

Optimization of a Protocol for Temporary Deafferentation and Proof-of-Concept of Effectiveness for Upper Limb Rehabilitation

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Background: Temporary deafferentation (TD) is a technique that uses short-term anesthesia, to inactivate sensation pathways from stronger muscles so that the brain releases inhibition that was placed on weaker muscles, thereby strengthening them. Unfortunately, there are many methods to do TD, and an optimized protocol for TD has yet to be fully developed. Here, we sought to optimize a protocol for TD using 5% lidocaine cream. Then, as a proof-of-concept, we evaluated hand dexterity and muscle strength was improved after a single session of TD. We hypothesized that triceps would show a gain in strength, with minimal changes in hand dexterity.

Methods: *Optimization:* Lidocaine cream (5%) was applied to the right biceps and sensation was assessed every 15 minutes using von Frey monofilaments. Sensation was assessed for 75 minutes. Percent sensitivity was assessed across time. *Proof-of-Concept:* Baseline dexterity and strength of biceps and triceps were assessed using the nine-hole peg test and a hand-held dynamometer, respectively. Lidocaine cream (5%) was applied to the right biceps of 20 healthy volunteers and was removed after 50 minutes. Thirty minutes of exercises to activate their triceps were then performed, and measurements of dexterity and biceps and triceps strength were again recorded.

Results: Peak deafferentation was achieved 50 minutes after lidocaine application, with at least 50% of the monofilaments having less than 50% sensitivity. Our results suggested that 50 minutes is required to achieve maximum TD after application of lidocaine cream. Hence, we conducted a proof-of-concept study combining therapy exercises to activate the triceps after 50 minutes of TD to identify possible effectiveness for upper limb rehabilitation. Our preliminary data suggests that triceps strength is enhanced after one session of TD ($p=0.02$).

Conclusions: Our results suggest that one session of TD can improve dexterity and biceps strength in healthy subjects. Our future work will assess how TD impacts triceps muscle activity.