Electrical Stimulation for Reducing Trapezius Muscle Dysfunction in Cancer Patients: Traditional Treatment Protocols Also Work

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RE: Baldwin ERL, Baldwin TD, Lancaster JS, et al. Neuromuscular electrical stimulation and exercise for reducing trapezius muscle dysfunction in survivors of head and neck cancer: A case-series report. *Physiother Can*. 2012;64:317–24. <http://dx.doi.org/10.3138/ptc.2011-230>

Dear Editor,

We read Baldwin and colleagues' report¹ in the summer 2012 issue of *Physiotherapy Canada* with great interest. The topic they raise is of particular interest to us, as we recently treated a patient with oral cancer. Following his neck-dissection surgery, the patient developed a neuropathy of the XIth cranial nerve, with paralysis of the trapezius and sternocleidomastoid muscles. The encouraging results obtained by Baldwin and colleagues led us to try electrical stimulation to promote strength gain in the trapezius muscle and to foster recovery. Unfortunately, the advanced technology used by the authors (allowing, for instance, electrical stimulation to be triggered by electromyographic feedback) was not available at our clinic. Although the technology used by Baldwin and colleagues was interesting, we believed that similar effects could be achieved even without such a feedback system.

We therefore started a 6-week treatment programme that included electrical stimulation (ES) and therapeutic exercises (ergocycle, active range of motion [AROM], strengthening). The ES component used a Gymna apparatus designed to stimulate denervated muscles (galvanic current, 1 ms pulse width). The patient came to the clinic three times per week for 6 weeks. The treatment sessions always began with a warm-up period consisting of ergocycle pedaling with moderate resistance for 5 minutes. The patient then completed an exercise routine with the assistance of ES. Specifically, the patient was asked to actively flex both shoulders at the onset of ES and to maintain the contraction as long as he felt the

electric current in his dorsal (trapezius) area. The electrodes were positioned on the affected right lower trapezius muscle, based on our physical examination,² during which we observed marked weakness of the inferior portion of the trapezius. We began with 2 sets of 10 repetitions, then gradually progressed to 3 sets of 12 repetitions at the end of week 2. ES duration was initially set at 5 seconds, progressing to 10 seconds (ON:OFF ratio = 1:3).

As Table 1 shows, the strength of the affected trapezius significantly improved after treatment. This improvement was associated with increased AROM and, presumably, increased shoulder function. The most important change in muscle strength was observed in the lower trapezius, consistent with our electrode placement.

The treatment protocol used significantly improved the strength of the patient's middle and lower trapezius muscle. We cannot exclude the possibility that the treatment also had beneficial effects on the upper portion of the trapezius. However, because we were unable to break the muscle contraction during our evaluation, we cannot fully appreciate its effect on upper trapezius strength.

Table 1 Active shoulder range of motion (ROM) and shoulder strength before and after treatment*

	Unaffected shoulder		Affected shoulder	
	Before	After	Before	After
Active ROM flexion, degrees	—	—	114	137
Muscle strength, kg				
Upper trapezius	>50	—	>50	>50
Middle trapezius	14.4	—	13.6	18.5
Lower trapezius	8.8	—	0	11.5

*Active shoulder ROM was measured with a standard goniometer with the patient in a standing position (average of three measures); muscle strength was measured by isolating each muscle section individually, using the method advocated by Hislop and Montgomery.² The greatest change in muscle strength was observed in the lower trapezius.

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The absence of upper trapezius weakness at initial evaluation surely raises important questions. Given the patient's history and the structure probably affected by the surgery (the spinal accessory nerve), we would have expected weakness in the whole trapezius muscle. We believe that the strength measured during shoulder shrug might in fact be due to compensation by the levator scapulae muscle. Perhaps a more specific evaluation technique (i.e., with slight arm abduction to inhibit the levator scapulae muscle) would have produced a different pattern of results.

As mentioned above, the protocol reported here is simple and easy to apply in a standard physiotherapy clinic setting. Unlike Baldwin and colleagues, we used no feedback system to initiate ES of the affected trapezius. We also placed the electrodes on the muscle itself rather than on the spinal accessory nerve, to avoid the negative impact that ES might have on nerve recovery.^{3,4}

In conclusion, our experience suggests that the treatment protocol described in Baldwin and colleagues' research can be modified slightly yet remain effective. Of course, we believe that physiotherapy practice must evolve and take advantage of the technological breakthroughs and new equipment that are emerging in the medical and paramedical field. Nevertheless, those who have access to a more modest array of equipment can still use ES effectively to treat patients with peripheral nerve lesions.

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Response from the Authors

Dear Editor,

In *Physiotherapy Canada* 64:3 (Summer 2012) we published a case-series report describing promising results from a combined neuromuscular electrical stimulation (ES) and resistance exercise protocol in cancer survivors with persistent trapezius muscle dysfunction due to spinal accessory nerve damage.¹ We were pleased to read the letter to the editor from Charest-Hallée and Léonard describing their success using a modified version of the protocol with a survivor of oral cancer.² We commend Charest-Hallée and Léonard for maintaining the essence of our approach while modifying it to achieve a technique that “can easily be applied in a standard physiotherapy clinic.”² Below we outline our thoughts on the potential implications of these modifications.

Our approach involved triggering the ES from the onset of voluntary muscle activity, measured using electromyography, and thus required specialized equipment and a computer to control the ES. Charest-Hallée and Léonard used a simplified approach, delivering the ES in an “on”/“off” cycle and asking the participant to contract when the stimulation was “on.” In our opinion,

both approaches should be equally effective, and certainly Charest-Hallée and Léonard's approach is more readily transferrable to the clinic.

The primary difference between the two approaches, however, is that we delivered ES over the (spinal accessory) nerve trunk, while Charest-Hallée and Léonard delivered the stimulation over the lower fibres of the trapezius muscle, the portion of the muscle most affected in their patient. Their rationale for this decision was ease of electrode placement, targeting the lower trapezius, and “to avoid the negative impact that ES might have on nerve recovery.”² While we understand the merits of targeting the most affected muscle and concede that locating the nerve trunk can be problematic, we were surprised by the rationale regarding nerve recovery, for two reasons. First, we found in our review of the literature that the bulk of the evidence indicates that ES promotes, rather than impedes, nerve recovery.^{3,4} Second, ES generates contractions by depolarizing axons beneath the stimulating electrodes; thus, regardless of whether it is applied over the muscle or over the nerve, ES will increase activity in sensory and motor axons⁵ and influence nerve growth. In most circumstances we would

encourage applying ES over a nerve trunk, because this typically requires less stimulation current and more easily activates the entire muscle, whereas stimulation over the muscle belly requires higher currents and preferentially recruits motor units beneath the stimulating electrodes.⁶ In addition, during stimulation over the nerve trunk a portion of the contraction can be generated through reflex pathways, which is a more natural way to produce contractions.⁵ If, however, the goal is to stimulate a specific muscle group or portion of a muscle, muscle belly stimulation may be preferred.

We thank Charest-Hallée and Léonard for sharing their evidence in support of combining ES and voluntary exercise to strengthen the trapezius muscle in people with oral cancer. We encourage other clinicians to consider this approach for any case that involves disuse-related muscular atrophy, provided that there is still at least some residual voluntary control. The evidence for this approach for rebuilding muscle is clear, and it can also simultaneously promote recovery in neural structures that control the affected muscle.^{1,5}

Sincerely,

David F. Collins (on behalf of co-authors Margie McNeely, Evan Baldwin, Terri Baldwin, and Josh Lancaster)

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