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Verbal memory after epilepsy surgery in childhood

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Summary
Purpose: To investigate verbal memory after epilepsy surgery both group-wise and at the level of individual children, and to assess associations with side of surgery and removal of the temporal lobe.
Methods: A prospective controlled study in a consecutive sample of 21 children undergoing epilepsy surgery, with comprehensive assessments of verbal memory before surgery and six, 12 and 24 months after surgery. For each patient, two age- and gender-matched controls were tested at similar intervals. Standardized regression-based (SRB) analysis was applied to compare post-surgical change in individual patients with change in controls.
Results: Group-wise, average normed scores on verbal memory tests were higher after epilepsy surgery than before, corroborating earlier reports. By dint of empirically based SRB analysis, however, considerable individual differences in post-surgical change were revealed. Children with resections that included the left temporal lobe functioned significantly poorer than predicted on the basis of their pre-surgical performance. In contrast, verbal memory performance after surgery was consistent with pre-surgical baseline in the majority of children with resections that spared the left temporal lobe.

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Conclusions: Despite cessation of epileptic seizures, verbal memory remains vulnerable in children who required surgery including the left temporal lobe. In most — but not all — children with other types of surgery, post-surgical verbal memory is consistent with their individual pre-surgical base level.

Introduction

The prognosis of verbal memory function in children who will have epilepsy surgery is far from clear. More studies have reported stability than decline after temporal resection (for a review, see Lah, 2004), but the variety of methods and patient selection hampers interpretation. As investigated mainly in adults, verbal memory outcome after epilepsy surgery is influenced by a large number of factors, including side of surgery (Bell et al., 2011; Helmstaedter et al., 2011; Sherman et al., 2011), language lateralization (Binder et al., 2008), age at onset of epilepsy (Binder et al., 2008; Dulay and Busch, 2012), age at surgery (Hermann et al., 1995; Baxendale et al., 2006), pre-surgical memory performance (Stroup et al., 2003; Baxendale et al., 2006), pre-surgical hippocampal volume and adequacy (Dulay and Busch, 2012; Stroup et al., 2003), and mood (Busch et al., 2011). In children, these factors and their interactions may be different. It has also been suggested that verbal memory may be vulnerable after extra-temporal surgery in children (Lah, 2004), although at least two studies that included children with extra-temporal resections have found no evidence of decline (Lendt et al., 2002; Mabbott and Smith, 2003).

Assessment of post-surgical cognitive change requires recognition of and account for factors associated with repeated testing, such as test—retest reliability, regression to the mean and practice effects (Duff, 2012). Empirically based methods such as the calculation of Reliable Change Indices (RCI) and standardized regression-based (SRB) change scores are considered the gold standard for assessing cognitive change after surgery (Sherman et al., 2011). These methods have only rarely been used to assess verbal memory (before and) after childhood epilepsy surgery and when used have not included specific correction for practice effects (Lendt et al., 1999).

With respect to children, interpretation of changes is further complicated by developmental effects: whereas adult age norms are often fairly stable over retest intervals of up to 10 years, in children development of cognitive function means that age norms typically increase, often rapidly. Hence, in adults lower age-normed scores at retest generally mean that raw scores were lower as well (and vice versa, except with older populations or very long follow-up). In children on the other hand, lower age-normed scores at retest may be derived from either lower, unchanged or even higher raw scores than at initial assessment (Fig. 1). Even in the latter case, of a higher raw score, a lower age-normed score at retest indicates that the child has fallen (further) behind his peers, due to lesser development over the retest interval. Whether a lower age-normed score is the result of surgery (as might be concluded for child A in Fig. 1) or simply the continuation of a previously deflected development (as might be concluded if child B obtains score #3 at retest), such changes in normed score have important implications for counseling of parents and patients.

A definite answer to the question what impact surgery per se has on a particular cognitive function would require a randomized controlled trial (RCT), but with rare exceptions (Wiebe et al., 2001) ethical considerations preclude such research designs, especially with the long follow-up that is necessary to assess cognitive outcome. The inclusion of a control sample of epilepsy patients rejected for surgery would introduce biases, as the control group would inevitably differ from the surgical sample. For example,

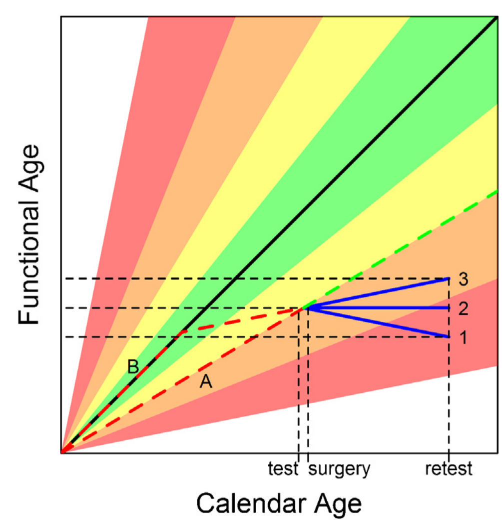

Figure 1 Schematic characterization of the relation between raw and normed scores during development. Shaded areas represent scores within 1 standard deviation (SD; in green), between 1 and 2 SD (yellow), between 2 and 3 SD (orange), and between 3 and 4 SD (red) from average development (solid black line). Dashed red lines represent different courses that lead to identical scores at initial assessment (test; i.e., shortly before epilepsy surgery): child A has poor but steady development from the beginning, child B initially has average development but then his development deflects. At initial assessment, both children score 2 SD below average (this would mean a score of 70 on the Verbal Memory Index of the Test of Memory and Learning as used in the present study — see below). Dashed green line represents continued development at 2 SD below average. Solid blue lines show either lower raw scores at retest after epilepsy surgery (#1), unchanged raw scores at retest after epilepsy surgery (#2) or higher raw scores at retest i.e. after epilepsy surgery (#3; this continues the trajectory of child B prior to initial assessment). Note that in all three cases the score at retest is considerably more than 2 SD below average.