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Effect of Scapular Mobilization on Improvement of Shoulder Flexion Range in Erb's Palsy Children

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Abstract

Objectives: The aim of this work was to show Effect of scapular mobilization on improvement of shoulder flexion in erbs palsy.

Method: Thirty children were enrolled in this study and randomly assigned into two groups; group A (scapular mobilization plus traditional physiotherapy program), and group B (traditional physiotherapy program only). Standard goniometer was used to detect and follow shoulder flexion in addition to stand and reach test. This measurement was taken before initial treatment and after 12 weeks of treatment. The children parents in both groups B were instructed to complete 3 hours of home routine program.

Results: Data analysis was available on the 30 Erb's palsy children participated in the study. The mean value of shoulder flexion ROM test in both groups at baseline measurement (pre-treatment) was insignificant ($p>0.05$). By comparison of both groups there was significant improvement in shoulder flexion ROM post-treatment ($p<0.05$). The difference between pre and post treatment results was significant in both groups in favor of the study group ($p=0.0079$).

Conclusion: According the results of this study it can be concluded that the combined effect of physiotherapy training program in addition to scapular mobilization can be recommended in improvement shoulder flexion range of motion in erbs palsy children.

Keywords: Scapular mobilization; Shoulder flexion in erbs palsy

Introduction

Synchronous motion of the sternoclavicular, acromioclavicular, scapulothoracic, and glenohumeral joints occurs when the arm is elevated through 180 degrees. Full mobility of all of the joints is critical for complete, normal shoulder motion. In 180 degrees of shoulder abduction, glenohumeral motion accounts for 120 degrees of the motion and outward rotation of the scapula accounts for 60 degrees. On initiation of abduction, the scapula is reported to abduct or adduct slightly, to oscillate, or to remain fixed in what has been termed the "setting phase, " which occurs in the first 30 degrees of abduction and in the first 60 degrees of forward flexion. With further elevation of the arm, a 2:1 relationship of gleno -humeral movement to scapula-thoracic movement develops, so that for every 15 degrees of motion, 10 degrees is gleno-humeral motion, and 5 degrees is motion of the scapula on the thorax [1].

Scapula-humeral rhythm is the motion of the scapula on the thorax which permitted by motion at the sterno-clavicular and acromio-clavicular joints. Elevation at the sterno-clavicular joint is nearly complete within the first 90 degrees of arm elevation. For every 10 degrees of elevation of the arm, the clavicle elevates 4 degrees, resulting in a total of 36 degrees of motion. About 20 degrees of acromioclavicular motion occurs in the first 30 degrees and after 135 degrees of arm elevation. As synchronous motion of all of the joints is critical for normal shoulder mobility, dysfunction in one component part may affect the other parts and restrict normal motion [1].

When the arm is resting at the side, the capsule of the glenohumeral joint is taut in the lateral (external), superior portion and loose in the medial (internal), inferior portion, which is deflected downward like a pouch on the shaft of the humerus .This structure allows freedom of movement throughout the full ROM. The tendons of the rotator cuff muscles serve to increase capsular strength throughout the ROM with the exception of the inferior portion. This joint structure allows the head of the humerus to move inferiorly in the glenoid fossa during normal elevation of the arm [1].

When scapular stability is poor, the normal glenohumeral rhythm is disrupted and the humerus and scapula move as one unit. The muscles between the scapula and humerus, such as the terse major and latissimus dorsi, never elongate fully and may become shortened. Abduction, forward flexion, and lateral rotation generally are limited, and the scapula instability excessively with passive elevation. In the child with cerebral palsy who has spastic trunk [2].

Joint ROM is limited by capsular or ligamentous tightness or adherence, passive mobilization can be used to lengthen shortened structures or to rupture the adhesions. Parislo, the mobilization must be performed at the limit of the joint's available range of movement, taking the tissue into the area of plastic deformation on the stress strain curve, or, when adhesions are present, to the point of failure, causing rupture. Techniques presumably would have to be performed at the end of the range of movement. When the associated findings of muscle shortening, hypo or hyperactive stretch reflexes, skeletal deviations, and muscle weakness are considered, the use of mobilization to enhance or restore joint mobility .When joint hypo-mobility has led to capsular dysfunction; mobilization may be an effective technique for increasing ROM [3].

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Manual therapy has been stated to be most effective when directed at "mechanical joint dysfunction in which there is restriction of accessory motion due to capsular or ligamentous tightness or adherence. Accessory movements particular to that joint should be detected to determine the presence of pain or resistance to movement which typically produced by either capsule-ligamentous tightness (stiffness) or muscle tightness. The resistance produced by stiffness is described as being consistent in strength and position in the range of movement, whereas that produced by muscle tightness varies in response [4].

Material and Method

Subject: subject

30 Erb's palsy children with age ranged between6 and 9 years at the time of recruitment. The site of lesion includes both distal and proximal type of lesion in Erb's palsy. Patients were excluded from the study if they had seizures and patients with shoulder fixation. The thirty subjects that met the study criteria were randomly assigned into two groups of equal number:

Group A (study group)

Consists of 15 Erb's palsy cases (4 females and 11 males) (6 right handed and 9 left hand) and were treated by specialized physiotherapy program (traditional physiotherapy program plus scapular mobilization).

Group B (control group)

Consisted of 15 patients (5 females and 10 males) (10 right handed and 5 left hand) and were treated with traditional physiotherapy program only.

Outcome measurements

The study was a comparative experimental design with a baseline therapeutic procedure of traditional physiotherapy program. The effect of scapular mobilization on improvement of shoulder ROM in flexion compared between study and control group.

Stand and reach test (measured in centimeters), using a measuring vertical tape scale. The child stands side on to a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded for quick follow up of cases [5].

Tape measured distance: Place the hand behind back reach in centimeters. The subject was standing with feet shoulder width apart. With thumb extended, the subject reached the affected extremity upwards and towards the midline to a maximum hand behind back position. The rater used a tape measure to record the distance in centimeters from the thumb tip to T1 spinous process, for quick follow up of cases [6].

Flexability test: Tightness of the posterior capsule may be suggested by decreased internal rotation of the affected arm with the shoulder at 90 degrees of flexion and the elbow flexed to 90 degrees.

Range of motion test for shoulder flexion: Of all the joints, the shoulder has the greatest range of motion. The assessment of shoulder range of motion is important in the diagnosis of disorders of the shoulder and for the evaluation of the strategies that may alter shoulder function. There have been a number of tools designed to measure joint range of motion using a plastic Goniometry (measured in degrees can be used reliably for measuring active movements of flexion, . The subject was positioned in sitting. The subject moved the affected extremity (thumb pointing upwards) to the end of active range of shoulder flexion.

Measurement tool: Plastic Goniometer.

Testing position: Supine with hips and knees bent and lumbar spine flat. Arm is at the side with the palm in and the thumb up.

Stabilization: Body weight should stabilize scapula but manual stabilization may be required to prevent excessive scapular rising and tipping posteriorly.

Goniometer axis: Lateral aspect of the center of the humeral head approximately 1" below the acromion process.

Stationary Arm: Parallel to midaxillary line of the trunk.

Moving arm: Parallel to longitudinal axis of the humerus pointing toward the lateral epicondyle

Movement: Shoulder flexion.

Expected ROM: 120° of pure GH flexion; 150° with GH, AC, SC, and scapulothoracic contribution; 180° if lumbar hyperextension permitted.

Intervention

For all children, the programs were conducted three times weekly, for 12 weeks. Each session lasted 45 minutes manual and 15 minutes electrical in addition to 1 hours of home program, 7 days a week during the treatment period.

Both groups (A and B) received a traditional physiotherapy program, as the following

An appropriate therapy program consists of maintaining full shoulder motion and strengthening of the shoulder using proper posture and proprioceptive exercise. The goal of a strengthening program is to enhance the compensatory muscles and to regain muscular balance about the shoulder.

• Hot packs on shoulder girdle to improve circulation and relax muscle tension for 10 minutes.

• Facilitation of peri-scapular and shoulder muscles: tapping , scratching followed by movement, quick stretch, weight bearing ex., approximation, vibration, irradiation to weak muscles by strong muscles, ice application for brief time. For 5minutes.

• Passive stretching was performed to tight muscles as sub-scapularis, pronator, pectoralis major, biceps brachii, wrist flexors to destruct adhesions in muscles and sheath. Also passive stretch occurs for levator scapulae, and pectoralis minor. For 10 minutes.

• Graduated active exercise was performed for upper limb muscles, serratus anterior, trapezius, and rhomboids muscles for 5 minutes.

• Balance training program which include dynamic approach for 5 minutes.

The experimental group (group A) received specialized physiotherapy program as following

• Scapular mobilization is performed from side lying position facing to physiotherapist, the index hold medial border of scapula, thumb hold lateral border of scapula and web space hold inferior angle of scapula, then perform mobilization in upward rotation and down ward rotation, adduction the abduction of scapula. Sets of 10 repetitions were applied with a rest interval of 30 seconds between sets.

• The intervention consisted of applying superior and inferior gliding, rotations, and distraction to the scapula of the affected shoulder. The participants laid the affected forearm on their back. The therapist stood before the patient's affected shoulder, placing the index finger of one hand under the medial scapular border, the other hand grasping the superior border of the scapula. The scapula was moved superiorly and inferiorly for superior and inferior glide, and then the scapula was rotated upward and downward for scapular rotation. Second, with the patient was in the same position the physiotherapist put the ulnar fingers under the medial -scapular border and distracted the scapula from the thorax. These patterns were chosen because decreases in scapular upward rotation, posterior tilt, superior tilt, and external rotation [7].

• Shoulder joint gliding with scapular mobilization from side lying position backed to physiotherapist the thumb hold medial border of scapula, index hold shoulder in completely adduction and resting on trunk the apply upward rotation of scapula with superior gliding and downward rotation of scapula with inferior gliding, then retraction of scapula with posterior gliding of shoulder and protraction of scapula with anterior gliding of shoulder. Sets of 10 repetitions were applied with a rest interval of 30 seconds between sets.

• Shoulder manipulation the child in side lying backed to physiotherapist , one hand of physiotherapist fix scapula and the other hand perform adduction of shoulder with gradual flexion in shoulder which perform stretch on posterior capsule of shoulder. Repeat 3 times for 5 times maximum with a rest interval of 30 seconds between sets.

• The abnormal scapular biomechanics that occur as a result of dysfunction create abnormal scapular positions that decrease normal shoulder function. Therefore, treatment of shoulder dysfunction should include scapular-mobility exercises, or scapular-mobilization (SM) techniques. It involves the manual application of a sustained mobilization (in 4 directions) by a therapist to a scapula-thoracic joint.SM is the treatment technique widely used in the management of musculo-skeletal disorders of the shoulder.

• The presence of immature growth plates is another reason for caution. If joint mobilization were to be used for younger children or children undergoing growth spurts, for example, only gentle oscillations should be used to avoid the production of pain or reactive muscle spasm during treatment

Results

Patients characteristics

Table 1 shows the demographic and clinical characteristics of all patients. There were 16patients (53.33%) boys and 14 patients (46.67%) girls. Right hand dominance reported in 16patients (53.33%), while 14 patients (46.67%) were left hand dominance. There was no significant difference between the two groups in terms of age (p=0.9434), hand dominance (p=0.0952) and in term of sex (p=0.6140).

Changes in shoulder flexion ROM

Mean test scores and standard deviations for both groups are shown in the table 2. The mean value of shoulder flexion ROM test in both groups at baseline measurement (pre-treatment) was insignificant (p>0.05). By comparison of both groups there were significant improvement in shoulder flexion ROM post-treatment (p<0.05). The statistical difference between pre and post treatment results was significant in both groups in favor of the study group (p=0.0079). The average improvement of shoulder flexion ROM tended to being highly significant in the study group (100.4 ± 8.32 versus 105.71 ± 10.13, p=0.0079) than in the control group (98.07 ± 4.77 versus 98.36 ± 5.02 p=0.040). The percentage of improvement of shoulder flexion ROM was (5.289 %) in the study group compared to the (0.296%) in control group.

Variables	Control group n=15	Study group n=15	p-value
age	7.43 ± 1.09	7.40 ± 1.06	0.9434
Sex N (%) Boys girls	 5 (33.3%) 10 (66.6%)	 11 (73.33%) 4 (26.67%)	0.6140
Hand dominance N% Right left	 10 (66.67%) 5 (33.33|%)	 6 (40%) 9 (60%)	0.0952

Table 1: Patient's characteristics.

Average test of shoulder flexion ROM test	Study group Mean ± SD	Control group Mean ± SD	p-values (Between group)
Pre-treatment	100.4 ± 8.32	98.07 ± 4.77	0.3573
Post-treatment	105.71 ± 10.13	98.36 ± 5.02	0.0235
% improvement	5.289%	0.296%	0.0066
p-values (Within group)	0.0079	0.040	

Table 2: The average test of shoulder flexion ROM test in both groups.

Discussion

Under lying mechanism of scapular mobilization in improvement of shoulder flexion

End-of-range passive movements may reduce peripheral input to the CNS, thereby decreasing pain, in two ways. The first is via a temporary reduction in intra-articular pressure due to decreased tension on the joint capsule and inhibition of muscle contraction by discharge produced in joint afferents with end of joint mobilization movement. This decrease in tension could be due either to fluid reduction within the joint space or to stretch of collagen fibrils. The second way in which end-of-range passive movements may reduce peripheral input to the CNS is through adaptation of the encapsulated endings of joint nerves to the mechanical stimulus of prolonged stretch of the periarticular soft tissue.

Secondary effects of improved mobility include beneficial effects on joint cartilage and improved blood and lymphatic flow. Passive motion has demonstrated significant increases in cellularity, cell products, strength, and mobility in those tissues receiving passive motion. A possible mechanism for this increase in range may be the improved nutrition of cartilage produced by movement, improved matrix organization, collagen concentration, strength, and linear stiffness of ligament scars that were moved in immobilization [8].

Joint Mobilization Is a type of passive movement performed by the PT at a speed slow enough that the patient can stop the movement. The tech. may be applied with Oscillatory motion TO ↓Pain and (or)↑mobility. All can be treated with gentle joint play technique to stimulate neurophysiological & mechanical effects.

Neurophysiological effect: Small amplitude oscillatory mov → stimulate mechano-receptor → ↓ transmission of nociceptive stimuli via: stimulate. Theories of pain:

Mechanical effects: Small-amplitude movement → synovial fluid motion→ bring nutrients to the avascular portions of articular cartilage (↓ischemia). Gentle joint play → maintain nutrient exchange → prevent painful effects of stasis when a joint is painful or swollen and can't move through a ROM. (but not in acute or massive swelling) [9].

Developmental considerations

There are a number of neurodevelopmental disabilities for which joint mobilization and, particularly spinal manipulation, would be strongly contraindicated. Although physical therapists would likely not use joint mobilization in the presence of hyper mobile joints, specific statements about the children for whom this treatment is contraindicated are warranted. In the child with pure athetoid and ataxic forms of cerebral palsy, joints tend to be hyper mobile. Hypermobility of the spine in children with athetoid cerebral palsy may lead to cervical instability; researchers have noted that "rapid and repetitious neck movements seem to accelerate the progression of cervical instability in athetoid CP patients." Another common neurodevelopmental disability in which joints are hypermobile secondary to lax ligaments is Down syndrome. In a report of 265 individuals with Down syndrome, 23% of the subjects had patellar instability leading to subluxation or dislocation and 10% had hip subluxation or dislocation. 51 Of even greater concern in Down syndrome is the presence of atlantoaxial instability, which has been reported in up to 15% of individuals with this disorder 52 other, less common, neurodevelopment disabilities, such as Prader-Willi syndrome, may be characterized by generalized hypotonia and hypermobile joints 53 for these children as well, joint mobilization would be contraindicated. Many children with generalized development delay of unknown etiology also exhibit hypotonia and ligamentous laxity.

In the typically developing child, somatic muscle growth is stimulated by skeletal growth as a result of the increasing distance imposed on the muscle attachments as bone grows. Thus, skeletal muscles "increase in length in parallel with, and apparently in response to, bone growth. Such changes in muscle may develop if opposing muscles are paralyzed or weak, as in the case of the child with erbs palsy or in a child with hypotonia. When the agonist muscle fails to grow normally, muscle tightness result. Similarly, changes in muscle can have an effect on bones or joints (e.g. muscle tightness will lead to a decrease in joint movement with possible subsequent conversion of part of the articular cartilage into fibrous tissue). Growth cartilage is present at three sites in the developing child: the epiphyseal plate, the joint surface, and the apophysis or tendon insertion Injuries to each of these sites as a result of the repetitive stresses .The predisposition of immature growth plates to injury-particularly during growth spurts-suggests the need to be cautious when using joint mobilization in children [10].

Although muscle and bone growth are delayed in the involved limbs of children with erbs palsy. Growth spurts presumably take place, because overall growth occurs. Paralysed muscle grows more slowly than normal muscle in relation to bone growth. The musculoskeletal development of children with erbs palsy is different from typically developing children. Alterations in bone and muscle growth occur as a result of the effect of prolonged paralysis [11].

Movement restriction in older children with long-standing hypo-mobility may be secondary to capsular tightening and adhesions in addition to muscle tightness. Joint mobilization in conjunction with neuro-physiological forms of therapeutic exercise, may be indicated for such children. Cautions however, that capsular dysfunction may be difficult to differentiate from movement restriction caused by muscle tightness [12].

The capsular changes seen in adhesive capsulitis have been described as a "gluing together" of the synovial surfaces in the pouched area of the capsule. This portion of the capsule becomes thickened and contracted; the synovial fluid becomes more viscous, and the walls of the capsule adhere to each other. These capsular changes prohibit the downward movement of the humerus in the glenoid fossa during abduction and forward flexion. Even when positioning and handling are used to inhibit increased tone and facilitate movement, joint ROM may remain limited because of capsular tightening.

Inferior shoulder capsule tightness might affect shoulder flexion and abduction, because the scapulo-thoracic joint is composed by muscles, not like synovial joints. SM may break up adhesions and release these muscles; hence, scapular movement may be increased. The improvement of shoulder movement might also be related to increased scapular movement.

It is accepted that the glenohumeral and scapulothoracic joints are in the closed kinetic chain. We assume that if glenohumeral mobilization improves shoulder movements and normalizes the scapula-humeral rhythm, SM should improve shoulder movements; this is related with our findings, because of the relation between shoulder and scapular. Joint-mobilization techniques also have neurophysiologic effects, which are based on the stimulation of peripheral mechanoreceptors and the inhibition of nociceptors. These mechanoreceptors are present mostly around synovial joint. Synovial joint mobilization may provide sufficient sensory input to activate the endogenous pain-inhibitory systems [2, 6].

Scapular mobilization may be related to muscle structures rather than the synovial joint, which is rich in mechanoreceptors. Shoulder flexion function after the application of SM. Our primary interest was to assess SM related to shoulder ROM and shoulder-function disabilities. When scapular and shoulder movements are improved, shoulder functional status gets better [13].

Conclusion

The use of mobilization as an adjunct to neuro-physiological treatment approaches for children with erbs palsy. With a greater knowledge of mobilization and its use in combination with neurophysiological approaches, therapists may have a valuable tool for the treatment of shoulder flexion limitations in children with erbs palsy

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