Abstract

There is a need for appropriate classification to describe gross motor function status in a child with cerebral palsy (CP). It was hypothesised that: greater the number of limbs involved, higher would be the Gross Motor Function Classification System (GMFCS) level; and, there would be spectrum of GMFCS level for each of the topographical types of the cerebral palsy.

A cross-sectional study of 182 children of both sexes in the age group of 7 months to 30 years having spastic CP who attended CP clinic from 2008 to 2009 in tertiary care hospital were assessed for topographical diagnosis and GMFCS levels. Topographical distribution showed diplegia (42%), quadriplegia (30%), hemiplegia (23%), triplegia (4%) and monoplegia (1%). GMFCS levels were almost evenly distributed, level II (26%) was most common followed by level V (23%). Statistical analysis was done using Cramer’s ratio and Pearson’s Chi-square test.

Cramer’s ratio of 0.277 showed fairly weak correlation between GMFCS levels and topographical CP types. Pearson’s Chi-square (12) =41.7, p=0.000 indicates that there is significant difference between expected and observed values of number of limbs involved in GMFCS levels, further substantiating the weak correlation.

These results mean that GMFCS in different topographical groups have different distributions. It was also observed that GMFCS had weak correlation with the number of limbs involved, thus reflecting that the GMFCS is a better indicator of gross motor function impairment than the traditional topographical categorisation of CP that specifies the number of limbs involved.

Keywords: Cerebral palsy, topographical, correlation, spasticity.

Introduction:

Assessing the cerebral palsy (CP) child remains an enigma for researchers and clinicians. This study is an attempt to analyse the gross motor function status in accordance with the Gross Motor Function Classification System (GMFCS), and its correlation with the topographical diagnosis in CP.

CP describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing foetal or infant brain. The motor disorders of CP are often accompanied by disturbances of sensation, perception, cognition, communication, and behaviour; by epilepsy, and by secondary musculoskeletal problems. CP is a clinical description and by itself is not informative about the outlook of these infants. The lesions in the developing brain or CP aetiology alone also do not provide information about function and prognosis. In our day to day practice of CP rehabilitation, it is important to follow a classification system that tells the parents and patients about the functional status and future prognosis, at the same time helping the managing team to plan intervention for the CP child, as well as for measuring the
outcome of rehabilitation. Unfortunately the many
different classifications of the various types of CP that
are in use lead to great confusion, and uniformity of
observation is impeded at a time when increasing
attention to disabled children gives some promise of
real advances in management.2

Given the complex and variable nature of the movement
disorders in children with CP, experts believed that
consensus should be reached as an essential step in
the development of a valid classification system and
subsequent use of the system in clinical practice and
research. The results of the nominal group process
and Delphi survey consensus methods provided
evidence of the validity of the GMFCS.3 The
international groups of experts were unanimous in their
agreement that there is a need for a classification
system for children with CP that is based on the
construct of disability and functional limitation. The
GMFCS is a five-level classification that differentiates
children with CP based on the child’s current gross
motor abilities; limitations in gross motor function, and
need for assistive technology and wheeled mobility.3

Until recently, the severity of CP was described in
subjective terms such as mild, moderate, and severe.
The Gross Motor Classification System (GMFCS)
provides the physiatrists, orthopaedic surgeons,
neurologists, paediatricians and therapists with a
common language to describe functional status of
children with CP. It is reliable and stable over time. It
is easy to learn and can be worked out for specific
child in about five minutes. The use of common
classification to describe gross motor function in a child
with CP improves communication and understanding
between all professionals taking care of the CP child.

The purpose of this study was to observe correlation
of GMFCS with topographical diagnosis in children
with spastic cerebral palsy. It was hypothesised that (1) greater the number of limbs involved, higher
would be the MFCS level, (2) there would be a
spectrum of GMFCS level for each of the topographical
CP types.

Patients and Method:
A cross-sectional study was done in 182 CP children
of both sexes in the age group of 7 months to 30 years
who attended CP clinic in Department of PMR, VMMC
and Safdarjang Hospital, New Delhi from March 2008
to May 2009. Children were assessed for number of
limbs involved (topographical diagnosis) and
corresponding GMFCS levels. Only those patients with
spasticity who were diagnosed as CP, (as per definition
of Executive committee Chaired by Rosenbaum et al)1
were included in the study. Data obtained from the
clinical examination was recorded and interpreted. For
statistical analysis, the data were coded and compiled
accordingly and processed by using computer based
program SPSS version16. Pearson Chi-square test with
95% confidence interval and Cramer’s ratio were done
to see the level of significance of correlation.

Results:

Male: female ratio 3:2; male predominance.

Table 1: Age Distribution (n=182)

<table>
<thead>
<tr>
<th>Age</th>
<th>No. of cases</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 2 years</td>
<td>50</td>
<td>27</td>
</tr>
<tr>
<td>&gt;2-4 years</td>
<td>47</td>
<td>26</td>
</tr>
<tr>
<td>&gt;4-6 years</td>
<td>45</td>
<td>25</td>
</tr>
<tr>
<td>&gt;6-12 years</td>
<td>37</td>
<td>20</td>
</tr>
<tr>
<td>More than 12 years</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

*Age distribution was almost uniform from 2 to 12 years of age

Fig 1: Percentage Representation of Each Topographical Type and Each GMFCS Level (n=182)

In our study (Fig 1) topographical distribution was diplegia (42%), quadriplegia (30%), hemiplegia (23%), triplegia (4%) and monoplegia (1%). GMFCS levels had almost uniform distribution; level II (26%) was most common followed by level V (23%).
In diplegics GMFCS levels I to V was almost evenly distributed. Quadriplegia had (63.6%) on the severe side of spectrum; levels IV and V, however it had significant percentage representations in other levels as well. Hemiplegia had more favorable GMFCS levels (level I -34% and level II 54 %.). Triplegia had equal (25%) representation in levels II to IV and (12.5 %) on either end of spectrum in level I and level V. Of the two cases of monoplegia where there was upper limb involvement in both cases, one had GMFCS level II and other had level IV.

In level I diplegia (39%) and hemiplegia (42%) were dominating which continued in level II as well (diplegia 39% and hemiplegia 45 %.). Level III and IV had maximum number of diplegia and quadriplegia combined (more than 80% in each level), with a continued trend of rise of level V in Quadriplegia, while hemiplegia was just (4%) and (11%) respectively. In GMFCS level V quadriplegic group had maximum (54%) representation followed by diplegia (33%) with only minimal representation in the other topographic types. Our results in Figs 2 and 3 show that a CP child can have varied levels of function with different number of limbs involved.
In our study it was hypothesised that more the number of limbs involved, higher the GMFCS levels. However on statistical analysis with Cramer’s ratio (for correlation of two variables), result was 0.277 implying that topographical classification and GMFCS are weakly correlated. On Pearson’s Chi-square test of significance at degree of freedom 12, the value was 41.7 with significance of $p=0.000$. This tells us that there is significant difference between expected and observed values of number of limbs involved in GMFCS levels, further substantiating the weak correlation of GMFCS with topographical diagnosis.

**Discussion:**

Male : female (3:2) with higher incidence of male children in our study is comparable to other studies.\(^4\) In our observation diplegia (42%) was the most common topographical group followed by quadriplegia (30%) and hemiplegia (23%) respectively; triplegia (4%) and monoplegia (1%) were least common. These findings are in accordance to Vohr et al\(^{10}\) where the most common type of CP was spastic diplegia (39%) followed by quadriplegia (27.3%), hemiplegia (13.8%), hypotonic CP (9.9%), triplegia (6.0%), and monoplegia (3.9%). However there was significant difference in topography compared to Howard et al\(^{8}\) in Victorian study where hemiplegia (35%), diplegia (28%) and quadriplegia (37%) were found. In a study of adults with CP by Margre et al\(^{9}\) in Brazil, quadriplegia was the most common group followed by diplegia and hemiplegia.

Our study showed that GMFCS level II was most common (26%) followed by level V (23%), level III was least common (14%). Similar observations were found in Victorian study where level I was most common (35%) followed by level V (18%), and level III was least common (14%).\(^8\)

Vohr et al\(^{10}\) studied a longitudinal cohort of 282 children with CP and found children with more limbs involved had more abnormal GMFCS levels reflecting more severe functional limitations. Spearman rank-order correlations were run to assess the relationships among the topography classification for spastic CP, and the GMFCS levels. There was strong correlation between topography and the GMFCS ($r = 0.894$; $p = 0.0001$). However, for each CP topographical category, there was a spectrum of gross motor functional levels. Though our results had a spectrum of GMFCS for each topographical type, in contrast to Vohr et al\(^{10}\) the two classifications were not as strongly correlated.

Howard et al\(^{8}\) in Victorian study found within the spastic group, differences in motor function among the three topography groups were extremely clear-cut. Compared to children with hemiplegic distribution, children with diplegia were more severe on the GMFCS scale. Children with spastic quadriplegia had the lowest levels of function, being significantly higher on the GMFCS scale than those with hemiplegia and diplegia. Our observation of hemiplegic children are in accordance with those of Howard et al\(^{8}\) who also found hemiplegic children had better functional profile than bilateral syndromes. However our study did not show statistically strong correlation between number of limbs involved and GMFCS levels.

Gorter et al\(^{11}\) also found that majority (87.8%) of children with hemiplegia were classified as level I as observed in our study where hemiplegic children had maximum representation in levels I and II (34% and 54%) respectively. They also observed children with a

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### Table 2: Comparison with Other International Studies

<table>
<thead>
<tr>
<th>GMFCS level</th>
<th>I %</th>
<th>II %</th>
<th>III %</th>
<th>IV %</th>
<th>V %</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>SJH India</td>
<td>17.60% (n=32)</td>
<td>25.80% (n=47)</td>
<td>13.70% (n=25)</td>
<td>19.20% (n=35)</td>
<td>22.50% (n=41)</td>
<td>100% (n=182)</td>
</tr>
<tr>
<td>Victoria(^8)</td>
<td>35.30% (n=114)</td>
<td>16.40% (n=53)</td>
<td>14.20% (n=46)</td>
<td>16.10% (n=52)</td>
<td>18.00% (n=58)</td>
<td>100% (n=323)</td>
</tr>
<tr>
<td>Ontario(^8)</td>
<td>27.90% (n=183)</td>
<td>12.20% (n=80)</td>
<td>18.60% (n=122)</td>
<td>20.90% (n=137)</td>
<td>20.50% (n=135)</td>
<td>100% (n=657)</td>
</tr>
<tr>
<td>Sweden(^8)</td>
<td>40.70% (n=68)</td>
<td>18.60% (n=31)</td>
<td>13.80% (n=23)</td>
<td>11.40% (n=19)</td>
<td>15.60% (n=26)</td>
<td>100% (n=167)</td>
</tr>
</tbody>
</table>

*In our study least percentage (13.7%) of cases were in GMFCS level III and highest (25.8%) in level II. Representations in levels I, IV and V are comparable to those of internationally observed results.*
bilateral syndrome were represented in all GMFCS levels, with most in levels III, IV, and V which is similar to our study.

In our study we found GMFCS and topographic diagnosis had a fairly weak correlation with Cramer’s ratio and Pearson’s Chi-square test. Similar observation was made by Gorter et al\textsuperscript{11} who found classifications by GMFCS and ‘limb distribution’ or by GMFCS and ‘type of motor impairments’ were significantly associated, though the correlation for limb distribution by GMFCS was low. The association between limb distribution and GMFCS levels was modest at best. Gorter et al\textsuperscript{12} found that GMFCS classification in infants is less precise than classification over time in older children. Children can be classified by the GMFCS early on, but there is a need for reclassification at age 2 or older as more clinical information becomes available.

**Conclusion:**

GMFCS and topographical distribution of limb involvement are weakly correlated. There is a variable spectrum of GMFCS levels in each topographical type of CP. A mild quadriplegia with GMFCS II can differ vastly from a severe quadriplegia with GMFCS V. The GMFCS is hence a better indicator for grading the child’s gross motor functional performance than the topographical diagnosis. GMFCS is a simple, intuitive and reliable tool to classify gross motor function in children with CP. GMFCS tells the parents and the patient about the functional status and the future prognosis, at the same time helping the managing team to set goals for measuring the outcome of rehabilitation.

**References:**