



# Potential role of Intraoperative neurophysiological evaluation of central motor conduction time : case series



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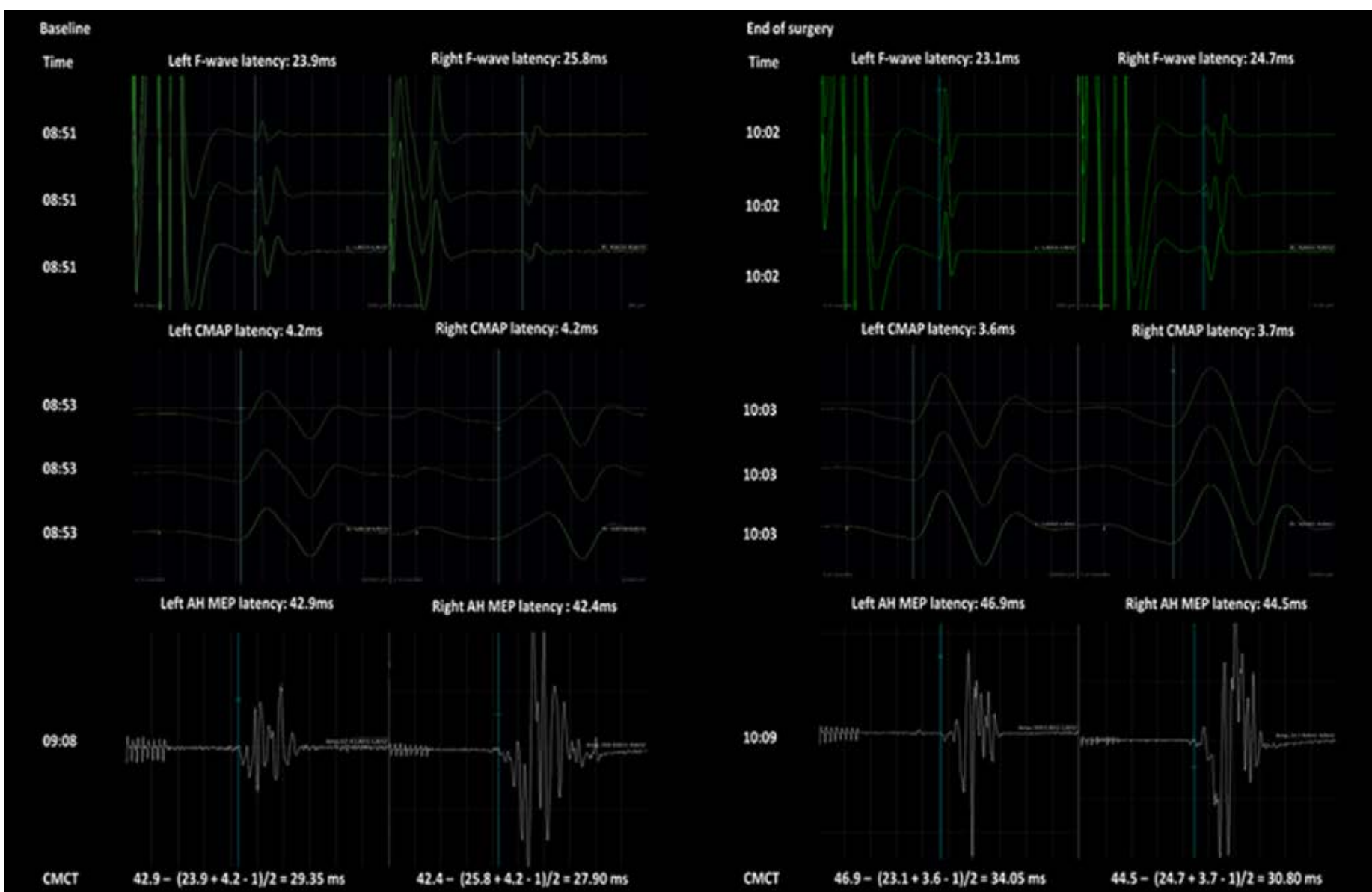
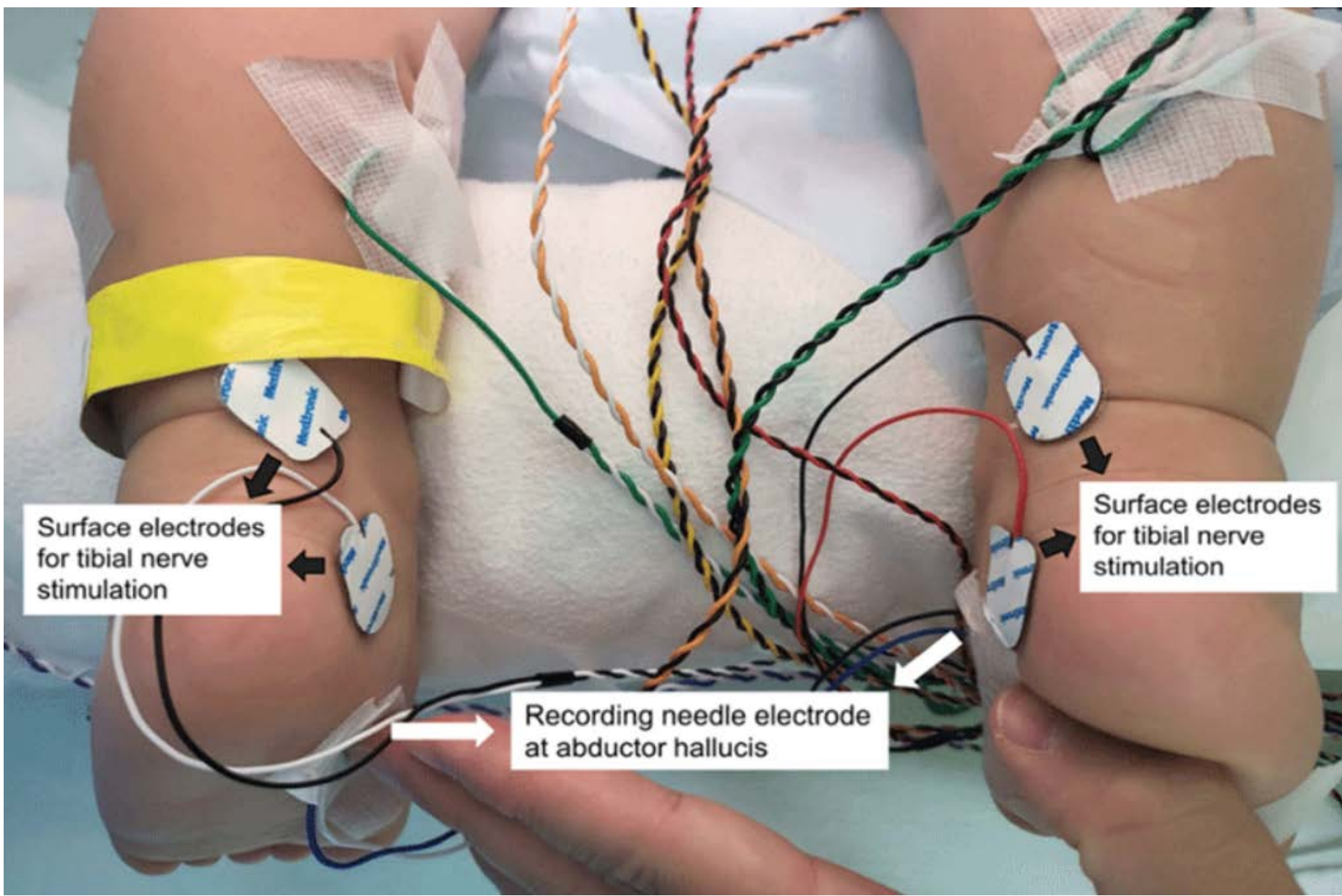
## Background & Objective

- Tethered cord syndrome (TCS) is a disorder characterized by the presence of a neural tube defect, in which the distal spinal cord is anchored caudally to an immobile bony structure, occasionally causing injury to the conus-cauda region.
- Untethering surgery is indicated to prevent neurological deficits, ranging from simple cutting of the filum terminale to removal of the complex, intermingled lipomatous tissue. Intra-operative neurophysiological monitoring including EMG, MEP, SSEP, BCR, and pudendal SSEP, plays a key role in detecting injuries during untethering.
- However, MEP alone cannot differentiate the integrity of function of the spinal cord in conus lesions and lumbosacral root damage, in untethering procedure.
- We demonstrate the case series in which the intra-operative central motor conduction time (CMCT) was measured during untethering surgery to provide additional information about spinal cord function, distinct from peripheral nervous system.

## Methods

- **Study design**  
Single center (Seoul National University Hospital Children's Hospital), observational, retrospective cross-sectional study
  - From January 2023 to June 2023.
  - Data from total 21 patients were included.
  - Patients with unreliable or unprovoked MEP were excluded.
- **Method**  
Intra-operative CMCT measurement (Fig. 1)
  - intra-operative F- and M-wave were measured.
  - Pair of surface disc electrodes was attached around medial malleolus to stimulate tibial nerve, recording needle electrodes in abductor hallucis muscle.
  - CMAP and F-wave were recorded in three consecutive stimulation trains to improve the reliability.
  - CMCT was calculated as following:  $CMCT = MEP - (F + M - 1) / 2$Retrospectively collected the following data
  - Intra-operative CMCT, Pre-operative urodynamic study, Pre-operative EMG/NCS, Pre-operative spine MRI

Figure 1. (a) Instruments for measuring central motor conduction time. (b) Measurements of central motor conduction time during surgery



- **Statistical analysis**
  - Values were presented as mean  $\pm$  standard deviation for continuous variables, numbers and percentages for categorical variables.
  - Student's t-test were used for intergroup comparisons.

## Results

Table 1. Baseline characteristics of the participants

| Demographic variables                       |                 |
|---|-----------------|
| Sex (F:M)                                   | 9:12            |
| Age (Month), mean $\pm$ SD                  | 15 $\pm$ 26     |
| Height (cm), mean $\pm$ SD                  | 74.4 $\pm$ 20.4 |
| Type of lesion                              |                 |
| Thickened filum terminale, N(%)             | 2 (9.5%)        |
| Filar lipoma, N(%)                          | 5 (23.8%)       |
| Retained medullary cyst, N(%)               | 4 (19.0%)       |
| Limited dorsal myeloschisis, N(%)           | 5 (23.8%)       |
| Lipomyelomeningocele, N(%)                  | 1 (4.8%)        |
| Transitional spinal lipoma, N(%)            | 1 (4.8%)        |
| No identifiable lesion, N(%)                | 2 (9.5%)        |
| Spine MRI                                   |                 |
| Conus medullaris at or below L3 level, N(%) | 13 (61.9%)      |
| Syrinx formation, N(%)                      | 6 (28.6%)       |
| Electrodiagnostic test finding              |                 |
| Abnormal finding, N(%)                      | 8 (40.0%)       |
| Urodynamic study                            |                 |
| Bladder neck incompetence, N(%)             | 9 (42.9%)       |
| Vesicoureteral reflux, N(%)                 | 0               |
| Underactive bladder, N(%)                   | 5 (23.8%)       |
| Detrusor-sphincter dyssynergia, N(%)        | 4 (19.0%)       |
| Low bladder compliance, N(%)                | 14 (66.7%)      |
| Involuntary detrusor contraction, N(%)      | 1 (4.8%)        |

■ Baseline characteristics of the participants are shown in table 1.

■ CMCT could be measured in all participants

- Right CMCT (ms): 34.2 $\pm$ 8.0
- Left CMCT (ms): 34.4 $\pm$ 9.9

■ Intergroup comparisons are shown in table 2.

- Among compared variables, level of conus medullaris at or below L3 was significantly associated with delay in CMCT.

Table 2. Result of group comparisons

| Variables                               |           | Average CMCT*   |              |
|---|-----------|-----------------|--------------|
|   |           | mean $\pm$ SD   | P-value**    |
| Level of conus medullaris               | $\leq$ L3 | 38.4 $\pm$ 7.6  | <b>0.002</b> |
|   | >L3       | 27.6 $\pm$ 6.1  |              |
| Syrinx                                  | Present   | 31.5 $\pm$ 11.1 | 0.375        |
|   | Absent    | 35.4 $\pm$ 7.8  |              |
| Abnormal Electrodiagnostic test finding | Present   | 33.2 $\pm$ 5.2  | 0.444        |
|   | Absent    | 36.2 $\pm$ 9.9  |              |
| Bladder neck incompetence               | Present   | 34.1 $\pm$ 8.4  | 0.930        |
|   | Absent    | 34.4 $\pm$ 9.4  |              |
| Underactive bladder                     | Present   | 32.7 $\pm$ 4.5  | 0.653        |
|   | Absent    | 34.8 $\pm$ 9.8  |              |
| Detrusor-sphincter dyssynergia          | Present   | 31.9 $\pm$ 6.5  | 0.550        |
|   | Absent    | 34.9 $\pm$ 9.3  |              |
| Low bladder compliance                  | Present   | 35.7 $\pm$ 8.6  | 0.307        |
|   | Absent    | 34.8 $\pm$ 9.8  |              |

\* Average CMCT= (Right CMCT + Left CMCT)/2, \*\* Student's t-test

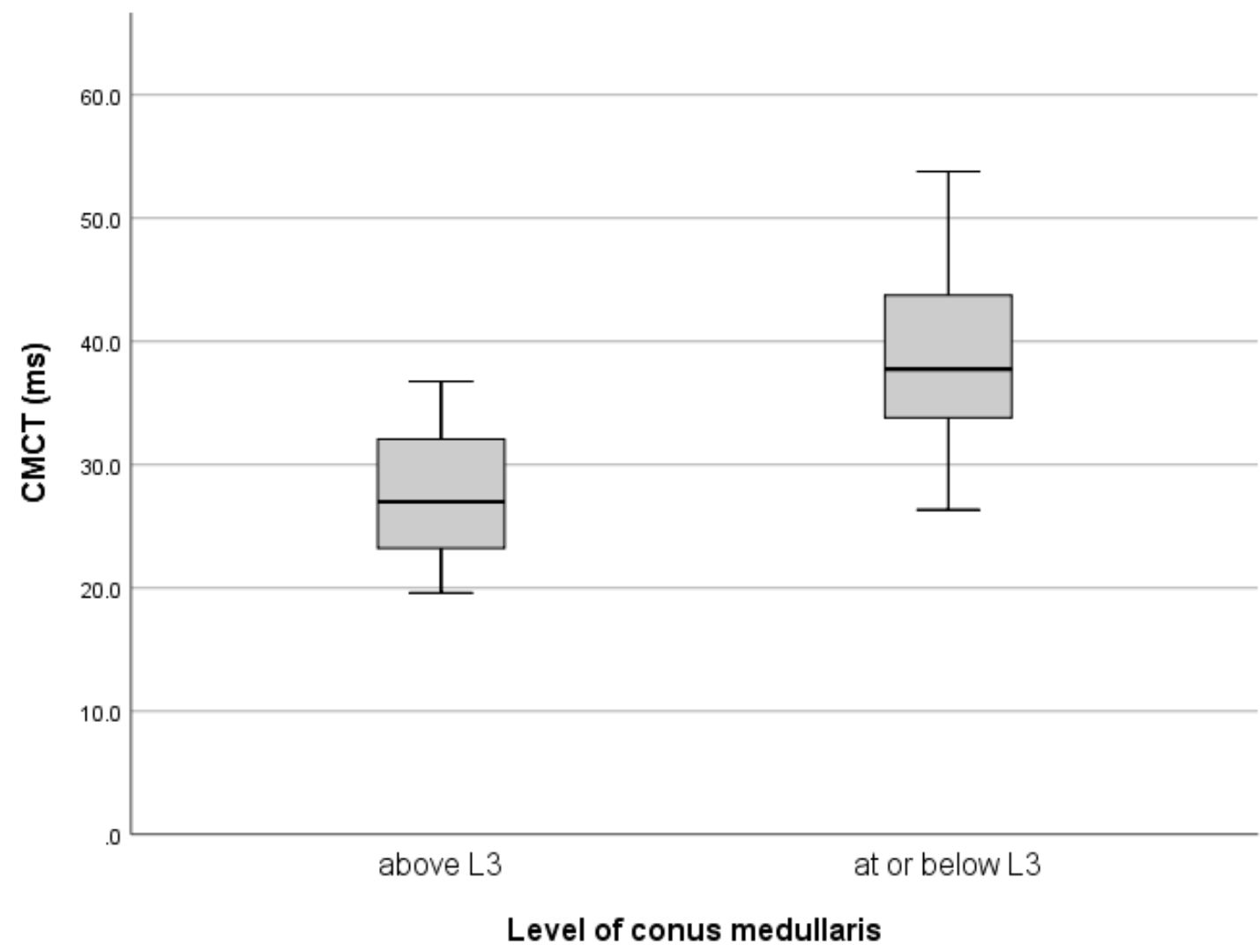


Figure 2. Comparison of CMCT between group with conus medullaris at or below L3, and group with conus medullaris above L3

## Discussion & Conclusion

- Intra-operative CMCT measurement was performed in patients with tethered cord syndrome receiving untethering surgery.
- Significant spinal cord dysfunction could be detected intra-operatively, especially in those with low lying conus medullaris.
- Further studies for reliability, validity are required.