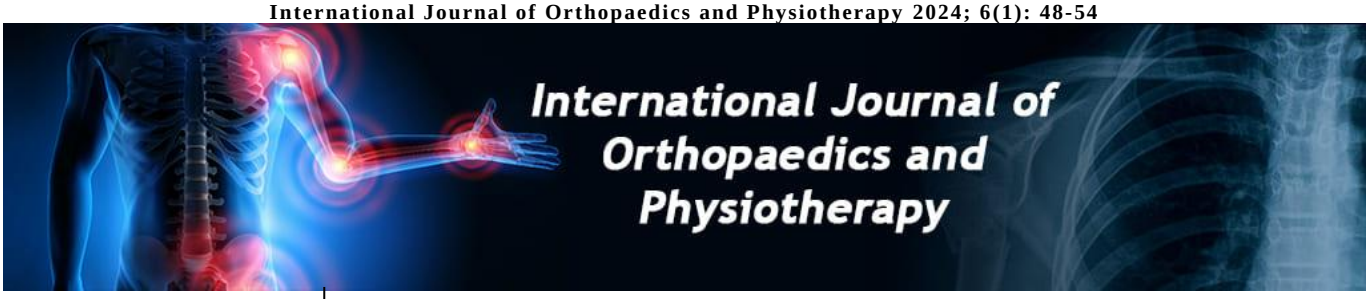

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A comparative study of the effectiveness of manual therapy v/s conscious control of scapula along with conventional physiotherapy to correct scapular dyskinesia in post-surgical cancer patients

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Abstract
Objective: one of the complications of neck dissection in patients with oral cancer surgery is post-surgical neck and shoulder - pain and stiffness, limitation in ROM, which interfere with normal muscle firing around periscapular and shoulder musculature; this long term misfiring pattern may lead to scapular dyskinesia; it affect ADL activities and QOL in these patients. This study aims to focus on to compare effectiveness of manual therapy v/s conscious control of scapula along with conventional physiotherapy to correct scapular dyskinesia in postsurgical cancer patients.
Methods: A randomized controlled trial was performed, Forty patients were randomly allocated with oral cancer surgery into the two groups, Group A -Manual therapy along with conventional physiotherapy; Group B - Scapular-focused exercises along with conventional physiotherapy was performed on both groups after neck dissection surgery for 3 months. Shoulder pain intensity, active range of motion (AROM) of shoulder abduction, scapular muscle strength and activity under maximal voluntary isometric contraction (MVIC), scapular muscle activity and QoL were measured while performing scapular movements 3 months after at the end of intervention.
Results: Both groups showed a significant improvement in outcome measure; however Group A (Manual therapy + conventional physiotherapy) showed significant improvement in shoulder AROM, pain, QOL, improvement in strength of lower trapezius and serratus anterior compared with Group B (conventional physiotherapy + scapular focused exercise).
Conclusion: Post-surgical cancer patients with scapular dyskinesia manual therapy along with conventional physiotherapy have promising effect. Manual therapy with conventional physiotherapy showed a significant improvement in shoulder AROM, pain, QOL, improvement in strength and muscle activation pattern of lower trapezius and serratus anterior muscle.

Keywords: Scapular dyskinesia, SAT, SRT, GH, QOL, DASH (disability arm shoulder hand score), manual therapy

Introduction

One of the distressful side effects of head and neck cancer and its treatment is pain that affects patient during and after the treatment adding the problem such as their ability to speak, swallow, breath and feed etc. Manual therapy is one of standard set of physiotherapy treatment that is use for alleviating and managing the neck pain.

Radiotherapy is standard practice for patients with cancer and those at risk of recurrence. High-energy X-rays interact with tissue molecules, releasing electrons and ionizing them, which damages nearby tissues further. It is believed that the radiation damage to healthy tissues is typified by the combined changes in the vascular and parenchymal tissues. While a restricted capacity to expand because of connective tissue restrictions is assumed to have an impact on the effectiveness of muscle contraction, changes in the vascular network are regarded to be the source of muscle ischemia. These findings suggest that motor control impairments in the shoulder complex, which may persist for a long time, play an important role in the development of shoulder and neck pain and dysfunction in postsurgical cancer survivors. A significant and crucial part of appropriate shoulder function is played by the scapula. Its posture and range of motion set the conditions for the shoulder's normal physiology and biomechanics.

Shoulder and neck pain have been linked to changes in scapular kinematics.

Because of its responsibilities in scapula humeral rhythm and its correlation with a wide range of clinical shoulder ailments, the scapula has been highlighted as a critical component of efficient shoulder and arm function. Weakness of the scapulothoracic muscles potentially leads to abnormal positioning of the scapula, disturbances in scapulohumeral rhythm, and generalized shoulder complex dysfunction. The serratus anterior and lower trapezius are the most commonly weak or inhibited muscles of the scapulothoracic joint that may lead to abnormal movement. Scapular motion is primarily used to maximize the dynamic, task-specific balance between scapular mobility and stability. One Scapular stability offers a stability against loads and momentum of arm motion, a stable platform for the best activation of the scapular-based muscles, and a stable fulcrum for arm function as a first-class and third-class lever. In addition to resulting in maximal concavity/compression and dynamic GH stability throughout the entire arm motion, scapular mobility also positions the arm and hand in three-dimensional space for optimal function and moves the acromion for optimal arm elevation. These factors all contribute to optimal glenohumeral (GH) joint ball and socket kinematics.

Determination of the presence or absence of dyskinesia can be accomplished through observational evaluation of resting and dynamic scapular motion and position through scapular dyskinesiatest. The patient's resting posture should be checked for side-to-side asymmetry and especially for inferomedial or medial border prominence.

Clinical testing is performed by visual observation of static position at rest with arms at the side and dynamic arm motion using the Scapular Dyskinesia Test (SDT) The exam is conducted by having the patients raise the arms in forward flexion to maximum elevation, and then lower them three to five times. Prominence of any aspect of the medial scapular border or inferior angle on the symptomatic side is recorded as "yes" (Prominence detected) or "no" (Prominence not detected).

The relationship of the dyskinesia to the clinical symptoms can be assessed through the scapular correctives maneuvers, the SAT, the SRT, and the Low Row Test.

In the SAT, the examiner applies gentle pressure to assist scapular upward rotation and posterior tilt as the patient elevates the arm. A positive result occurs when the painful arc of impingement symptoms is relieved, and the arc of motion is increased.

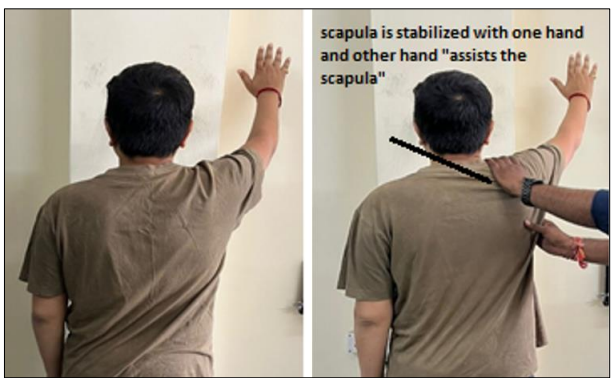

Fig 1: Scapular Assistance Test (SAT)-The patient actively elevates the arm while the scapula is stabilized and assisted through its correct motion plane

Scapular Assistance Test (SAT)-The patient actively elevates the arm then the scapula is stabilized with one hand and the other hand "assists" the scapula through its correct motion plane.

In the SRT, the examiner grades flexion strength using standard manual muscle testing procedures or evaluates labral injury in association with the modified dynamic labral shear test. The examiner then places and manually stabilizes the scapula in a retracted position A positive test occurs when demonstrated flexion strength is increased or the symptoms of internal impingement related to possible labral injury are relieved in the retracted position.

Fig 2: Scapular Retraction Test (SRT)-The examiner stabilizes the medial border of the scapula and repeats the flexion manual strength test, noting any improvement in strength or relief of impingement symptoms

Fig: Scapular Retraction Test (SRT)-The examiner first performs a traditional flexion manual strength test. The examiner stabilizes the medial border of the scapula and repeats the test; if the impingement symptoms are relieved and strength improved, the test is positive

1. The Low Row Test can be used to assess the integrity of the lower trapezius and serratus anterior muscles. To perform this maneuver, the patient is standing with the involved arm resting at the side with the palm facing posteriorly. The patient is instructed to extend their trunk and push their hand maximally against an examiner's resistance in the direction of shoulder extension and instructed to retract and depress the scapula. This maneuver assesses both muscles' ability to actively stabilize the scapula while providing the examiner a visual depiction of lower trapezius muscle contraction.

Fig 3: The Low Row Test-The patient extends their trunk and pushes their hand against resistance, retracting and depressing the scapula to assess lower trapezius and serratus anterior muscle function

The relationship of dyskinesia to shoulder pain and injury is likely due to 3 key characteristics related to scapular function.

First, muscles that attach to the scapula allow for simultaneous and synchronous muscle activation and stabilization to occur during arm movement. This allows for numerous degrees of freedom, which results in variations between individuals performing the same task.

Second, the ellipsoid shape of the thorax prevents single plane movement from occurring primarily. The absence of a single plane movement is caused by the different fiber orientations of the muscles that act on the scapula in addition to the thoracic shape.

Third, the scapular rotational movement that is described as accessory arthrokinematic motions, can be characterized as physiologic motion.

Scapular roles involve almost every aspect of shoulder and arm and neck function. Scapular dyskinesia during dynamic arm movement can be clinically characterized by early scapular elevation or shrugging upon arm elevating, quick downward rotation upon arm lowering, and/or medial or inferior medial border prominence. Considering the literature has consistently noted that scapular dyskinesia, in isolation, is not an injury or a musculoskeletal diagnosis but rather a physical impairment, scapular dyskinesia should be viewed as an impairment with a causative origin.

The exact incidence of clinically significant scapular dyskinesia is not known. There are many reasons for this deficit, including different methods of definition and evaluation of dyskinesia, differences in targeted populations, and reliance on clinical methods of qualitative observational examination, which may lead to variable measurements. Most studies reveal an incidence between 64% and 100% depending on the anatomic diagnosis.

Accordiing to AfsunNodehi *et al*. Evidence suggests that patients related with shoulder pain or neck pain specifically in post-surgical cancer patients; presents scapular kinematic abnormalities such as decreased scapular upward rotation, decreased scapular posterior tipping, and external rotation. It has been proposed that abnormal scapular kinematics may be linked to weakness of scapular muscles. Specifically, with decreased activation of the lower trapezius and serratus anterior has been proposed to be related to altered scapular position and motion.

According to Cools *et al*. patients with upper quadrant persistent symptoms may benefit from the following useful instructions for the rehabilitation of scapular dyskinesia:

1. **Conscious muscle control of the scapular muscles:** To enhance proprioception and restore the typical scapular resting position during the initial stages of scapular training, conscious muscle control of the scapular muscles may be required.
2. **Muscle (re) training:** It may concentrate more on muscle control and cocontraction (Advanced control during basic activities) or muscular strength during scapular muscle training, contingent upon the findings of the clinical examination. It is possible to train scapular co-contraction through fundamental postures, motions, and exercises. The muscles in the shoulder girdle should be trained to respond to both open and closed-chain activities. This can be achieved by using weight-bearing and non-weight-bearing upper limb tasks to challenge the maintenance of the new scapular position under load. These ought to be in line with the patient's functional requirements.
3. **Exercises for general scapular strengthening:** In the scapular muscle rehabilitation, general scapular strengthening exercises can be employed to build muscle strength after muscle balance has been regained.

Objective

1. To estimate the effectiveness of conscious control of scapular exercise along with conventional exercise on shoulder pain, scapular muscle strength, and upper extremity function, AROM of the shoulder joint in postsurgical head and neck cancer patients to correct scapular dyskinesia.
2. To explore the effectiveness of manual therapy along with conventional physiotherapy on shoulder pain, scapular muscle strength, and upper extremity function, AROM of the shoulder joint in postsurgical head and neck cancer patients to correct scapular dyskinesia.
3. To compare the effects of Manual therapy v/s scapular focused exercise along with conventional exercise on shoulder pain, scapular muscle strength, and upper extremity function, AROM of the shoulder joint in post-surgical head and neck cancer patients to correct scapular dyskinesia.

Methodology

The participants were enrolled from the rehabilitation center of a hospital from February 2022 to January 2023. Both males and females were selected in the study based on inclusion criteria.

40 participants were included in this study for each group. Participants were randomly allocated into two groups.

Group A: Manual therapy + conventional physiotherapy.

Manual therapy includes Grade III& Grade IV mobilization was performed, including arthro-kinematic movements for different sub-joints at the shoulder, such as the glenohumeral, scapulothoracic, sternoclavicular, and acromioclavicular joints, and cervical spine. The manual therapy involved glenohumeral joint mobilization (anterior, posterior, and inferior glides) with a rationale to reduce the resistance in movements and increase ROM. The anterior, posterior, and inferior glenohumeral joint mobilization increases external rotation, internal rotation, and abduction of the shoulder respectively. The soft tissue techniques were also applied at the affected muscles.

Both groups received conventional physical therapy, including pain management; scar mobilization; stretching; active and passive ROM exercises of the shoulder joint.

Group B: Conscious control of scapula + conventional physiotherapy.

1. Scapular pinches - Conscious correction of scapula begins with the patient standing and being instructed to actively “squeeze your shoulder blades together” and hold it for 3 seconds. Utilization of mirrors or mobile devices can assist patients with visualizing correct scapular positioning.
2. Robbery maneuver exercise.
3. Lawn mower exercise.
4. Cheerleader Exercise - Using single piece of theraband held with both hands in front of body, elbows completely extended, pull theraband apart in bilateral

horizontal abduction. Return to starting position, then pull theraband in D2 diagonal position with right arm up, then alternate into D2 diagonal with left arm up.

Fig 4: Conventional physical therapy includes pain management, scar mobilization, stretching, and active and passive ROM exercises of the shoulder joint

Conventional physical therapy includes pain management; scar mobilization; stretching; active and passive ROM exercises of the shoulder joint.

Each participant was participated in 12 sessions over 3 months of study period, with each session lasting 60 minutes of Intervention.

Inclusion criteria

1. Newly diagnosed oral cancer with clinical signs of spinal accessory nerve dysfunction (eg, shoulder droop, limited AROM of shoulder abduction, and insufficient muscle strength of the shoulder abductor against gravity).
2. Presence of scapular dyskinesia on observation.
3. Age: Between 30 to 55 years.
4. Gender: Both males and females were included in the study.
5. Positive SAT
6. Positive SRT
7. Positive low row test.

Exclusion criteria

1. Pregnant or breastfeeding.
2. Distant metastasis or recurrence.
3. Not able to communicate or comprehend the questionnaires.
4. History of shoulder pain in last 1 year prior to neck dissection/radiculopathy.
5. Any musculoskeletal / neurological disorder that could influence movement performance or activity.
6. Bilateral neck dissection.
7. History of acute trauma.
8. Any other systemic illness.

Outcome Measure

1. NPRS
2. DASH

The outcomes and outcome measures for the study were as follows: the disability of the arm, shoulder, and hand (DASH)questionnaire was used to evaluate functional capacity, the numeric pain rating scale (NPRS) for pain, and goniometry was used for scapular ranges, i.e., scapular protraction and upwards rotation.

Result

Table 1: Comparison between and within groups according to NPRS score

NPRS score	Group A (N=20)	Group B (N=20)	t value (Unpaired)	df	p value
Pre	7.2±1.15	7.05±1.09	0.423	38	0.674
1st month	5.95±0.94	6.3±0.98	1.153	38	0.256
3rd month	4.05±1.43	5.5±0.89	3.850	38	<0.001*
t value (Paired)	7.292	8.718			
df	19	19			
p value	<0.001*	<0.001*			

Pre NPRS score among Group A and B was 7.2 and 7.05, and this shows that that there was insignificant difference (p>0.05) in pain score before treatment.

In Group A, which received manual therapy along with conventional therapy, the NPRS score dropped from 5.95 to 4.05 (p<0.001) and in group B, which received scapular focused exercise along with conventional therapy, the NPRS score dropped from 6.3 to 5.5 (p<0.001). This shows that both methods are effective. But when we compare methods with each other it was observed that at 1st month NPRS sore in group A was 5.95 and in Group B it was 6.3, which shows that pain is more reduced in Group A as compared to Group B, but this difference in NPRs score was insignificant at 1st month. Again at 3rd month NPRS pain score of Group A and B was 4.05 and 5.5 respectively, but this time this difference in pain score was significant (p<0.001) which shows that pain score was significantly lower in Group A as compared to Group B.

Table 2: Comparison between and within groups according to dash score

DASH score	Group A (N=20)	Group B (N=20)	t value (Unpaired)	df	p value
Pre	86.15 ± 9.46	86.35 ± 9.64	0.066	38	0.948
1st month	54.35 ± 12.07	63.65 ± 14.29	2.223	38	0.032*
3rd month	35.9 ± 7.49	47.9 ± 12.01	3.792	38	<0.001*
t value (Paired)	10.869	7.451			
df	19	19			
p value	<0.001*	<0.001*			

Pre DASH score among Group A and B was 86.15 and 86.35, and this shows that that there was insignificant difference (p>0.05) in pain score before treatment.

In Group A, which received manual therapy along with conventional therapy, the DASH score dropped from 54.35 to 35.9 (p<0.001) and in group B, which received scapular focused exercise along with conventional therapy, the

DASH score dropped from 63.65 to 47.9 (p<0.001). This shows that both methods are effective. Also, when we compare methods with each other it was observed that at 1st month NPRS sore in group A was 54.35 and in Group B it was 63.65 and at 3rd month NPRS pain score of Group A and B was 35.9 and 47.9 respectively, but this time this difference in pain score was significant (p<0.001) which shows that pain score was significantly lower in Group A as compared to Group B.

Discussion

The purpose of this study was to investigate Effectiveness of manual therapy v/s conscious control of scapula along with conventional physiotherapy to correct scapular dyskinesia in post-surgical head & neck cancer patients. Recently, several studies have examined the effectiveness of a scapula-based rehabilitation programme. In the study of Hariharasudhan Ravichandran *et al*. closed and open kinetic chain exercises are used to correct the abnormal firing patterns of scapular stabilizers with the goal of achieving an active control on scapular reposition and orientation to enhance muscle flexibility. Another study by W. Ben Kibler *et al*. Supports that dyskinesia has been found in association with a large percentage of population with lower trapezius dysfunction, therefore LT must be involved for rehabilitation and management of shoulder and neck pain.

In this study, there includes 40 subject (group A, Manual therapy + conventional physiotherapy) = 20, group B; Received conscious control of scapula + conventional physiotherapy = 20) of age between 30-55yrs as per inclusion criteria pre-test assessment was made by- Positive SAT, Positive SRT, Positive low row test. Pre assessment NPRS &DASH score was taken for both groups. Subjects of Group A were made to be done with Manual therapy approach and Group B subject were made to be done with conscious control of scapula. Both group undergoes 3 months of supervised protocol; treatment assessment was made through scores of NPRS & DASH, measured at pre and followed by 3 months (Post treatment).

This study showed that the addition of manual therapy to an exercise protocol improved function, pain, and scapular movement after 3 months of intervention inpost surgical head & neck cancer patients to correct scapular dyskinesia. This research emphasizes the importance of exercise with manual therapy in both male and female patients.

However in group B because the posteriorly positioned scapula cannot be visualized, it is possible that the lack of visual feedback leads to the alterations in scapular kinetics. It is possible that patients struggle with performing conscious scapular correction properly not only because of the scapula's posterior placement, but also because scapular motion is mostly characterized as accessory motion (ie, involuntary motion). Visual acuity is the strongest type of feedback humans use for knowledge of results, knowledge of performance, and overall motor control. Too little feedback may leads to be a limitation of conscious scapular control & kinetics. Considering the scapula as a "link" within the kinetic chain, the feedback approach may be better suited for re-establishing scapular control. Feedback serves as an integrated approach to develop a conscious control of scapula with focused exercise.

The first important finding in study was that, comparison of DASH score of group A and group B have shown a significant improvement in Rom of shoulder, scapular kinematics & functional ability within 3 months in both males and females.

The second important finding in study was that, comparison of NPRS score of group A and group B have shown a significant improvement in pain within 3 months in males as well as females with this discussion it shows that both Manual therapy and conscious control of scapula are beneficial for managing pain, improving ROM and restoring scapular kinematics.

However, GROUP A showed a marked improvement than GROUP B. Hence group A is better for improving functional ability and reducing symptoms of pain improving ROM, scapular control and functional ability of patients with scapular dyskinesia and these changes were large enough to be considered clinically meaningful.

Conclusion

In summary scapular kinematic changes have been linked to neck and shoulder pain in post-surgical head and neck cancer patients. Along with changes in the surrounding muscles' strength, existence of postsurgical scar, flexibility, motor control, and timing, there is evidence of altered scapular muscle recruitment patterns in these patients. More specifically, a therapy plan for these patients may be based on their lack of scapular muscle control combined with SA and LT muscle dysfunction. The available evidence in clinical trials supports the use of manual therapy in these patients' recovery; further study is needed to validate the efficacy of these exercise regimens.

Limitations of the study

1. The sample size is too constraint. To assess the biomechanical effects of manual therapy combined with conventional physiotherapy, more research is required.
2. Study was performed only on young adults (30-55 yrs), it may also require to involve adolescent age population.
3. It lacks use of quantitative measure to check scapular muscle activation pattern and scapular kinematics. Analysis was done only with the use of observational analysis or with some special test like SAT, SRT etc to check scapular kinematics.

Conflict of Interest

Not available

Financial Support

Not available

References

1. Sana Tauqeer, Ayesha Arooj, *et al*. Effects of manual therapy in addition to stretching and strengthening exercises to improve scapular range of motion, functional capacity and pain in patients with shoulder impingement syndrome: a randomized controlled trial. BMC Musculoskelet Disord. 2024 Mar;25:192. doi: 10.1186/s12891-024-0495-2.
2. Tsuruike M, Ellenbecker TS. Serratus anterior and lower trapezius muscle activities during multi-joint isotonic scapular exercises and isometric contractions. J Athl Train. 2015. doi: 10.4085/1062-6050-49.3.80.
3. National Athletic Trainers' Association, Inc [Internet]. [cited 2024 Jul 20]. Available from: www.natajournals.org.

4. Hariharasudhan R, Janakiraman B. Assessment and rehabilitation of scapular dyskinesia: a case study. Arch Med Health Sci. 2017 Jan;4(2).
5. Kibler WB, Lockhart JW. Managing scapular dyskinesia. Phys Med Rehabil Clin N Am. 2023;34:427-451. doi: 10.1016/j.pmr.2022.12.008.
6. Chen YH, Liang WA, Lin CR, *et al*. A randomized controlled trial of scapular exercises with electromyography biofeedback in oral cancer patients with accessory nerve dysfunction. Support Care Cancer. 2022;30:8241-8250.
7. Khan AA, *et al*. Role of physiotherapy in rehabilitation of oral potentially malignant disorder (OPMD) and oral cavity cancers. J Head Neck Phys Surg. 2022 Jun;10(1):61-67. doi: 10.4103/jhnps.jhnps_70_21.
8. Agamawi YM, Kato MG. The effectiveness of physical therapy following neck dissection: a meta-analysis. Am J Biomed Sci Res. 2021 Mar 03;12(1). DOI: 10.34297/AJBSR.2021.12.001726.
9. Mozzini CB, Rodrigues TR, *et al*. Adherence to a shoulder dysfunction physical therapy protocol after neck dissection with accessory nerve preservation in head-and-neck cancer patients: an uncontrolled clinical trial. ISSN: 1658-3639. Aug 2022.
10. Cools AM, Struyf F, De Mey K, *et al*. Rehabilitation of scapular dyskinesia: from the office worker to the elite overhead athlete. Br J Sports Med. 2014;94:692-627.
11. Neto CM, Pezarat P. Effects of Breast Cancer Treatment on Shoulder Function: What to Expect and How to Treat? Int J Phys Ther Rehabil. 2018;4:147. Available from: https://doi.org/10.15344/2455-7498/2018/147.
12. Da Silva FP, Moreira GM. Manual Therapy as Treatment for Chronic Musculoskeletal Pain in Female Breast Cancer Survivors: A Systematic Review and Meta-Analysis. J Manipulative Physiol Ther. 2019;42(7):503-513.
13. Roren A, Fayad F, Poiraudeau S, *et al*. Specific scapular kinematic patterns to differentiate two forms of dynamic scapular winging. Clin Biomech (Bristol, Avon). 2013;28:941-947.
14. Gane EM, McPhail SM, Hatton AL, Panizza BJ, *et al*. The relationship between physical impairments, quality of life and disability of the neck and upper limb in patients following neck dissection. J Cancer Surviv. 2018;12:619-631.
15. Stuiver MM, van Wilgen CP, *et al*. Impact of shoulder complaints after neck dissection on shoulder disability and quality of life. Otolaryngol Head Neck Surg. 2008;139:32-39.
16. Eickmeyer SM, Walczak CK, *et al*. Quality of life, shoulder range of motion, and spinal accessory nerve status in 5-year survivors of head and neck cancer. PM R. 2014;6:1073-1080.
17. McGarvey AC, Osmotherly PG, *et al*. Impact of neck dissection on scapular muscle function: a case-controlled electromyographic study. Arch Phys Med Rehabil. 2013;94:113-119.
18. Orhan KS, Demirel T, Baslo B, *et al*. Spinal accessory nerve function after neck dissections. J Laryngol Otol. 2007;121:44-48.
19. McGarvey AC, Osmotherly PG, Hoffman GR. Scapular muscle exercises following neck dissection surgery for head and neck cancer: a comparative electromyographic study. Phys Ther. 2013;93:786-797.
20. Başkurt Z, Başkurt F, *et al*. The effectiveness of scapular stabilization exercise in the patients with subacromial impingement syndrome. J Back Musculoskelet Rehabil. 2011;24:173-179.
21. Struyf F, Nijs J, Mollekens S, *et al*. Scapular-focused treatment in patients with shoulder impingement syndrome: a randomized clinical trial. Clin Rheumatol. 2013;32:73-85.
22. Park SI, Choi YK, Lee JH, Kim YM. Effects of shoulder stabilization exercise on pain and functional recovery of shoulder impingement syndrome patients. J Phys Ther Sci. 2013;25:1359-1362.
23. Moezy A, Sepehrifar S, Solaymani-Dodaran M. The effects of scapular stabilization based exercise therapy on pain, posture, flexibility and shoulder mobility in patients with shoulder impingement syndrome: a controlled randomized clinical trial. Med J Islam Repub Iran. 2014;28:87.
24. Turgut E, Duzgun I, Baltaci G. Effects of scapular stabilization exercise training on scapular kinematics, disability, and pain in subacromial impingement: a randomized controlled trial. Arch Phys Med Rehabil. 2017;98:1915-1923.e3.
25. Bialosky JE, Bishop MD, *et al*. The mechanisms of manual therapy in the treatment of musculoskeletal pain: a comprehensive model. Man Ther. 2009;14(5):531-538.
26. Degenhardt BF, Darmani NA, Johnson JC, *et al*. Role of osteopathic manipulative treatment in altering pain biomarkers: a pilot study. J Am Osteopath Assoc. 2007;107(9):387-400.
27. Corey SM, Vizzard MA, Bouffard NA, Badger GJ, Langevin H. Stretching of the back improves gait, mechanical sensitivity and connective tissue inflammation in a rodent model. PLoS One. 2012;7(1).
28. Berrueta L, Muskaj I, Olenich S, *et al*. Stretching impacts inflammation resolution in connective tissue. J Cell Physiol. 2016;231(7):1621-1627.
29. Crane JD, Ogborn DI, Cupido C, *et al*. Massage therapy attenuates inflammatory signaling after exercise-induced muscle damage. Sci Transl Med. 2012;4(119):119ra13.
30. Darby IA, Hewitson TD. Fibroblast differentiation in wound healing and fibrosis. Int Rev Cytol. 2007;257:143-179.
31. Denham JW, Hauer-Jensen M. The radiotherapeutic injury-a complex 'wound'. Radiother Oncol. 2002;63(2):129-145.
32. Rubin JS, Lieberman J, Harris TM. Laryngeal manipulation. Otolaryngol Clin North Am. 2000;33(5):1017-1034.
33. Krisciunas GP, Golan H. A novel manual therapy programme during radiation therapy for head and neck cancer-our clinical experience with five patients. Clin Otolaryngol. 2016;41(4):425-431.
34. Langmore SE, McCulloch TM, Krisciunas GP, *et al*. Efficacy of electrical stimulation and exercise for dysphagia in patients with head and neck cancer: a randomized clinical trial. Head Neck. 2016;38 Suppl 1.
35. Westbury CB, Yarnold JR. Radiation fibrosis-current clinical and therapeutic perspectives. Clin Oncol (R Coll Radiol). 2012;24(10):657-672.

36. Paine R 3rd, Voight ML. The role of the scapula in the rehabilitation of shoulder injuries. Int J Sports Phys Ther. 2013;8(5):617-629. PMCID: PMC3811730 PMID: 24175141

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