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Does intra-uterine environment influence fetal head-position preference?☆ A comparison between breech and cephalic presentation

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Abstract

Background: Cephalic fetuses have increasing lateralised head-position near term.
Aim: Is this development affected by breech presentation?
Subjects and methods. Fetal head-position was studied longitudinally in 13 healthy fetuses in breech presentation and 10 healthy fetuses in cephalic presentation by means of real-time ultrasound. Recordings were obtained weekly from 33 weeks gestational age until birth.
Results: As in previous research, a significant (p=0.045) decrease in midline head-position was found for the cephalic fetuses with advancing gestational age. The development of a lateralised head-position preference was clearly less outspoken in the breech fetuses when compared to the cephalic ones, especially after 36 weeks gestational age. Furthermore, as cephalic fetuses showed a preference for a right-sided head-position, breech fetuses that did show a lateralised head-position did not have a clear preference for left or right. Our data show an association between the orientation of the fetal vertebral column and head-position predominance in the

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group of cephalic fetuses, which complies with Previc's left-otolithic dominance theory. No association could be detected between fetal head shape and head-position preference.
Conclusions: This study shows evidence that development in head laterality is influenced by the breech presentation. The discussion addresses possible explanations for the differences we found between the breech and cephalic fetuses.

1. Introduction

Since Gesell's [1] observation in the late 1930s of a right-sided head-orientation preference in supine healthy human newborns, there has been increasing interest in and knowledge about this early manifestation of lateralised behaviour and its relation to further motor development. The observation that postural biases are already present in infants within 1 h after birth [2] strengthens the idea that the origin of these asymmetries must be prenatal. There are various theories offering explanations for laterality-development that can roughly be divided into two major categories: the nature and the nurture theories. The nature theories emphasise a genetic basis for laterality, the latter focus on environmental influences. A general theory explaining all major aspects of the phenomenon of functional lateralisation is, however, still not available.

The left-otolithic dominance theory [3] about the origins of cerebral lateralisation in humans is based on the asymmetric prenatal environment experienced by the fetus. About 2/3 of cephalic fetuses have their backs to the left side of the mother in the third trimester of pregnancy. This is a result of the fact that the pregnant uterus tends to have a torsion to the right, leaving more room for the head and body of the fetus on the left side. This, in combination with the fact that the fetal head is thought to be in a rather fixed position because of its engagement in the bony maternal pelvis in the final weeks of pregnancy, leads to an unequal shearing of the hair cells in the left and right fetal otoliths during maternal walking. This will result in left-otolithic dominance for most fetuses. Fibres from the vestibulospinal tract innervate the ipsilateral sternocleidomastoid muscle and a left-otolithic dominance will thus be related to a left-sided bias in activation of this muscle. This, in turn, will lead to a turning of the head to the right for the majority of fetuses.

Ververs et al. [4] found a change from a midline to a lateralised—mostly right-sided—head-orientation preference in healthy cephalic fetuses between 30 and 38 weeks gestational age.

The breech fetus offers the possibility to study the influence of environmental (intra-uterine) factors on the development of head laterality. By studying this group of fetuses we have the opportunity to test the left-otolithic dominance theory. On the one hand, presuming that the majority of breech fetuses also have their backs to the left side of the mother in the last trimester of pregnancy, this theory would predict the mirrored behaviour of that observed in fetuses in cephalic lie. Thus a dominance not for the left, but for the right sternocleidomastoid muscle, leading to a preferred head-orientation to the left for most breech fetuses. On the other hand, breech fetuses could have more freedom of head movement than cephalic ones, because their head is positioned at the upper side of the uterus instead of it being engaged in the bony maternal pelvis at the end of pregnancy. This could lead to a less pronounced difference in stimulation between the left and the right otoliths and thus to a weaker manifestation of lateralisation.

Breech babies are known to have a mild skull deformation called dolicocephaly, which comprises of a long occipitofrontal diameter, a parallel-sided head and elongated face and a prominent occiput with a suboccipital shelf [5]. Side-to-side flattening of the skull, as is probably increased in preterms by lying with the head to one side on the hard incubator mattress, has been shown to influence the development of head lateralisation [6]. By looking at the relation between skull shape and head-position preferences in our study population, we can determine if anthropometric factors have an influence on the development of head lateralisation before birth.

This article describes the development of head-orientation preference in healthy breech fetuses in comparison to healthy cephalic fetuses. Since we do not know how long a fetus has to be in breech presentation before any effect on the development of lateralisation can arise, we include only those fetuses of which we are sure that they have been in breech presentation from 33 weeks gestational age onwards. The questions addressed in this paper are: 1. How does head-position preference develop in breech fetuses? 2. Is the development of head-