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Effectiveness Of Action Obsevation Therapy Versus Mirror Visual Feedback In Bells Palsy

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ABSTRACT

Background: Bell's palsy is characterized by a unilateral facial weakness or paralysis brought on by acute peripheral facial nerve malfunction that has no known cause. In addition to being a sign of good health, facial resting symmetry and expressions determine facial attractiveness. Mirror therapy is a promising approach to facial neuromuscular rehabilitation that uses visual input to enhance symmetry, abnormal contraction of muscles, and functional movement. Action observation therapy is also a promising approach to enhance motor recovery in various conditions but remains underexplored in bell's palsy.

Methodology: Present study was a randomized controlled experiment with 30 individuals randomly assigned into two equal groups of 15 the experimental group (A) – Action observation therapy and the control group (B) – mirror therapy. Facial disability index was used to assess functional improvement. The evaluation was conducted both at baseline and six weeks after the intervention.

Result: Action observation therapy showed improved facial disability indices, indicating that it significantly improved facial functional mobility and can be used as a promising approach in bell's palsy population. Nonetheless, the mirror therapy group demonstrated a significantly greater improvement in all parameters when compared to the AOT group, indicating that mirror therapy may be more effective in enhancing facial functional mobility in individuals with Bell's palsy.

Conclusion: The study concluded that action observation therapy led to significant improvements in facial disability in bell's palsy emphasizing that it can a be used as an approach in treating patients with bell's palsy. However, mirror visual feedback led to more significant improvements in physical, social function measured by facial disability index as compared to action observation therapy highlighting its superior efficacy.

Keywords: *Bell's palsy, facial impairment, Mirror therapy, action observation therapy, mirror neurons.*

1. INTRODUCTION

A common cranial neuropathy is Bell's palsy, commonly referred to as "acute facial palsy of unknown cause."[1] Bell's palsy is an idiopathic, acute peripheral nerve palsy that affects the facial nerve, which powers all of the expressive muscles of the face.[2] Acute, unilateral, partial, or total facial paralysis is a hallmark of Bell's palsy.[3] One side of the face may become completely or partially immobile due to paralysis.[4] Bell's palsy affects 20 to 40 out of 100,000 people annually, with an average age of onset of 40 years. Both sexes are equally affected.[5] Bell's palsy may be caused by immunological, infectious, or ischemic causes, according to a variety of data, although the exact cause of classical Bell's palsy is still unknown.[6]

Partial or total weakness may be accompanied by numbness, mild pain, enhanced hearing sensitivity, and changed taste.[3] The corner of the mouth falls, the nasolabial crease and facial folds vanish, the crown of the head unfurrows, the lids of the eyes droop and resist to stay up, and the eye moves upward when the eyelids shut (Bell's phenomenon).[2]

There is mounting evidence that the outcome is significantly influenced by the patient's therapy. Some Bell's palsy patients have severe facial impairment and a lower quality of life if they don't receive treatment.[7] It can have a detrimental effect on patients and their families and result in both physical and psychological issues.[1]

To achieve the best possible recovery of facial nerve function, evaluation and treatment are essential. Patients with Bell's palsy may benefit from particular physiotherapy techniques that enhance both their physical and mental health.[8]

It has been demonstrated that physiotherapy techniques such electrotherapy, massage, therapeutic exercise, patient feedback, and heat therapy can hasten recovery, enhance face functioning, and lessen problems.[4]

Creating the illusion of an injured limb by reflecting it in a mirror is the foundation of mirror therapy (MT).[9] A mirror is placed between both extremities , and the participant is told to move the less affected limb while looking at its reflection.[10]Patients with complicated regional pain syndrome, stroke, cerebral palsy, phantom limb pain, and fracture rehabilitation have all benefited from mirror treatment.[9]

A facial neuromuscular rehabilitation method known mirror therapy provides visual input to improve functional mobility, symmetry, and irregular muscle activation. Neuroplasticity is a phenomena that can be activated using Mirror Therapy (MT).[11] The fact that mirror therapy creates plasticity in the motor cortex explains its effectiveness. Either by increasing motor activity on the paretic side or by reducing motor activity on the normal side, plasticity takes place. Mirror neurons are stimulated in order for mirror therapy to work.[12] Both observing and performing a motor act excite mirror neurons, a group of cells in the premotor cortex and inferior parietal lobule. The goal-directed structuring of motions is the responsibility of the brain cells. Furthermore, these neurons exhibit plasticity in healthy people.[13]

A non-invasive rehabilitation technique called Action Observation (AO) treatment, which is based on selective action observation and imitation, has been shown to be successful in teaching or improving the execution of particular motor skills.[14] Patients are often told to closely watch actions of healthy individuals in video clips as part of action observation treatment, after which they are instructed to practice and mimic similar actions.[15] Most of the research indicated that Action observation therapy was effective in improving motor function in both orthopedic and neurologic conditions.[16] As of right now, adult chronic stroke patients' recovery of upper limb functions has shown that action observation therapy is an effective rehabilitative technique.[17]

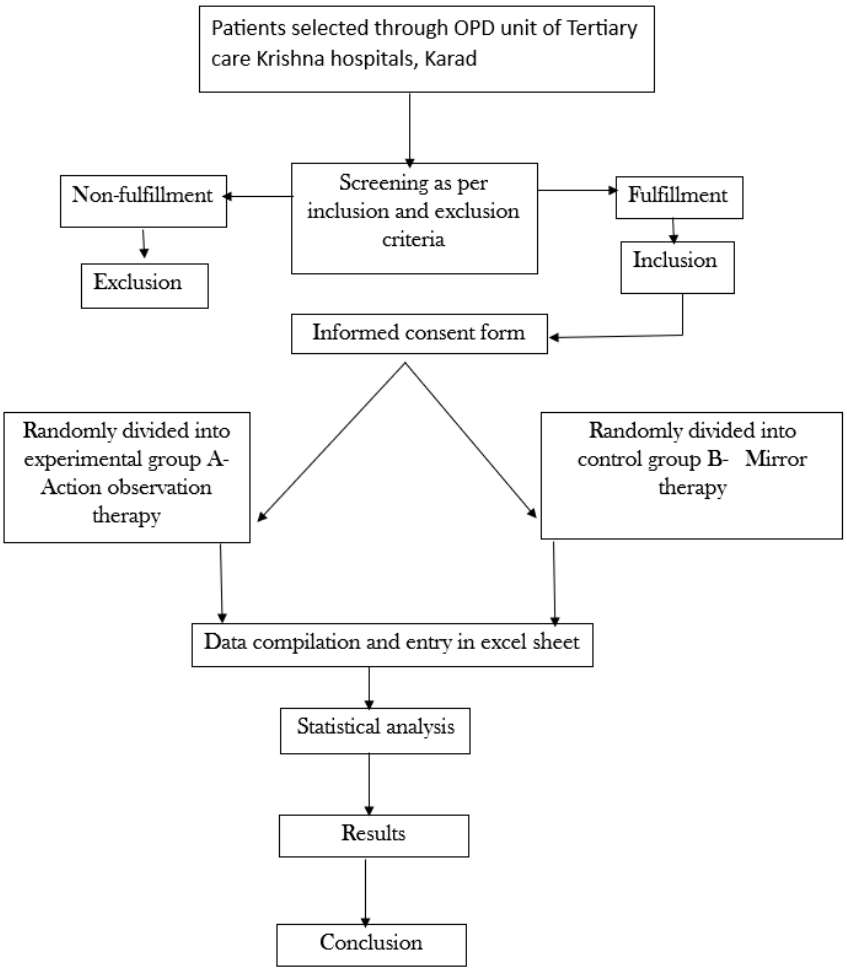
For people with moderate to severe upper limb impairment following a stroke, action observation therapy is a potential treatment for upper limb and functional rehabilitation. [18] This approach could contribute to increase lower limb motor recovery in idiopathic Parkinsons disease patients.[19] Action observation therapy improved the motor function of the upper limbs in children with hemiplegic cerebral palsy, [20] and seems like a potential technique for CP children's rehabilitation. [17]

Mirror neurons, which fire when one moves or observes another move, provide the basis for action observation training. [21] It is well known that action observation recruits’ areas within the mirror neuron system as a function of motor experience and competence of the observed actions.[22] Action observation therapy is a significant and legitimate consideration for the physician because it is thought to be a useful tool in promoting neuroplasticity and motor learning.[23]

Considering that mirror visual feedback and action observation therapy both work on the principle of activation of mirror neurons [11] [12] [21] [23] and mirror therapy was found out to be beneficial in improving functional movement in bell’s palsy based on the above principles, [11] it was necessary to investigate the effect of action observation therapy too in bell’s palsy for the improvement of functional movement/motor recovery. It is also interesting to highlight that action observation therapy has an effect in improving motor function regardless of the disease and the severity of motor impairment. [16]

2. MATERIALS METHODOLOGY

The study evaluated the effects of two methods of intervention; action observation therapy and mirror therapy on individuals-based study was an experimental design with measurements taken prior to and following the test in which patients ' functional facial movement was evaluated both before and after the six-week period. The study spanned six months and was carried out at a tertiary care hospital in Karad, Maharashtra. The appropriate ethics committee's ethical approval was obtained prior to the study's commencement. Thirty Bell's palsy patients were chosen for the study based on the inclusion criteria. Every patient had either both or at least one side of their face paralyzed. Patient both male and female aged between 20 to 70 years were included in the study. Patients not willing to participate, whose cause for bell’s palsy was genetic, patients with visual impairment or auditory impairment and who were unable to give feedback or mentally disturbed were excluded in the study. 30 participants were allocated into two treatment groups after selected by simple random sampling. All participants were fully informed about the goals, procedures, and possible dangers of the study before being asked to sign an informed consent form attesting to their voluntary participation Participants were given adequate details about the study before signing the consent form after reviewing the facts. Their privacy was protected during the entire research process. Thirty participants were recruited for the study with their consent, and both groups received six weekly intervention sessions for six weeks, as well as pre- and post-assessments to assess the therapies' efficacy both prior to and following therapy.



A structured rehabilitation protocol was implemented six times a week for 60 minutes over six weeks duration. The treatment plan was progressively designed as follows

INTERVENTION

Weeks	Goals	Physiotherapy Management	Treatment regimen
Week 1	To improve mobility of facial muscles	1 electrical stimulation Frontalis Corrugator Orbicularis oculi Orbicularis Oris Buccinator Mentalis 2 Facial exercises Face puffing Eye blinking Lifting the eyebrows Grinning forehead frowning	15 contractions 2 sets Once a day 10 times 1 set

		Teeth clenching Mouth opening producing the sounds M, O	
Week 2-3	To improve mobility Of facial muscles	1 electrical stimulation Frontalis Corrugator Orbicularis oculi Orbicularis Oris Buccinator Mentalis 2.Facial exercises Face puffing Eye blinking Lifting the eyebrows Grinning forehead frowning Teeth clenching Mouth opening producing the sounds M, O	15 contractions 3 sets Once a day 10 times 2 sets
Week 4-6	To improve mobility of facial muscles	1 electrical stimulation Frontalis Corrugator Orbicularis oculi Orbicularis Oris Buccinator Mentalis 2 Facial exercises Face puffing Eye blinking Lifting the eyebrows Grinning forehead frowning Teeth clenching Mouth opening producing the sounds M, O	30 contractions 3 sets Once a day 15 times 2 sets

ELECTRICAL STIMULATION

ACTION OBSERVATION THERAPY

Patients who were admitted to the experimental group ("action observation therapy") were given electrical stimulation (interrupted galvanic current) to motor points on the affected side. Then were made to sit comfortably in a chair with their arms resting on a table throughout the rehabilitation sessions. Above week wise regimen was followed with a large mobile screen that was placed two meters in front of them was freely visible to them. After carefully watching video sequences that featured facial exercises and movements, they were instructed to again practice the actions they had seen. The videos featured young, non-disabled actors, both male and female. While the therapist continuously maintained the patient's attention with verbal feedback, patients were asked to closely watch the films to get ready to mimic the actions that are shown. After each sequence, the therapist gave the patient verbal instructions or assistance if necessary, and asked them to repeat the same exercises with the paretic side.

MIRROR THERAPY

Patients who were admitted to the control group (mirror therapy) were also given electrical stimulation (interrupted galvanic current) to motor points on the affected side. Were then instructed to place their arms on a table and sit comfortably in a chair. Mirror was placed right Infront of them. Then the facial exercises were demonstrated by the physiotherapists. Following that, the patient completed the week wise regimen mentioned above of facial exercises on the paretic side by looking in the mirror and examining themselves.

STATISTICAL ANALYSIS AND INTERPRETATION

Table 1-Gender

Gender	Frequency
Male	18
Female	12

Interpretation – As per table 1, 60 %population affected were males and 40 % population females

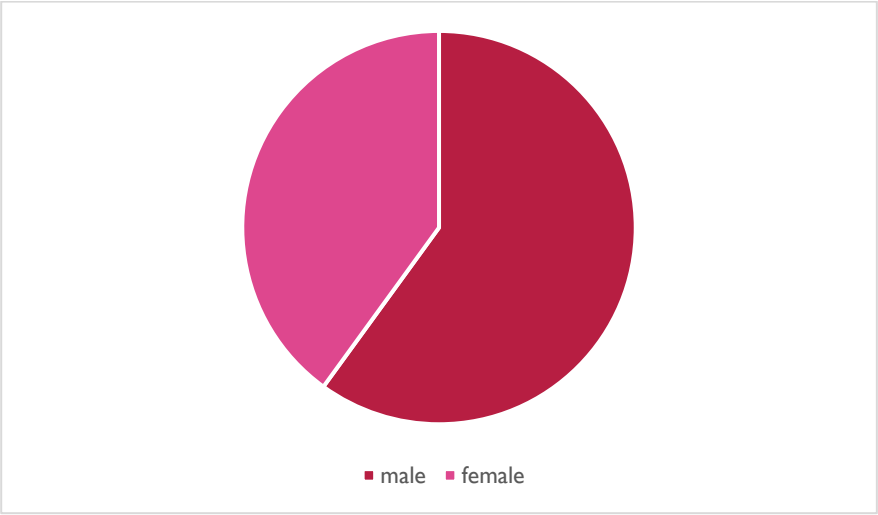


Table 2- Physical function values of Pre and Post intervention.

PHYSICAL FUNCTION	PRE	POST	P VALUE
Group A	35.2 ± 5.78	69.66 ± 5.98	<0.0001
Group B	35.93 ±7.34	75.53 ± 8.03	<0.0001

Interpretation - As per *Table 2*, We can conclude that, in accordance to the Wilcoxon Matched-Pair Test, both Group A and Group B demonstrated significant improvements in physical function after completing their respective interventions . Although both interventions were effective at improving physical function, Group B's (MT) intervention produced greater improvement in physical function than Group A's (AOT).

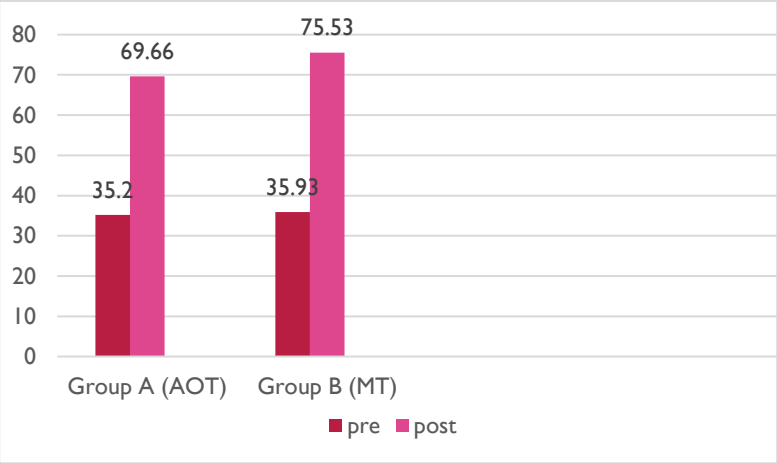


Table 3– Social function values of pre and post intervention

SOCIAL FUNCTION	PRE	POST	P VALUE
Group A	47.83 ± 5.66	61.23 ± 5.29	<0.0001
Group B	48.53 ± 9.66	68.53 ± 11.6	<0.0001

Interpretation: Following the completion of their respective interventions, Groups A and B both showed substantial improvements in social function, according to the Wilcoxon Matched-Pair Test. Social function was improved by both interventions, but was significantly improved more by Group B's (MT) intervention than by Group A's (AOT).

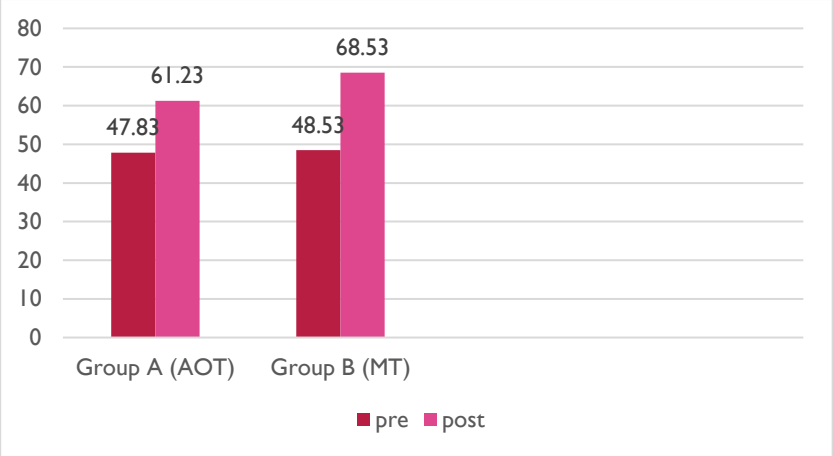


Table 4– Total function values of pre and post intervention

TOTAL	PRE	POST	P VALUE
Group A	83.03 ± 6.23	136.89 ± 7.09	<0.0001
Group B	84.46 ±11.06	144.06 ± 11.128	<0.0001

Interpretation: The Wilcoxon Matched-Pair Test demonstrated that both Groups A and B had significantly improved total after completing their respective interventions. Both interventions improved total function, although Group B's (MT) intervention considerably outperformed Group A's (AOT).

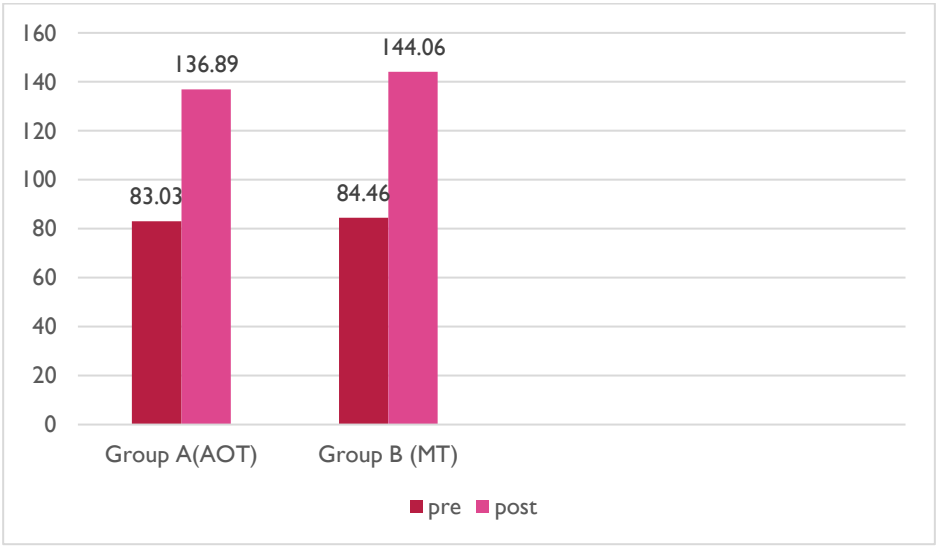
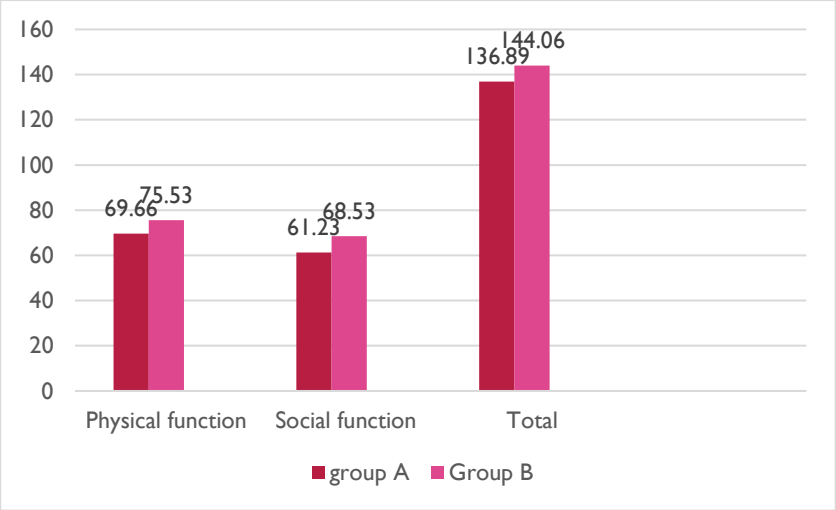


Table 5 – Post comparison of physical ,socail and total function of mirror therapy and action observation therapy

Components	Group A (post) Mean and SD	Group B (post) Mean and SD	P value
Physical Function	69.66 ± 5.98	75.53 ± 8.03	0.0001

Social Function	61.23 ± 5.29	68.53± 11.6	0.0003
Total	136.89 ± 7.09	144.06 ± 11.128	0.0004

Interpretation: In all three parameters (physical function, social function, and total), the results show highly significant differences between Group A and Group B; p-values of less than 0.0001 indicate findings that are highly significant. For physical function group A showed a mean of 69.66 and group B showed a mean of 75.53 suggesting that Group B exceeded Group A. Likewise for social function group B mean 68.53 is greater than group A mean 61.23 corroborating the pattern of higher values in Group B. For total, a similar trend was seen, with Group A mean of 136.89 and Group B having a mean of 144.06. These steady and significant variations indicate that Group B witnessed greater improvement across all components of Facial disability index, suggesting a more substantial effect from their intervention. The incredibly low p-values for every measure further highlight the effectiveness of the intervention in Group B by confirming that these changes are very unlikely to be the result of chance.



3. DISCUSSION

The current study compared the effectiveness of action observation therapy and mirror therapy in improving the severity of facial mobility impairment and disability scores in patients with Bell's palsy.

Untreated, a lower quality of life and significant facial disability are experienced by certain Bell's palsy patients. [7] Psychological and physical challenges are among the most challenging effects that patients and their families may experience. [1] Appropriate assessment and therapy are crucial for the best potential recovery of facial nerve function. There is increasing evidence that the outcome is significantly influenced by the patient's management. Certain physiotherapy methods that improve the physical and mental well-being of Bell's palsy patients may be beneficial. [8]

The current study showed a statistically significant improvement in the patients' periods of recuperation. The findings demonstrated that the action observation therapy was effective for improving the severity of facial mobility impairment but mirror therapy showed more significant improvements for the same as compared to action observation therapy.

A study was carried out to determine how action observation therapy affected children's upper limb motor function. Ten to fifty-nine people made up the sample. 10.7 minutes of observed action performance and 12 minutes of action observation therapy per session. When it came to improving motor recovery and structure, activities, and involvement in children with hemiplegic cerebral palsy, the results showed that action observation therapy was a better rehabilitative alternative to conventional motor training for the rehabilitation of the upper limbs.

Because action observation therapy potentially aided activation of their mirror neuron system through video monitoring, it was determined that the additional action observation therapy intervention for hemiplegic CP children on upper limb motor function was more beneficial. Among these were the effects of the mirror neuron system (MNS) on upper limb function brought about by the observation of movements and the actual implementation of similar neural structures.[20]

According to a previous retrospective study, action observation therapy significantly enhanced upper extremity motor function and daily living activity performance while reducing upper limb spasticity in stroke patients., that recruited 70 stroke patients who were hospitalized at Rehabilitation Medical Center between according to the inclusion criteria. Thirty action videos featuring the same model performing were used. The "observation execution matching mechanism executed by the

mirror neurons for the rehabilitation of upper extremity function in stroke patients via activation of the corresponding neural circuits" was found to be recruited by action observation therapy.[24]

Another study evaluated the effectiveness of a movement-based mirror biofeedback technique in improving facial motor recovery in individuals with facial palsy. FDI and the Facial Clinometric Evaluation Scale were used as outcome measures to quantify facial impairment and bad quality of life. The results demonstrated improvements in facial movements and impairment. Thus, it was demonstrated that mirror visual biofeedback is a useful therapeutic approach for individuals with facial palsy throughout the regeneration phase.[25]

In a review article on the clinical aspects of mirror therapy in rehabilitation, the treatment's basic mechanism of action is explained. Mirror therapy is based on the activation of mirror neurons. Additionally, watching other people move and visualizing motor tasks in the mind both cause mirror neurons to fire. The mirror mechanism promotes the growth of motor memory.[26]

Since the principle of mirror neuron activation is the basis for both action observation therapy and mirror visual feedback,[11] [12] [21] [23] and using the above mentioned principle, mirror therapy was found to be helpful in enhancing facial functional mobility in Bell's palsy [11] , It was necessary to investigate into how action observation treatment benefited Bell's palsy patients' for the improvement in functional mobility and motor recovery. It’s also intriguing to note that action observation therapy can improve motor function irrespective of the illness or degree of motor impairment. [16]

Facial disability index was used to assess the improvement in functional mobility of facial muscles. Comparing the facial disability scores Group B exhibited the highest improvement in physical and psychosocial and total scores, suggesting that the mirror visual feedback leads to superior recovery. Group A showed significant but slightly lower improvement, emphasizing that the action observation therapy effectively enhances facial motor recovery but may lack the additional benefit of visual reinforcement. The results demonstrated extremely significant differences between Group A and Group B in all three parameters (physical function, social function, and total); findings that are highly significant determined by p-values being less than 0.0001.

4. LIMITATIONS OF THE STUDY-

- Only thirty people participated in the study, segregated into two groups, which limits the generalizability of the findings. A bigger sample size would better represent a range of patient demographics and offer more reliable statistical power**.**
- Patients in the study were not categorized according to the degree of facial paralysis or duration since onset. Therapy could respond differently in different stages of Bell's palsy, necessitating specialized treatment strategies.

5. RECOMMENDATIONS FOR FUTURE RESEARCH

- To assess the long-term impacts, longer study periods and follow-up evaluations are essential.
- Facial therapy could become more accessible and engaging with the development of virtual reality (VR) or augmented reality (AR)-based apps that offer real-time visual feedback.

6. CONCLUSION

The study concluded that action observation therapy led to significant improvements in facial disability in bell’s palsy emphasizing that it can be used as a promising approach in treating patients with bell’s palsy, however mirror visual feedback led to more significant improvements in physical, social function measured by facial disability index as compared to action observation therapy highlighting its superior efficacy.

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