Directional Tumescent Controlled Radiofrequency For Skeletal Neuromuscular Ablation

Sofya H. Asfaw, MD; Gaby Doumit, MD, MSc; Melissa P. Piliang, MD; Can Ozturk, MD; Francis A. Papay, MD

Abstract

Introduction: Glabellar frown lines may produce a cosmetically unappealing appearance. Botulinum toxin and other injectable dermal fillers may reduce the appearance of these frown lines but their results are temporary. Percutaneous selective radiofrequency nerve ablation (RFA) is a minimally invasive method for treating the glabellar area. Several small series have reported success using RFA to treat glabellar furrowing, but there is morbidity associated with burns and extraneous damage to non-targeted tissue. Tumescence can be used to control temperature, pain, electrical conductivity and ease of needle penetration into different tissue layers. No studies have monitored the target muscles or looked at the histopathologic changes that can occur after muscle and nerve have been targeted with and without tumescent. In an effort to better target facial muscles and determine the histopathologic effects of RFA and tumescence on nerve and muscle tissue, we conducted a pilot study.

Methods: Each gastrocnemius muscle (GC) of eight Lewis rats was ablated for either 30 (N=8) or 60 seconds (N=8) at 80°C with a 22-gauge custom made electrode. Sciatic nerves were ablated at the same temperature for 15 (N=8) or 30 seconds (N=8). Two rats were injected with 0.5mL of normal saline tumescent. Five rats were sacrificed at 4 days and three at 4 weeks. All nerves and muscles were stained with hematoxylin and eosin (H&E) and analyzed.

Results: At longer ablation times the nerves showed inflammation, necrosis and degeneration at 4 days. With tumescent there was less inflammation, no necrosis and milder degeneration compared to the group without. The muscles ablated for 60 seconds without tumescent showed inflammation and necrosis and those ablated with tumescent showed minimal or no inflammation. At 4 weeks, the nerves showed severe constriction and the muscles were severely atrophic in rats without tumescent and with longer ablation times. No ambulation defects were observed.

Conclusions: RFA is effective in producing muscle and nerve damage in the Lewis rat GC without causing a noticeable ambulation defect. In this model, the use of directional tumescent lessens the degree of muscle inflammation and nerve necrosis on histopathologic examination. A larger study is needed to determine optimal variables for percutaneous RFA to produce a desired defect and if directional tumescence can be used as an adjunct to reduce morbidity.

References

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