NAME:

REPORT IS ON A DISORDER OR A MOTOR CONTROL ISSUE (circle one)

<table>
<thead>
<tr>
<th>Exceptional</th>
<th>Good</th>
<th>Some Improvement Needed</th>
<th>Weak</th>
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<tbody>
<tr>
<td>obvious extra effort in research &amp; reporting</td>
<td>correct facts at sufficient detail to explain issues, and presentation without any significant errors</td>
<td>facts &amp; detail explain issues, but more detail, easily possible, or some explanation confusing. Presentation with some significant errors</td>
<td>facts &amp; detail do not explain issues, or some significant errors. Presentation with very significant errors</td>
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<td>5</td>
<td>4</td>
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FACTUAL CONTENT

- WHAT IS IT? May include physiology of the normal system, what has gone wrong, incident rates, populations affected, (not symptoms)
- review critical issues in the topic - using subheadings
- CAUSES or hypothesized causes
- review critical issues in the topic - using subheadings
- SYMPTOMS, including motor control symptoms/effects
- review critical issues in the topic - using subheadings
- TREATMENT (not emphasizing my role)
- key issues yet to be resolved
- HOW I WOULD WORK WITH A PERSON WITH SUCH A DISORDER
- how I would use this motor control information when working with a person in my career

PREPARATION OF PAPER

- paper and paragraph organization of material, use of required headings to organize material
- spelling, punctuation, & sentence structure
- minimum 7 references: >= 4 journals, <= 1 book, <= 3 quality web sites, up-to-date information
- reference list follows APA modified sample style. Citations within paper follow sample style

1.5 pages, no wasted space ✔

Grading sheet attached /

General Comments:

All of paper was very well written, so it clearly explained key issues regarding NMES. Great work!

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325/33 = 21.7/22 updated 3/14/09
The Role of Neuromuscular Electrical Stimulation in Strengthening Injured Muscles

What it is

Neuromuscular electrical stimulation (NMES) has been utilized by medical practitioners in various forms of rehabilitation for decades. It incorporates the use of electrical current to activate skeletal muscle and facilitate contraction. Neuromuscular reeducation and strengthening required post-operation, enhancement of force production, increased muscle recruitment, and quicker recovery of function are a few of the widely known uses of NMES. NMES can also be used to increase muscular strength and endurance.

How it works

Application of NMES requires electrical current to stimulate the muscle contractions. Electrodes are placed on the cutaneous belly of the injured muscle. The electrical stimulation then stimulates the motor neurons in the current flow area. From here there is debate as to how exactly the NMES works, but it is agreed that muscles fatigue faster with NMES as opposed to voluntary contraction.

Normally in a submaximal voluntary muscle contraction small motor units are recruited before larger motor units. Some studies show that NMES reverses normal motor unit recruitment order so large motor units are recruited first. This reversal happens regardless of the intensity of the current.

Others believe the electrical signal stimulates fast and slow muscle fiber types equally in the muscle, regardless of force of stimulus. Their support involves a study by Bickel et al. (2003), which demonstrated that muscles with mainly fast muscle fibers fatigue at the same rate as muscles with slow muscle fibers. In a normal contraction the muscle with more slow, oxidative fibers would fatigue slower than the muscle with fast, less oxidative fibers. Another study by Feiereisen, Duchateau, & Hainaut (1997), suggests the recruitment order is highly dependent on fiber type in the muscle. Fast muscle fibers were recruited before the slow in 28-35% of cases when the tibialis anterior was stimulated, which Gregory and Bickel (2005) pointed out was the same as the percentage of fast muscle fibers typically seen in the muscle, about 30%. This suggests a non-selective recruitment pattern in the largely slow fiber type tibialis anterior muscle.

Applications on Injured Muscles

Regardless of how exactly it works, NMES is beneficial after injury because it either allows recruitment of fast muscle fibers before the slow fibers, or an equal recruitment of fast and slow fibers. This allows even a small current to prevent hypertrophy and even gain muscle strength.

Severe injuries to muscles and joints often require surgery followed by long periods of immobilization. Immobilization causes muscles to atrophy and lose their strength. Because the area is weak and unstable, conventional strength training techniques cannot be used to regain strength and mobilization. NMES is a way to increase strength in a controlled environment without potentially causing more damage to the surgery site. Postoperative rotator cuff repair is an example of a muscle strengthening situation perfect for NMES.

Another example of NMES usage is the strengthening of the quadriceps muscle following ACL surgery. Studies have shown that NMES and voluntary muscle contraction treatments are equally effective in strengthening skeletal muscle weakened by ACL surgery, when performed at the same intensity.
When performed on healthy individuals without injured muscle, however, strength gain has been minimal at best when using a small force of 20% of maximal voluntary contraction. This finding is opposite that found when NMES is used during injury.

Key Issues Yet to be Resolved

NMES can also be used in conjunction with voluntary muscle contractions. When used simultaneously with volitional exercises NMES is known as superimposed (SI) NMES (Bax, et al & Paillard et al). There are two different techniques of SI NMES; twitch interpolation where the electrode is placed over the nerve and percutaneous where the electrode is placed over the belly of the muscle. (Paillard) SI NMES has shown to be more effective than volitional exercises or NMES alone at increasing both force and muscular volume recovery. It has also shown to be more effective than volitional exercises alone at improving the recovery of injured subjects with post-traumatic rehabilitation programs (Paillard). There is little research in this area but due to differences in motor unit recruitment order, combining voluntary muscle contractions with NMES should increase the number and variety of motor units recruited and therefore force output (Paillard). If so, SI NMES would be more effective for rehabilitation purposes than NMES or volitional exercises alone.

How Can it be Used Professionally

NMES is effective in all clinical settings due to the fact that there are no differences in strength gains with respect to age and gender differences. Since any age person will get similar results, NMES would be very effective in rehabbing or strengthening elderly patients that either can’t move on their own or have difficulty moving. SI NMES is more effective than NMES or voluntary exercises at increasing both force and muscular volume recovery after injury or surgery. Peak force production in post-surgery patients was higher when they used NMES compared to no NMES use. An increase force and muscular volume recovery as well as increased peak force production would all result in an accelerated recovery time which is very applicable to any career involving rehabilitation.

References


