

fizjoterapia polska

POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 3/2024 (24) DWUMIESIĘCZNIK ISSN 1642-0136



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Effectiveness of shoulder kinesio taping and conventional exercises on Fugl-Meyer assessment scale and Rivermead mobility scale in sub-acute hemiplegic subjects with shoulder subluxation: A single group pre-post design

Skuteczność tapingu barku za pomocą taśmy Kinesio i konwencjonalnych ćwiczeń w skali oceny Fugl-Meyer oraz skali mobilności Rivermead u pacjentów z podostrą hemiplegią z podwichnięciem barku: projekt przed-po dla pojedynczej grupy

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Abstract

Background. Most hemiplegic patients develop subluxation in the acute stage of stroke. Despite the administration of various prevention strategies in the acute stage, more than 80% of stroke survivors develop shoulder subluxation. Subluxed shoulder and associated postural deviations affect functional mobility in gait, balance, and transfers. Most of the time their posture is associated with flexor synergy in the elbow, forearm, wrist, and fingers. This eventually ends up with poor upper limb functions and functional mobility in gait and balance in their sub-acute and chronic stages.

Purpose. Kinesio tape application helps in reducing the subluxation distance and thereby normalizes upper body posture. Conventional exercises consisting of passive range of motion (PROM) exercises/active range of motion (AROM) exercises and passive stretching to the elbow, wrist, hand, and fingers. Bilateral arm exercises, sitting balance training, pelvic control and trunk dissociation exercises, standing balance training and gait training improve lower body posture and movement. Both these interventions together improve the whole body's performance. i.e., shoulder, trunk, and lower limb. Therefore, this study intends to evaluate the differences in upper limb functions and functional mobility of sub-acute hemiplegic patients with shoulder subluxation in consideration for shoulder kinesio taping and conventional exercises for a period of 8 weeks.

Method. Thirty-three subjects (post-stroke duration (45.42 ± 2.90) days) who could communicate adequately with intact cognitive functions and of Brunnstrom stages 2, 3, and 4, participated in a shoulder kinesio taping and conventional exercise intervention. Kinesio tape was applied twice a week whereas conventional exercises are applied for 5 days a week. The individual session duration was about 40 minutes a day. This fashion was continued for eight weeks.

Results. At the end of the intervention with shoulder kinesio taping and conventional exercises, there was a notable change in upper limb function and functional mobility in sub-acute hemiplegic patients with shoulder subluxation.

Conclusion. The intervention comprising shoulder kinesio taping and conventional exercises showed beneficial differences in upper limb functions and functional mobility in sub-acute stage hemiplegic patients with shoulder subluxation.

Keywords

shoulder kinesio taping; conventional exercises; sub-acute hemiplegic subjects; upper limb functions; functional mobility

Streszczenie

Wstęp. Większość pacjentów z hemiplegią rozwija podwichnięcie w ostrym stadium udaru. Pomimo stosowania różnych strategii zapobiegawczych w ostrym stadium, ponad 80% osób, które przeżyły udar, rozwija podwichnięcie barku. Podwichnięty bark i związane z nim odchylenia posturalne wpływają na mobilność funkcjonalną podczas chodu, równowagi i transferów. Najczęściej ich postawa jest związana z synergią zginaczy w łokciu, przedramieniu, nadgarstku i palcach. Ostatecznie prowadzi to do słabych funkcji kończyn górnych i mobilności funkcjonalnej podczas chodu i równowagi w ich podostrym i przewlekłym stadium.

Cel. Zastosowanie taśmy kinesio pomaga w zmniejszeniu odległości podwichnięcia, a tym samym normalizuje postawę górnej części ciała. Konwencjonalne ćwiczenia składają się z ćwiczeń biernego zakresu ruchu (PROM), ćwiczeń aktywnego zakresu ruchu (AROM) oraz biernego rozciągania łokcia, nadgarstka, dłoni i palców. Dwustronne ćwiczenia ramion, trening równowagi w siedzeniu, kontrola miednicy i ćwiczenia dysocjacji tułowia, trening równowagi w staniu i trening chodu poprawiają postawę i ruchy dolnej części ciała. Obie te interwencje razem poprawiają wydajność całego ciała, tj. barku, tułowia i kończyny dolnej. Dlatego niniejsze badanie ma na celu ocenę różnic w funkcjach kończyn górnych i mobilności funkcjonalnej pacjentów z podostrą hemiplegią z podwichnięciem barku, z uwzględnieniem tapingu barku za pomocą taśmy kinesio oraz konwencjonalnych ćwiczeń przez okres 8 tygodni.

Metoda. Trzydziestu trzech pacjentów (czas po udarze wynosił $45,42 \pm 2,90$ dnia), którzy mogli komunikować się odpowiednio z zachowanymi funkcjami poznawczymi i byli na etapach 2, 3 i 4 w skali Brunnstroma, uczestniczyli w interwencji tapingu barku za pomocą taśmy kinesio oraz konwencjonalnych ćwiczeń. Taśma kinesio była nakładana dwa razy w tygodniu, natomiast konwencjonalne ćwiczenia były stosowane 5 dni w tygodniu. Pojedyncza sesja trwała około 40 minut dziennie. Taki schemat kontynuowano przez osiem tygodni.

Wyniki. Na koniec interwencji tapingu barku za pomocą taśmy kinesio oraz konwencjonalnych ćwiczeń zaobserwowano znaczną zmianę w funkcji kończyn górnych i mobilności funkcjonalnej u pacjentów z podostrą hemiplegią z podwichnięciem barku.

Wnioski. Interwencja obejmująca taping barku za pomocą taśmy kinesio oraz konwencjonalne ćwiczenia wykazała korzystne różnice w funkcjach kończyn górnych i mobilności funkcjonalnej u pacjentów z hemiplegią w podostrzej fazie z podwichnięciem barku.

Introduction

Upper limb function and functional mobility are two important areas requiring recovery in stroke subjects [1]. Evaluation of these two areas is very essential in planning appropriate management strategy. There are numerous validated scales and AI-powered devices to extract upper limb function and functional mobility parameters like gait, posture, and transfers [2]. Reflexes, sensory functions, motor functions, posture, and gait are affected in stroke hemiplegics and it differs with the extent of involvement of brain areas [3]. There are also associated disorders like agnosia and apraxia which make recovery complex and time-consuming. Upper limb function and functional mobility are vital areas that encourage active participation in activities and reentry to the community [4]. Upper limb functions and functional mobility like transfers are commonly described under kinematics and muscular forces [5]. There are acceptable ranges of differences in these areas of healthy individuals. Hemiplegic patients' mobility determinants vary with affected brain areas like motor and sensory cortical surfaces and sub-cortical areas like basal ganglia and finally with cerebellum [6]. Most of the time patient learns a range of compensatory movements in the sub-acute stage [7]. Literature reviews with many types of research evaluated upper limb function and functional mobility focusing on analytical and empirical methods to assess and document differences [8]. Few studies evaluated the advantages of the Fugl Meyer assessment scale of the Upper limb. The Fugl-Meyer Assessment (FMA) is developed specifically for stroke and is a performance-oriented impairment index [9]. It is developed to monitor motor, balance, sensation, and joint functioning aspects in stroke hemiplegic subjects. It is very commonly used in clinical and research areas to estimate severity, and recovery, and to assess the effectiveness of the intervention [10]. The scale consisted of motor function aspects of the upper extremity, wrist, hand, and coordination speed components with a total of 66 points. Similar to upper limb function, functional mobility helps to better initiate walking, balancing, and transferring. Pelvic activity aids in improving the stability of core muscles responsible for gait and balance [11]. A stable pelvis has a better balance reaction compared to a flaccid one. Shoulder Kinesio taping when applied to hemiplegic subjects improves shoulder control and upper trunk symmetry [12]. Improved shoulder control and tone have a corresponding reduction in subluxation distance and balance upper body postural reactions [13]. Similarly, exercises involving Passive range of motion (PROM), Active range of motion (AROM), Passive stretching to elbow, wrist, hand, and fingers, bilateral arm exercises, sitting balance training, pelvic control exercises, and trunk dissociation exercises, standing balance training and gait training improve trunk and lower body tone and postural control [14]. The trunk and lower limb activity also improves stability. The Rivermead mobility scale (RMS) analyses movement transitions standing, transfers, walking indoors and outdoors, and other components [15]. Many research articles utilized RMS as a primary outcome measure for documenting functional mobility. This RMS is reliable, valid, and internally consistent for use in research [16]. The majority of hemiplegics have under-

gone different rehabilitative components in their acute settings [17]. Considering participant interest and willpower an eight-week intervention protocol was executed in this study. Therefore, the main purpose of this pre-post design study was to evaluate the effectiveness of 8 weeks of shoulder Kinesio taping and conventional exercises in upper limb function and functional mobility in Sub-acute hemiplegic subjects with shoulder subluxation with the help of Fugl Meyer assessment scale upper limb and Rivermead mobility scale respectively.

Materials and Methods

We recruited 33 hemiplegic subjects with shoulder subluxation of the age range between 45 and 65 years (mean age 55.60 years). Inclusion criteria were ischemic-type stroke, sub-acute stage with shoulder subluxation (third week to a third month), Brunnstrom stages 2, 3, and 4, and capable of adequate communication. Exclusion criteria were patients with a history of recurrent stroke, Complex Regional Pain Syndrome (CRPS), aphasia, uncooperative behavior, and any other orthopedic or neurological condition affecting the upper limb, or sensory issues. All participants received physiotherapy at the Physiotherapy Outpatient Department of N. M Wadia Hospital on an outpatient basis. The rehabilitation protocol was tailored to the individual, having a normalization of functions and elimination of compensatory movements as the aim. Treatment was altered considering aerobic capacity and individual postural control status. The protocol comprises two components. The First component is the shoulder Kinesio taping component. Patients were positioned in a comfortable sitting posture. Kinesio tape was applied to the shoulder joint twice a week for the following purposes: 1) Supraspinatus activation taping, 2) Deltoid support for functional correction, 3) Decompression tape in the AC Arch, 4) Mechanical correction to prevent internal rotation and 5) Posture correction. The tension applied over the Kinesio tape for all five mentioned tasks during the initial 8 weeks was set at 20-40% of the therapeutic zone. The second component is the conventional exercises. Patients underwent conventional physical treatment for other joints in the form of Passive range of motion (PROM) Exercises/Active range of motion (AROM) Exercises and Passive stretching to the elbow, wrist, hand, and fingers, Bilateral Arm Exercises, Sitting Balance training, Pelvic control and trunk dissociation exercises, Standing Balance Training and Gait Training. Participants were made to perform each exercise for 5 repetitions. Each session lasted for approximately 40 minutes. The researcher administered the kinesio taping while the physiotherapist in the physiotherapy department provided the conventional physiotherapy. Kinesio taping helps in improving shoulder control and conventional exercises promote range of motion and flexibility. Bilateral arm exercises are aimed to improve symmetry and other exercises were to improve standing and walking. The assessments of outcomes were performed on every patient before and after intervention. Fugl Meyer's assessment upper extremity and Rivermead mobility scale were used as outcome measures. Heesoo et al and Lisa Radman et al found the scales reliable, valid, and responsive for the Fugl Meyer assessment and Rivermead mobility Index respectively.

Results

The normality of data distribution was assessed with the help of Kolmogorov-Smirnov test. Within-group differences from pre-test to post-test measurements were evaluated using paired t-tests. A p-value < 0.05 was considered to be statistically significant. The contrast between FMA and RMS scores before and after intervention was assessed

using paired t-tests. The Karl Pearson correlation coefficient method was used to establish the intensity of the linear relationship between FMA and RMS for pre- and post-intervention. The R-value was calculated, and a p-value < 0.05 was considered statistically significant. Table 1 shows demographic characteristics like age, gender, side of weakness, and duration from onset of stroke.

Table 1. Demographic Characteristics (N = 33)

Characteristic		
Age (mean)		55.60(SD 5.56)
Gender	Male	18 (54.55%)
	Female	15 (45.45%)
Side of weakness	Right	14 (42.42%)
	Left	19 (57.58%)
Duration from onset of Stroke in Days (mean)		45.42(SD 2.90)

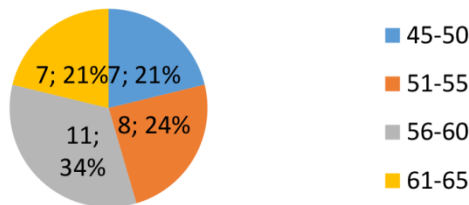


Figure 1. Age distribution

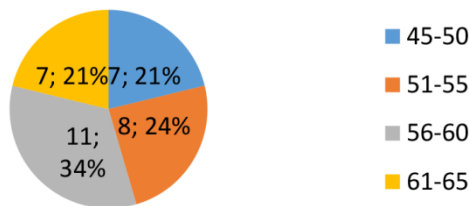


Figure 2. Gender distribution

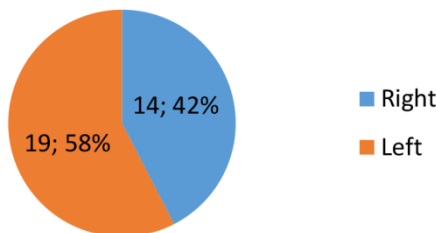


Figure 3. Affected side

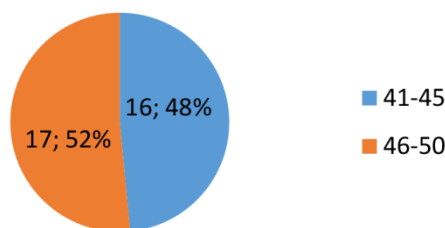


Figure 4. Duration from onset of Stroke in Days

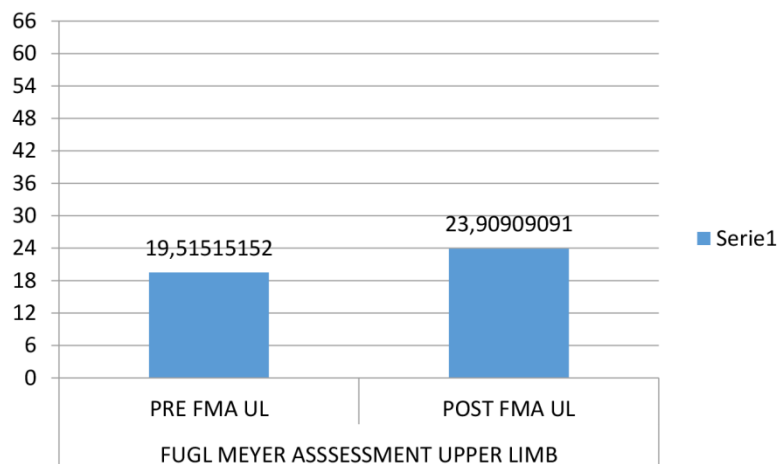


Figure 5. Pre-Post comparison of Fugl Meyer assessment scale Upper Limb

There was an increase in FMA UL score from a pre-intervention average of 19.5151 to a post-intervention average of 23.9090. The p-value was < 0.00001 , which indicates a

statistically significant improvement from pre- to post-intervention. The effect size of Cohen's d is 2.46 which is large indicating the practical difference.

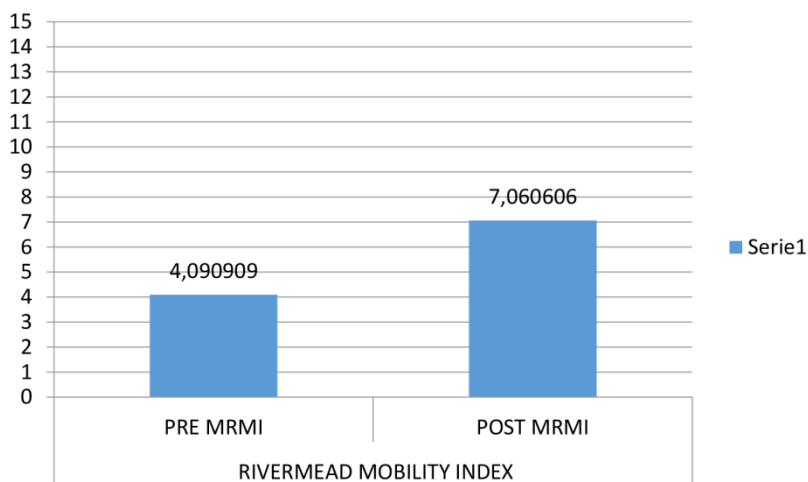


Figure 6. Pre-Post comparison of Rivermead Mobility Index

There was also an increase in the Rivermead mobility index from a pre-intervention average of 4.0909 to post-intervention 7.0606 (Figure 6). The p-value was < 0.00001 , which

indicates a statistically significant improvement from pre- to post-intervention. The effect size of Cohen's d is 3.53 which is large indicating the practical difference.

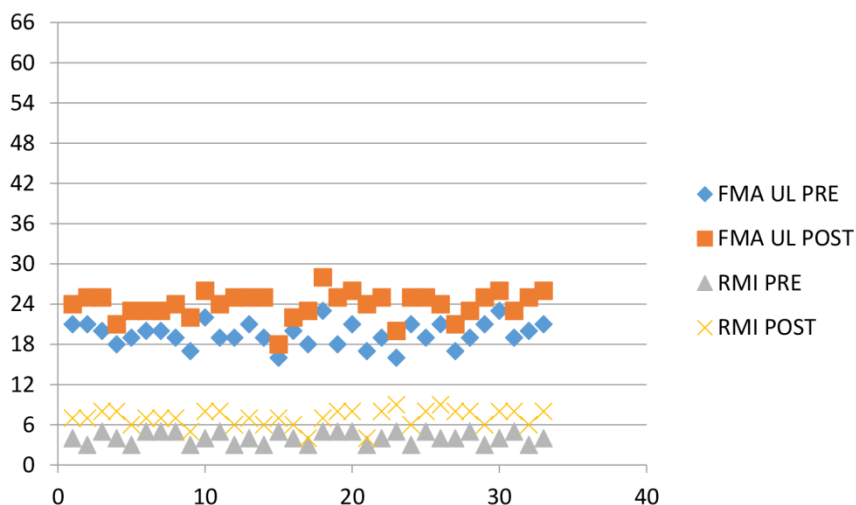


Figure 7. A Single scatter plot for both Pre and post-FMA UL and RMI

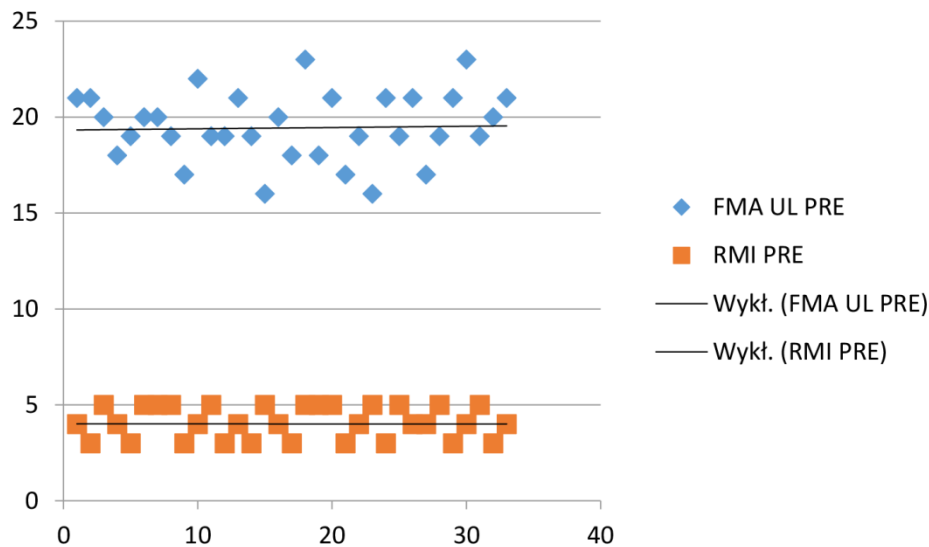


Figure 8. Relationship between Pre FMA UL and Pre RMI (Very Weak negative correlation)

There was a non-significant weak negative correlation between the pre-intervention scores of FMA UL and RMI (Figure 8), i.e., the increase in the FMA UL was noticed with no increase in the RMI score pre-intervention. The value of R

was -0.03206. Although technically a negative correlation, the relationship between variables was weak (the nearer the value was to zero, the weaker the relationship). The p-value was 0.8594. The result was not significant at $p < 0.05$.

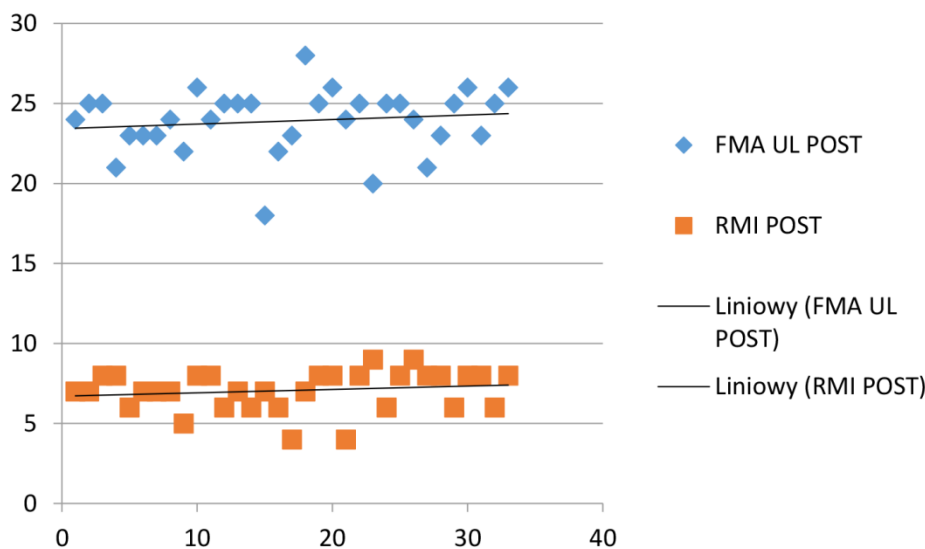


Figure 9. Relationship between Post FMA UL and Post RMI (Weak positive correlation)

There was a non-significant very small positive correlation between the post-intervention scores of FMA UL and RMI, i.e., the increase in the FMA UL score was noticed with an increase in the RMI score post-intervention (Figure 9). The value of R was 0.01486. Although technically a small positive correlation, the relationship between variables was very weak (the nearer the value was to zero, the weaker the relationship). The p-value was 0.9346. The result was not significant at $p < 0.05$. The value of R^2 , the coefficient of determination, was 0.0148. The p-value was 0.49. The result was significant at $p < 0.05$. The study interpretation showed that the FMA UL score and RMI score were valuable in documenting upper limb motor function and functional mobility in response to shoulder Kinesio taping and conventional exercises. The significance of progress on the total FMA UL and RMI scores was high.

The results suggested that the FMA UL and RMI were linked between shoulder control and mobility in terms of gait, balance, and transfers.

Discussion

In this study, we identified considerable betterment in upper limb functional performance between pre-and post-intervention protocols. Upper limb functional performance post-intervention was associated with changes in posture and voluntary control grades [18]. Ditouah Didier Niama Natta et al in their study observed FMA-UL showing better performance levels in 28 stroke patients before and after their intervention protocol [19]. Shoulder Kinesio taping activates the dermatome and facilitates tone in the corresponding myotome [20]. Stretch pressure maintained reduces the

gravitational pull, thereby allowing a recruitment pattern on the phasic principle [21]. Supraspinatus tape works on facilitation of the supraspinatus muscle, Deltoid taping supports the deltoid muscle in maintaining the acromiohumeral distance, and Decompression tape at the AC arch prevents compression of supraspinatus tension and relieves pain [22]. Activity is enhanced in pain free state. Mechanical correction tape maintains the arm in an externally rotated position which is the desired position for the majority of functional activities [23]. Finally, the posture correction tape promotes symmetry between the right and left sides of the trunk. Conventional exercises focusing on balance have beneficial effects. Balance is influenced by deviated trunk proprioception and trunk muscle deconditioning [24]. Postural flexibility of trunk musculature expected during ADLs is the basis for achieving posture against the influence of gravity [25]. Sitting balance training improves stability in lateral and forward-backward directions [26]. The findings coincide with balance scales. Similar training in standing helps in fall prevention and it promotes confidence among participants. There is evidence supporting functional mobility with the Rivermead mobility scale. Trunk rehabilitation is achieved with the help of conventional exercises [27]. Enhanced Upper limb function and functional mobility also aid in improving the NIHSS score. The higher the NIHSS score, the higher the independence of participants [28]. Utilization of relevant rehabilitation techniques improves weight transference. Weight transference is ultimately required for transfer activities. A recent RCT explored the importance of conventional exercises in functional mobility. The provision of sitting and standing balance rehabilitation in sub-acute hemiplegics proved to enhance reaching activities and gait performances [29]. We also found significant improvement in RMS. Highly improved components were Component A and B in FMA UL and components standing unsupported, up and down stairs RMI. Improvements in Components A and B of FMA UL were observed in the form of improved reaching and holding activities respectively. Similarly standing unsupported and up & down stairs were observed in the form of balanced movement transitions and symmetry in weight acceptance. The differed scores observed incremental fashion after the intervention program; the results

suggested that the FMA UL and RMI were linked between shoulder control and mobility in terms of gait, balance, and transfers. The minimal clinically important difference of the Fugl Meyer Assessment upper limb is estimated as scores ranging from 4.25 to 7.25 points. The difference obtained in this study is 4.39. So the results coincide with the estimated values [30]. Similarly, the minimal clinically important difference of the Rivermead mobility scale is estimated as scores > 4.5 points. The difference obtained in this study is 2.97. So the results are less than the estimated value. The symmetry of the entire body is achieved with kinesio taping and relatively conventional exercises. The results of this eight-week protocol revealed beneficial changes; hence, continuing the protocol for a further 2 weeks will result in better performance.

Conclusions

The protocol comprising shoulder Kinesio taping and conventional exercises showed beneficial changes in upper limb motor performance and functional mobility in sub-acute stage hemiplegic patients with shoulder subluxation. Using the FMA UL motor performance and the Rivermead mobility scale is a convenient way to observe improvements in overall recovery. Limitation: This study had a minimal sample size and included only ischemic type stroke. The participant's medication intake was not taken into consideration. Advanced AI-powered outcome measures such as AI EMG, and Biodex balance devices were not used which can give more accurate results.

Recommendations

Randomized controlled studies involving a larger sample, advanced activation techniques, and increased intervention duration will reveal perfect information on its effectiveness and significance.

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