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# General movement assessment and motor optimality score in extremely preterm infants



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## ABSTRACT

Studies on general movement assessments (GMs) have included small numbers of extremely preterm (EP) infants. We determined the GMs and motor optimality score (MOS) of 40 EP infants. Poor repertoire at writhing age normalising to fidgety movements was the most common finding. MOS was lower than for published term infants.

## 1. Introduction

The assessment of the quality of the general movements (GMs) in early infancy can be used to detect infants at risk of developing neurologic impairment [1–3]. Observation of the quality of GMs of preterm and term infants can provide information on likely future motor function, in particular cerebral palsy [4,5]. The advantage of using this assessment tool is that detection at an early age offers the opportunity for early intervention therapies to be instituted with the aim of improving the long term outcome for these children [6]. There is an increasing awareness of this assessment and calls for it to be more widely used [6,7].

Preterm infants have an increased risk for neurodevelopmental problems [8,9]. The standardized assessment of GM quality in high-risk infants has been shown to be a useful prognostic tool for identifying infants who will develop long term neurodevelopmental problems, in particular cerebral palsy [2,10]. GM assessments have been shown to be more sensitive and specific than detailed neurologic examination of infants or head ultrasound findings at predicting cerebral palsy [11]. GM assessment has been shown to have similar sensitivity and specificity as term corrected age MRI to predict preterm infant's neurologic outcome [3,12]. Preterm infants have been reported to have higher rates of abnormal GMs at the term equivalent age than term infants [13,14]. However, most of the preterm studies on GMs have included small numbers of extremely preterm infants [12] and thus the developmental trajectory of GMs in extremely preterm infants has not been well described.

The assessment of motor repertoire (through the motor optimality score, MOS) is an assessment describing the quality and quantity of the

concurrent motor repertoire noted during GM assessment [15]. The concurrent motor repertoire includes other movements that co-occur with fidgety movements such as kicking, hand to face contact, foot to foot contact, leg lift and visual scanning. An abnormal concurrent motor repertoire in preterm infants with fidgety movements has been shown to be associated with later impaired cognitive and motor outcomes in preterm infants [16]. This assessment has not been widely reported in extremely preterm infants.

This prospective pilot study from a single centre, King Edward Memorial Hospital (KEMH) describes the GMs and MOS in extremely preterm infants born less than or equal to 25 completed weeks of gestation.

## 2. Method

### 2.1. Subjects

Premature infants born with a gestational age less than or equal to 25 completed weeks of gestation admitted to the neonatal intensive care unit (NICU) and who lived in the metropolitan area were invited to join the study. KEMH is the sole tertiary neonatal hospital for the state of Western Australia (WA). WA is a vast state with an area of 2.646 million km<sup>2</sup>.

After informed consent was given by the parents the infants were videoed at approximately term age for assessment of writhing GMs and at 10–20 weeks for fidgety movements. All videos were performed at KEMH.

Infants were excluded if they lived in regional or remote WA due to the vast distances parents would need to drive to return to KEMH for

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the videos. Other excluded infants were those who died before the videos could be performed and infants whose parents refused consent.

As this was a pilot study, 40 infants were planned to be recruited to the study. This number was chosen as it was thought to be feasible to recruit in 1 year.

The study was approved by the Human Research Ethics Committee of KEMH with approval number 2013022EW.

## 2.2. Procedure for videos

Infants were videoed for GM assessment at approximately term age and again at 10–16 weeks post term age, either as an inpatient or as an outpatient. The videos used a standardized procedure. Infants were videoed supine, wearing minimal clothing, lying on a plain white sheet. At term age they were in a large cot with nesting boundaries removed so that all limbs were freely able to move. The recordings were for 30 min and were timed so that the infant was awake. At 10–16 weeks post term they were videoed on a mat on the floor covered with a white sheet for 10 min. A digital camera was placed high above a cot or mat so that the infant did not fixate on the camera. A member of the study team was present for the recordings.

## 2.3. Procedure for General Movement assessment

At term age the GMs on the video were assessed using the Precht's qualitative assessment and classified as normal or abnormal depending of the presence of fluency, complexity and variability [8]. Abnormal writhing movements were further classified as poor repertoire, cramped synchronised or chaotic [17].

At 10–16 weeks the GM's were assessed for the presence or absence of fidgety movements [8].

The videos were assessed by all three members of the study team and any differences were resolved through discussion. Two of the assessors (AC and NA) had completed the advanced GM's certification from the General Movement Trust and MS had completed the basic certification.

The team was involved in the clinical care of the infants and was aware of the infant's neonatal course including imaging.

## 2.4. Procedure for assessment of motor repertoire

An optimality score (OS) of motor repertoire was calculated at writhing age [18]. The OS is calculated from the following categories: Quality (max 4 points), sequence (max 2 points), amplitude (max 2 points), speed (max 2 points), space (max 2 points), rotary components (max 2 points), onset and offset (max 2 points), tremulous movements (max 2 points).

An assessment of motor repertoire was made and a motor optimality score (MOS) was derived from the fidgety age video [15,19]. There are 5 categories to the score. These are fidgety movements (max 12 points), repertoire of co-existent other movements (max 4 points), quality of other movements (max 4 points), posture (max 4 points) and movement character (max 4 points). The category scores are added to a max of 28 points.

The OS and MOS were scored by AC and NA who had training through the advanced GM course.

## 3. Results

As planned, 40 infants were recruited in 13 months. The median gestation was 24 weeks and 3 days (range: 23 weeks to 25 weeks and 6 days). The birthweight median was 693 g (range: 484 g to 1015 g). There were 11 female infants and 29 male infants.

Videos were performed on 40 infants at term writhing age and 38 at the fidgety age. Two infants were lost to follow up for the fidgety age

## 3.1. Reliability

Inter-rater reliability was 100% for normal/abnormal classification at fidgety age between the 3 investigators, and 98.5% at term writhing age. There was 1 case at term age where there was disagreement between the investigators over normal/abnormal classification. Two of the investigators felt the infant had poor repertoire and 1 thought the infant was normal. The overall decision was to class the infant as poor repertoire.

Intra-observer reliability was done by MS on 10 videos randomly selected. The assessment of GMs was repeated more than 4 months after the first assessment. There was 100% concordance between the original and repeated assessments for normal and abnormal classification.

For the motor optimality scoring there was agreement between the 2 scorers in 34 out of 38 cases (90%). Scores differed by 1 in 4 out of 38 cases (10%). Where a difference occurred the higher score was used.

## 3.2. Writhing age

The videos were taken between 37 and 46 weeks 6 days post menstrual age, with a median age of 40 weeks. Normal writhing movements were seen in 9 (22.5%) infants, 24 (60%) had poor repertoire and 7 (17.5%) had cramped synchronised movements. No infant had chaotic movements. Bilateral leg extension with lift was seen in all infants.

The median OS was 12 (range from minimum of 8 to maximum of 18).

2 infants were lost to follow up,

## 3.3. Fidgety age

The fidgety age videos were taken between 10 and 16 weeks post term age, with a median age 13 weeks. There were 38 videos available to review. There were 33 (87%) with normal fidgety movements and 5 (13%) infants with absent fidgety movement. Of the 5 infants with absent fidgety movements all had cramped synchronised movements at term corrected age. No infants showed the bilateral leg lift that was present at writhing age.

The median MOS was 22 (range from 6 to 28). Of the 33 infants with normal fidgety movements only 6 had the highest score of 28. Infants with absent fidgety movements had optimality scores between 6 and 11. Details of the MOS are shown in Table 1. The most predominant postural abnormality was body and limbs "flat" on surface which occurred in 29 out of 38, followed by extended arms on surface in 9 out of 38 and extended legs on surface in 6 out of 38.

Details of the components of the motor optimality score are shown in Table 1.

**Table 1**  
Motor optimality score.

Motor optimality list	Score	N (%)
Fidgety movements	Normal	34 (87)
	Exaggerated	0
	Absent	5 (13)
Repertoire of coexistent other movements	Age adequate	10 (26)
	Reduced	19 (48)
	Absent	10 (26)
Quality of other movements	Normal > Abnormal	36 (92)
	Normal = Abnormal	0
	Normal < Abnormal	3 (8)
Posture	Normal > Abnormal	17 (44)
	Normal = Abnormal	11 (28)
	Normal < Abnormal	11 (28)
Movement character	Smooth and fluent	9 (23)
	Abnormal, not cramped-synchronised	27 (69)
	Cramped synchronised	3 (8)

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