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Electrophysiologic innervation patterns by facial nerve branch in normal healthy adults

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Introduction

The cross-muscle response, commonly known as the lateral spread response (LSR), is widely utilized for intraoperative monitoring and as a diagnostic marker of hemifacial spasm (HFS). Previous cadaveric studies have demonstrated substantial variability in the branching and innervation patterns of the facial nerve. Therefore, consideration of these anatomical variations is essential in the interpretation of LSR findings. This prospective observational study aims to evaluate the prevalence of non-target muscle responses for individual facial nerve branches in healthy adults and their symmetry, and to establish baseline normative data regarding branch-specific innervation patterns using LSR methodology.

Methods

❖ Study design:
- A prospective, observational study

❖ Population:
- Inclusion criteria:
  - Adults aged 19 years or older
  - Written informed consent.
- Exclusion criteria:
  - Individuals with a history of facial nerve-related conditions, such as facial palsy or hemifacial spasm
  - Individuals who have undergone facial surgery, sustained facial trauma, or received botulinum toxin injections within the past 6 months

❖ Nerve conduction study protocol (Figure 1)
- Compound muscle action potentials (CMAPs) were recorded on 4 muscles (frontalis, orbicularis oculi, orbicularis oris, and mentalis) by individually stimulating four specific facial nerve branches (temporal, zygomatic, buccal, and mandibular)
- To maximize the target muscle CMAP amplitude while minimizing volume conduction, stimulation intensity was titrated to the minimal effective level (<15 mA).
- For individual branch stimulation, the anode-proximal technique was applied. Anode was positioned proximally and the cathode was positioned distally along the course of the facial nerve. Cathode was subtly rotated to identify the optimal selective stimulation site, as performed in LSR studies for HFS.

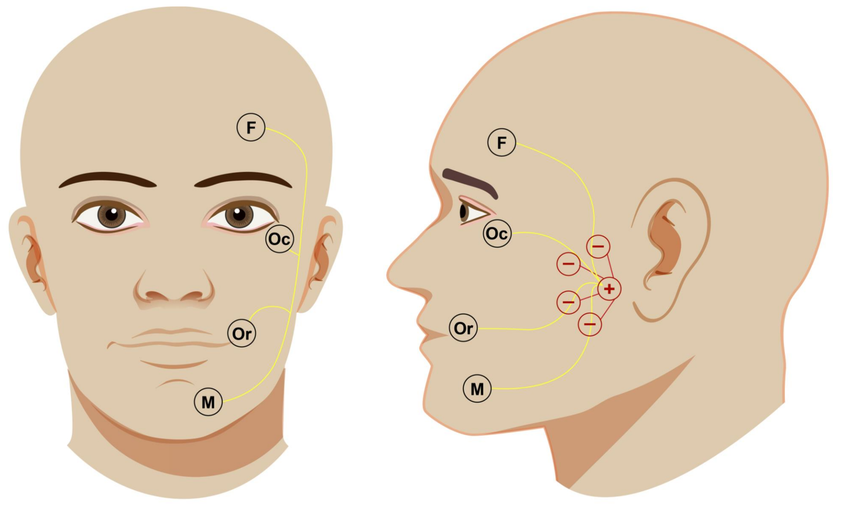

Figure 1. Location of recording and simulation electrodes for facial nerve conduction study

❖ Outcome Measure

➢ Cross-branch response:
- We defined a cross-branch response as a reproducible CMAP, clearly distinguishable from baseline artifacts and exceeding 50 μV in amplitude, recorded from a non-target muscle following stimulation of an individual facial nerve branch, thereby minimizing the influence of technical artifacts.

➢ True LSR:
- Among the non-target muscle responses, those with a latency of ≥10.0 ms were defined as true LSRs.

➢ The prevalence of cross-branch response was analyzed for each facial nerve branch.

Results

- A total of 15 healthy adult subjects were analyzed. All subjects exhibited one or more cross-branch responses.

❖ Prevalence of cross-branch response
- Buccal-Orbicularis oculi: 14 subject (93.3%)
- Zygomatic–Orbicularis oris: 8 subjects (53.3%)
- Temporal–Orbicularis oculi: 2 subjects (13.3%)
- Mandibular–Orbicularis oculi: 2 subjects (13.3%)
- These cross-branch responses were bilaterally symmetric in 12 individuals, while 3 subjects (20.0%) exhibited unilateral variations.
- Electrophysiologic innervation patterns by facial nerve branch are presented in Figure 2.

❖ None of the participants showed true LSRs

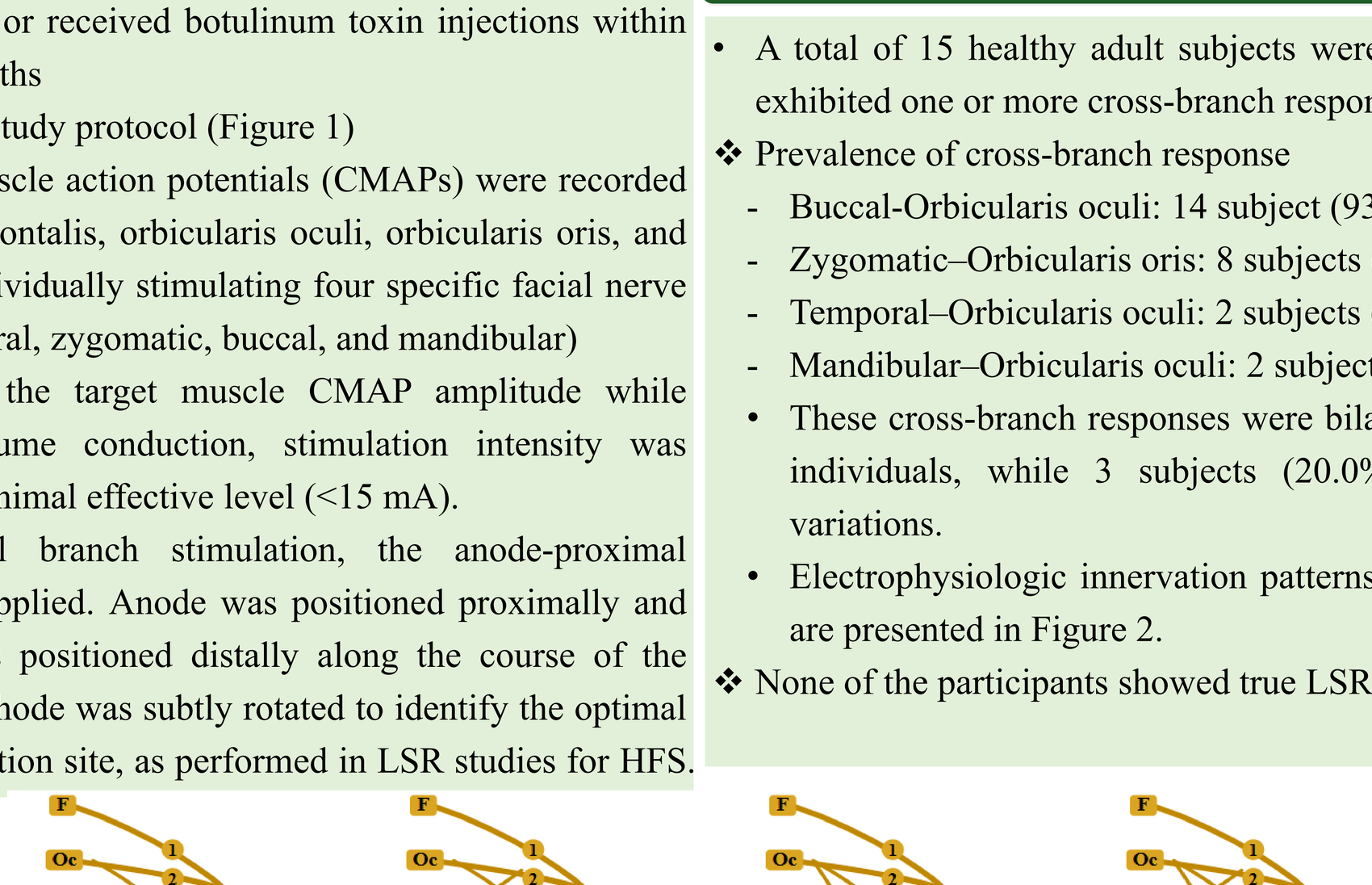

Figure 2. Electrophysiologic innervation patterns by facial nerve branches

Conclusion

Electrophysiologic cross-branch responses were observed in 100% of healthy adults, most frequently in the zygomatic–orbicularis oris and buccal–orbicularis oculi, and showed a strong tendency toward bilateral symmetry despite variable patterns. By establishing normative electrophysiologic innervation patterns in healthy adults, this study provides reference data that may improve the interpretation of electrophysiologic findings in patients with HFS.