical diameter, however, in older papers/textbooks the term occipitomental diameter (OMD) was used for the same parameter.

Our inclusion criteria were:

1) Data collection on term, healthy babies (i.e. not syndromic, or with head shape abnormalities, e.g. craniosynostosis)
2) Data collection on head shape/size other than only head circumference
3) Measurements made soon after birth (arbitrarily set at <48 h)
4) Measurements made by direct method (i.e. using an instrument such as calipers, as opposed to inferring from photographic or radiological methods)

We were aware that with older studies, measurements conducted after vaginal delivery may reflect an excessive degree of moulding not evident in current obstetric practice. Our initial aim was to exclude these studies, however taking into account the difficulty of determining a single date after which it was the norm for intervention in 'prolonged' labour, and the homogeneity between results of older and more recent studies, we decided against this.

We only included studies in which measurements were made soon after birth, since the head shape and size during this time are most likely to reflect that of the unborn baby at the time of applying forceps (i.e. included a degree of moulding). We did not limit our results by country, with the knowledge that anthropometric racial differences would result in a degree of variation of measurements, but this is reflected in the multicultural nature of British society.

Results

A total of 3983 records were identified through database searching (2779 Medline, 1135 Embase, 69 CINAHL) and reduced to 3199 following removal of duplicates. Each title and abstract were assessed by two independent reviewers (AQI and JC) and full articles of all references that were likely to fulfill predefined inclusion criteria were obtained. Any discrepancies were referred to a third party (KMI) for final decision. Full texts of the chosen articles were again assessed by two independent reviewers (AQI and JC) against the same inclusion criteria to obtain a final list. Of the 3199 references identified by database searching, 57 were determined to be of relevance. Fifty of these were later excluded for different reasons (Fig. 1), leaving 7 studies that were suitable for data extraction. The quality of included studies was assessed using a bespoke quality assessment scoring system (given the lack of a suitable alternative), including relevant criteria for assessing the accuracy and reliability of newborn head measurements [Table 2]. This included mode of delivery, and delay from birth to measurement (loss of impact of head moulding); number of investigators conducting measurements (interoperator variability); and whether any methods were used to assess the accuracy and reliability of measurements (e.g. repeated, or checked by second investigator). This scoring system was not validated, however, no studies were excluded based on the quality score.

Data on head width were available from 7 studies, involving 551 neonates [20–26]. The included studies were from Africa, Europe, UK and USA, and their dates ranged from 1962 to 2009. Four studies specified the type of delivery in their inclusion criteria, and this included caesarean section (elective, or all) and vaginal delivery [20,22,25,26]. In three of the studies measurements were made within 3 h of birth [20,24,26], in one study it was within 24 h of birth [22], and within 48 h in the remaining three studies [21,23,25]. Taking into account the number of measurements in each study, we calculated a mean BPD of 94.0 mm (range 90.7 mm–95.5 mm, SD 1.65) [Table 1]. We identified only one study which measured head length, in 38 babies [26]. The study population was from the US, from 1977. The type of delivery was vaginal and elective caesarean section, and measurements were made within one hour of birth. They found a difference of 10 mm between the two types of delivery, but, given the very small sample size – 23 born by vaginal delivery, 15 by elective caesarean section – it is doubtful there was sufficient power to identify significant differences, and as such we only included an averaged figure of 134.5 mm [Table 1].

Discussion

Our findings in light of what is already known

The mean BPD calculated in this study (94 mm) is near the lower margin for the 50th centile BPD values for term fetuses (37–

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