



Does a parent-administrated early motor intervention influence general movements and movement character at 3 months of age in infants born preterm?



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ABSTRACT

Background: Studies of preterm and term-born infants have shown absent fidgety movements and an abnormal movement character to be related to brain lesions and unfavourable neurological outcomes.

Aims: The present study examines what effect a parent-administered early intervention program applied to preterm infants in a randomised control trial (RCT) between 34 and 36 weeks gestational age has on their fidgety movements and overall movement character at three months of age.

Study design: The study was part of the RCT in an early intervention programme including preterm infants born between 2010 and 2014 at three Norwegian university hospitals.

Subjects: 130 preterm infants participated in the study, with 59 of them in the control group and 71 in the intervention group.

Outcome measures: Fidgety movements and overall movement character at three months corrected age.

Results: No difference was found between the intervention group and the control group in terms of fidgety movements or movement character. Approximately half of the infants in both groups showed an abnormal movement character.

Conclusion: No evidence was found in this RCT to suggest that an intervention at 34 to 37 weeks gestational age has a significant effect on the fidgety movements or overall movement character of preterm infants. This is in line with the assumption that absent fidgety movements and an abnormal movement character are due to permanent brain injury and are therefore good predictors for later neurological impairments.

1. Introduction

Twenty years ago the authors of a study published in The Lancet [1] concluded that the quality of so-called general movements (GMs), i.e. spontaneous motor activity in early infancy, indicates whether or not infants require early intervention against neurological abnormalities. Several subsequent studies on fidgety movements (FMs), i.e. GMs at three months of age, have proved absent FMs or present sporadic FMs to be valid predictors of later neurological impairment, mostly in the form of cerebral palsy (CP) [2–7]. After GMs were found to be an effective reference for the functional assessment of the developing nervous system [8], a method of GM evaluation known as General Movement Assessment (GMA) [8–10] was developed, which has since been

frequently used in studies on prognoses of neurological outcomes [1–3,11]. Studies of preterm- and term-newborns and young infants have shown that abnormal GMs can be related to brain lesions and unfavourable neurological outcomes [8,12–14]. Abnormality of the overall movement character is also a reasonably good predictor of later cognitive and/or motor outcomes [15–17]. Interestingly enough, an abnormal movement character at three months of age seems to be a common finding in term-born infants, even though most of them go on to develop a normal motor repertoire [18].

Over the years, GMA has become a major tool for predicting neurological impairment and is widely used in follow-up programs for infants with increased risk of adverse neurological outcome. When combined with results of early magnetic resonance imaging (MRI),

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GMA is arguably the most reliable predictive tool available [2,19,20]. However, as far as we know, there are no reports in medical literature of using GMA as an evaluative tool in a motor intervention trial.

Studies have shown that early intervention can help the brain to reorganize aberrant signal patterns and optimise motor development in infants born preterm [21,22]. Clinical effects of early intervention have been hard to identify in randomised controlled trials (RCTs). Three systematic reviews were published very recently aiming to identify effective kinds of interventions for specific outcomes at specific ages [2,23,24]. One review indicates that dosing is critical for effectiveness and that multifaceted interventions may be the best option for a child and family, although no significant differences were documented in RCTs included in that review [23]. Another systematic review of 34 studies including 10 RCTs reports promising evidence that early intervention (defined as between birth and two years of age) which involves child-initiated movement, parental education and environmental modification has a positive effect on motor development [25]. In a meta-analysis of 36 trials (25 randomised, 11 non-randomised), motor-specific interventions yielded positive effects at three, six, twelve and 24 months. The effect was most obvious in specific motor components at three months [24]. A new RCT shows that early intervention at 34 to 36 weeks postmenstrual age (PMA) has an effect on the motor function as compared with controls assessed by Test of Infant Motor Performance (TIMP) immediately after the intervention, at 37 weeks PMA [26]. However, TIMP and GMA do not assess the same movement qualities and specific effects of intervention on general movements has never been analysed in a RCT setting.

The strong predictive power of absent fidgety movements with respect to later neurodevelopmental outcomes indicates that the absence of FMs is a consequence of permanent brain lesions that influence the function and integrity of the subplate and its neural connections during fetal life [27]. Early intervention is therefore unlikely to influence the quality of FMs or the movement character even if an effect on other motor functions is demonstrated in other tests like TIMP or the Bayley Scales of Infant and Toddler Development (BSID) [24,26]. On the other hand, if fidgety movements or the overall movement character can be modified by intervention, this may indicate that other, more complex mechanisms are involved in generating general movements at three months of age, which would also affect the predictive ability of GMA.

The aim of this study was to examine what effect a parent-administered early intervention programme applied to preterm infants in a RCT [26] at 34 to 36 weeks gestational age has on their fidgety movements and the overall movement character at three months of age. A possible effect of the intervention on GMs at three months could be relevant for predicting an altered outcome at two years of age, given a strong predictive ability of GMA. The results presented here constitute the second report from ClinicalTrials.gov NCT01089296. The first report was published in *Pediatrics* 2016 [26].

2. Methods

2.1. Study design and intervention

The present study was part of a multicentre RCT on the effect of an early intervention programme for infants born between March 2010 and October 2014 at the University Hospital of North Norway, the Trondheim University Hospital, and the Oslo University Hospital. A description of the study design was previously published [28]. The purpose of the RCT was to evaluate the effect of customized physiotherapy on preterm infants' motor development. Performed by parents during a period of three weeks while their infants resided at the NICU, the intervention integrated key elements from the modified version of the Mother-Infant Transaction Program as well as elements from interventions in other studies that have shown a positive effect on preterm-born children's motor development [28]. The main principles of intervention were to promote symmetry and midline orientation in

different positions while supporting the child's own activity. The handling and motor stimulation was carried out according to Girolami and Campbell [29] and the social interaction between the parent and the infant as described by Kaarensen et al. [30]. Postural support was given to facilitate the infant's midline orientation as a base for social interaction and for increasing the infant's variation of movements. Each infant performed at least one activity in each of the following positions: prone, side-lying, supine, supported sitting, and in transition between positions. A detailed list of 15 activities has been published [28]. Examples of parental intervention include activating neck flexors, shoulder and abdominal muscles, assisting the child to bring their arms forward and guiding them from supine to upright sitting. The intervention was individualized based on the infant's level of development and tolerance for movement. The parents were taught to support and facilitate activity and to adapt their support to the infants' response. They were given a booklet with photos and written descriptions of activities implemented in different positions. Intervention time was limited to 10 min twice a day at 34, 35 and 36 weeks PMA. The intervention was stopped if the infant's behavioural state did not allow intervention – i.e. if they were fussing, falling asleep, hungry, or showed signs of stress. The parent kept a daily log to record the time and duration of intervention. The motor development of all infants was assessed at regular intervals between three and 24 months corrected age, including videos recordings of their GMs. The final endpoint of the study is motor development at 24 months corrected age.

2.2. Study population

Preterm-born infants with a gestational age ≤ 32 weeks were eligible for the study. Gestational age determination was based on the second-trimester routine ultrasound. Exclusion criteria were triplets or higher plurality, major malformations and recent surgery. Information on birthweight, sex and results of cerebral ultrasound investigation was collected from the medical records.

2.3. Video recording and assessment of fidgety movements and overall movement character

Video recordings followed the procedure described by Einspieler et al. [9]. Assessment of video recordings was carried out by three certified and experienced paediatric physiotherapists blinded to the infants' clinical histories. First, fidgety movements were assessed independently by each observer. Then the overall movement character was assessed by the same observers by replaying the videos. Based on additional evaluations, a consensus was reached in cases of disagreement.

To verify sufficient inter-rater reliability in the assessment of present and absent fidgety movements, inter-rater agreement was identified by means of Cohen's kappa. Cohen's kappa is a statistical measure used to determine inter-observer agreement taking into account agreement by chance [31].

Fidgety movements are classified as present or absent. If fidgety movements are present, they are interspersed with pauses. According to the duration of these pauses, the temporal organisation of fidgety movements can be classified as continual (F + +), intermittent (F +) or sporadic (F +/–). If fidgety movements are exaggerated, they are classified as abnormal (AF) [9,32]. In our study we classified fidgety movement as present when continuous or intermittent, and as absent when sporadic or absent. “Movement character” refers to the fifth subcategory in the “Assessment of Motor Repertoire – 3 to 5 months” [9]. It was classified as normal or abnormal. A normal movement character was smooth and fluent; abnormal movements were monotonous, jerky and stiff and could be slow or fast [33]. The fifth subcategory, the global score of “Movement character”, was assessed because this item has previously been shown to be predictive of later motor and cognitive outcomes [16]. The motor optimality score of the

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