Objective
Cerebral Palsy (CP) can be classified in different ways according to impairment- and functional-based components, all of which are valuable in describing a child’s abilities. It is recognized that different patterns of abnormal tone such as dystonia and spasticity can co-exist in CP even when a single motor type descriptor such as “spastic” is used. This study aimed to investigate the relationship between brain lesions, as assessed by magnetic resonance imaging (MRI) pattern, and motor subtypes, including patterns of hypertonia directly measured in a clinical setting in children with CP.

Design
Cross-sectional, population-based cohort study. Participants and setting: Children with CP ages 2-16 years attending a tertiary children’s hospital.

Method
One hundred and thirty five subjects were recruited; 78 male, 57 female; mean age at assessment 8.7 years (SD 5.0); 94% were on the state CP Register. According to motor subtype, 84% had spasticity, 15% dyskinesia and 1% ataxia. Hypertonia was differentiated in each limb by application of the Hypertonia Assessment Tool (HAT) by a research Physiotherapist, with severity of dystonia and spasticity measured using the Barry Albright Dystonia (BAD) and Modified Ashworth Score scales respectively (1). Each subject’s most recent MRI was reviewed and classified by a Radiologist blinded to clinical information using the Surveillance of CP in Europe (SCPE) neuroimaging classification: 1) maldevelopments; 2) white matter injury (WMI); 3) grey matter injury (GMI); including focal vascular insults; 4) miscellaneous; and 5) normal.

Results
Seventy-four percent (100/135) of subjects had MRI scans available for assessment. WMI was observed in 45% of scans, GMI in 25% (including 9% with focal vascular insults), miscellaneous findings in 12%, normal in 10% and maldevelopments in 6%. There were no significant associations between level of motor severity by GMFCS and imaging pattern, although there was a trend towards an association between milder motor phenotypes (GMFCS III) and both WMI and normal imaging patterns. In WMI 91% had spasticity subtypes, most commonly diplegia followed by hemiplegia and quadriplegia. In the upper limbs of children with WMI, as measured by application of the HAT, pure dystonia was observed in 40%, mixed tone (both spasticity and dystonia) in 26%, normal findings in 32% and pure spasticity in 1%. In the lower limbs of children with WMI, pure dystonia and normal findings were uncommon (6% and 4%) with most having mixed tone (77%) or pure spasticity (13%). Dystonia severity (by BAD score) in WMI was universally in the slight/mild range. In GMI, spastic hemiplegia and dyskinesia were the most common subtypes, followed by spastic quadriplegia. On upper limb assessment in GMI dystonia was observed either alone or in combination with spasticity in 76%; pure spasticity was infrequent (10%), with similar findings in the lower limbs. Dystonia severity scores in GMI were mostly in the mild/normal range with a lesser proportion in the moderate/severe range.

Discussion
This study found that the majority of subjects (90%) had abnormal MRI scans, consistent with similar studies. Despite some differences in recruitment methodology, the distribution of pattern abnormalities is very similar to that observed by Reid et al in a larger Australian population (2). Within the group, WMI and GMI were the most common imaging abnormality patterns. Motor severity by GMFCS level was influenced by the recruitment method used, rather than reflecting the background geographic population which has a high proportion of cases of mild CP.

WMI
While WMI findings were mostly associated with the spasticity motor phenotype, dystonia was frequently identified on examination using the HAT in both upper and lower limbs. Although this generally measured as slight/mild according to the BAD score, it may influence function, such as in children with spastic diplegia who are noted to have difficulties with bimanual function. This is not well recognised or understood in those children typically considered to have spastic CP.

GMI
In this pattern, spasticity typically co-existed with dystonia, regardless of overall motor subtype category. Although it may be assumed that damage to structures such as basal ganglia may associate with a more significant degree of dystonia, this was an inconsistent finding.

This study should inform both future research into the co-existence of abnormal tone patterns in CP and the development of classification methods to reduce hypertonia pattern ambiguity in motor subtype classification.

References:

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