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Neuromuscular physiotherapeutic reeducation in the function of the paretic upper limb after stroke

Abstract

The stroke is the acute onset of neurological clinical manifestations, which may be ischemic or hemorrhagic, leading to several related signs and symptoms the affected areas. Aimed to evaluate the function of the paretic upper limb before and after a neuromuscular physical therapy rehabilitation program. It is a multiple case study, cross-sectional and quantitative. The sample consisted of three participants characterized as participants P1, P2 and P3. Steps have been taken before and after a neuromuscular based intervention program and used the following data collection instruments: a clinical, sociodemographic and inspection of member form; the Mini-Mental State Examination; the modified Ashworth scale; the Fugl-Meyer Scale and the Arm Motor Ability Test. The neuromuscular program was performed 2 times per week for fifty minutes totaling ten sessions and consisted of: 1) Guidelines and general care; 2) specific skills training for upper limb, and 3) application of Kinesio Taping®. It was observed cognitive preservation and tonus ranging between normal and slightly hypertonic. Two participants reported pain: P2 on the handle and P3 on the shoulder. All showed improvement of motor function. In the assessment of functional ability and movement quality all participants showed improvement. All showed gains for functionality, quality of movement and functional ability, as well as decreased pain, which showed that the program had effectively on the rehabilitation process.

Keywords: physiotherapy, neurology, hemiplegia, stroke, reeducation

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Introduction

The stroke is the acute onset of neurological clinical manifestations and can be expressed in ischemic or hemorrhagic way, leading to several signs and symptoms corresponding the areas that were affected the nervous system central.[1] In Brazil is the major cause of mortality, with higher rates among females, and is considered one of the more diseases sequelae and functional disability leave.[2] After the episode of stroke, the main clinical manifestations are found motor sequelae, sensory and cognitive, affecting the quality of life of these people.[3] The motor manifestations from the stroke are usually hemiplegia or hemiparesis contralateral limb injury, affecting the general motor activities.[4]

The motor activities of the paretic upper limb of an individual who was affected by stroke are limited, noting changes in performance from simple activities to more elaborate, since occurring power loss and muscle tone, beyond reduction the range of motion and motor skill coordination of the affected limb. Therefore, these changes are likely to affect the normal and member of stability biomechanics due to the loss of motor control and the installation of abnormal movement patterns, leading to changes in the soft tissues and misalignment of joints, particularly with regard to the joint activity glenohumeral.[4,5]

Physiotherapy is very important in the rehabilitation of people affected by stroke, with respect to the upper limb activities, preventing secondary complications such as shoulder subluxation, shoulder-hand syndrome and deformities of the affected limb, as well as acting at the neuromuscular reeducation. Thus, there are several physical therapy resources used to achieve this goal, among them is the use of classical therapeutic exercise, electrical stimulation, facilitation techniques such as Kabat method, method Rood and Bobath concept. Moreover, in recent years, another has been employed in order to keep the action of the classic exercise for longer, such as the use of Kinesio Taping®.[4,6]

The Neurological Physiotherapy is about stimulate the basic mechanisms of motor control, training patients in functional skills, and also involve guidance and caregiver training as a way to continue the physical therapist work, in order to avoid possible secondary complications and disability resulting from chronic conditions, contributing to improved quality of life and autonomy of these patients.[7,8]

Due to several sequels and high rates of morbidity brought about by stroke, this study is justified by the interest in increasing scientific knowledge to the practice of physical therapy resources, focused on neuromuscular re-education of the paretic upper limb function in patients affected by stroke, as there is a need for more knowledge in the literature on this subject, and because of this condition lead to various losses entailed by hemiparesis. The study seeks to improve the functionality and prevent secondary complications of the affected upper limb, providing greater independence in activities of daily living and the individual's quality of life. Therefore, this research aims to evaluate the function of the paretic upper limb by stroke before and after a neuromuscular physiotherapy rehabilitation program.

Methods

It is a study of multiple cases of cross-sectional quantitative approach. The study population consisted of three hemiparetic subjects of both sexes after stroke episode that were on their heightened stage. The participants were selected from the patient waiting list of school clinic of an educational institution from João Pessoa (Brazil).

Initially, nine people were selected, but only four have been adequate on the criteria being considered as non-probabilistic obtained for accessibility by observing the inclusion and exclusion criteria for this study. However, after the initial screening evaluation, of those participants dropped out for health complications reason, thus composing a final sample of three individuals who underwent

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taken pre and post intervention measure based on neuromuscular principles for improved functionality paretic upper limb. They were considered in the study inclusion criteria: having a clinical diagnosis of ischemic or hemorrhagic stroke, by a medical report, of less than 6 (six) months; Present hemiparesis independent upper lateral member; Display preserved cognition observed by evaluation conducted with Mini-Mental State Examination, adjusting the cutoff points according to the education patient.[9,10]

Initially the participants were informed about the research, those who agreed to participate signed a consent form and informed consent form, after the initial evaluation using a form of screening and sociodemographic to define the subjects included the survey was conducted. The evaluation form containing questions about the clinical data, a member of the inspection affected and data demographic consisted of participant's personal data such as age, education level, monthly income, marital status, clinical diagnosis with International Classification of Diseases (CID), medical history, social history, stroke features such as affected half body, laterality, ambulation of stroke onset time, visual impairment and speech, and the use of walking aids devices in addition to the physical examination with assessment of muscle tone, swelling, sensitivity through exteroceptive stimuli using varying textures and pain using the Visual Analog Scale (VAS).

To check the effects of the methods and techniques used in neuromuscular physical therapy rehabilitation protocol in the paretic upper limb functionality after stroke, the following data collection instruments were used: the Mini Mental State Examination, Ashworth Scale modified to check the spasticity level, the Fugl-Meyer scale adapted to evaluate the functionality and Arm Motor Ability Test (AMAT). The Mini Mental State Examination was used to screening of cognitive status purposes and sample selection. According to Chaves,[11] it is one of the tools most used in research worldwide, offering information from various cognitive parameters, with validated versions in different languages and countries. Group questions into seven categories to assess cognitive functions specific to the temporal orientation (5 points), spatial orientation (5 points), three-word record (3 points), attention and calculation (5 points), recall of three words (3 points) language (8 points) and visual constructive capacity (1 point). The Mini Mental score may vary with the minimum of 0 points, which indicates the highest level of cognitive impairment of participants up to a maximum total of 30 points, which is the highest level of cognitive ability. Furthermore, considering the educational level it was considered as cut-off point ≤24 points education over 4 years of study and scores ≤7 points with education below 4 years of study.[9]

The Ashworth Scale in the original version or the Modified Ashworth Scale, remain as the reference method for the clinical evaluation of spasticity.[12] It is based on a qualitative evaluation by professional assesses the member/joint affected by muscular hypertonia, that is the resistance during the abnormal muscle strain generated by increased tone muscular.[13] On this scale, the rate consists in five levels: Level 0 = no increase in muscle tone; Grade 1 = slight increase in muscle tone, manifested by a detention and release of the movement, or a minimum resistance at the end of the joint range of motion, the member during extension and flexion; Grade 1+ = minimal resistance at least half of the remaining arc of the joint movement; Grade 2 = increased muscle tone, substantially all of the arc range of motion, the affected part is easily mobilizable; Grade 3 = more marked increase in muscle tone, in almost all of the range of range of motion, the affected part is difficultly; Grade 4 = affected part in stiffness / joint ankylosis. No passive or active joint movements.[13]

For the analysis of the functionality was used Fugl-Meyer scale adapted to the upper member. Originally it is characterized as a cumulative numerical scoring system that objectively assessing the patient six aspects: range of motion, pain, tenderness, motor function and balance upper and lower edge, and the coordination and speed. In motor evaluation are included the measurement of movement, coordination and reflex activity of shoulder, elbow, wrist, hand, hip, knee and ankle.

The scale has a total score of 100 points for normal motor function, where the maximum score to the upper end points is 66 and the bottom is 34 points. The score indicating Fugl-Meyer motor impairment determined that a lower score of 50 points indicates severe motor impairment of 50-84 points marked is described as motor impairment, points 85-95 is considered moderate motor impairment and compromised engine is classified as mild when the score is between 96-99 points, but in this study will only be considered the score for the upper limb.[14]

For use only the upper limb evaluation was conducted an apportioning the scoring described above, which is characterized as severe motor impairment less than 33 points, indicative of motor impairment 33-55 marked points, the score of 56-61 points it is characterized as moderate impairment and 62-65 points as mild impairment. The AMAT is an assessment tool of disabilities in activities of daily living involving the upper limb. The tests also classify each component of the task in accordance with two major scales for recovery of motor function: Functional Ability (ability to apply a technique) and movement quality (how well the task movement was performed), providing information on aspects of movement. It consists of 13 tasks that reproduce daily activities, evaluated by a scale ranging from 0 to 5 in the items: (a) Functional ability, where 0 = not have, 1 = very little, 2 = little, 3 = moderate, 4 = almost normal and 5 = normal; and (b) quality of movement, where 0 = not have, 1 = very poor, 2 = poor, 3 = moderate, 4 = almost normal and 5 = normal.

The performance time of each AMAT task is timed and may vary from 60 to 120 seconds, the tasks with the indication of letter (a) are characterized as bilateral activities, and with the indication of (b) have a time limit of 2 minutes, and the other tasks with a time limit of 1 minute.[15] The physiotherapy intervention program for rehabilitation consisted of the following steps: 1) delivery of a Guidance manual for the care of the person after stroke; 2) Warm up phase consisting of passive or active assisted mobilizations using Kabat scapular and upper limb diagonals (primitive and functional) for 20 minutes; and passive or active assisted stretching of the affected limb muscles for 15 minutes; 3) Specific Skills Training Phase; using electrostimulation with the Russian current in the supraspinatus, lateral deltoid and posterior muscles during 20 minutes associated with active mobilization in the Balkan frame, Strengthening through developmental postures and functional activities using Kabat, Rood and Bobath concept, fine motor skills exercises using plug-in games; 4) Completing the protocol with application of *Knesio Taping*® on the supraspinatus, deltoid, wrist extensors and thumb abductors muscles.

The intervention lasted 50 minutes and was performed twice a week, with a total of 10 sessions per participant. Data were collected prior to the application of the neuromuscular physical therapy rehabilitation protocol and at the end of the 10 sessions, the evaluative measures were again applied. The following materials were used: Stethoscope, Sphygmomanometer, 10-channel Neurodyn appliance, adhesive electrodes, stretcher, textured ball, Balkan frame, sponge, ADL board, fitting objects, *Knesio Taping*® and 3B tape scissors.

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The project was sent to the Human Research Ethics Committee, which was evaluated and approved according to the guidelines and norms of Resolution 466/2012 of the the National Health Council/ Ministry of Health, CAAE: 39526014.8.0000.5176 with observation and preservation in the bioethical principles fundamental to the individual, their autonomy, the practice of charity and justice. The researcher signed compliance with the ethical precepts established in resolution 466/2012, by signing the Researcher's Commitment Term. Moreover, to participate in the study, the research subjects had knowledge and signed the Informed Consent Form that informed about the proposed objectives of the study, which guaranteed the confidentiality of the participants names, the exposure of the subjects to risks or presentation of the minimum foreseeable risks and the guarantee of non-mandatory participation and/ or collaboration in the study.

The data was tabulated in a Microsoft Excel spreadsheet and then passed on to the Statistical Package for Social Sciences (SPSS) version 20.0, where descriptive analysis was performed using average, standard deviation, maximum and minimum values. The values of the Fugl-Meyer Scale adapted for the upper limb and the AMAT, were analyzed for normality by the Shapiro-Wilk test, in which the normal distribution was confirmed, followed by inferential analysis with the paired T-test for averages difference, where the adopted significance level was $p < 0.05$.

Results

Participants in the present study were characterized as participant 1 (P1), participant 2 (P2) and participant 3 (P3). The male P1, aged 27 years, married, with complete education level, right-handed, with clinical diagnosis of hemorrhagic stroke confirmed by magnetic resonance imaging 6 months ago. Physical examination showed: right hemiparesis with independent ambulation, no previous history of diseases or social habits that could characterize risky lifestyle for the development of stroke. Preservation of speech and visual function was observed, and hypoesthesia was identified in the half affected mainly regarding heat sensitivity. There was no edema or painful complaint in the paretic upper limb. Table 1 below shows the initial assessment of pain, tone, functionality and ability of P1.

Table 1 Assessment of pain, tone, functionality and ability of P1's paretic upper limb

Scales	Variables	I	F	MS
Analogic Visual Scale	Shoulder	0	0	NA
	Elbow	0	0	
	Wrist	0	0	
Modified Ashworth Scale	Shoulder flexors	Grade 0	Grade 0	NA
	Elbow flexors	Grade 1	Grade 1	
	Wrist flexors	Grade 2	Grade 2	
	Finger flexors	Grade 2	Grade 2	
Scale of Fugl Meyer	Passive Movement and pain	40 points	48 points	48 points
	Sensibility	10 points	10 points	12 points
	Motor Function	24 points	45 points	60 points
	Coordination and speed	3 points	4 points	6 points
	Total	77 points	107 points	126 points
Arm Motor Ability Test	Functional ability	16 points	39 points	65 points
	Movement quality	10 points	33 points	65 points
	Total	26 points	72 points	130 points

Source: Research data

Abbreviations: I, initial evaluation; F, final evaluation; NA, not apply

It can be observed that P1 presented in the Fugl-Meyer Scale in the pre-intervention measure a total score of 77 points, characterizing a severe motor impairment. After the intervention program, a total score of 107 points was obtained, which is characterized as a striking motor impairment. His greatest initial difficulty was related to: flexor synergy (I= 6 points; F= 10 points), extensor synergy (I= 4 points; F= 8 points), movements with and without synergy (I= 4 points; F= 6 points), wrist control (I= 2 points; F= 6 points) and hand activity (I= 6 points; F= 12 points) However, after the intervention program there was an improvement in all these items. In Arm Motor Ability Test, P1 obtained very low scores for both Functional Ability and Movement Quality with a total of 26 points, pointing to a greater impairment of fine motor skills and the use of unilateral activities to perform activities of daily living. After the program it was obtained a total score of 72 points, characterizing an improvement for both Functional Ability and Movement Quality.

The second participant named P2, female, 55 years old, widowed, with a complete elementary school level, right-handed, with clinical diagnosis of ischemic stroke confirmed by magnetic resonance imaging 6 months ago. Physical examination showed: right hemiparesis with independent walking using a walker. She reported being diabetic with no history of social habits that could characterize risky lifestyle for the development of stroke. Preservation of speech and corrected visual impairment (myopia) were verified. The superficial, deep and combined sensitivity was preserved in the paretic upper limb, as

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well as no edema or sight of slope. Table 2 below shows the initial evaluation of pain, tone, functionality and ability of the P2.

P2 presented wrist pain with passive and active mobilization according to the Visual Analogue Scale characterizing as grade 5 of tired type, which may have been caused by lack of joint mobility or muscle weakness, where after having been submitted to the intervention program, presented a decrease in wrist pain characterizing as grade 2 of tired type.

In the pre-intervention measurement in the Fugl-Meyer Scale, it presented a deficit with a total score of 95 points, characterizing a remarkable motor impairment. After the intervention program it was obtained a total score of 120 points, characterized as a moderate motor impairment. The lowest initial evaluation scores were related to flexor synergy (I= 8 points; F= 10 points), movements with and without synergy (I= 4 points; F= 11 points) and wrist control (I= 5 points; F= 7 points). After the intervention program, it can be observed that it obtained improvement in all aspects.

Table 2 Assessment of pain, tone, functionality and ability of P2's paretic upper limb

Scales	Variables	Iev	Fev	MS
Analogic Visual Scale	Shoulder	0	0	na
	Elbow	0	0	
	Wrist	5 (tired tipe)	2 (tired type)	
Modified Ashworth Scale	Shoulder flexors	Grade 0	Grade 0	na
	Elbow flexors	Grade 1	Grade 1	
	Wrist flexors	Grade 0	Grade 0	
	Finger flexors	Grade 0	Grade 0	
Scale of Fugl Meyer	Passive Movement and pain	42 points	48 points	48 points
	Sensibility	12 points	12 points	12 points
	Motor Function	37 points	54 points	60 points
	Coordination and speed	4 points	6 points	6 points
	Total	95 points	120 points	126 points
Arm Motor Ability Test	Functional ability	50 points	65 points	65 points
	Movement quality	47 points	61 points	65 points
	Total	97 points	126 points	130 points

Source: Research data

I, initial evaluation; F, final evaluation; NA, not apply

The initial assessment of the P2's Arm Motor Ability Test presented the greatest deficit for Functional Ability and Movement Quality, especially in the questions that involved fine motor skills, unilateral activities and resistance to perform ADLs, obtaining a total test score of 97 points. After the intervention program, he obtained a considerable improvement for both Functional Ability and Movement Quality with a total score of 126 points in the final evaluation.

The third participant P3, male, aged 37 years, married, with complete higher education level, with clinical diagnosis of ischemic stroke confirmed by magnetic resonance imaging 1 month ago. Physical examination shows right hemiparesis with independent ambulation. He reported having heart diseases (using a pacemaker and having surgery on the mitral valve), with no history of social habits that could characterize a risky lifestyle for the development of stroke. It presents language disorder characterized as Broca's Aphasia and preservation of visual functions. Hypoesthesia was found mainly for superficial sensitivity of the paretic upper limb and no edema and sight of slope were observed. Table 3 below shows the initial assessment of pain, tone, functionality and ability of P3.

It can be observed that P3 presented shoulder pain according to the Visual Analogue Scale (VAS) characterized as grade 6 of the hooked type, which may also have been caused by the lack of joint mobility, where after being submitted to the intervention program, did not presented any of the shoulder pain to passive and active mobilization. Also, P3 presented in the adapted Fugl-Meyer Scale an important deficit in the pre-intervention measurement, characterized as a marked motor impairment with a total score of 92 points. After the intervention program, presented a total score of 123 points, characterized as mild motor impairment.

Its lowest initial scores on this scales were related to: Passive movement and pain, especially regarding mobility (I= 18 points; F= 24 points), flexor synergy (I= 7 points; F= 12 points), movements with and without synergy (I= 8 points; F= 12 points) and wrist control (I= 4 points; F= 9 points). However, after being submitted to the intervention program, there was a great improvement in all mentioned items. Regarding the Arm Motor Ability Test, P3 at the initial assessment obtained low scores for Functional Ability and Movement Quality, with greater difficulty especially in the movements of unilateral activities involving fine motor skills to perform daily living activities with a total score of 71 points. After being submitted to the intervention program showed improvement for both Functional Ability and Movement Quality with a total score of 126 points. Comparing the means of the participants in the pre- and post-intervention measurements, it was found that all improved the performance (Table 4) of the paretic upper limb activity, reaching higher average values on the Fugl-Meyer Scale ($p = 0.004$).

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Table 3 Assessment of pain, tone, functionality and ability of P3's paretic upper limb

Scales	Variables	I	F	MS
Analogic Visual Scale	Shoulder Elbow Wrist	6 (stinging type) 0 0	0 0 0	NA
Modified Ashworth Scale	Shoulder flexors Elbow flexors Wrist flexors Finger flexors	Grade 0 Grade I Grade 0 Grade I	Grade 0 Grade I Grade 0 Grade I	NA
Scale of Fugl Meyer	Passive Movement and pain Sensibility	39 points 8 points	48 points 10 points	48 points 12 points
	Motor Function	40 points	59 points	60 points
	Coordination and speed	5 points	6 points	6 points
	Total	92 points	123 points	126 points
Arm Motor Ability Test	Functional ability	39 points	64 points	65 points
	Movement quality	32 points	62 points	65 points
	Total	71 points	126 points	130 points

Source: Research data

I, initial evaluation; F, final evaluation; NA, not apply

Table 4 Descriptive analysis of the scores obtained on the Fugl-Meyer Scale by the subjects in the pre- and post-intervention measurements

	Pre- intervention			Post- intervention		
	Minimum value	**Maximum value**	**Mean**	**Minimum value**	**Maximum value**	**Mean**
Fugl-Meyer	77 points	95 points	88 points	107 points	123 points	117 points

Source: Research Data

When comparing the means of pre and post intervention measures, it was found that participants improved their performance (Table 5) by increasing their post intervention averages with respect to the Arm Motor Ability Test assessment ($p = 0.030$).

Table 5 Descriptive analysis of the scores obtained in the Arm Motor Ability Test by the subjects in the pre- and post-intervention measurements

	Pre- intervention			Post- intervention		
	Minimum value	**Maximum value**	**Mean**	**Minimum value**	**Maximum value**	**Mean**
Arm Motor Ability Test	26 points	97 points	64,7 points	72 points	126 points	108 points

Source: Research Data

Discussion

The three individuals participating in this research (P1, P2 and P3) had considerable gains in terms of: improved motor function, improved movement quality and functional ability of the paretic upper limb. In addition, participants P2 and P3 showed decreased pain in the upper limb affected at the initial assessment. Given the data presented, the hypothesis that a neuromuscular physiotherapy intervention program, when applied early, has benefits in the reeducation of paretic upper limb functionality by stroke is confirmed.

The functionality gains obtained in the present study corroborate Horn and collaborators[16], who proved the efficacy of early physical therapy resources to improve upper limb motor activity and prevent shoulder pain incidence. In the research conducted by these scholars, classical kinesiotherapy and the Bobath concept principles were used as a rehabilitation resource, in sessions lasting 30 minutes every day, 48 hours after stroke until hospital discharge. At the end, it was observed that of the 21 individuals who underwent the treatment program improved shoulder and shoulder motor activity ($p < 0.001$), improved functional movements of the affected limb and progressed without pain until hospital discharge.

In addition to the classic kinesiotherapeutic resources, the present study proposed the use of electrostimulation with the Russian current. Although this type of electrostimulation is not commonly used in the rehabilitation of people with stroke, it has the objectives and possibly helped in the functional recovery of the upper limb motor activity after ethics after stroke.

Corroborating with Corrêa and collaborators[17] reported in their case report study conducted with three people with stroke, that after 10 physical therapy interventions through the combination of conventional kinesiotherapy and functional electrical stimulation, performed twice in the week and lasting 60 to 70 minutes, there was an improvement in the range of motion and motor function of the affected upper limb by assessing the Fugl-Meyer Scale, pain reduction and shoulder subluxation analysis.

In addition, Marques and Nogueira[18] showed in a case report survey conducted with two individuals with ischemic stroke, where patient 1 underwent treatment with the combination of the Kabat method and the use of electrostimulation, and patient 2 only with use of electrostimulation. The treatment of both totaled 20 interventions, in the frequency of three weekly sessions lasting 40 minutes. In this study, both achieved improvement in passive movement, pain, tenderness, and upper limb motor function by assessing the Fugl Meyer Scale.

Moraes and collaborators[19] demonstrated in a quasi-experimental study conducted with 7 individuals diagnosed with stroke with functional impairment of the affected MS according to the Fugl-Meyer Scale assessment and quality of life assessment using the SF-36. The subjects of this study underwent a specific bilateral resistance training intervention program for the scapular stabilizer muscles for 13 weeks, at a frequency of three times in a week. The results of this study showed positive effects on the quality of life of these individuals, in which the treatment was effective to improve the physical and functional capacity of the participants.

Another study that corroborates the results of this research is that of Farias, Michaelsen and Rodrigues,[20] in the pilot study conducted with an individual with stroke in its subacute phase, who underwent training based on symmetrical and asymmetrical bilateral activities for the upper limbs, held every day of the week in a total of ten sessions, where each intervention lasted 60 minutes. After the training period, an improvement in short-term bilateral upper limb function can be observed in the performance of daily living activities. In the present research, in addition to the kinesiotherapeutic and electrical resources provided for the rehabilitation of people with motor impairment after stroke, Kinesio Taping was used to optimize the participants' functional results.

Positive results with the use of Kinesio Taping were obtained by Santos and collaborators,[6] together with three people with brachial predominant hemiparesis resulting from a stroke, who presented inferior shoulder subluxation. After two months of applying kinesio taping on the participants' shoulders, a reduction in the lower shoulder subluxation, as well as an improvement in postural symmetry and active movement of the upper limbs, was confirmed.

Salles, Almeida and Ferreira[21] express that in a study conducted with a patient diagnosed with acute stroke who underwent eight physical therapy sessions, during five weeks using the Kabat diagonals for the upper limb associated with the application of Kinesio taping, mobility gains were observed in the use affected upper limb function, promoting movement quality and independence in activities of daily living. Finally, Silva and Gester[4] demonstrated in a longitudinal and prospective study conducted with 10 people with stroke in the acute phase, with the application of a physical therapy protocol based on the concept of proprioceptive neuromuscular facilitation, with a total of 12 sessions lasting 45 minutes. The protocol was effective in preventing painful shoulder, but also showed significant improvement in the motor function of the affected upper limb and patients' conditions regarding independence to perform activities of daily living.

Conclusion

Through the results obtained in this research, it was found that the three participants submitted to the intervention program showed gains in functionality, quality of movement and functional ability, as well as decreased pain in the paretic upper limb, which showed that for these individuals this program elaborated was effective on the reeducation of the functionality of the affected limb.

It is noteworthy that participants 1 and 2 were referred for continuation of individual physical therapy treatment at the Clinical School of Physiotherapy of the institution participating in this study, while P3 was discharged from physical therapy. It is hoped that this research will contribute to other studies on the subject in question and to the physical therapy practice in the rehabilitation of people who will be affected by stroke, in which future research with a larger sample and period of interventions is suggested.

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None.

Conflicts of interest

The authors declare no conflicts of interest.

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