Original Research Paper

Volume : 5 | Issue : 9 | September 2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 69.48

Knowledge of Result Versus Knowledge of Performance in Learning Motor Skilled Activity for Upper Limb in Recovery Stage of Stroke – A Randomized Experimental Study

Medical Science

KEYWORDS : Stroke, motor learning, knowledge of result, knowledge of performance

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ABSTRACT

Purpose of the study: *Stroke is a clinical syndrome characterized by the sudden development of a persisting focal neurological deficit. The rehabilitation interventions to treat motor deficits following stroke include, motor learning strategies like strategy development, feedback, practice, etc. knowledge of result and knowledge of performance are two extrinsic feedback. There are scant evidences to conclude which one of them could be more effective for stroke patients.*

Materials and methods*: 30 patients, both males and females were divided into 2 groups by random allocation, group 1 as knowledge of result and group 2 as knowledge of performance. Both the groups were made to practice a task of throwing soft spongy ball, where group 1 got the distance of the throw as feedback and group 2 were showed the video replay of their performance and were given verbal cues.*

Results*: Both the groups showed significant improvement from the pre value to post value of the thrown distance with p value <0.001, but there was no significant difference between the groups shown by p value 0.564.*

Conclusion*: Based on the results, the study concluded that the knowledge of performance proved more effective than knowledge of result for the given task.*

Introduction:

Cerebrovascular diseases play an important worldwide role in the morbidity and mortality of adults posing serious medical, socioeconomic and rehabilitation problem. The tragedy of the cerebrovascular disease lies in the fact that it does not always kill rapidly. In fact, it is the chief and most horrible of the crippling diseases, destroying body and mind alike. It is the leading cause of death after cancer and heart diseases, produces considerable morbidity and is an important public health problem all over the world.[1]

The prevalence of stroke in India was estimated as 203 per 100,000 populations. [2] The incidence of stroke is about 19% higher in males than females.[3]

The world health organization defined stroke as a 'rapidly developed clinical sign of focal disturbance of cerebral function of presumed vascular origin and of more than 24 hours duration'. [4]The focal brain lesion encountered in patients with stroke produces wide variety of neurologic deficits such as hemiplegia, hemi sensory loss, aphasia, hemianopia, etc.[5]

Loss of arm function is one of the most common and challenging sequel and it limits patients' autonomy in the activities of daily living and may lead to permanent disability.[6]When commencing the rehabilitation for the individuals with stroke, rehabilitation of upper extremity holds utmost important role along with rehabilitation of posture, balance and gait. For the upper extremity, it is more important to focus on the rehabilitation of the function than rehabilitation of isolated movements.

Rehabilitation interventions for stroke includes motor learning strategies i.e. strategy development, feedback, practice, motor relearning program and motor control training.[7]

Motor learning has been described as a set of process associated with practice or experience leading to relatively permanent changes in capability for producing skilled action.The role of feedback and practice cannot be neglected in motor learning.

The term feedback means return of some of the output of a system as input so as to exert some control in process.[8]There are two types of feedback; Intrinsic and extrinsic.Intrinsic feedback is provided by the sensory systems. Extrinsic feedback is provided by external cues which does not typically received in the task. Since the extrinsic feedback adds value to intrinsic feedback, it is also termed as augmented feedback.[9]

Augmented feedback about the end result or overall outcome of the movement is termed knowledge of results (KR). Augmented feedback about the nature or quality of the movement is termed knowledge of performance.[5]

Knowledge of result will be beneficial for the following reasons: 1) learners often use KR to confirm their own assessment of the task intrinsic feedback, even though it may be redundant with task intrinsic feedback. 2) Learners may need KR because they cannot determine the outcome of performing skill on the basis of the available task intrinsic feedback. 3) Learners often use KR to motivate them to continue practicing skills. 4) Practitioner may want to provide only Kr in order to establish discovery learning.[9]

Knowledge of performance can be beneficial when; 1) skills must be performed according to specific movement characteristics. 2) Specific movement components of skills that require complex coordination must be improved or corrected. 3) The goal of the action is a kinematic, kinetic or specific muscle activity, 4) KR is redundant with the task intrinsic feedback.[9]

Though, there are many studies on KR and KP for sports individuals and asymptomatic individuals, there arescant evidences to prove the relative effectiveness of KR and KP for the individuals with stroke.Hence the study was designed for individuals with stroke with knowledge of result and knowledge of performance as a feedback for motor learning.

Materials and method:

The ethical approval was obtained from the institutional ethical committee. Informed written consent was taken from all the subjects. Individuals both males and females were included if they had middle cerebral artery stroke, between the age of 45 years to 75 years, Mini mental examination score above 24, having score 35 or above in Fugl Meyer assessment of physical performance for upper extremity, Spasticity grading of Modified Ashworth scale not more than 1+.

Individuals with complete recovery, any other neurological deficits, medically unstable, severe musculoskeletal

deformity in upper limb or severe cardiovascular deficits were excluded.

Procedures:
14 subjects were randomly selected from the population, and they were divided into two groups by random allocation with lottery method. Both the groups were given a task of throwing soft spongy ball as far as possible with affected arm. The distance measured as pre test was taken as an average of first five trials for both the groups.

Knowledge of result group (group 1): All the subjects were given a task of throwing a soft spongy ball. In a day 40 trials were given. Each subject got break time of 40 seconds after every 10 trial. After every 10 trials the subjects were given knowledge of result as feedback, in the form of highest distance thrown by them in thrown 10 trials. The practice session was given for 2 weeks, six sessions per week.

Knowledge of performance group (group 2): All the subjects were given a task of throwing a soft spongy ball. In a day 40 trials were given. Each subject got break time of 40 seconds after every 10 trials. After every 10 trials the subjects were given feedback in the form of knowledge of performance, i.e. verbal cueing and video tape replay of their own performance. The practice session was given for 2 week, six sessions per week.

The post practice throw was taken at the end of two weeks as an average of 5 trials for both the groups. The comparisons of the data were done by the use of statistical tool.

Results:
The data of the thrown distance by both the group was analysed using paired "t" test. In the data, the mean, the standard deviation and the standard error was obtained for the thrown distance for both the groups. And the inter group analysis was done using unpaired "t" test.

Table 1 – shows pre and postmean values and standard deviation, improvement, t value and p value.

Group	Pre (mean±SD)	Post (mean±SD)	Improvement	t value	p value
1 (KR)	27.24(3.87)	56.44(5.13)	29.20	25.61	<0.001
2 (KP)	27.24(3.70)	59.40(6.47)	32.15	22.65	<0.001

The mean improvement of group 1 is 29.20 with t value 25.61, and p value <0.001, which indicates there is a significant improvement in the distance of the throw in individuals with stroke.

The mean improvement of group 2 is 32.15 with t value 22.65, and p value <0.001, which indicates there is a significant improvement in the distance of the throw in individuals with stroke.

Table 2- shows mean and standard deviation of the improvement of both the groups, with t value and p value.

Group	**Improvement (mean±SD)**	t value	p value
1 (KR)	29.20(2.99)	1.629	0.564
2 (KP)	32.15(3.75)		

Improvement of group A is 29.20, and group B is 32.15, with t value 1.629 and p value 0.564, which shows there is no significant difference between the groups.

Discussion:
The study was designed to find out and compare the effectiveness of knowledge of result and knowledge of performance on learning skilled motor activity in individuals with recovery stage stroke. The study consisted of 14 individuals with stroke, randomly allocated to two groups. Distance of the throw was taken as an outcome measure. Practice sessions were given as 6 sessions per week for 2 weeks. Group 1 got knowledge of result as a feedback, and group 2 got knowledge of performance as a feedback.

The results show improvement in both the groups, group 1 which received knowledge of result as feedback, which showed improvement of 29.20 with p value <0.001, which indicates there is significant improvement from the base line value.

The above findings are also supported byCAROLEE J S WINSTEIN[10]who stated that Motor learning as "an area of the study focusing in the acquisition of skilled movement as a result of practice." And knowledge of results considered a practice variable that is capable of affecting both temporary and relatively permanent (i.e. learning) changes in performance.

BRISSON TA, ALAIN C A[11] Stated that knowledge of result was an influential variable for learning the criterion pattern because both the group that received the knowledge of result in addition to knowledge of performance learned the pattern better than those that did not receive knowledge of result.

Group 2 received knowledge of performance as a feedback, showed improvement of 32.15 with p value <0.001, which indicates there is significant improvement from the baseline value.

Kernodle and Carlton[12] in their study on 'information feedback and learning multiple degree of freedom activties' had a similar finding and stated that the results support the hypothesis that knowledge of performance can lead to significant gains in skill acquisition.Zubiaur M, Ona A and Delgado J[13] in their study stated that knowledge of performance tends to be more effective for learning.

When comparing the mean improvement of group 1 and 2, group 1 having mean 29.20 and group 2 having mean of 32.15, t value 1.629 and p value 0.564, it showed there is no significant difference between the improvement of group 1 and group 2.

The possible reason for this finding can be that the protocol given was of short duration to show the effectiveness of a particular feedback. Also, because the intervention was performed on small sample, the relative effectiveness cannot be established clearly.

Cirstea CM, Ptito A, Levin MF[7], on the contrary reported that knowledge of performance during repetitive movements resulted in better motor outcomes. Our results showed that given appropriate feedback (i.e. KP) even severely impaired patients showed decreased motor impairment (83% to 86% of patients) and 75% improved motor function. But they had 37 individuals of stroke as their sample.

Though, there is no significant difference between group 1 and group 2, clinically group 2 performed better than group 1.

The possible explanation for the better performance of knowledge of performance group is stated by Tzetzis[14],

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who says that, goal setting and feedback are among the most important factors for learning physical skills. However, they suggest that when feedback is separated from goals, feedback does not improve performance. Intuitively, this makes sense as typically in any kind of coaching instructions, there is some goal involved because the nature of feedback has to refer to a goal even if it is implicit. Whereas Henk Van Dijk, and Ensched[15] say that, research comparing the two types of augmented feedback suggests that kinetic feedback is of more benefit in learning motor skills than knowledge of results. However, this is likely to be dependent on the complexity of the learned task.

In this study, both the groups, knowledge of result and knowledge of performance showed significant improvements in learning skilled activity. There was no significant difference found between both the groups, but in the study, a simple task was analysed which could be the reason for low improvement difference between the groups. More complex task, if taken for the learning may be able to optimize the performance.

Further, follow up of retention of the learned movement was not taken into consideration, a study with retention of the learned movement is recommended to enlighten the problem in a better way.

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