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# The effectiveness of training in Prechtl's method on the qualitative assessment of general movements

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**KEYWORDS**
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**Abstract**

*Background:* Prechtl's method on the qualitative assessment of general movements (GMs) is a highly sensitive and specific diagnostic tool for the assessment of the integrity of the young nervous system.
*Aim:* To find out whether the ability to assess GMs correctly could be gained after receiving a few days' standardised training.
*Study design:* We evaluated 700 scoring sheets (containing a total of 8019 assessments) from the final tests of 18 training courses held between 1997 and 2002.
*Results:* Eighty-three per cent of the assessments were correct after completing a 4- to 5-day training course. The correct discrimination between normal and abnormal GMs was 92%. It proved more difficult to assess infants correctly if they had been recorded around term age.
*Conclusion:* Standardised training courses enable professionals in the field of infant and child neurology to apply Prechtl's method of GM assessment accurately.


## 1. Introduction

Prechtl's method on the qualitative assessment of general movements (GMs) has proven to be an objective, reliable and valid technique for the functional assessment of the young nervous system [1—3]. GMs are the most frequently occurring, long-lasting and complex pattern of the foetal and neonatal motor repertoire and can be observed up to 5 months postterm age (PTA) [3]. While

*Abbreviations:* CS, cramped-synchronised; GMs, general movements; FMs, fidgety movements; PMA, postmenstrual age; PR, poor repertoire; PTA, postterm age.

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involving the whole body in a variable sequence, GMs wax and wane in intensity, force and speed. Rotations and often slight changes in the direction of the movement make the movement elegant, complex and variable [4]. GMs have an age-specific pattern. Preterm (or foetal) GMs are followed by writhing GMs around term. Writhing movements gradually disappear at 8 to 9 weeks PTA and are replaced by GMs that appear fidgety [3,5]. Fidgety movements (FMs) are of small amplitude, moderate speed and variable acceleration of neck, trunk, and limbs in all directions [3,6]. They normally occur from 3 to 5 months PTA.

Recognition of the significant clinical relevance of GM assessment led to a growing number of requests for training in the method. To meet this demand, training courses in Prechtl's method on the GM assessment have been provided since 1993. In 1997, the GM Trust was founded and the training procedure was standardised along the lines of a strict protocol. Although a number of studies have reported on the inter-observer agreement for the GM assessment [1,4,7—23] the question was never raised whether a few days' training was sufficient to enable professionals in the field of infant neurology to apply Prechtl's method accurately. The inter-observer agreements reported on so far were obtained from experts in the field of GM assessment [7—14,16—23] or from doctors, students and nurses untrained in GM assessment [4,15,25]. The standardised GM Trust training courses enabled us to evaluate the effect of this training. The specific questions we addressed were: How often are GMs correctly assessed after a few days of training? Is the number of correct assessments in agreement with objectivity data reported previously? Are some GM patterns more difficult to assess than others?

## 2. Methods

From 1997 to 2002, 18 courses were offered under the auspices of the GM Trust. A total of 700 experts in the field of infant and child neurology (child neurologists, neuropaediatricians and paediatricians, neonatologists, occupational- and phy-

**Table 1** Age at time of recording and the quality of GMs of 25 cases whose video recordings were used for the different test tapes

| Case | Age (weeks) | GM quality | Number of assessments | Correct assessments | Correct discrimination N versus A |
|---|---|---|---|---|---|
| 1 | 29 PMA | N | 224 | 189 (84%) | 189 (84%) |
| 2 | 32 PMA | PR | 473 | 342 (72%) | 441 (93%) |
| 3 | 32 PMA | PR | 223 | 202 (91%) | 210 (94%) |
| 4 | 34 PMA | Ch | 224 | 216 (96%) | 221 (99%) |
| 5 | 35 PMA | N | 474 | 436 (92%) | 436 (92%) |
| 6 | 36 PMA | CS | 472 | 437 (93%) | 472 (100%) |
| 7 | 36 PMA | N | 472 | 427 (90%) | 427 (90%) |
| 8 | 38 PMA | CS | 224 | 172 (77%) | 218 (97%) |
| 9 | 40 PMA | N | 224 | 209 (93%) | 209 (93%) |
| 10 | 3 PTA | CS | 473 | 303 (64%) | 466 (99%) |
| 11 | 3 PTA | PR | 134 | 59 (44%) | 64 (48%) |
| 12 | 4 PTA | PR | 473 | 377 (80%) | 402 (85%) |
| 13 | 6 PTA | PR | 402 | 306 (76%) | 365 (91%) |
| 14 | 6 PTA | PR | 224 | 141 (63%) | 202 (90%) |
| 15 | 9 PTA | AF | 157 | 90 (57%) | 126 (80%) |
| 16 | 11 PTA | N | 697 | 650 (93%) | 650 (93%) |
| 17 | 12 PTA | AF | 473 | 341 (72%) | 420 (89%) |
| 18 | 12 PTA | F— | 474 | 429 (91%) | 470 (99%) |
| 19 | 12 PTA | N | 290 | 262 (90%) | 262 (90%) |
| 20 | 12 PTA | N | 25 | 18 (72%) | 18 (72%) |
| 21 | 13 PTA | N | 292 | 249 (85%) | 249 (85%) |
| 22 | 14 PTA | F— | 224 | 190 (85%) | 196 (88%) |
| 23 | 15 PTA | F— | 223 | 214 (96%) | 221 (99%) |
| 24 | 16 PTA | AF | 224 | 198 (88%) | 200 (89%) |
| 25 | 17 PTA | N | 224 | 219 (98%) | 219 (98%) |
| Total | | | 8019 | 6676 (83%) | 7353 (92%) |

The percentages of correct assessments as well as correct discrimination (normal GMs versus abnormal GMs) are given.
N, normal; A, abnormal; PMA, postmenstrual age (weeks); PTA, postterm age (weeks); PR, poor repertoire of general movements; Ch, chaotic general movements; CS, cramped-synchronised general movements; AF, abnormal fidgety movements; F—, absence of fidgety movements.

siotherapists) participated. The duration of the courses varied from 3.5 to 5 days. At the end of a course the trainees' ability to assess GM patterns was tested by playing a test video tape showing 10 to 12 cases twice. The trainees had to fill in their assessment on a score sheet. These score sheets containing a total of 8019 legible assessments formed the data base for the present study.

Video sequences of 25 different infants have been used to guarantee variation of the test tapes over the years. The sequences were of comparable recording quality and lasted 1:30 min each. All infants were videotaped with informed consent of the parents and according to the standards set by the local research ethics committee. Each infant serving as a test case had to be assessed independently and a 100% agreement was required among the seven licensed GM Trust trainers. Seven infants had to be assessed for their preterm GMs (age: 29 to 36 weeks PMA); another seven infants for their writhing GMs (age: 38 weeks PMA to 6 weeks PTA); and another 11 infants, aged 9 to 17 weeks PTA, for their FMs. Nine infants had normal age-specific GMs and sixteen were considered abnormal: six had poor repertoire (PR), three infants had cramped-synchronised (CS) and another one chaotic GMs; three 3- to 5-month-olds had abnormal FMs and the remaining three had no FMs (Table 1). 'Correct assessment' was defined as the agreement (in %) between trainees and trainers. In addition, the ability to discriminate correctly between normal GMs and abnormal GMs was calculated. In this case the trainees correctly identified abnormal GMs, but failed to identify the subcategory (PR versus CS versus chaotic GMs; abnormal FMs versus absence of FMs).

For data analysis we used Cohen's Kappa ($\kappa$), Chi-square ($\chi^2$) test, and a linear regression analysis. SPSS 11.0 was used. A value for $p<0.05$, two-tailed, was chosen to indicate statistical significance.

**Table 3** The percentage of correct assessments of the 25 test tape infants

| | Correct assessment (%) | Correct discrimination: normal versus abnormal (%) |
|---|---|---|
| Preterm GMs | 88 | 94 |
| Writhing GMs | 73** | 89 |
| Fidgety GMs | 87 | 92 |

GMs, general movements.
** $p<0.01$.

## 3. Results

The number of correct assessments for each case is given in Table 1. In total 83% were correctly

**Table 2** Kappa values ($\kappa$) and interscorer agreement (%) of trained and untrained observers participating in various studies dealing with Prechtl's method on the qualitative assessment of GMs

| | Number of observers | Specific training in GM assessment | Number of infants assessed | Interscorer agreement or $\kappa$ |
|---|---|---|---|---|
| Prechtl [4] | 10 | No | 20 | 90% |
| van Kranen-Mastenbroek et al. [25] | 4 | No | 30 | $\kappa=0.84$ |
| Geerdink and Hopkins [14] | 3 | Yes | 35 | 87% to 93% |
| Albers and Jorch [15] | 8 | No | 22 | 67% to 99% |
| Einspieler[a] [16] | 1 | Yes | 20 | Test–retest reliability 85% |
| Bos et al. [8] | 2 | Yes | 19 | $\kappa=0.92$ |
| Bos et al. [17] | 2 | Yes | 6 | 98% |
| Cioni et al. [21] | 2 | Yes | 66 | 91% |
| Cioni et al. [22] | 2 | Yes | 58 | 87% |
| Einspieler et al. [1] | 51 | Yes | 30 | 84% to 88% |
| Bos et al. [18] | 2 | Yes | 15 | 96% |
| Bos et al. [19] | 2 | Yes | 27 | $\kappa=0.84$ |
| Cioni et al. [9] | 3 | Yes | 32 | $\kappa=0.91$ |
| Bos et al. [20] | 2 | Yes | 48 | 94% |
| Einspieler et al. [10] | 2 to 6 | Yes | 36 | 92% to 97% |
| Guzzetta et al. [11] | 3 | Yes | 22 | 92% to 97% |
| Hadders-Algra et al. [23] | 3 | Yes | 89 | $\kappa=0.81$ |
| Present study Correct assessment | 700 | Yes | 25 | 83% $\kappa=0.76$ |
| Present study Normal versus abnormal | 700 | Yes | 25 | 92% $\kappa=0.83$ |

[a] Using a detailed scoring sheet retest was performed in random order 2 years after the first assessment. Seventeen out of twenty infants were given the same score again, the remaining three differed by one point from the first observation.

**Table 4** The quality of GMs of 25 cases used in different test tapes and their percentage of correct assessments

| | Number of assessments | Correct assessments (%) |
|---|---|---|
| Normal GMs | 2922 | 91 |
| Poor repertoire GMs | 1929 | 74 |
| Cramped-synchronised GMs | 1169 | 78 |
| Chaotic GMs | 224 | 96 |
| Absence of FMs | 921 | 90 |
| Abnormal FMs | 854 | 74 |

GMs, general movements; FMs, fidgety movements.

assessed. Cohen's Kappa [24] was 0.78, indicating an excellent agreement. The discrimination of normal GMs versus abnormal GMs was correctly performed in 92% of the 8019 assessments; $\kappa = 0.83$.

Table 2 provides the details of eleven previous studies [1,4,10,11,14,15,17,18,20–22] using inter-scorer agreement. Some ninety observers assessed 358 cases with an average agreement between 89% and 93%. The average $\kappa$, obtained in five other studies [8,9,19,23,25], was 0.86. In these studies 197 cases were assessed by 14 observers. Thus, the above reported agreement between the trainees and their trainers was in accordance with the previous objectivity data (Table 2).

The assessments of trainees were less accurate for writhing GMs ($p < 0.01$, Table 3). However, if we just considered the correct discrimination between normal GMs and abnormal GMs, the assessment was not influenced by the infant's age at the recording (Table 3).

The trainees identified accurately at least 90% of all the normal GMs, of the chaotic GMs and the absence of FMs (Table 4). Poor repertoire GMs, CS GMs and abnormal FMs were correctly assessed by approximately 75% (Table 4).

All results were independent of the various trainers but the number of correct assessments increased from 1997 (69%) to 2002 (89%, $p < 0.001$).

## 4. Discussion

The assessment of the quality of GMs has often been blamed to be subjective since the assessment is based solely on the observer's visual Gestalt perception. Admittedly, Gestalt perception is vulnerable as far as attention to detail is concerned but it is a powerful instrument when it comes to the analysis of complex phenomena. In his paper 'Gestalt Perception as a Source of Scientific Knowledge' the Nobel prize laureate Konrad Lorenz pointed out that 'Gestalt perception is able to take into account a greater number of individual details and more relationships between these than in any rational calculation' [26]. Visual Gestalt perception is used whenever dynamic or static images are globally assessed. Complex pattern recognition strategies are employed in the procedure and it remains superior to any computer-based analysis.

The inter-observer reliability of GM assessment has been repeatedly investigated by various groups (Table 2) and proves to be around 90% ($\kappa = 0.86$). However, the question of the effect of training has not yet received the necessary attention. The present study is the first to measure the effectiveness of the training courses offered by the GM Trust since 1997 on the accuracy of GM assessment using Prechtl's method. The substantial number of trainees ($N = 700$) from all over the world and their collective assessments provided a solid basis for a training course to learn GM assessment. At the end of a training course the number of correct assessments reached 83%. A 92% agreement was achieved for the correct discrimination between normal GMs and abnormal GMs (without necessarily identifying correctly the detailed subcategories of GM abnormalities). It seemed that infants around term were more difficult to assess than preterm infants or infants at 3 to 5 months PTA. The correct identification of the most relevant GM patterns for clinical purposes, namely normal GMs (predicting normal neurological development in 96% of cases [3,6]), as well as the absence of FMs (predicting dyskinetic [10] and spastic [3,6,9,11] forms of cerebral palsy) was high. Another significant GM pattern in the clinical setting, the CS GMs, still proved more difficult to identify for trainees (78% accurately assessed). In order to improve the correct assessment particularly of those GM patterns which turned out to be more difficult to judge, further training has been provided during the last few years. Additional training of some 100 participants significantly increased the correct assessment from 83% to 89% [3].

Certainly a pre-test would have strengthened our results, however, our data was collected retrospectively. Some studies dealing with the judgement of untrained observers [4,15,25] reported on 67% to 99% correct discrimination between normal GMs and abnormal GMs, but did not focus on the various subcategories of abnormal GMs.

The accuracy of trainees definitely increased from 1997 to 2002 pointing to an improvement of the quality of the course due to increased experience on the part of the trainers. An important observation was that the individual teaching style did not influence the results.

Our results show that in a time of ever more technical diagnostic procedures, direct observation as a functional neurological assessment technique for young infants can be successfully taught to other examiners and that it takes only a few days of intensive training to do so.

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