Neuromuscular Electrical Stimulation and Post-Stroke Glenohumeral Subluxation

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**Introduction**

A cerebral vascular accident (CVA) occurs when the blood supply to the brain is interrupted, either because a blood vessel has been occluded or the blood vessel has ruptured. This typically results in hemiplegia or paralysis of the muscles on the side of the body contralateral to the lesion site within the brain. The humeral head sits in the glenoid cavity and is stabilized by the labrum; the glenohumeral, coracohumeral, and coracoacromial ligaments; the infraspinatus, teres minor, subscapularis, supraspinatus, and the deltoid. The deltoid and the supraspinatus muscles are noted as the greatest contributors towards counteracting glenohumeral subluxation (GHS).

Post-stroke hemiplegia renders the muscles ineffective in contributing to the stability of the humerus and counteracting gravitational forces, therefore weaker structures, like the ligaments and the labrum, are unsuccessfully relied upon for support. This can lead to GHS, which is diagnosed through radiographs or palpation (see figures 1-3). GHS has a reported prevalence of 17%-64%.

Hemiplegia on its own limits an individual’s ability to participate in occupations, such as dressing, maintaining hygiene, or feeding; however, motor recovery can be compounded further by the occurrence of a subluxation as distal mobility of the upper extremity is dependent upon proximal stability. Occupational therapists specialize in returning individuals to meaningful occupations with the greatest level of independence possible; therefore, they must confront the issue of subluxation in rehabilitation either through prevention or treatment. Traditionally lapboards, arm troughs, and slings are used to treat GHS (see figures 4-6).

**Neuromuscular Electrical Stimulation**

Neuromuscular electrical stimulation (NMES) is the electrical stimulation of an intact lower motor neuron for the purpose of stimulating paretic muscles. NMES can be likened to an electrical form of shoulder support. NMES has been noted to be effective in preventing or treating GHS.

NMES systems are classified as either transcutaneous, where an electrode is applied to the skin’s surface, or implanted, where the electrode is implanted below the skin’s surface (see figures 7 and 8). Neuromuscular electrical stimulation (NMES) is the electrical stimulation of an intact lower motor neuron for the purpose of stimulating paretic muscles. NMES can be likened to an electrical form of shoulder support. NMES has been noted to be effective in preventing or treating GHS. NMES systems are classified as either transcutaneous, where an electrode is applied to the skin’s surface, or implanted, where the electrode is implanted below the skin’s surface.

**Methods**

**Objective:** To investigate the effectiveness of NMES for treating or preventing post-stroke GHS

**Databases Searched:** PubMed, Medline, Cochrane, PEDro, CINAHL, Proquest, Scopus

**Keywords Used:** Stroke, Electrical Stimulation, Subluxation

**Results:** Out of 222 total results, 9 randomized controlled trials were selected for the systematic review.

**Inclusion Criteria:** Evidence from 1986-2015, RCT designed studies, NMES used alone or with conventional treatments, patients with a diagnosis of CVA without the presence of other neurological diagnoses

**From Baseline to End of Treatment:**
- A significant \( p \leq 0.05 \) decrease in subluxation was reported in 5 of the studies.
- In contrast, 4 studies did not demonstrate a significant decrease in subluxation and 2 studies did not.
- The last study indicated an increase in subluxation at follow up, although a comparison was not made to the baseline measurement.

**Conclusion**

Overall, the selected studies demonstrated that NMES is effective in treating post-stroke GHS, however the studies do not indicate that NMES is effective in preventing GHS.

The studies suggest that NMES has greater effectiveness for reducing GHS when used in earlier post-stroke stages and that once NMES has been discontinued that the gains made during the treatment period may be reduced.

**Implications**

On average the duration of NMES required per treatment session exceeds a typical 60 minute therapy session, therefore NMES may be better suited for at home use. Occupational therapists should provide patient and family education on the at home use of NMES in order to maximize patient recovery.

Future high quality studies are needed to address the best time to use NMES post-stroke and the most effective form of NMES, as well as NMES’s role in prevention of GHS. As technology, such as implanted forms of NMES evolve, future studies may be warranted to assess its effectiveness on GHS.