Voluntary Neuromuscular Control of Gracilis Free Functioning Muscle Transfer for Elbow Flexion: Spinal Accessory Nerve vs Intercostal Nerve

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DISCUSSION: The results demonstrate that the SAN is a superior donor nerve for a gFFMT when motor control is desired. SAN are motor nerves that innervate the Sternocleidomastoid and Trapezius muscles, and ICN are mixed nerves responsible for both motor and sensory functions that innervate the intercostal muscles. Hence, there is a knowledge gap in the objective quantification of the effectiveness of the SAN versus the ICN in gFFMT. In this study, it was hypothesized that subjects reinnervated with the SAN would have better neuromuscular control in the gracilis muscle (gFFMT to the bicep) when used for elbow flexion.

METHODS: Twenty adult subjects with a gFFMT surgery following a brachial plexus injury were recruited from the Brachial Plexus Injury Clinic at the Mayo Clinic. The subjects were grouped by the donor nerve used for the gFFMT. Two subjects from the SAN group were excluded from the analysis due to technical issues during data collection. After exclusion, the SAN group (27 ± 8 years) and the ICN group (38 ± 10 years) consisted of 9 subjects each. The groups were similar in height and weight. Subjects were evaluated with a custom device that measured elbow flexion torque (TS11–20, Interface Inc.). The experimental sessions were comprised of a resting trial, a trial involving maximum voluntary contraction, and eight sequential trials of increasing difficulty.

RESULTS: The SAN group performed better in all outcome measures. The adjusted contraction latency was 10 times lower in the SAN group compared to the ICN group (p < 0.05) (Fig. 1 a). The adjusted relaxation latency value was 7 times lower in the SAN group compared to the ISN group (p < 0.05). The SAN group also showed a weak amount of modulation in their adjusted relaxation latency (value decreased) as the target torque increased (Fig. 1 b). The adjusted hold time was 6 times higher in the SAN group than the ICN group (p < 0.05) (Fig. 1 c). Percentage target torque was not a significant factor for the outcome measures (adjusted latencies and hold time) and the independent variables (nerve used, percentage target torque, and their interactions). Statistical significance was defined as p < 0.05.

DISCUSSION: The results demonstrate that the SAN is a superior donor nerve for a gFFMT when motor control is desired. SAN are motor nerves that innervate the Sternocleidomastoid and Trapezius muscles, and ICN are mixed nerves responsible for both motor and sensory functions that innervate the intercostal muscles. The surgeons have more motor nerves available while using the SAN for a gFFMT. Hence, using the SAN reinnervated gracilis for motor control is more intuitive compared to ICN. Bhat et. al.’s article showed that healthy individuals modulated the latency with elbow torque demand. The SAN group had a similar, but weak, ability compared to the ICN group. Oliver et. al.’s systematic review states that the success rates of gFFMT using the SAN or the ICN were similar. Hence, SAN as a donor nerve is a better option for gFFMT.

CLINICAL RELEVANCE: Selection of the right nerve for a gFFMT is crucial. The SAN, when available, is the best choice for a gFFMT. The findings of this study can be used to guide surgeons performing gFFMT.

REFERENCES:

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