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Effect of Task Oriented Training on Spasticity in Post Stroke Individuals

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Abstract

Purpose: Post-stroke spasticity may be maladaptive and interfere with an individual's ability to perform functionally useful movement. However studies investigating how the spasticity relates to motor recovery are rare. Reducing the limb spasticity will help post stroke individuals function better at the activities of daily living. There is a paucity of literature showing the effect of task oriented approach on spasticity when compared to the standard conventional approach. Hence, there is a need to find out the effect of task oriented training on spasticity in post stroke individuals. **Methods:** A comparative study with a study design of Randomised Clinical Trial (RCT) was conducted among 60 post stroke individuals (30 post stroke individuals in group A and Group B respectively). Group A was given a task oriented approach for managing the spasticity and group B was given conventional treatment along with a task oriented approach to manage the spasticity. The treatment protocol for both the groups lasted for 6 weeks (4 days a week). **Results:** The mean and standard deviation on the Modified Ashworth Scale of Group A and Group B at baseline is 3.46 ± 0.68 and 3.56 ± 0.72 respectively which shows no significance (p value = 0.2925 and t value = 0.5493). The mean and standard deviation of Group A and Group B at 6 weeks is 2.4 ± 1.04 and 1.33 ± 1.1 respectively which is significant (p value = 0.0003, t value = 3.877.) **Conclusion:** It can be concluded that task oriented training alone is effective in acute stroke survivors, but in chronic stroke survivors it is not remarkably efficacious and requires a combined approach of task oriented training along with conventional management for finer outcomes.

Keywords: Activities of Daily Living, Spasticity, Stroke, Task Oriented Approach

1. Introduction

Stroke is distinguished by neurological deficits occurring from the cerebrovascular damage and leads to problems such as cognitive, speech and language, motor and sensory impairments.

Stroke may lead to major life changes as it limits participation in daily activities[1]. Stroke is a leading source of high degree of morbidity and long term functional disability in individuals[2,3]. The upper motor neuron damage can be differentiated into positive and negative ones. Increase of muscle tone and tendon jerks, extensor stretch reflexes, clonus and released flexor reflexes such as Babinski reflex are the positive ones. The negative ones include the loss of fine motor control, paresis, loss of dexterity, increased fatigability of muscles and hypotonia in the early phase of upper motor neuron damage[4]. Approximately 50% of stroke survivors are having disability regarding arm-hand performance, which often persists throughout their lives[5].

It takes intense rehabilitative efforts to bring out the best functional outcome of patients with severe hemiparesis, yet the results are poor. Full arm function is regained only in 5% individuals (having complete paralysis) and 30-66% is never able to regain the use of the affected arm. Of the individuals who gain unwavering upper-limb function, fine motor control or dexterity often remains impaired[3]. Not only the upper limb function, but the ambulatory or the walking function also becomes severely impaired in post stroke individuals. The potential to walk is impaired in more than 80% of stroke survivors. These impairments are a consequence of residual motor weakness, poor motor control and spasticity leading to an altered gait pattern, poor balance and risk of falls during locomotion[6].

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Spasticity is one of the signs indicating damage of the upper motor neuron system on spinal or cerebral level[4]. Spasticity is outlined as a velocity - dependent increase of tonic stretch reflexes (muscle tone) with exaggerated sinew jerks, ensuing from hyperexcitability of the inborn reflex, jointly part of the UMN syndrome. Fitfulness may be a common impairment, that is gift in additional than a 3rd of the patients at a year when stroke occured[7]. Spasticity is a common impairment, which is present in more than a third of the patients at a year after stroke occured[7]. Spasticity has been put forth to cause a decrease in range of motion, stiffness, painful spasms and contractures. These can lead to complications with posture, transfers, physical therapy, nursing care and hygiene[7]. Hand spasticity causing hindrance in hand motor function is a common sensorimotor disorder after stroke, can be incapacitating, and is associated with development of pain and contracture[8]. However, marked spasticity may be a barrier to functions and cause difficulty in activities in daily living. In such cases, management options should be considered[4]. Managing and diminishing the effects of spasticity has remained one of the crucial aims for physiotherapists as a part of the rehabilitation program following stroke.

Task oriented approach is a clinical therapeutic approach built on rehabilitation science and is constructed on the principles of motor re-learning, motor control, and neuroplasticity. It validates patients with functional disabilities to self-motivate and then select and perform various tasks followed by practicing them accordingly[2]. Rehabilitation post-stroke has evolved over the past few years from analytical approaches to task oriented training approaches that imply training of the basic functions, skills and movements (anatomical). The task oriented training approach goes with patient training preferences and has been proven to be efficacious for the enhancement of skilled arm-hand performance post stroke[5]. Task oriented approach incorporating repetitive practice of meaningful daily activities is more fruitful than the traditional approaches to the rehabilitation post stroke and can give on to an increased activation of the affected sensorimotor cortex[3]. It is important to identify the missing components while manifesting the task oriented approach on post stroke individuals and so will cause optimization of the training programs[5]. Recent studies have proven that exercise interventions in the form of task oriented training which are purposeful to support the relationship between training and functional performance, as a plan to improve balance and functional mobility in post stroke individuals[1].

In this study, a "training component" refers to a task-oriented approach characteristic with a specific effect on motor re-learning. For example, "random practice" is a training component that has proven to have positive effects on retention of learned motor actions. Post-stroke spasticity may be maladaptive and interfere with an individual's ability to perform functionally useful movement. However studies investigating how the spasticity relates to motor recovery are rare. Reducing the limb spasticity will help post stroke individuals function better at the activities of daily living. There is a paucity of literature showing the effect of task oriented approach on spasticity when compared to the standard conventional approach. Hence, there is a need to find out the effect of task oriented training on spasticity in post stroke individuals. This if found effective to reduce spasticity in a lesser duration of span will help to improve the treatment protocol and management of spasticity in post stroke patients.

2. Methods

The materials required for the study are Data collection sheet, Consent form, Demographic data sheet, Modified Ashworth Scale and Modified Barthel Index. It was a comparative study with a study design of Randomised Clinical Trials (RCT). The sample size for the study was 60 post stroke individuals with 30 post stroke individuals in group A and 30 post stroke individuals in group B. the sampling method applied was purposeful sampling technique with a sampling formula as shown below:

Sampling Formula: $n = [Z1 - + Z]^2 \text{ X } [SD_1 + SD_2]^2$

$n = [1.28 + 0.84]^2 \text{ X } [0.87 + 0.71]^2$

$n = [2.12]^2 \text{ X } [1.58]^2$

$n = 4.49 \text{ X } 2.49$

$n = 11.18$

Minimum sample size is $n = 11.18$

We have taken 30 post stroke individuals in group A (Task oriented approach) and 30 post stroke individuals in group B (conventional management along with task oriented approach).

The study was conducted in Krishna Institute of Medical Sciences "deemed to be" University, Karad for duration of over 6 months. The target population for the study was post-stroke individuals with spasticity (Brunnstrom stage 2-4).

2.1 Objective of the Study

The find out the effect of task oriented approach on spasticity in post stroke individuals.

2.2 Eligibility Criteria

- Post stroke patients with spasticity (Brunnstrom stage 2-4).

- Individuals suffered from stroke in the past one year.
- Both male and female.
- Individuals between 40-65 years of age.
- Individuals willing to participate voluntarily.

2.3 Exclusion Criteria

- Individuals with recent head injury.
- Individuals with recent head surgery.
- Non cooperative individuals.
- Individuals taking other forms of treatments (Medications for spasticity).
- Individuals not mentally competent to participate in the study.

2.4 Procedure

The selection of the subjects was made on the basis of the inclusion and exclusion criteria mentioned above. The individuals willing to participate were given an informed consent form to be filled. Prior to starting the treatment protocol the individuals were given demographic data collection sheets to be filled by them/relatives. The individuals were explained in detail about the treatment protocol. The individuals were grouped in 2 different groups by random selection. Group A (Task oriented approach) was given a task oriented approach for managing the spasticity and group B (Conventional and task oriented approach) was given conventional treatment along with a task oriented approach to manage the spasticity. The treatment protocol for both the groups lasted for 6 weeks. The treatment was 4 days a week and every individual progressed in the terms of treatment approach in both the groups once they could easily perform a task given to them. The spasticity was assessed at the start (0 week), at 2 weeks, at 4 weeks and at the end (6 weeks) of the treatment protocol. Spasticity was assessed using the Modified Ashworth Scale. The Activities of daily living were assessed on the Modified Barthel Index. An additional researcher was included to carry out the assessment procedure to rule on the possibilities of bias and human errors. The values observed were recorded on the data collection sheet. The approval for conducting the study on post stroke individuals was obtained from the institutional ethics committee of Krishna Institute of Medical Sciences.

2.5 Outcome Measures

Demographic details including the age, gender, affected side, dominant side, stroke subtype and the time elapsed from the stroke to measurement/assessment were taken at the recruitment.

The clinical assessment of the spasticity was made using the Modified Ashworth Scale, where grading from 0 to 5 were used for the purpose of simplified data analysis and statistics.

Modified Ashworth Scale grading used in the study is as follows[9]:

0 No increase in muscle tone.
1 Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) is(are) moved in flexion or extension.
2 (1+) Slight increase in muscle tone, manifested by a catch followed by minimal resistance through the remainder of the range of motion but the affected part(s) is(are) easily moved.
3 (2) More marked increase in muscle tone through most of the range of movement, but affected part(s) easily moved.
4 (3) Considerable increase in muscle tone, passive movement difficult.
5 (4) Affected part(s) rigid in flexion or extension.

Modified Barthel Index was applied to assess the activities of daily living at baseline, at 2 weeks, 4 weeks and post 6 weeks[10,11].

3. Results

The study was conducted among 60 post stroke individuals who suffered from stroke within the past one year and were having spasticity in Brunnstrom stage 2-4. A total of 27 individuals having age below and equal to 50 were recruited for the study. 33 individuals above the age of 50 were included in the study (refer Table no. 1). An equal of 15 male and 15 females were included for the study in group A and group B respectively (refer Table no. 2). The 60 individuals were randomly divided into 30 individuals in each Group A and B respectively. Group A individuals received the task oriented training for spasticity and Group B individuals received conventional management for spasticity along with the task oriented training. The statistical analysis was done using the INSTAT application. Unpaired "t" test was applied to compare the means and standard deviation of Group A and Group B at each baseline, at 2 weeks, at 4 weeks and at post 6 weeks of treatment. The patients received a total of 24 sessions of treatment over a period of 6 weeks. The progression during the 6 weeks in each group was analyzed using the repeated measures of ANOVA on the INSTAT application.

According to the data represented in table no. 3, the mean and standard deviation on the Modified Ashworth Scale of Group A and Group B at baseline is 3.46 ± 0.68 and 3.56 ± 0.72 respectively which shows no significance with a p value of 0.2925 and t value of 0.5493. The mean and standard deviation of Group A and Group B at 2 weeks is 3.26 ± 0.73 and 2.83 ± 0.83 respectively which is significant with a p value of 0.0375

and a t value of 2.129. The mean and standard deviation of Group A and Group B at 4 weeks is 2.73 ± 0.94 and 2.1 ± 0.94 respectively which is significant with a p value of 0.0125 and a t value of 2.577. The mean and standard deviation of Group A and Group B at 6 weeks is 2.4 ± 1.04 and 1.33 ± 1.1 respectively which is significant with a p value of 0.0003 and at value of 3.877. The above statistical analysis suggests that there is a significant difference in spasticity on MAS of group A and group B progressed over a period of 6 weeks.

Interpretation of the data represented in the Table no. 4 suggests that there is a significant reduction of spasticity clinically on MAS in both the groups. The spasticity reduced from 3.46 ± 0.68 at baseline to 2.4 ± 1.04 post 6 weeks in Group A with ANOVA f value of 36.548 and p value <0.000.1. The spasticity reduced from 3.56 ± 0.72 at baseline to 1.33 ± 1.1 post 6 weeks in Group B with ANOVA f value of 161.79 and p value <0.0001.

According to the data represented in Table no. 5, the mean and standard deviation on the Modified Barthel Index of Group A and Group B at baseline is 56.57 ± 7.22 and 56.2 ± 6.95 respectively which shows no significance with a p value of 0.8419 and t value of 0.200. The mean and standard deviation of Group A and Group B at 2 weeks is 57.6 ± 7.09 and 62.76 ± 6.73 respectively which is very significant with a p value of 0.0053 and a t value of 2.894. The mean and standard deviation of Group A and Group B at 4 weeks is 59.06 ± 7.78 and 76.17 ± 5.02 respectively which is extremely significant with a p value of <0.0001 and a t value of 10.116. The mean and standard deviation of Group A and Group B post 6 weeks is 61.1 ± 8.84 and 91.27 ± 5.87 respectively which is extremely significant with a p value of <0.0001 and a t value of 15.939. The above statistical analysis suggests that there is a significant difference in ADL's on Modified Barthel Index of group A and group B progressed over a period of 6 weeks.

Interpretation of the data represented in the Table no. 6 suggests that there is a significant improvement of ADL's clinically on Modified Barthel Index in both the groups. The dependency improved from 56.57 ± 7.22 at baseline to 61.1 ± 8.84 post 6 weeks in Group A with ANOVA f value of 47.061 and p value < 0.000.1. The dependency improved from 56.2 ± 6.95 at baseline to 91.27 ± 5.87 post 6 weeks in Group B with ANOVA f value of 445.40 and p value < 0.0001.

4. Discussion

The study was conducted among 60 post stroke individuals (30 individuals in group A - task oriented training and 30 individuals in group B - conventional management of spasticity along with task oriented training) who had suffered from stroke in the past one year having spasticity and ADL's affected. Individuals falling within Brunnstrom stage 2 to 4 were included in the study, as during those stages the spasticity begins to develop, plateaus for certain duration of time and then gradually begins to decrease during Brunnstrom stage 4. While recruiting the post stroke individuals a monotonous distribution of the patient was done in both the groups. The standard deviation of spasticity on Modified Ashworth Scale was kept as minimum as possible while selection at baseline (refer Table no. 3) to maintain a parallelism which led to a lesser risk of selection bias in either of the groups. Patient blinding was executed at the beginning of the study that is the patient was informed about the study and the treatment he was receiving, but was oblivious about the expected outcomes to avoid performance bias. An additional physiotherapist apart from the treating physiotherapist was involved during the study to assess all the patients at 2 weeks, 4 weeks, and post 6 weeks without having the knowledge of treatment received by the patient. Assessor blinding was implemented to avoid bias and inclination towards the expected outcomes.

There are studies conducted depicting the effects of task oriented training for improving the functional ability of post stroke individuals, but studies proving the effect of task oriented training on spasticity are rare. In this study we have made an attempt to prove the effects of task oriented training on spasticity which will eventually help in motor recovery as spasticity may hurdle the patient's path of gaining functional activities of daily living. According to the statistical analysis achieved post 6 weeks of treating the post stroke individuals suggests that, task oriented training is very much effective in reducing the spasticity as well as improving the activities of daily living.

Group A individuals who received only task oriented training for reducing spasticity showed a drop on MAS by 1.06 points post 6 weeks of training (refer Table no. 3). Group B individuals who received conventional management of spasticity along with task oriented training showed better results with a drop of 2.23 on MAS post 6 weeks of treatment sessions. One point decrease on Modified Ashworth Scale is considered to be minimal detectable change (MDC) for spasticity in stroke patients[12]. This suggests that both the groups have received a treatment which has a clinically significant improvement, but when a patient receives conventional management of spasticity along with task oriented training will lead to the better reduction in spasticity.

Group A who received only task oriented training for improving ADL's manifested an increase of Modified Barthel Index score of 4.53 from baseline (56.57) to post 6 weeks assessment (61.1) (refer Table no. 5). Group B individuals who received conventional management along with task oriented training depicted an exponential increase of 35.07 on Modified Barthel Index (refer Table no. 5). Ghandehari et al., 2012 researched on the reliability of Modified Barthel Index

and concluded that a minimum of 6.84 points difference is considered to be significant for a treatment to be effective[13]. At baseline all the post stroke individuals had a severe dependence according to the interpretation of the Modified Barthel Index (21-60: severe dependence) which went on to improve and fall under moderate dependence in Group A individuals (61-90: moderate dependence) and an striking improvement in Group B individuals leading to slight dependence after 24 treatment sessions over 6 weeks. (91-99: slight dependence)[10,11.] This propounds that task oriented training along with conventional management leads to a finer improvement in the ADL's of post stroke individuals.

CJ Winstein et al., (2016) in their study concluded that task oriented rehabilitation programs when compared to an equivalent dosage of customary occupational therapy did not significantly enhance motor recovery or functions[14]. These results can be considered parallel with our study in terms of ADL's or motor function recovery. Hence this study is superior, proving task oriented training along with customary or conventional management leads to significant enhancement in post stroke motor recovery and functional mobility. Frimpong et al., (2014) conducted a study on 20 acute stroke survivors and concluded that task oriented circuit training leads to increased walking speed, endurance and functional mobility. It can ultimately be concluded that task oriented training alone is effective in acute stroke survivors, but in chronic stroke survivors it is not remarkably efficacious and requires a combined approach of task oriented training along with customary management for finer outcomes.

This study has some limitations. This study was conducted in a smaller population for a short duration of time and probably a limited number of treatment sessions. Further studies can be done to perhaps bring out more robust results with a larger sample size of post stroke individuals and for a longer duration of time with extensive treatment sessions. A long term follow up study should be conducted to discern the effects of the therapy. A further study using similar rehabilitation in combination

Table 1. Age wise distribution of population included in the study

Age	Group A (Mean ± SD)	Group B (Mean ± SD)
≤ 50 (n = 27)	46.23 ± 1.69	46.28 ± 1.77
>50 (n = 33)	58.35 ± 4.51	57.81 ± 4.5

Table 2. Gender wise distribution of population included in the study

Gender	Group A (n = 30) (in percentage)	Group B (n = 30) (in percentage)
Male	50 %	50%
Female	50 %	50%

Table 3. Statistical analysis of Modified Ashworth Scale representing comparison between both the groups

Modified Ashworth Scale (MAS)	Group A (Mean ± SD)	Group B Mean ± SD	t value	p value	Significance
baseline	3.46 ± 0.68	3.56 ± 0.72	0.5493	0.2925	Not significant
at 2 weeks	3.26 ± 0.73	2.83 ± 0.83	2.129	0.0375	significant
at 4 weeks	2.73 ± 0.94	2.1 ± 0.94	2.577	0.0125	significant
post 6 weeks	2.4 ± 1.04	1.33 ± 1.1	3.877	0.0003	Extremely significant

Table 4. Statistical analysis of Modified Ashworth Scale representing progression of Group A and Group B respectively using the ANOVA

Modified Ashworth Scale	Group A (Mean ± SD)	Group B (Mean ± SD)
baseline	3.46 ± 0.68	3.56 ± 0.72
at 2 weeks	3.26 ± 0.73	2.83 ± 0.83
at 4 weeks	2.73 ± 0.94	2.1 ± 0.94
post 6 weeks	2.4 ± 1.04	1.33 ± 1.1
anova f value	36.548	161.79
p value	<0.0001	<0.0001

Table 5. Statistical analysis of modified Barthel Index representing comparison between both the groups

Modified Barthel Index	Group A (Mean ± SD)	Group B (Mean ± SD)	t value	p value	Significance
baseline	56.57 ± 7.22	56.2 ± 6.95	0.200	0.8419	Not significant
at 2 weeks	57.6 ± 7.09	62.76 ± 6.73	2.894	0.0053	Very significant
at 4 weeks	59.06 ± 7.78	76.17 ± 5.02	10.116	<0.0001	Extremely significant
post 6 weeks	61.1 ± 8.84	91.27 ± 5.87	15.939	<0.0001	Extremely significant

Table 6. Statistical analysis of modified Barthel Index representing progression of Group A and Group B respectively using the ANOVA

Modified Barthel Index	Group A (Mean ± SD)	Group B (Mean ± SD)
baseline	56.57 ± 7.22	56.2 ± 6.95
at 2 weeks	57.6 ± 7.09	62.76 ± 6.73
at 4 weeks	59.06 ± 7.78	76.17 ± 5.02
spost 6 weeks	61.1 ± 8.84	91.27 ± 5.87
anova f value	47.061	445.40
p value	<0.0001	<0.0001

with sensory inputs can be carried out to gain insight into the potentially a cut above out-turn.

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6. References

1. Moon JH, Park KY, Kim HJ, Na CH. The effects of task-oriented circuit training using rehabilitation tools on the upper-extremity functions and daily activities of patients with acute stroke: A randomized controlled pilot trial. Osong Public Health and Research Perspectives. 2018 Oct; 9(5):225. PMid: 30402377 PMCid: PMC6202022. https://doi.org/10.24171/j.phrp.2018.9.5.03
2. Kuberan P, Kumar V, Joshua AM, Misri ZK, Chakrapani M. Effects of task oriented exercises with altered sensory input on balance and functional mobility in chronic stroke: A pilot randomized controlled trial. Bangladesh Journal of Medical Science. 2017 Mar 23; 16(2):307–13. https://doi.org/10.3329/bjms.v16i2.24953
3. McDonnell MN, Hillier SL, Miles TS, Thompson PD, Ridding MC. Influence of combined afferent stimulation and task-specific training following stroke: A pilot randomized controlled trial. Neurorehabilitation and Neural Repair. 2007 Sep; 21(5):435–43. PMid: 17405883. https://doi.org/10.1177/1545968307300437
4. Rekand T. Clinical assessment and management of spasticity: A review. Acta Neurologica Scandinavica. 2010 Jul; 122:62–6. PMid: 20586738. https://doi.org/10.1111/j.1600-0404.2010.01378.x
5. Timmermans AA, Spooren AI, Kingma H, Seelen HA. Influence of task-oriented training content on skilled arm-hand performance in stroke: A systematic review. Neurorehabilitation and Neural Repair. 2010 Nov; 24(9):858–70. PMid: 20921325. https://doi.org/10.1177/1545968310368963
6. Frimpong E, Olawale OA, Antwi DA, Antwi-Boasiako C, Dzudzor B. Task-oriented circuit training improves ambulatory functions in acute stroke: A randomized controlled trial. Journal of Medicine and Medical Sciences. 2014; 5(8):169–75.
7. Kumar RT, Pandyan AD, Sharma AK. Biomechanical measurement of post-stroke spasticity. Age and ageing. 2006 Jul 1; 35(4):371–5. PMid: 16675479. https://doi.org/10.1093/ageing/afj084
8. Plantin J, Pennati GV, Roca P, Baron JC, Laurencikas E, Weber K, Godbolt AK, Borg J, Lindberg PG. Quantitative assessment of hand spasticity after stroke: Imaging correlates and impact on motor recovery. Frontiers in Neurology. 2019 Aug 12; 10:836. PMid: 31456734 PMCid: PMC6699580. https://doi.org/10.3389/fneur.2019.00836
9. O'Sullivan SB, Schmitz TJ, Fulk G. Physical Rehabilitation. F A Davis; 2019 Jan 25.
10. Shah S, Vanclay F, Cooper B. Improving the sensitivity of the Barthel Index for stroke rehabilitation. Journal of Clinical Epidemiology. 1989; 42:703–9. https://doi.org/10.1016/0895-4356(89)90065-6
11. Shah S, Cooper B. Documentation for measuring stroke rehabilitation outcomes. Australian Medical Records Journal. 1991; 21:88–95. https://doi.org/10.1177/183335839102100304
12. Shaw LC, Price CI, van Wijck FM, Shackley P, Steen N, Barnes MP, Ford GA, Graham LA, Rodgers H. Botulinum Toxin for the Upper Limb after Stroke (BoTULS) Trial: Effect on impairment, activity limitation and pain. Stroke. 2011 May; 42(5):1371–9. PMid: 21415398. https://doi.org/10.1161/STROKEAHA.110.582197
13. Ghandehari K, Ghandehari K, Saffarian-Toosi G, Masoudinezhad S, Yazdani S, Nooraddin A, Ebrahimzadeh S, Ahmadi F, Abrishamchi F. Comparative interrater reliability of Asian Stroke Disability Scale, modified Rankin Scale and Barthel Index in patients with brain infarction. ARYA Atherosclerosis. 2012; 8(3):153.
14. Winstein CJ, Wolf SL, Dromerick AW, Lane CJ, Nelsen MA, Lewthwaite R, Cen SY, Azen SP. Effect of a task-oriented rehabilitation program on upper extremity recovery following motor stroke: the ICARE randomized clinical trial. Jama. 2016 Feb 9; 315(6):571–81. PMid: 26864411 PMCid: PMC4795962. https://doi.org/10.1001/jama.2016.0276

7. Abbreviations

n = sample size
SD = Standard deviation
MAS = Modified Ashworth Scale
ADL's = Activities of daily living.
MDC = Minimal detectable change
KIMSDTBU = Krishna Institute of Medical Sciences "deemed to be" University.
No. = number