Original Article

Comparative study of the effect of taping on scapular stability and upper limb function in recovering hemiplegics with scapular weakness

Abstract

Background: Hemiplegia is the commonest form of paralysis, involving arm, leg and sometimes the face on one side of the body. Shoulder girdle in chronic hemiplegic suffers from two sorts of problems (a) spasticity of elevators and retractors, which pull the scapula into a fixed elevated and retracted position. (b) weakness of the opposite group of scapular muscles, i.e., depressors and protectors. This leads to instability of the scapulothoracic joint resulting in impaired functional use of the upper limb, taping is a method of maintaining orientation of the scapula by means of proprioceptive biofeedback to the patient. Aim of this study is to check the effect of taping on scapular stability and upper limb function in recovering hemiplegics. **Objectives of the Study:** (1) To study the effect of taping on functional performance of the hemiplegic upper extremity. (2) To compare the effect of taping combined with physiotherapeutic exercises v/s physiotherapeutic exercises alone on functional independence of the hemiplegic upper extremity. **Subjects:** All the 37 chronic hemiplegic patients with scapular weakness were taken and divided into two groups: Group A (Experimental group) and Group B (Control group). **Materials and Methods:** All the 37 chronic hemiplegic patients were evaluated by Fugl Meyer Physical Performance Assessment Scale for hemiplegic upper extremity before starting the treatment. Group A patients received scapular taping combined with physiotherapeutic exercises and Group B patients received only physiotherapeutic exercises for the period of 2 weeks. After 2 weeks both Group A and B patients were re-evaluated on Fugl Meyer Physical Performance Assessment Scale for hemiplegic upper extremity. **Results:** There was a significant improvement between the pre- and post-treatment scores of Group A patients on the Fugl Meyer Physical Performance Assessment Scale of hemiplegic upper extremity, whereas Group B patients score on the same scale was insignificant. **Conclusion:** Scapular taping has improved to be effective in improving stability of the scapula and also in improving functioning motor performance in hemiplegic upper extremities in recovering hemiplegic patients along with traditional physiotherapeutic exercises.

Key words:
Chronic hemiplegic, scapula muscles weakness, taping

Introduction

A number of techniques are used widely by the physiotherapists to treat the spastic hemiplegic patient but very few therapists are concerned about proximal control of scapulothoracic joint.[1] Scapulothoracic joint is having its direct relationship with shoulder, elbow, and wrist as a close kinetic chain. In residual paralysis hemiplegic, patient does not have proximal stability at scapulothoracic joint. So whenever a patient tries to do shoulder flexion/abduction, he will not be able to do isolated range of motion but he will do compensatory movements at the shoulder in order to complete the

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Dhwanit Shah, Divakar Balusamy[1], Mamtarani Verma[2], Giri Jui[3]

Departments of Physiotherapy, New Civil Hospital Campus, [1]Pharmacology and [2]Community Medicine, Government Medical College, Surat, Gujarat, [3]Physiotherapy, Terna College, Nerul, Navi Mumbai, Maharashtra, India

Address for correspondence:
Dr. Divakar Balusamy,
B-13, Assistant Professor Quarters, New Civil Hospital,
Majura Gate, Surat - 395 001, Gujarat,, India.
E-mail: divakarpharma@rediffmail.com

task.[2] People with motor dysfunction like stroke spontaneously utilize these compensatory strategies in order to achieve a goal and there is a strong tendency for such compensations to become learned. For example, a person who has difficulty activating the shoulder flexors and external rotators will reach forward by abducting and internally rotating the shoulder joint. This may assist individual to achieve the goal in the short-term but will interfere with his achieving in a different context. If he uses the same muscle activation pattern when he reaches for a glass of water or to shake hands, in both these later cases, he will not be very successful. This is an example of a compensatory strategy which is a fundamentally inappropriate action.[2] This continual practice of such a fundamentally inappropriate reaching action in the early stages following stroke will lead to the compensatory movement substituting for the more effective movement and this may be one of the mechanism, which limits recovery following brain damage.[2] So in recovering hemiplegic patient, the appropriate training strategies need to be investigated early in order to prevent compensatory movements substituting for the more effective movements. For example, for reaching to be regained as an efficient, flexible action, the brain must make adaptations so that the appropriate neural pathways become patent. It has been suggested that if compensation occurs, there is apparently no stimulus to the partially damaged system to recover.[2] In order to prevent these compensatory strategies, one of the treatment techniques is to gain stability of the proximal structure like scapulothoracic joint.

So the purpose of this study is to orient the scapula to its normal resting position by means of applying taping on the scapula and check if it affects the upper extremity functional outcome in hemiplegic patient or not.[3-7]

There is literature supporting the evidence that afferent input to the spinal cord by the movement of the proximal joints can reduce spasticity and so facilitate the normal movement. Abnormal scapula alignment and movement, or scapulothoracic dyskinesis, can result in clinical findings consistent with instability of the shoulder complex.[8]

Thus taping to the scapula applied in such a way that which muscles are hyperactive and produces abnormal synergistic movements of the scapula during arm raising activity and prevents the normal functioning of the affected upper extremity and restricts the normal movements of the scapula are inhibited.[6]

Taping has its effects of proprioception, sensory feedback, stability, correcting muscular imbalances, kinesthetic awareness, supporting action, etc., in different literatures.[3,4,6,7,9-12]

Scapular taping has its effects in to improve alignment, which promotes improved movement patterns, to alter length-tension properties by stretching tissues that are too short and reducing tension placed on tissues that are too long, to provide support and reduce stress to myofascial tissues under chronic tension[13] to provide kinesthetic awareness of scapular position during rest and movement. Even taping is also having an effect on inhibition and facilitation of muscular structures.[3-6]

Here, in this study, taping to scapula has been used to inhibit hyperactive upper trapezius muscle to depress the scapula in its normal resting position.[4,5] It will prevent associated movements of shoulder elevation during arm raising activities.

Taping also has been used to facilitate the Serratus anterior muscle which helps in elevating, laterally rotating and protracting the scapula, which is restricted or absent in spastic hemiplegic patients due to disuse or weakness of the Serratus anterior muscle.[5,6,14] Thus facilitation of it allows the hemiplegic patient to move his arm above the head in forward flexion or abduction.[5-7,10-12,14-16]

Short-term taping of 2-3 weeks may assist in improving neuromuscular control of the faulty movement patterns.[4,11]

Thus from all above discussion, here aim of study is to see how scapular taping helps the hemiplegic patients in improving his upper extremity functional outcome.

Need for the study

Chronic hemiplegic patient with residual scapular weakness has the spasticity of some of the scapular muscles, which disturb the proximal stability of the scapulothoracic joint.[9,17-20] These muscles are scapular elevators i.e., upper trapezius and scapular retractors, i.e., serratus anterior, which impaired the functional activity of the hemiplegic upper extremity.[3-5,9,17-19,21]

Thus, taping may be one of the techniques to correct these muscular imbalances[6] and to gain symmetry of the scapula at the scapulothoracic joint[12,20,22] to improve functional outcome at hemiplegic upper extremity along with other physiotherapeutic exercises.

There is lack of conclusive evidence to prove that taping by stabilizing scapula improves the functional performance of affected upper extremity. Hence the aim of this study is to check the effect of taping on scapular stability and upper limb function in recovering hemiplegics.

Materials and Methods

Objectives of study

1. To study the effect of taping on functional performance of the hemiplegic upper extremity

2. To compare the effect of taping combined with physiotherapeutic exercises v/s physiotherapeutic exercises alone on functional independence of the hemiplegic upper extremity.

Research hypothesis

Null hypothesis

Scapular taping has no effect on the functional independence of hemiplegic upper extremity.

Alternate hypothesis

Scapular taping has been beneficial in improving upper extremity functional independence in recovering hemiplegics with scapular weakness.

Subjects

Thirty-seven chronic hemiplegic patients with scapular weakness were taken and divided into two groups: Group A (Experimental group) and Group B (Control group).

Source of data collection

1. Yenapoya Medical College and Hospital, Derlakatte, Mangalore
2. Unity Health Complex, Mangalore
3. Shree Devi College of Physiotherapy – Out Patient Dept, Mangalore
4. Dr. N. Shanker's Mallikatte Neuro Centre, Mangalore
5. Government Wenlock District Hospital, Mangalore.

Inclusion criteria

1. Patients diagnosed as stroke leading to hemiplegia by neurologists
2. Chronic stroke patient more than 9 months
3. Hemiplegic patients demonstrating weakness of scapular muscles i.e., less than grade 3 on manual muscle testing scale.

Exclusion criteria

1. Unconscious patients
2. Hemiplegic patient with unstable vital parameters
3. Hemiplegic patient in flaccid stage
4. Hemiplegic patient having spasticity greater than grade 2 according to Modified Ashworth Scale
5. Hemiplegic patient having contractures and deformity of the upper limb
6. Hemiplegic patient with cognitive and perceptual disorders
7. Hemiplegic patient having sensory, behavioral dysfunction and emotional liability
8. Hemiplegic patient who is having any associated history of trauma and other medical disorders of hemiplegic upper extremity.

Sampling

Convenience sampling

Methods

Study design

Experimental study

In our study, we have taken 37 hemiplegic patients fulfilling the inclusion criteria. We have divided hemiplegic patients into two equal groups, Group A and Group B, randomly. Both groups of patients have been first evaluated on Fugl Meyer Physical Performance Assessment Scale for their motor performance on hemiplegic upper extremity before starting the treatment as pre-assessment scale.

After that, we have taken Group A patients, 19 patients, and we have applied two adhesive elastic tape (dynaplast) to these hemiplegic patients in order to orient in normal alignment. Hemiplegic patients have spasticity of the elevators, i.e., upper trapezius, and retractors i.e., rhomboids, which will pull the scapula into a fixed elevated and retracted position.

By this way, we have aligned the scapula in a near normal position. Then we have given the traditional therapeutic approaches for the treatment of spastic hemiplegic shoulder and also to strengthen and stabilize scapular muscles for the period of the 2 weeks with 30-45 min to each patient. We have treated the Group B patients (18 patients) with the only the traditional therapeutic exercise program without the application of the taping for the same period of time.

After the 2 weeks, we have reassessed the functional outcome at the hemiplegic upper extremity by the Fugl Meyer Physical Performance Assessment Scale (Post-treatment scale).

Tools [Figure 1]

- Elastic adhesive tape (Dynaplast)
- Non-elastic adhesive tape (Anchor)

Using these tools we have aligned the scapula in a near normal position. Then we have given the traditional therapeutic approaches for the treatment of spastic hemiplegic shoulder and also to strengthen and stabilize scapular muscles for the period of the 2 weeks with 30-45 min to each patient. We have treated the Group B patients (18 patients) with the only the traditional therapeutic exercise program without the application of the taping for the same period of time.

After the 2 weeks, we have reassessed the functional outcome at the hemiplegic upper extremity by the Fugl Meyer Physical Performance Assessment Scale (Post-treatment scale).

Data analysis

Means, standard deviations were calculated and data were subjected to statistical analysis using the computer package SPSS. Unpaired and paired *t* test were applied to determine any significant difference between the experimental and control groups immediately before the intervention and after the intervention.

Observations and Results

We have studied a total of 37 patients. All patients were randomly categorized in two Groups A and B; A Group having 19 patients; 15 male and 4 female patients. At the start of the experiment both groups were uniform in their socio-demographic features. Mean age of Group A and Group B patients was 48.21±12.61 years and 48.38±10.47 years respectively and it is statistically insignificant [Table 1]. Table 2 shows comparison of mean and standard deviation of upper arm, wrist and total upper extremity scores for Group A and Group B. There is a statistically significant result for upper extremity scores.

Figures 2 and 3 are the photographs of chronic hemiplegic patients with residual scapular weakness.

The weakness of the opposite group of scapular muscles i.e., depressors, i.e., middle and lower trapezius, and protractors, i.e., serratus anterior, due to counter stretch and non-use atrophy of these muscles.

Figure 4 shows the resting position of the right side of hemiplegic shoulder.

Here, we have used first tape to inhibit the upper trapezius muscle and inhibited the abnormal elevated position of the scapula and second tape have been used to facilitate the serratus anterior muscle and facilitated upward rotation and protraction of scapula.

We have first cleaned the scapular region of the patient with spirit and then applied two anchor (non-elastic adhesive tape) over which we have applied elastic adhesive tape. One tape is applied from the anterior aspect of the upper trapezius just above the clavicle over the muscle belly to approximately the level of 7th rib in a re- and post-test scores of Group A (mean=49.74, *P*=0.001 vhs) on the Fugl Meyer Assessment Scale, where as in Group B vertical line. Second tape has been used to facilitate the serratus anterior muscle.

Figures 5-10 show application of anchor over the upper trapezius in order to inhibit it.

Figure 1: Tools of our study

Figure 2: Spasticity of the upper trapezius muscle leading to elevated right shoulder

Figure 3: Abnormal elevated position of scapula

Figure 4: Abnormal elevated and retracted position of right side scapula

Table 1: Descriptive statistics of comparison of measures (mean and standard deviation) of age and sex (count and percentage) both groups

Group A and Group B	*N*	Mean	Standard deviation	*T*
Mean and SD for age				
A	19	48.21	12.61	0.047
B	18	48.38	10.47	*P*=0.96
Count and percentage for sex (%)				
Male	15 (78.9)	10 (55.6)	25 (67.6)	0.81 (*P*=0.42)
Female	4 (21.1)	8 (44.4)	12 (32.4)	0.878 (*P*=0.38)
Total	19 (100)	18 (100)	37 (100)	

*χ^2=2.30; *P*=0.129; SD – Standard deviation

Table 2: Comparison of measures (mean and standard deviation) of upper arm/wrist and total upper extremity scores pre to post treatment of Group A and Group B

Group	Paired differences		*T*	*P* value
	Mean	Standard deviation		
Upper arm				
With taping-A	−7.7895	4.93940	6.874	0.001
Without taping-B	−2.2778	2.08088	4.644	0.001
Wrist				
With taping-A	−8.6316	5.95549	6.318	0.001
Without taping-B	−1.8333	2.43141	3.199	0.005
Total upper extremity				
With taping-A	−16.4211	9.55868	7.488	0.001
Without taping-B	−4.1111	3.69242	4.724	0.001

*Statistically significant results for upper extremity scores at upper arm, wrist and total upper extremity for Group A patients after applying taping procedure

Figures 11-14 show application of anchor over the serratus anterior in order to facilitate it.

Pre-assessment Fugl Meyer Physical Performance Assessment Scale for both the groups was Group A (experimental) (mean=38.84) and Group B (control) (mean=42.38) which is statistically not significant (*P*=0.367 ns) [Table 3]. At the end of the experiment, however, we find that there is significant difference between the pre- and post-test scores of Group A (Mean mean=49.74, *P*=0.001 vhs) on the Fugl Meyer Assessment Scale, where as in Group B (mean=46.50, *P*=0.365 ns) [Table 3] the difference between pre- and post-assessment scores on Fugl Meyer Scale are not significant.

Discussion

On the basis of the statistical analysis of the data collection, we can see that result of Group A (experimental) (mean=38.84) and Group B (control) (mean=42.38) [Table 3] on pre-assessment scale is not significant (*P*=0.367 ns). At the end of the experiment, however, we find that there is very highly significant difference between the *P* (mean=46.50, *P*=0.365 ns) [Table 3] the difference between pre- and post-assessment scores on Fugl Meyer Scale are not significant. This shows that scapular taping has improved the functional outcome in upper extremity hemiplegics with scapular weakness. There may be some of the following reasons in improving functional out come in upper extremity of the hemiplegic patient with taping.

In chronic hemiplegic patients with scapular weakness, the spasticity of the scapular elevators, i.e., upper trapezius and scapular retractors, i.e., rhomboids which pull the scapula in to fixed elevated and retracted position and also has the weakness of the opposite group of scapular muscles i.e., depressors and protectors i.e., serratus anterior due to counter stretch and non-use atrophy of these muscles which produces the instability of the scapulothoracic joint resulting in impaired functional use of the upper extremity.

Scapular taping has improved the alignment of the scapula by inhibiting the hyperactive upper trapezius and facilitating the weak serratus anterior muscle by altering length-tension properties of muscles and providing kinesthetic awareness of scapular position during rest and movement of upper extremity. Scapular taping also produces traction and pressure on the skin which provides the cutaneous sensory cues, thus providing additional proprioceptive input to the Central Nervous System, which helps in orientation of the scapula.

Figure 5: The level of anterior application of the anchor

Figure 6: The level of posterior application of the anchor

Figure 7: The level of anterior application of the dynaplast over the anchor

Figure 8: The level of posterior application of the dynaplast over the anchor

Figure 9: The full view of the application of the anchor

Figure 10: The full view of the application of the dynaplast over the anchor

In such a way, short-term taping of 2 weeks improves control of the movement patterns. Thus, at end of the discussion, we can say that "External support to the scapula in order to realign it, has beneficial effects on motor performance of

Figure 11: Upper level of the application of the anchor

Figure 12: Upper level of the application of the dynaplast over the anchor

Figure 13: Full view of the application of the anchor

Figure 14: Full view of the application of the dynaplast

hemiplegic upper extremity." Thus, we accept the alternate hypothesis in favor of null hypothesis.

Precautions taken during taping procedure

1. Apply good material tape with proper aseptic precautions before applying tape like proper cleaning and shaving of skin over which tape is going to apply
2. Regular reapplication of tape as it becomes loose for its best results
3. Regular observation and inspection of surrounding skin areas for any redness or infection around taping.

Limitations

There are some limitations, which we found during our study, are listed down.

1. Maintenance of the tape over 2 weeks was difficult due to tape becoming loose after the 5-6 days of its application in some patients because of bathing, excessive use of affected extremity, and during other activities of daily living, which required re-application of tape
2. Taping for 2 weeks has produced rashes and marked redness over application area at the removal of the taping in some patients
3. Confounding variable of spontaneous recovery was difficult to control. Positive score on Fugl Meyer Assessment Scale could be partly attributed to natural or spontaneous recovery
4. Patient's willingness for not to continuing taping for the period of 2 weeks
5. If the taping is not reapplied after it became loose, it has shown its reduced effectiveness in improving functional outcome at affected hemiplegic upper extremity.

Thus above points of limitation should be taken care by physical therapists for the future studies with some modifications.

1. Increase sample size
2. Effect of taping on initial phases of stroke
3. Compare the result of the wrist and upper extremity in the same study.

Table 3: Descriptive statistics of comparison of measures (mean and standard deviation) of upper arm/wrist and total upper extremity

	N	Mean	Standard deviation	*T*
Mean and SD of upper arm pre- and post-treatment of Group A and Group B				
Pre				
Group-A	19	22.26	5.79	0.89
Group-B	18	24.00	5.99	*P*=0.37
Post				
With taping-A	19	27.78	5.09	0.85
Without taping-B	18	26.27	5.68	*P*=0.4
Mean and SD of wrist pre-and post-treatment of Group A and Group B				
Pre				
Group-A	19	16.57	7.67	0.81
Group-B	18	18.38	5.65	*P*=0.42
Post				
With taping-A	19	21.94	6.57	0.878
Without taping-B	18	20.22	5.26	*P*=0.38
Mean and SD of total upper extremity pre-and post-treatment of Group A and Group B				
Pre				
Group-A	19	38.84	12.46	0.91
Group-B	18	42.38	11.06	*P*=0.37
Post				
With taping-A	19	49.74	11.15	0.917
Without taping-B	18	46.50	10.27	*P*=0.365

*Statistically non-significant results after making comparison among both opposite Groups A and B both before and after application of taping at upper arm, wrist and total upper extremity level. SD – Standard deviation

Conclusion

From all of the above discussion and result, we conclude that scapular taping is effective in improving stability of the scapula and also in improving functional motor performance in hemiplegic upper extremity in recovering hemiplegic patients along with traditional physiotherapeutic exercises.

Summary

We have done the study on "A comparative study of the effect of taping on scapular stability and upper limb function in recovering hemiplegics with scapular weakness."

In this study, 37 hemiplegic patients fulfilling the inclusion criteria were taken randomly. We have divided patients into two groups. Group A (experimental group) and Group B (control group). Pre-treatment scale of both of the patients on Fugl Meyer Physical Performance Assessment Scale for hemiplegic upper extremity was taken. After that, scapular taping was given to the Group A patients in order to orient the scapula in normal position for the period of 2 weeks.

Group B patients were given only traditional physiotherapeutic exercises for the period of 2 weeks. After 2 weeks, we have taken the post-treatment scale on Fugl Meyer Physical Performance Assessment Scale for hemiplegic upper extremity for both the groups of patients.

On discussion, we found that experimental group (Group A) of patients gained highly significant improvement at the end of the experiment, whereas results were not significant for Group B (control) patients. Thus, study supports the alternate hypothesis.

Thus, on conclusion we can say that scapular taping is helpful in improving upper extremity functional outcomes in recovering hemiplegics with scapula weakness.

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