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*Original Article*

# Muscle Energy Technique Versus Maitland's Mobilization on Range of Motion in Patients with Shoulder Dysfunction After Neck Dissection Surgeries

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## Abstract

**Background:** Many patients can experience shoulder dysfunction and limited range of motion (ROM) following neck dissection that can have a detrimental impact on their quality of life
(QOL).

**Purpose:** To evaluate the therapeutic effect of muscle energy technique and mobilization on improving shoulder ROM following neck dissection surgeries and compare them.

**Materials and Methods:** This Randomized, single blind controlled trial was carried out on thirty-patients with shoulder dysfunction after neck dissection surgeries, their ages ranged from 25-70. The participants were selected from National Cancer Institute and were assigned at random into two groups, with each group including 15 patients. Group A (Muscle Energy Technique group): were given Muscle Energy Technique along with traditional physical therapy, three times weekly, throughout a duration of four weeks. and Group B (Maitland`s Mobilization group): were given Maitland`s Mobilization along with traditional physical therapy, three times weekly, throughout a duration of four weeks. **S**houlder range of motion (flexion, abduction, and external rotation) was measured pre and post four-weeks of intervention.

**Results:** There was a substantial improvement in shoulder flexion, abduction, as well as external rotation in both groups and the comparison between both groups revealed that there was a statistical difference in shoulder ROM in favour of group A ($p < 0.001$).

**Conclusion:** Both MET and Maitland's mobilization might be useful manual therapeutic techniques in improving shoulder ROM following neck dissection surgeries, but MET found to be superior to Maitland's mobilization in improving shoulder ROM.

**Keywords:** **Muscle energy technique; Maitland's mobilization; neck dissection; shoulder dysfunction.**

## Introduction:

Neck dissection is a surgical procedure in which the lymph nodes and surrounding tissues in the neck are removed. This procedure is often performed to treat or prevent the spread of cancer, particularly in cases of head as well as neck cancers **(1).** The spinal accessory nerve (SAN) is commonly at-risk during neck dissection procedures, and its preservation is attempted to minimize shoulder dysfunction. However, despite efforts to spare the nerve, complications can still occur **(2).** Shoulder pain, stiffness, muscle weakness, functional impairment, and compensatory mechanisms are often associated with the surgical manipulation and potential injury to the SAN during the neck dissection surgery **(3).** Muscles dysfunction after NDs can lead to complications such as adhesive capsulitis (frozen shoulder), observed in up to 40% of cases, and subsequently restrict shoulder mobility **(4).** Also, the C2-C4 dermatomes are commonly involved in neuropathic pain that starts in the neck area after damage to the cervical plexus. These deficiencies can lead to a decrease in ROM, especially in abduction and flexion, which can limit the ability to carry out everyday activities (ADLs) causing chronic pain **(5).** Shoulder dysfunction is present in 20% to 60% of patients following various forms of neck dissection **(6).** Shoulder dysfunction can significantly impact daily activities, including reaching, lifting, and performing overhead tasks. A patient's capacity to perform ADLs may be impaired due to functional impairment **(7).**

Physical therapy has proven to be efficacious in diminishing shoulder disability. Physical therapy Rehabilitation of shoulder following neck dissection surgery can be accomplished by several methods, including the use of scapula orthotic support, soft tissue treatment, electrotherapy or infrared heat, active and active-assisted cervical and shoulder exercises, resistant exercises, and stretching along with mobilization exercises **(8).** Manual therapy is a conventional series of physiotherapy treatments employed to reduce pain and enhance the quality of life in those who have survived Head and Neck Cancer.

The physiotherapist administered manual therapy techniques to the HNC patients, including mobilization, manipulation, as well as soft tissue techniques. It also encompassed the following: transverse friction massage, MET, MFR, active release technique, positional release approach, Bowen technique, Cyriax, as well as Graston. Application of manual therapy techniques to the shoulder has demonstrated effectiveness in enhancing outcome measures such as pain reduction, improvement in QOL, reduction of acute inflammation, and increased ROM **(9).** The muscle-energy technique (MET) is a manual therapy technique that is frequently used by physiotherapists to enhance muscle strength and length, decrease edema, enhance blood flow, and mobilize restricted joints **(10).** Research has shown that it is more efficient in enhancing the flexibility of shortened muscles compared to static stretching **(11),** and it also boosts muscle strength through isometric contractions. The increase in ROM and improvement in shoulder function may be attributed to the acquisition of strength **(12-14).** MET has many positive effects such as improving range of motion in the cervical, thoracic, and lumbar regions of the spine and the upper extremity **(10).** While physiotherapists frequently employ Maitland's mobilizations, another form of manual therapy, to treat musculoskeletal disorders **(15).** The oscillatory motions carried out during mobilization align with the joint's accessory motions, which play a crucial role in normal mobility. According to popular belief, these motions assist restore normal glenohumeral arthrokinematics by causing mechanical effects including collagen realignment, increased fiber glide, as well as adhesion break-up **(16).**

Neck dissections are known to substantially contribute to disability and morbidity. Nevertheless, present studies evaluating the efficacy of mobilization vs MET in alleviating shoulder impairment after neck dissection

procedures are severely lacking in both quantitative data and detailed information.

Therefore, this study aims to evaluate the impact of MET and mobilization on shoulder disability improvement after neck dissection surgeries and to conduct a comparative analysis of these treatments.

## Materials and Methods:

### Study design:

This single blind randomized controlled experiment was carried out between Jan 2023 to Nov 2023. Ethics approval was granted by the ethical committee of the Cairo University Faculty of Physical Therapy (P.T.REC/012/003370) prior to the beginning of the study.

### Sample size determination:

The sample size was calculated using the statistical software G*Power (version 3.1.9.2; Franz Faul, Universität Kiel, Germany). After analyzing the data, it was found that a sample size of 30 participants (about 15 in each group) is the most suitable for this study. Calculations were performed using an allocation ratio of N2/N1=1, with an effect size of 0.91, a level of significance of 0.05, and 80% power.

### Participants:

The study involved 30 patients who met the inclusion criteria: aged between 25-70 years, from both genders, and experiencing shoulder dysfunction within six months of undergoing neck dissection surgery. The participants in this study were selected at random from the physical therapy outpatient clinics at the National Cancer Institute, at Cairo University. Exclusion criteria included having previous shoulder pain, pregnancy, epilepsy, or undergoing radiotherapy or chemotherapy. In addition, patients who declined to participate or failed to complete the written consent form were eliminated. Upon receiving information regarding the study's characteristics, goals, and possible advantages, the 30 patients were assigned randomly to one of two groups: MET group or the Maitland's mobilization group, with equal numbers in each group. Participants were randomly assigned to their respective groups using sealed envelopes containing name cards. Depending on the card drawn, participants were placed into the corresponding group. Treatment began one week after the random assignment process. A signed informed consent form was requested of all participants who participated in the research. A 1:1 distribution ratio was used for patient randomization in order to reduce variation as well as bias between the two groups.

### Interventions:

Patients in the MET group were treated using the post-isometric relaxation (PIR) form of MET. This method entails an isometric contraction of the agonist muscle (the muscle that needs stretching) for a duration of 7 seconds, accompanied by a mild contraction to prevent an increase in muscular tone. The contraction begins immediately before the limiting barrier. Subsequently, the patient is instructed to relax for a duration of 2-3 seconds, following which the therapist proceeds to elongate the tense muscle in the opposing direction for a period of 30 seconds. This process is repeated three times for every muscle. Each session had a duration of 45 minutes, and there was a total of three sessions per week for a period of four weeks. The isometric contraction is performed during inhalation, as this phase activates most muscles, while relaxation occurs during exhalation, which inhibits most muscles. The isometric contraction associated with inhalation because it causes most muscles to be activated and relaxation associated with exhalation because it causes most muscles to be inhibited **(17,18).**

Patients in the Maitland's mobilization group had Maitland mobilization therapy for 45 min / session, 3 times per week, for a duration of four weeks. Every session started with the physiotherapist evaluating the patient's ROM in every direction to determine the glenohumeral joint's (GHJ) end-feel along with the end-range position. The Maitland mobilization treatment involved initiating rhythmic mid-range mobilization while the patient was lying on their

back. The therapist positioned their hands near the GHJ and moved the humerus into its maximum flexed position in the sagittal plane. The direction of mobilization was altered by adjusting the plane of elevation or the degree of rotation after 10 to 15 repetitions of intensive mobilization techniques in this end-range position. Different gliding and distraction approaches, including inferior, anterior, & posterior gliding, were used to change the direction of mobilization. Each direction of mobilization involved 10 to 15 repetitions, with the duration of prolonged stress adjusted taking into account the patient's tolerance **(19).**

All patients from both groups participated in the same traditional shoulder exercises, which included free active exercises for all physiological movements of the glenohumeral joint (GHJ), GHJ stretching, postural correction exercises, re-education of the scapulothoracic postural muscles, and strengthening of the shoulder muscles **(20).**

**Outcome measures:**

Shoulder ROM (flexion, abduction, as well as external rotation) before and after 4 weeks of the interventions. A 12-inch, 360-degree goniometer, marked in 1-degree increments with two adjustable overlapping arms, was used to measure shoulder flexion, abduction, as well as external rotation. The goniometer was positioned on the patient in a typical initial position, and the patient was directed to promptly move the joint through its full ROM right after the goniometer was calibrated to zero. The final reading on the goniometer determined the ROM. Consistent and effective contact among the patient as well as the goniometer was maintained throughout the measurement process **(21).**

**Statistical analysis**

The age distribution across groups was compared using an unpaired t-test, whereas the distribution of sexes among groups was compared using a Chi-squared test. The data's normal distribution was evaluated using the Shapiro-Wilk test. In addition, the Levene's test was used to confirm that the variances are homogeneous across the groups. In order to compare the groups' shoulder ROM, another unpaired t-test was performed. A paired t-test was used to compare the pre- and post-treatment data within each group. The statistical tests were conducted with a significance level of $p < 0.05$. Statistical Package for the Social Sciences (SPSS) version 25 for Windows (IBM SPSS, Chicago, IL, USA) was used to conduct all statistical analyses.

## Results:

**Subject characteristics:**

**Table 1** displays the demographic characteristics of both groups, indicating that there were no notable differences among the groups regarding age as well as sex distribution ($p > 0.05$).

**Within group comparison:**

Following treatment, there was a substantial improvement in flexion, abduction, as well as external rotation ROM compared to pre-treatment levels in both groups ($p > 0.001$). The percentage of change in flexion, abduction, and external rotation in the MET group was 54.51%, 76.92%, and 65.81% respectively, while in the Maitland's mobilization group, it was 39.50%, 46.53%, and 31.68% respectively, **(Table 2).**

**Between groups comparison:**

Before treatment, there was no noteworthy difference among groups ($p > 0.05$). Nevertheless, a post-treatment analysis comparing the groups revealed a considerable improvement ROM for flexion, abduction, as well as external rotation in the MET group when contrasted to the Maitland's mobilisation group ($p < 0.01$), **(Table 2).**

**Table 1. Comparison of subject characteristics between group A and B:**

| | MET group | Maitland's mobilization group | | | |
|---|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | MD | t- value | p-value |
| **Age (years)** | 46.47 ± 8.77 | 47.27 ± 8.82 | -0.8 | -0.24 | 0.81 |
| **Sex, N (%)** | | | | | |
| **Females** | 8 (53%) | 9 (60%) | | ($\chi$2 = 0.13) | 0.71 |
| **Males** | 7 (47%) | 6 (40%) | | | |

SD, Standard deviations; MD, mean difference; $\chi$2, Chi squared value p value, Probability value.

**Table 2. Mean shoulder ROM pre and post treatment of group A and B:**

| ROM (degrees) | MET group | Maitland's mobilization group | | | |
|---|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | MD | t- value | p value |
| **Flexion** | | | | | |
| **Pre treatment** | 92.33 ± 13.07 | 93.66 ± 14.45 | -1.33 | -0. 26 | 0.79 |
| **Post treatment** | 142.66 ± 11.47 | 130.66 ± 13.07 | 12 | 2.67 | 0.01 |
| **MD** | -50.33 | -37 | | | |
| **% of change** | 54.51 | 39.50 | | | |
| **t- value** | -9.95 | -17.48 | | | |
| | p = 0.001 | p = 0.001 | | | |
| **Abduction** | | | | | |
| **Pre treatment** | 69.33 ± 4.57 | 71.66 ± 3.61 | -2.33 | -1.54 | 0.13 |
| **Post treatment** | 122.66 ± 11.78 | 105 ± 14.63 | 17.66 | 3.64 | 0.001 |
| **MD** | -53.33 | -33.34 | | | |
| **% of change** | 76.92 | 46.53 | | | |
| **t- value** | -18.83 | -9.33 | | | |
| | p = 0.001 | p = 0.001 | | | |
| **External rotation** | | | | | |
| **Pre treatment** | 51.66 ± 5.56 | 53.66 ± 5.16 | -2 | -1.02 | 0.32 |
| **Post treatment** | 85.66 ± 3.72 | 70.66 ± 6.77 | 15 | 7.51 | 0.001 |
| **MD** | -34 | -17 | | | |
| **% of change** | 65.81 | 31.68 | | | |
| **t- value** | -18.49 | -11.74 | | | |
| | p = 0.001 | p = 0.001 | | | |

SD, standard deviation; MD, mean difference; p-value, probability value

## Discussion:

Individuals undergoing different neck dissection surgeries encounter shoulder dysfunction, which could disrupt their everyday activities, social interactions, and overall quality of life **(22, 23).** The severity and persistence of shoulder complications can vary among individuals and depend on factors such as the degree of the neck dissection, the patient's overall health, and the surgical technique used **(3).** Patients persist in encountering limited shoulder ROM a 6 month after the surgical procedure **(24).**

In our study, two manual therapy techniques were employed: MET, which focuses on soft tissues, and Maitland's mobilization, which targets the joints. To our knowledge, no study has specifically contrasted the effectiveness of MET as well as Maitland's mobilization in the limited ROM among patients suffering from shoulder dysfunction following neck dissection surgeries to determine which method is more effective in improving shoulder ROM following such surgeries. Our trial results align with previous studies, which have found that both muscle energy technique and Maitland's mobilization have beneficial therapeutic effects on shoulder ROM **(24 -29).**

Furthermore, our study discovered that MET is more efficacious than Maitland's mobilisation in enhancing ROM among patients experiencing shoulder dysfunction after neck dissection procedures. The therapeutic mechanism of MET in enhancing ROM involves muscle contraction against a counterforce, which activates the Golgi tendon organ. The sensory nerve signal originating from the Golgi tendon organ travels to the dorsal root of the spinal cord and communicates with an inhibitory motor neuron. This hinders the release of outgoing motor neuron signals, hence inhibiting more muscle contraction. Consequently, there is a drop in muscular tone, which causes the agonist muscle to relax and elongate, thereby contributing to an increase in ROM **(30).**

Research has demonstrated that MET can improve the extensibility of muscles and increase muscle strength by using isometric contractions **(24).** The increase in muscle strength could potentially contribute to the improvement in ROM as well as enhancement of shoulder function **(12)** MET exercises can improve joint mobility by correcting the natural balance between muscle length and tension. This balance can be disrupted by several reasons, both internal and external, leading to muscle shortening. The increase in ROM may additionally be attributed to the reflexive relaxation of the agonist muscle group after an isometric contraction. The inhibitory action of the Golgi tendon organ on the pool of alpha-motor neurons helps to relax the reflex. Another mechanism that may help improve joint mobility is the reciprocal inhibition that occurs because of antagonist muscle contractions **(12, 31).**

Conversely, Maitland's mobilization stimulates the activity of Golgi tendon organs at the end of the mobilization, triggering reflexive inhibition of the muscles. This reduction in muscle activity following joint mobilization leads to decreased joint concentric activation, thus relieving pain and reducing muscle tension in the surrounding periarticular tissue **(19).** Maitland's mobilization provides beneficial mechanical effects, potentially including the breakup of adhesions, realignment of collagen, or improvement of fiber glide. Passive joint mobilization can enhance range of motion through various mechanisms. For example, persistent movement towards the end of the range stimulates static, slow-adapting Type I mechanoreceptors. These receptors have a baseline firing rate that increases in proportion to the amount of tension within the joint capsule **(32, 33).**

The study has several limitations. Firstly, the relatively small sample size necessitates a larger sample for further investigation of the findings. Secondly, the lack of long-term follow-up for both groups limits the ability to conduct robust statistical analysis. Therefore, more investigation is needed to assess the long-term benefits of MET as well as Maitland's mobilization in shoulder

ROM improvement after neck dissection surgeries.

## Conclusions:

In accordance with the results of this investigation, it can be concluded that both MET as well as Maitland's mobilization are efficacious for increasing shoulder ROM among patients suffering from shoulder dysfunction after neck dissection surgeries. However, MET appears to be superior to mobilization in increasing shoulder range of motion.

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