Getting the mix right – defining the goal and level of surgical intervention for the ambulant child with cerebral palsy

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The factors leading to the development of musculoskeletal deformity in children with CP appear complex and may relate to a combination of impaired growth because of altered muscle innervation and an altered pattern of loading (Gough and Shortland, 2012). The resulting reduced muscle volume is associated with a reduction in muscle strength which may be exacerbated by the reduced capacity of the child with CP to maximally activate their muscles (Stackhouse et al 2005). SEMLS can alter muscle length and improve skeletal lever arm function and alignment, but will not influence motor control or proprioception. Surgery may promote muscle growth (Fry et al 2007), possibly by allowing the muscle to work at a more appropriate joint position with less eccentric loading, and may reduce the demands of standing or walking by improving lower limb alignment, but will not in itself alter the underlying cause of impaired muscle growth and a gradual recurrence of musculoskeletal deformity may occur in some children following surgery. Surgery also has the potential to lead to further muscle impairment: the distal lower limb muscles in particular in children with CP have reduced volume and altered morphology with increased intramuscular fat (Noble et al 2014). Surgical intervention which exceeds the reparative capacity of a muscle may increase musculotendinous unit length but may lead to an increase in fat and connective tissue within the muscle with a resulting adverse effect on muscle function.

How do we decide which children with cerebral palsy (CP) would benefit from single event multilevel surgery, and decide when and what surgery should be considered? The prerequisite for such surgery should be a realistic, relevant and attainable functional goal such as the improvement or maintenance of longterm mobility or comfort for the child. The formulation of such a goal will be influenced by factors including the functional level of the child, the likely natural history of mobility and function for that child, the level of deformity present and the cognitive ability of the child. This goal then needs to be discussed with the child and family to ensure that it is acceptable and relevant to them. The GMFCS classification (Rosenbaum et al 2008) can guide the formulation of functional goals for each child: children at GMFCS level I and II may maintain their independent walking skills through adolescence, so surgery here may be aimed at improvement of their gait pattern. Children at GMFCS level III and IV, however, may reach their peak in terms of mobility around the age of 7 years and may then show a decline in mobility with growth (Hanna et al 2009) so surgery for these children may be aimed at maintaining or prolonging their limited level of mobility. The timing of development or presentation of lower limb deformity may also be influenced...
by the level of involvement of the child in that children at GMFCS levels III & IV may present at an earlier age with significant fixed deformities of the lower limbs which have not responded to nonoperative intervention. Limited surgery for this group can be effective, together with rapid postoperative resumption of walking, in maintaining or prolonging mobility and in delaying the expected deterioration of mobility with growth (Gough et al 2008). Children at GMFCS levels I & II may present at an older age, may have a greater capacity for rehabilitation and may benefit from more extensive lower limb surgery aimed at improving their gait pattern (Schwartz et al 2003). Three-dimensional gait analysis can help differentiate between children with a stable level of mobility, for whom surgery will be aimed at an improvement in their gait pattern, and children with a deteriorating level of mobility for whom surgery will be aimed primarily at maintaining mobility (Gough and Shortland 2008).

The decision regarding the timing and extent of surgery will be informed also by discussion with the child. The degree to which a child can understand what surgery entails and can agree to proceed will depend on their age and cognitive level but it is important that the child is involved in the discussion at an appropriate level and that the child’s understanding of the surgery and of the goals of surgery are considered during the discussion. The degree to which a child can commit to the necessary postoperative rehabilitation programme also needs to be considered. If a child does not agree to the surgery and is not happy to proceed, then going ahead with surgery, even with the approval of the parents and the agreement of the multidisciplinary team, is unlikely to result in an optimal functional benefit for the child.

Single-event multilevel surgery for a child with CP can be considered if the functional benefit from surgical intervention, in terms of the child’s mobility and comfort, will be greater than would be the case without intervention and if the likely benefits of intervention outweigh the risks. This may not always be a straightforward decision as the evidence for the longterm benefit of surgery, although increasing, remains limited. It is hoped that through closer collaboration between centres we may be able to build up detailed longterm outcome data for SEMLS: in the meantime, a pragmatic approach seems best which focuses on optimising the child’s longterm comfort and function, allows for discussion with the child and family within a multidisciplinary setting, and above all considers the child as an individual with individual goals and needs.