

Intraoperative neuromonitoring and mapping during spinal cord untethering surgery; a single-centre paediatric neurosurgery unit experience



**Birmingham Women's
and Children's**
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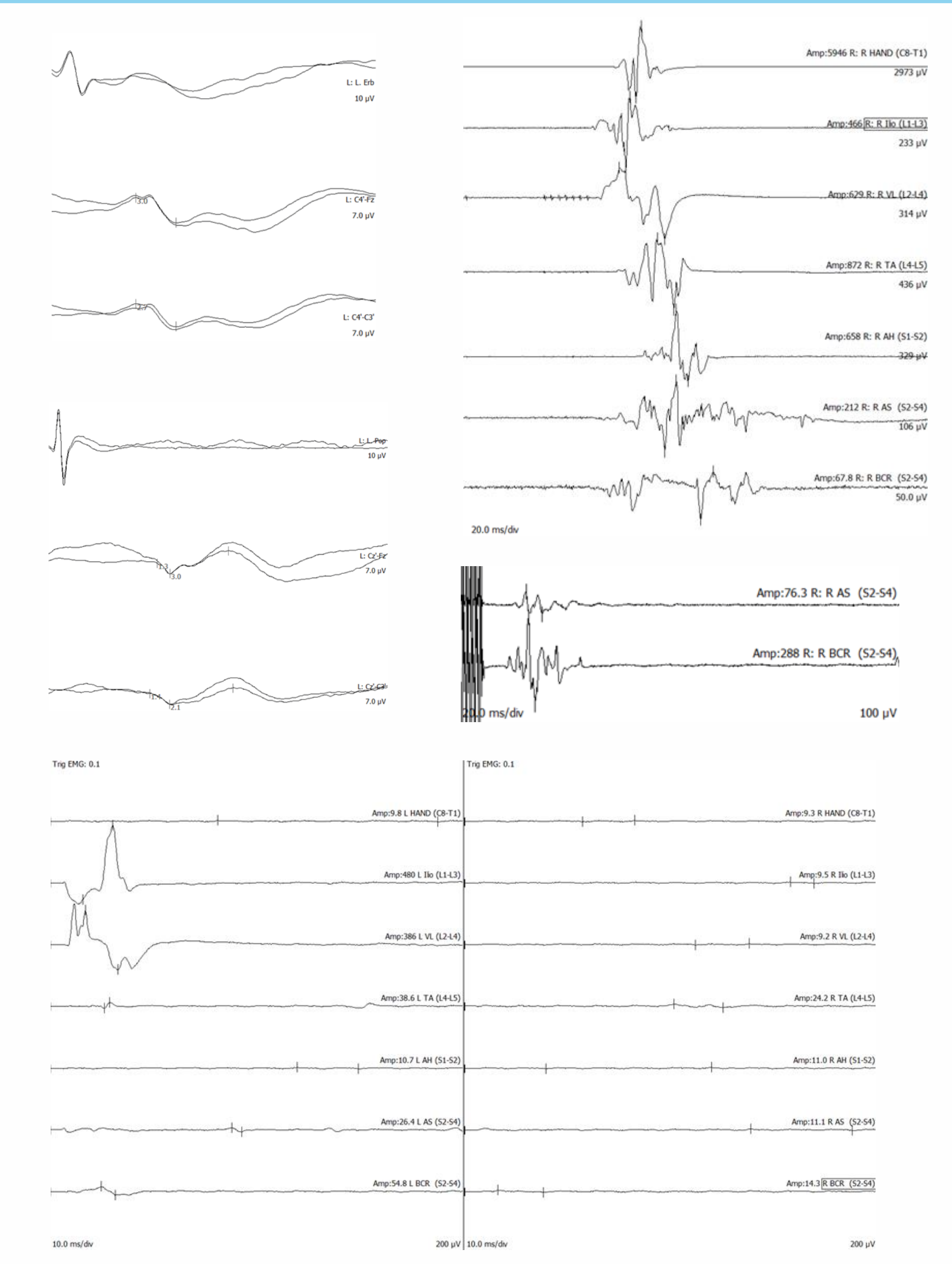
Introduction

Unique aspects of intraoperative neuromonitoring (IONM) and mapping (IONMa) apply to tethered cord surgery:

- Not all cases require SSEP monitoring.
- Accurate EMG interpretation depends on the equipment and methodology used.
 - There is no consensus on what MEP amplitude decrease should be alert criteria.
- Stimulation techniques and equipment used vary.
 - Incomplete myelination in young children could prevent consistent IONM.

Therefore, additional observational studies reporting IONM/IONMa utility in paediatric tethered cord surgery are still required.

We report on IONM/IONMa feasibility, alert criteria employed, measures taken to prevent postoperative injury, and patient outcome, with particular attention to our institution's monitoring and mapping methodology.



Images

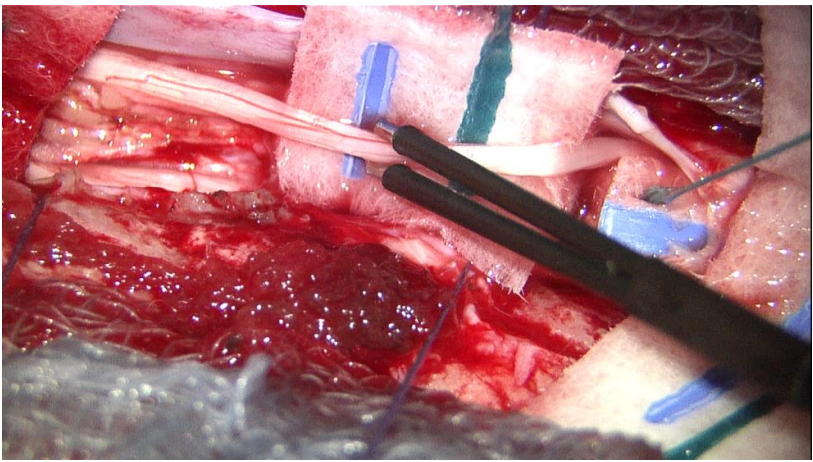


Figure 1: Bipolar stimulation technique. Both anode and cathode (silver poles) are in continuity with the structure to be stimulated and attempts are made to isolate the structure from surrounding cerebrospinal fluid and adjacent conductive tissue. Response from muscle at 0.1mA stimulation intensity.

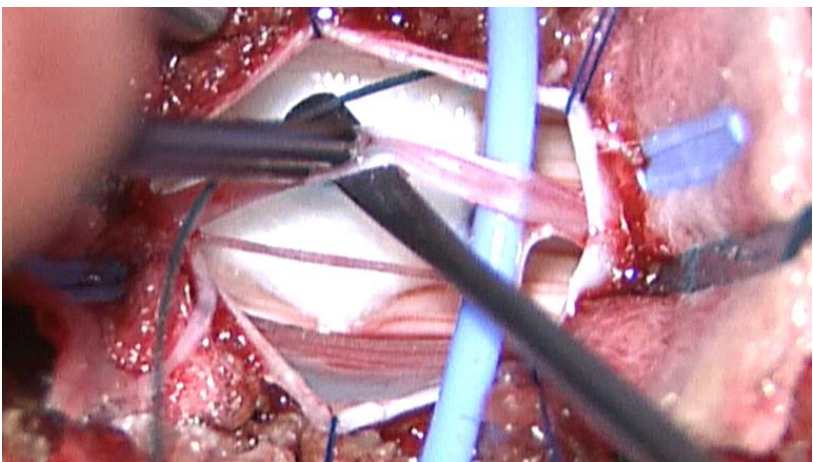


Figure 2: Bipolar stimulation technique of structure thought to be the filum. No response >10mA stimulation intensity.

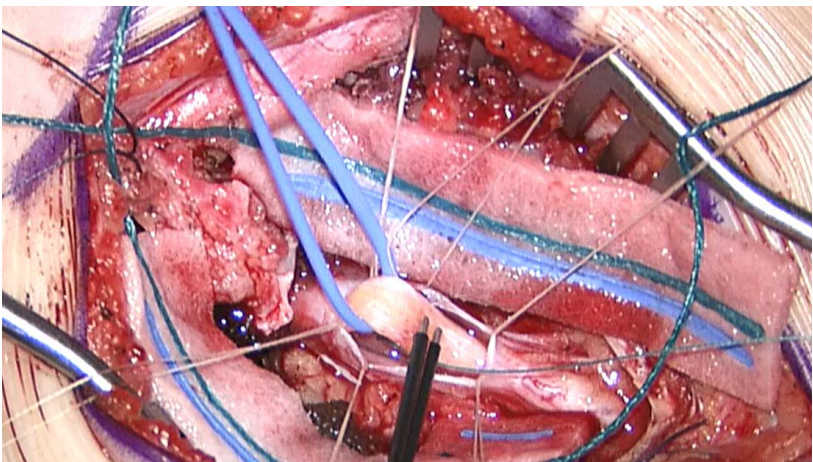


Figure 3: Bipolar stimulation of structure thought to be the filum. Response at 4.5mA stimulation intensity: further dissection/exploration warranted.

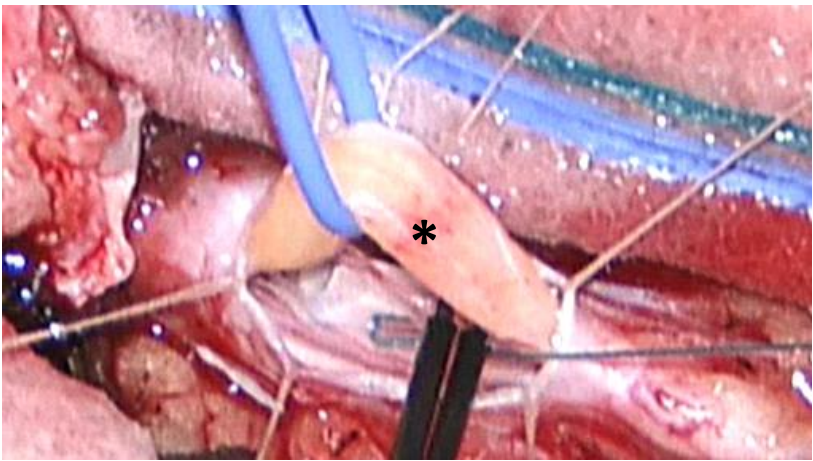


Figure 4: On exploration, rootlet found tethered to the ventral aspect of filum (asterisk).

Results

Characteristic	Number (%) n=122
Age group	
≤2 years old	48 (39)
>2 years old	74 (61)
Female	74 (61)
Presence of signs and symptoms of tethered cord syndrome (TCS)	
Urological	76 (62)
Musculoskeletal	56 (46)
Paresis	43 (35)
Paraesthesia	44 (36)
Prophylactic	15 (12)
Successful intraoperative neuromonitoring and mapping	
EMG	122 (100)
MEPs	88/89 (99)
SSEPs	36/40 (90)
BCR	58/79 (73)

Table 1. Patient and surgical characteristics

- 122 patients (Median age: 3 years; IQR: 2-7), most with a Morota 4 lipoma (n=35, 29%) or fatty/thickened filum (n=26, 21%); refer to table 1 for detail.
- Tr-EMG identified nerve rootlets adhered to the filum in 16% of filum disconnection surgeries.
- Unsuccessful BCR was associated with gender (p<0.001) and Morota lipoma category (p=0.039).
- Alert criteria breaches triggered an intervention protocol¹ and were associated with Morota lipoma category (p=0.037). Alert criteria breaches occurred in 13 patients (11%).
- Alerts were reversed in 11 (85%) with no permanent neurological deficit.
- In 2 (15%), alerts were irreversible, and one developed a permanent neurological deficit.
- Signs/symptoms of tethered cord had either stabilised (≥64%), improved (≥20%), or worsened (≤4%) at 3-month postoperative review.

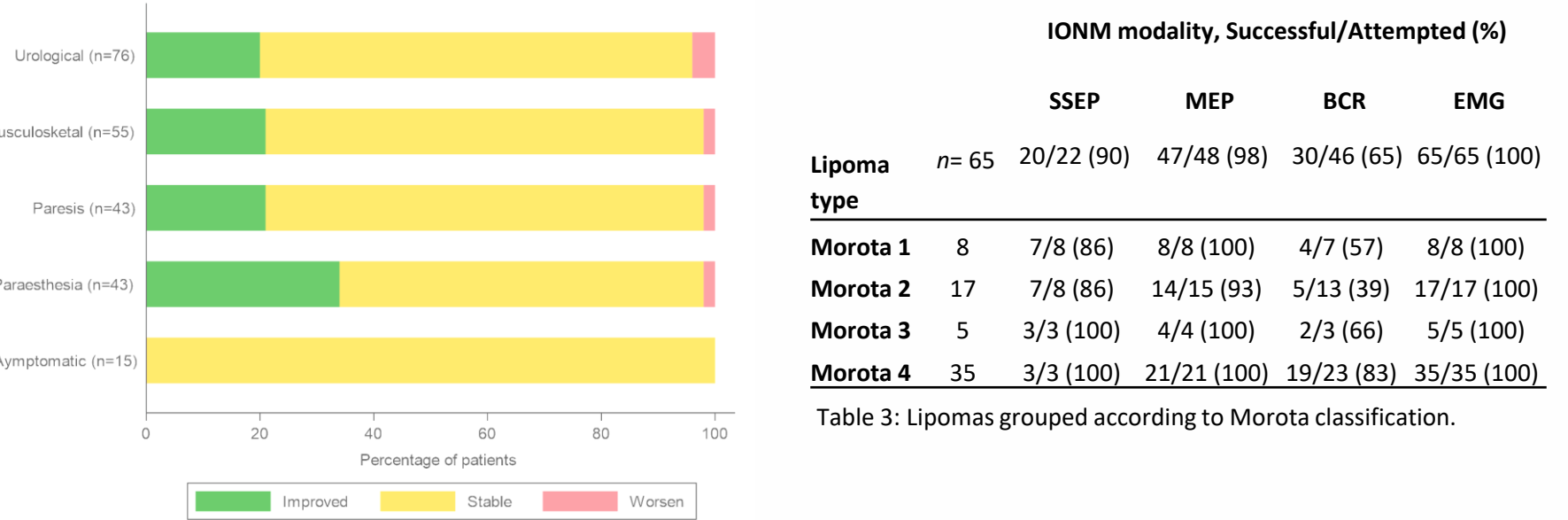


Table 3: Lipomas grouped according to Morota classification.

Figure 5: Preoperative signs/symptoms of patients with tethered cord, grouped as improved, stabilised, or worsened postoperatively.

References and links

1. McDevitt et al. Amplitude-reduction alert criteria and intervention during complex paediatric cervical spine surgery. Clin Neurophysiol Pract. 2022;7:239-244.



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Key findings

BCR monitorability is associated with gender and lipoma type.

Alert criteria breaches are associated with lipoma type.

Take home message

Testing for nerve roots adhered to the filum prior to disconnection is essential to avoid neurological injury.

