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Developments of specific movement patterns in the human fetus

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Summary

Studies on animals have shown that spontaneously generated motility is a naturally occurring phenomenon in embryos and fetuses and that the development of motor activity reflects the prenatal development of the nervous system. It was very difficult to carry out similar studies in humans for a long time because direct observation of fetal motility could only take place after a termination of the pregnancy or with the use of techniques for intrauterine observation which endangered the fetus. Now that ultrasound technology has achieved a high degree of safety and perfection it is possible to accurately study human fetal motor development. This applies to both qualitative (differentiation into the various movement patterns and performance of the movements concerning the speed, force and amplitude) as well as quantitative (incidence of movements) aspects of the movements throughout the whole pregnancy (Chapter 1).

In a history of the investigations which have led to the present understanding of fetal motility, attention is focussed on both the changes in observation techniques and on the means of judging motility. Some of the questions which are discussed are: does the fetus move spontaneously or only after exogenous stimulation and is there a similarity between pre- and postnatal motility (Chapter 2)?

Extensive studies on ultrasound show that no biological effects on the fetus have, to date, been found for the type of ultrasound employed nowadays and with the applied norms of exposure (Chapter 3).

In order to study the development of fetal motility the fetuses of three groups of pregnant women were observed. The ultrasound images were taped on video for a period of one hour and analysed at a later stage. Details of the subjects and methods are given in Chapter 4. In a first group, 12 fetuses were observed weekly from 7 to 15 weeks until birth (Chapters 5, 6 and 7). In a second group, the motility was studied during the morning, afternoon and evening of one day in 7 fetuses at 13 weeks and 10 fetuses at 20 to 22 weeks of gestation. Moreover, the fetal heart rate was recorded at 20 to 22 weeks for a period of 24 hours (Chapter 8). A third group which was investigated consisted of 8 fetuses with anencephaly. Observations were made to see if a relationship could be found between their abnormal movements and the structure of the nervous system as found at post-mortem (Chapter 9).

Qualitative analysis of the movements in the first group shows the surprisingly early differentiation of distinct movement patterns between 7 (5 weeks after conception) and 15 weeks of gestation. There is no period with non-specific movements prior to the emergence of the specific movement patterns. The various movement patterns remain recognizable throughout gestation. They resemble the movements of the neonate to such a degree that the existing classification of normal neonatal motility could be applied to the description of fetal motility. A variety of movement patterns exists from 15 weeks of gestation onwards: general movements (the whole body can participate, always coordinated, varying in force, speed and amplitude); "startles" (quick jerky

movements initiated in arms and legs); breathing movements; hiccups; isolated movements of head, arms, legs, fingers; hand-face contact; sucking and swallowing; yawns; stretches (Chapter 5).

The incidence of the various movement patterns varies a great deal per observation period. The movement patterns do, however, display certain tendencies in the course of the pregnancy or at least from 7 to 20 weeks of gestation. After that, the fetus cannot be viewed satisfactory for the various movements to be quantified accurately (Chapter 6).

Inter- and intra-fetal differences and consistencies are discussed. Two fetuses show differences in their total motor activity and general movements, compared with the group of 12 fetuses (one fetus more and one less active). This is not found to be the case with the other movement patterns. The specific movements of each fetus have been rank ordered from high to low incidence. The rank orders are strictly age dependent and very similar for each fetus at the various gestational ages (Chapter 7).

The study on motility in the second group which was carried out at three different times of the day shows that no differences in activity over the day are found at 13 weeks. At 20 to 22 weeks fetal motility, as well as fetal heart rate and heart rate variation change during the day. These differences are also present at the end of gestation where they are even larger (Chapter 8).

Fetuses with anencephaly have been found to have qualitatively abnormal motility (too forceful, too jerky, too large an amplitude). Changes in the incidence of the movements are, however, also found. The severity of the change of the movements seems to be related to the degree of abnormality found in the nervous system (Chapter 9).

Chapter 10 is concerned with the question of whether the ultrasound images of the fetus evoke a reaction in the parents. This seems to be the case. The question remains, however, as to whether the parents are influenced positively or negatively in their relationship towards their child and if this has a longlasting effect.

In Chapter 11 the question arises as to whether enough knowledge has been acquired from the investigations to allow recognition and judgement of the motility of any fetus with a normal development. It was concluded that it seems to be possible to recognize the normal development of the motor output of the developing nervous system. Moreover, the specific characteristics of normal motility enable its application for clinical use. Adequate knowledge of fetal activity and especially of inactivity prevents false interpretations.

Some of the present ideas of the development of fetal motility are discussed in Chapter 12. It seems plausible that movements appear as soon as neural and muscular structures are present. Most movement patterns have no clear prenatal function but are likely to be precursors of postnatal functions. The exceptions are discussed.

The results of the investigation provide a foundation for normative data of fetal motor development and thus an important means of assessing the actual condition of the fetal nervous system. First observations of the motility of fetuses in non-optimal intrauterine circumstances, reveal that the performance of the various movement patterns change at an earlier stage than the amount of movements.