

## Original Article



# Impact of Botulinum Toxin Along with Task-Specific Training in Post-Stroke Quality of Life in Focal Hand Dystonia

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## Author's Contribution

<sup>1,5</sup>conceptualized supervised the project and revised the manuscript

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## ABSTRACT

**Objective:** To investigate the impact of BOTOX, along with task-specific training, on focal hand dystonia in post-stroke patients and to determine the correlation between quality of life and motor outcomes in upper extremity dystonic patients.

**Methodology:** A quasi-experimental involving 20 patients, study was conducted at Holy Family Hospital (HFH), Chambeli Institute of Rehabilitation in Rawalpindi, and Neurocounsel Clinic in Islamabad. A convenient sampling technique was utilized to select participants for inclusion in the study. Assessments were conducted at four time points: baseline (0 weeks), 4 weeks, 8 weeks, and 12 weeks. The assessment tools used were the Abductor Digiti Minimi Abduction (ADDA) test, Modified Ashworth Scale (MAS), and Stroke-Specific Quality of Life (SS-QoL) questionnaire. Repeated measures ANOVA was employed to analyze mean differences in data across various weeks. The associations between scales were evaluated using Spearman's rho and Pearson correlation coefficients, based on different variables.

**Results:** The mean age was  $42.7 \pm 10.45$  years. The study included 14 males and 6 females. Repeated measures ANOVA indicated a significant difference between MAS scores for upper extremity and quality of life in post-stroke dystonic patients, with a p-value of 0.001\*\*. A strong positive correlation coefficient was found between MAS and SS-QoL through Spearman's correlation analysis, with a p-value of less than 0.05.

**Conclusion:** The administration of Type a Botulinum toxin, coupled with task-specific training, not only exhibited improvements in upper limb motor outcomes but also in the quality of life of focal hand dystonic patients after a stroke.

**Keywords:** Type A Botulinum toxin, Task specific training, quality of life.

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## Introduction

Stroke is considered the most common neurological condition worldwide. The morbidity and mortality rates due to stroke have increased significantly across the globe.<sup>1</sup> In Pakistan, the mortality rate from stroke is particularly high, ranging from approximately 7-20%, and it exceeds 63% in developing countries.<sup>2</sup> Motor impairments are the predominant manifestations after a stroke, accounting for 83%, while cognitive, speech, and psychological impairments, neuropathic pain, and seizures constitute 50%, 36%, 8%, 10%, and 20% respectively.<sup>3</sup>

Annually, over 350,000 patients suffer from stroke in Pakistan. Besides cardiovascular diseases like hypertension and atherosclerosis, individuals with diabetes in Pakistan also experience strokes. Due to the lack of government funding and proper management, people in our country have to bear hospital care expenses themselves. In third-world and developing countries where support systems are lacking, those suffering from such illnesses become financially and physically dependent on their families, exacerbating their burdens.<sup>4</sup> Not only patients and their families are affected by such conditions, but the community as a whole also suffers. Both patients

and families endure the adverse effects of stroke not only physically and socially but also psychologically.<sup>5</sup>

Depending on the area of brain affected, stroke sufferers experience various complications.<sup>6</sup> Activities of daily living (ADLs) of stroke patients are profoundly affected by post-stroke complications. After a stroke, movements become of paramount importance as different types of movement disorders are observed at different stages, depending on the affected brain area.<sup>7</sup> Dystonia is the most prevalent type of hyperkinetic movement disorder, with subtypes such as segmental or focal dystonia.<sup>8</sup> Focal hand dystonia patients commonly experience affected agonist and antagonist muscles of the hand and forearm, resulting in repetitive and involuntary hand movements alongside fixed postures. The quality of life of dystonic patients is severely compromised due to these movement disorders.<sup>9</sup>

Several interventions have been utilized for focal hand dystonia, including baclofen, intrathecal baclofen, dopamine depletors, anticholinergics, selective peripheral denervation, surgical ablation procedures, bilateral pallidal stimulations, deep brain stimulation (DBS), and pallidectomy, as well as BOTOX.<sup>10,11</sup> Various conservative treatments are also found in the literature, such as KT tape, splinting, serial casting, stretching, strengthening, and electrical stimulations like NMS and EMS. Constrained induced muscle training (CIMT) and task-specific training have been considered beneficial in the literature. However, the study of quality of life in such patients remains limited.<sup>12-14</sup> This study aims to examine the impact of Botulinum toxin A and task-specific training on upper extremity focal hand dystonia and to explore the association between post-stroke patients' quality of life and motor outcomes.

## Methodology

Those patients were included in the study who developed focal hand dystonia after the stroke, which affected their arm functions and mobility. Patients who had experienced a stroke more than six months prior and had not undergone any treatment with BOTOX type A were also included. However, female patients who were pregnant and individuals who had developed contractures or were suffering from neuropathies were excluded from the study due to potential interference with the rehabilitation process. Informed consent was obtained from all patients before intervention.

The participants in the study were injected with type A botulinum toxin and subsequently received task-specific

training, which was a specific physiotherapy intervention. Each participant underwent one hour of therapy session for a duration of 12 weeks, with a maximum of three therapy sessions per week.

The outcomes were measured at baseline, the 4th week, the 8th week, and the 12th week using the Arm Dystonia Disability Scale (ADDS), Motor Assessment Scale (MAS), and Stroke-Specific Quality of Life (SS-QoL) questionnaire. Three participants were dropped from the study, leaving 20 patients for evaluation using these tools.

The sample size for the current study was calculated using Epitool (n=23). A total of 23 patients were initially included in the study.

Data was analyzed using SPSS version 21 and Microsoft Excel. The normality of the data was assessed using the Shapiro-Wilk test. Since the p-values were greater than 0.05, the data was considered to be normally distributed, allowing for the use of parametric tests in the data analysis. Repeated measures ANOVA was employed to analyze the mean differences in data across the various weeks. The association between the scales was assessed using Spearman's rho and Pearson correlation, based on different variables.

## Results

The mean age of participants in this study was  $42.7 \pm 10.45$  years. Among the participants, there were 14 males (70%) and 6 females (30%). Of the patients, 65% (13) had experienced an ischemic stroke, while 35% (7) had suffered from a hemorrhagic stroke. The frequency of right-sided involvement was observed in 85% (n=17) of participants, while left-sided involvement was seen in only 15% (n=3), totaling 19%. An improvement in focal hand dystonia severity was observed after the 12-week treatment protocol in comparison to the baseline measurement. The frequency of hand dystonia after the 12-week intervention is presented in Table I.

**Table I: Dystonia stage & frequency from 0 week (baseline) to 12th week.**

	Readings at Base line	Readings at Week 4	Readings at Week 8	Readings at Week 12
ADDS				
0	0%	0%	5% (1)	20% (4)
1	10% (2)	20% (4)	45% (9)	35% (7)
2	50% (10)	50% (10)	30% (6)	45% (9)
3	40% (8)	30% (6)	20% (4)	0%

Upon comparing the mean and standard deviation of variables at different weekly intervals, a significant difference was found ( $p < 0.001^{***}$ ) through repeated

measures ANOVA at baseline, the 4th week, the 8th week, and the 12th week. Table II

were improved based on functional assessment (MAS-UE), dystonia severity, and quality of life (SF-36).

**Table II: Repeated measures Anova at different weeks showing mean scores of MAS and SS-QOL.**

Variable	Mean $\pm$ SD At Base Line	Mean $\pm$ SD At 4 <sup>th</sup> week	Mean $\pm$ SD At 8 <sup>th</sup> week	Mean $\pm$ SD At 12 <sup>th</sup> week	F Value	P Value
MAS-UL	5.2 $\pm$ 2.87	7.1 $\pm$ 3.02	9.55 $\pm$ 3.63	12 $\pm$ 3.83	48.98	<0.001 ***
Stroke specific QOL	101.05 $\pm$ 22.17	122.15 $\pm$ 26.04	152.5 $\pm$ 38.43	164.2 $\pm$ 40.84	61.58	<0.001 ***

Pearson correlation was employed to assess the correlation coefficient between MAS-UL and SS-QoL, while Spearman's rho test was used for ADDS, MAS, and SS-QoL. A negative correlation was observed between ADDS and MAS-UL, as well as between ADDS and quality of life (SS-QoL), with p-values below 0.05. Conversely, a positive correlation was found between MAS and stroke-specific quality of life, with a p-value of 0.001, which was less than 0.05. These correlations were observed across different weeks, including baseline, the 4th week, the 8th week, and the 12th week. Table III.

**Table III: Correlation at different weeks between ADDS & MAS and SS-QOL and MAS and SS-QOL**

Correlation	Time intervals (Weeks)	Correlation Coefficient	P- value
ADDS and MAS-UL	0	-0.86	<0.001 ***
ADDS and MAS-UL	4	-0.82	<0.001 ***
ADDS and MAS-UL	8	-0.86	<0.001 ***
ADDS and MAS-UL	12	-0.83	<0.001 ***
ADDS and SS-QOL	0	-0.85	<0.001 ***
ADDS and SS-QOL	4	-0.81	<0.001 ***
ADDS and SS-QOL	8	-0.84	<0.001 ***
ADDS and SS-QOL	12	-0.74	<0.001 ***
MAS-UL & SSQOL	0	0.87**	<0.001 ***
MAS-UL & SSQOL	4	0.864**	<0.001 ***
MAS-UL & SSQOL	8	0.833**	<0.001 ***
MAS-UL & SSQOL	12	0.803**	<0.001 ***

## Discussion

To the best of the authors' knowledge, the current study is the first of its kind in Pakistan to focus on the treatment of post-stroke focal hand dystonia. The combination of BoNT-A and TST (Task-Specific Training) has been found to be highly effective for enhancing hand function in focal dystonia of the hand. The outcomes in this study

Rosales et al elucidated the role of botulinum toxin in dystonia treatment. According to their review, botulinum toxin is the most effective therapy for dystonia, blocking acetylcholine action not only on extrafusal fibers but also on intrafusal fibers. This action on intrafusal fibers leads to the modulation of pre-synaptic inhibition, influencing the central programming of the motor system as a form of plasticity.<sup>15</sup> The current study employed botulinum toxin in conjunction with task-specific training for post-stroke focal hand dystonia. As focal hand dystonia is believed to arise from maladaptive plasticity causing uncontrolled sensorimotor map reorganization, leading to altered muscle activities and hindering smooth contractions, the use of both botulinum toxin and task-specific training is a promising means of inducing neural plasticity. Task-specific training involves continuous repetition of less intense functional tasks, promoting the development of new brain pathways that result in improved function in various neurological conditions through cortical reorganization.<sup>16</sup>

Cloud et al outlined different treatment options for various forms of dystonia, including focal hand dystonia. They highlighted botulinum toxin as the preferred treatment for focal dystonias due to its ability to counteract muscle over-contraction by inhibiting acetylcholine release at the neuromuscular junction. They also discussed the roles of physical and occupational therapy, mentioning sensory-motor retuning, constraint-induced movement therapy, and arm immobilization in a sling as potential therapeutic options for focal hand dystonia.<sup>13</sup> The present study incorporated both pharmacological treatment (botulinum toxin) and physical therapy (task-specific training). While the mentioned review did not specifically endorse the physical therapy treatment regimen utilized in this study, it did not directly address post-stroke focal hand dystonia.<sup>17,18</sup> However, task-specific training has demonstrated efficacy in enhancing upper limb function post-stroke, which could contribute to the promising results observed in this study.

Gambhir et al conducted a case report investigating the effects of electrical muscle stimulation alongside sensorimotor training, reporting positive outcomes for

focal hand dystonia in a patient.<sup>19</sup> They implemented training involving various tasks, including sensorimotor exercises, posture correction, fine motor skills practice, and cognitive behavioral training over 20 days, leading to marked improvements in hand function.<sup>19</sup> Similarly, the current study employed physiotherapy exercises as task-specific training to improve hand function in post-stroke focal hand dystonia.

Cogiamanian et al's narrative review highlighted the elusive pathophysiology of focal hand dystonia, attributing it to potential factors like inhibition loss at different nervous system levels, abnormal plasticity, or atypical sensory/motor representation. They suggested that a multifaceted approach should be adopted for effective treatment, involving retraining, immobilization, botulinum toxin, neuromodulation, and more. Vigorous training can induce structural neuronal changes through appropriate synaptic alteration.<sup>21</sup> A review by Simpson et al reported significant improvements in various movement disorders, including focal upper extremity dystonia, through botulinum toxin treatment.<sup>22</sup>

The current study demonstrated enhanced quality of life alongside improved hand function following task-specific training, with or without botulinum injection. Notably, the group receiving both interventions exhibited greater improvement than the group undergoing task-specific training alone. Mueller et al conducted a study to evaluate the impact of pallidal deep brain stimulation on quality of life in hand dystonia, reporting significant enhancements in health-related quality of life post-treatment. Consistent with their findings, the present study indicates that as dystonia improves, quality of life also sees positive changes. Utilizing ADDS for dystonic hand disability evaluation and a stroke-specific quality of life questionnaire for quality of life assessment, the study found a negative correlation between ADDS disability scores and quality of life, meaning lower disability scores corresponded to higher quality of life scores.<sup>23</sup> Similarly, different hand function scales exhibited similar relationships with quality of life, indicating an association between hand function improvement and enhanced quality of life.

## Conclusion

It is concluded from this study that when outcomes of focal hand dystonia were compared on different scales such as MAS, short form 36 item QoL, we found significant difference on week 4<sup>th</sup>, 8<sup>th</sup> and 12<sup>th</sup>. So, profound improvements were seen in post stroke dystonic patients.

Hence, BoNT type A along with Task specific training is an effective treatment option for this condition.

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