Research Article

Effectiveness of Facial Neuromuscular Retraining with and without Mirror Visual Feedback in Patients with Bell's Palsy

Samraiz Mughal[1], Filza Shoukat[2], Arooj Munawar[3], Ramesha Tahir[4]

[1]Research Officer, College of Physical Therapy, GC University Faisalabad; [2,3]Assistant Professor, University Institute of Physical Therapy, University of Lahore; [4]Lecturer, Department of Physical Therapy, Faisal Institute of Health Sciences, Faisalabad

Abstract

Objective: Bell's palsy is one of the most frequent forms of facial palsy affecting 75% of the cases. Different physiotherapy techniques are utilized for treating Bell's palsy which aims to rebuild normal facial expressions and restore normal strength and function of facial muscles alongside decreasing all associated symptoms. This research was conducted to evaluate the effectiveness of facial neuro-muscular retraining with and without mirror visual feedback in patients with Bell's palsy.

Methods: A randomized controlled trial was conducted. 64 subjects were recruited in the sample. Patients were randomly divided into two groups with 32 patients in each group. Both groups received Neuromuscular Retraining exercises (NMR). Group 1 received Mirror Visual Feedback (MVF) additionally. Facial symmetry and motor function of facial muscles was assessed by using Facial Disability Index (FDI) and House Brackmann Scale (HBS). Readings were taken at baseline and then at 3rd and 7th week follow ups. Research took 9 months duration to complete and data analysis was done using SPSS 22.

Results: Results of the research demonstrated no significant difference of FDI-P, FDI-S and HBS score at baseline between both groups with p value being 0.893, 0.321 and 0.317 respectively. Significant difference was observed in FDI-P, FDI-S and HBS scores at 3rd week and 7th week follow up between 2 groups with p value being 0.00 for all outcome measures.

Conclusion: Mirror Visual Feedback used in combination with NMR was found more effective in improving the facial symmetry and movement and in decreasing the functional disability than NMR used alone in Bell's palsy patients.

Corresponding Author | **Samraiz Mughal,** Research Officer, College of Physical Therapy, GC University Faisalabad **Email:** drsamraiz@gmail.com

Key Words: Bell's Palsy, Peripheral Palsy, Mirror Visual Feedback, Mirror Therapy, Neuromuscular Reeducation, Neuromuscular Retraining.

Introduction:

Bell's palsy is a type of peripheral paralysis of Facial Nerve (CN VII) which causes sudden unilateral facial weakness in facial expression muscles supplied by facial nerve. Associated symptoms may include changes in taste and hearing sensations, changes in facial sensations and ear pain. Facial nerve may be damaged by autoimmunological reactions, infection, ischemia, tumor or any other structure compressing the nerve.[1]

Bell's palsy is one of the most frequent forms of facial palsy affecting 75% of cases. The peak incidence found between ages 14-45 years.[2] These cases are predominantly reported in winter (31.38%) and autumn (30.13%) season. The seasonal incidence of Bell's palsy is because of increased rate of viral upper respiratory tract infection during cold months. It supports the infectious cause of Bell's Palsy.[3]

Central facial palsy can be distinguished from Peripheral facial palsy by the involvement of periocular muscles in the latter one. Lower motor neuron lesion (LMNL) or Bell Palsy affects all ipsilateral muscles. In contrary, upper motor neuron lesion (UMNL) or facial palsy affects the lower quadrant of face at opposite side. Central facial palsy doesn't affect frontalis muscle thus sparing the forehead movements.[4]

The sequelae of Bell's palsy could be synkinesis, contracture, crocodile tears, spasm, ringing in ears or deafness. Synkinesis is a sequelae of Bell's Palsy which is aesthetically very disturbing for the patient. Synkinesis is an abnormal facial movement performed involuntarily during voluntary movement of other muscles e.g. smiling, eating or speaking. It occurs due to improper regeneration of facial nerve.[5]

Onset of Synkinesis starts 3 to 4 months after Bell's palsy and can continue for a period of 2 years. There are 2 common forms of synkinesis: ocular-oral and oral-ocular. Ocular synkinesis comprises of voluntary ocular movement combined with involuntary oral movement. Whereas, oral synkinesis comprise of voluntary oral movement combined with involuntary ocular movement.[6]

Different physiotherapy techniques are utilized for treating Bell's palsy. These techniques include massage, thermotherapy, electrical stimulation, facial exercises and mirror therapy. Treatment aims to rebuild normal facial expressions and restore normal strength and function of facial muscles alongside decreasing all associated symptoms.[7]

Neuromuscular facial re-education is the process of facilitating the restoration of the required facial movement functional patterns and suppressing of abnormal facial movements and expressions. The process utilizes sensory feedback for teaching re-education of facial expressions and movements.[8]

Patients can learn and control facial movements even in presence of synkinesis by using some kind of feedback. This biofeedback can be provided by using mirror therapy. Mirror therapy provides visual feedback for the facial exercises performed in front of mirror. Mirror therapy is beneficial for increasing contractions in weak muscles, decreasing activity in hyper stimulated muscles and for reducing post palsy synkinesis.[9]

In the light of knowledge-body build after searching some major medical databases, no such study has been found which well documents the comparative effectiveness of facial neuro-muscular retraining with and without mirror visual feedback in Bell's palsy patients. No preexisting data was found to determine the comparative effects of facial neuro-muscular retraining with and without mirror visual feedback in Bell's palsy patients. These interventions can reduce recovery time and improve neuro-muscular coordination in Bell's palsy patients.

The primary motive of the present research was to determine the comparative effectiveness of facial neuro-muscular retraining with and without mirror visual feedback in patients with Bell's palsy using different outcome measurement tools i.e. Facial Disability Index and House Brackman Scale for measurement of facial dysfunction.

Methods:

This randomized controlled trial was performed at Department of Physiotherapy, Mujahid Hospital, Madina Town, Faisalabad. It was an assessor blinded study. Sampling technique used was purposive sampling, a type of non probability sampling. Sample included patients having idiopathic one-sided Bell's palsy. Age range between 15-60 years was taken.[10] First of all, ethical approval was gained from The University of Lahore's Ethical Committee. Then, calculation of sample size was done by use of previously published evidence by taking assistance from the undermentioned formula.[11]

$$n= 2\alpha^2[Z_{1-\alpha/2} + Z_{1-\beta]/}(\mu_1- \mu_2)^2$$

Sample size calculated through this method was 54 patients divided equally in 2 groups with 27 patients in each group.

By the addition of dropout rate of 20%, total sample size recruited was 64 with 32 patients in every group.

Detail of patient allocation and follow up is mentioned in figure 1 given below.

Patients were allocated into 2 groups through the use of computerized randomization table. The whole process of research was explained to the participants and then informed consent was taken from them. Patients in group 1 received mirror visual feedback and neuromuscular reeducation and patients in group 2 received neuromuscular reeducation only. Every patient was enrolled for seven weeks. Total three times, questionnaire was filled, first at the baseline, then after third week, and then final assessment after seventh week. Consecutive sessions were given to the patients in first three weeks and then patient was guided to perform home exercises and come for follow up when needed. Assessment and treatment was given by two different therapists throughout the study session. Assessment was done by using Facial Disability Index (FDI) and House Brackman Scale (HBS). Computer generated method was used for randomization.

Data analysis was performed by the use of SPSS V.22. The data was presented in the form of mean + S.D. with p-values. Significance was defined as a p value of less than 0.05. The frequency table and percentages were used to display qualitative variables. To display a summary of group measurements taken over time, frequency tables, line charts, bar charts, and pie charts are utilized. The Friedman test was used to determine changes in FDI and HBS variables within groups. The Mann-Whitney U test was used to compare outcome measures between both groups.

Figure 1: *CONSORT Flow Diagram*
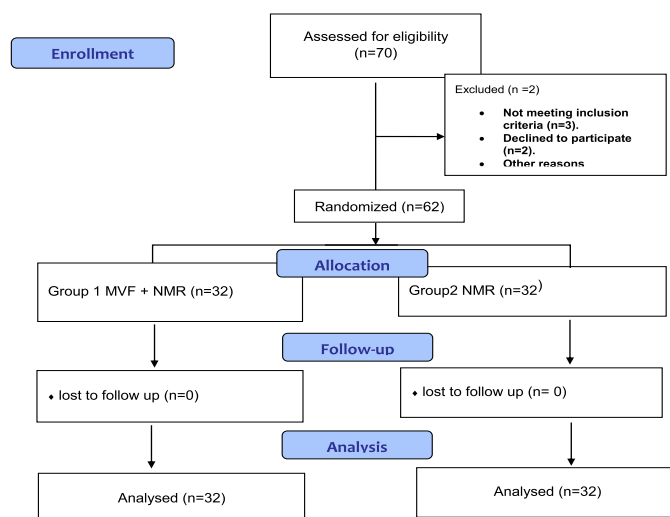
Results:

Mean and standard deviation of group 1 and 2 was 42.06 ± 9.339 and 41.25 ± 9.339 respectively. Group 1 comprised of 6 (18.75%) males and 26 (81.25%) females, whereas group 2 contained 13 (40.63%) males and 19 (59.38%) females.

In group 1, amongst a total sample of 32 patients majority of patients (n = 12) had weight in the range of 85-94 kg and minimum patients (n = 2) had weight in range of 105-114 kg. In group 2, from the same sample size of 32, 17 patients fall in the weight range of 85-94 kg and only 1 patient had weight in 105-114 kg range. Group 1 had 15 (46.88%) patients with affected right side and 17 (53.13%) patients with affected left side. Whereas, group 2 had 11 (34.38%) patients with affected left side and 21 (65.63%) patients with affected right side.

The data was initially evaluated for normality by measuring skewness and kurtosis. With large samples (> 300), the Kolmogorov Smirnov and Shapiro Wilk tests are "unreliable." They are, in crux, too "sensitive." If the sample size is between 50 and 300, the Z value is |3.29|, which indicates that the data is normally distributed.[12]

A Shapiro Wilk's test (p > .05) and a visual review of their histograms, box plots and normal Q-Q plots revealed that data for all outcome variables i.e. Facial Disability Index (Physical and Social) Score and House Brackmann Scale were not normally distributed with values falling outside the range of -3.29 to + 3.29 range.[13,14]

As data was found non-normally distributed, thus non-parametric tests were performed. Mann-Whitney U-Test was conducted to find difference in Group A and Group B at pre-assessment, 3rd and 7th week. House Brackmann Scale and Facial Disability Index Physical and Social Score of each patient were assessed at different time points. Friedman test was conducted to find difference in these outcome measures at 3 time points. The results of Mann Whitney U-test and Friedman test are presented in the form of table 1 and 2 respectively.

Table 1: *Within group comparison (Friedman Test) for all outcome measures.*

Measure	p-Value	
	Group 1 MVF + NMR	**Group 2 NMR**
FDI-P	0.000	0.000
FDI-S	0.000	0.000
HBS	0.000	0.000

*FDI-P = Facial Disability Index- Physical Score, *FDI-S = Facial Disability Index-Social Score, *HBS = House Brackmann Scale, *MVF = Mirror Visual Feedback, *NMR = Neuromuscular Reeducation, *p-value = probability.

The table above demonstrates the within group comparison for all outcome measures which were investigated using Friedman test. Table above demonstrates that there was significant reduction in mean FDI-P, mean FDI-S and mean HBS scores across pre-treatment, week 3 and after week 7 measurement in patients of both groups with p value being 0.00.

Table 2: *Between group comparison (Mann Whitney U-Test) for mean change in FDI-P, FDI-S and HBS at baseline, follow up at 3rd week and follow up at 7th week.*

Session	Group 1 MVF+NMR Mean± S.D	Mean Rank	Group 2 NMR Mean± S.D	Mean Rank	p-value	Effect Size
FDI-P at Baseline	30.0781+5.45267	32.72	30.0469+5.93358	32.28	.893	0.028
FDI-P at 3rd week	89.7188+6.61735	48.06	58.7031+6.51655	16.94	.000	0.745
FDI-P at 7th week	109.3125+1.84806	47.88	88.0000+10.91093	17.13	.000	0.768
FDI-S at Baseline	87.13+7.308	34.73	87.00+4.977	30.27	.321	0.015
FDI-S at 3rd week	32.12+5.326	17.89	49.81+7.455	47.11	.000	0.637
FDI-S at 7th week	1.38+3.748	17.56	14.13+6.344	47.44	.000	0.700
HBS at Baseline	4.97+.177	32.00	5.00+0.00	33.00	.317	0.015
HBS at 3rd week	2.53+.507	24.94	3.06+0.435	40.06	.000	0.247
HBS at 7th week	1.06+.246	20.88	1.91+0.588	44.13	.000	0.520

*FDI-P = Facial Disability Index- Physical Score, *FDI-S = Facial Disability Index-Social Score, *HBS = House Brackmann Scale, *S.D = Standard Deviation, *MVF = Mirror Visual Feedback, *NMR = Neuromuscular Reeducation, *Sig = Significance.

Results demonstrated no significant difference of FDI-P, FDI-S and HBS score at baseline between both groups with p value being .893, .321 and .317 respectively. Significant difference was observed in FDI-P, FDI-S and HBS scores at 3rd week and 7th week follow up between 2 groups with p value being 0.00 for all outcome measures.

Discussion:

Current study demonstrated the comparison of Mirror Visual Feedback and Neuromuscular Retraining and Neuromuscular Retraining alone in improving the degree of severity and disability scores in Bell's palsy patients. In the present study statistically significant improvement was demonstrated in reducing recovery time of the patients. Although, significant difference was demonstrated between both groups at 3rd and 7th week. Results showed the benefit of using Mirror Visual Feedback with Neuromuscular Reeducation on Bell's palsy.

Another research evaluated the effect of mirror biofeedback program with movement for facial muscle training in patients of facial palsy. Patients were recruited in the research accordingly the clinical classification by House Brackmann Scale. Facial Clinimetric Evaluation Scale and FDI were used as outcome measures to objectify facial disability, facial asymmetry and poor quality of life. Results demonstrated improvement in facial movements and disability. Thus, it was proved that mirror visual biofeedback is

a useful treatment tool during the regeneration phase in facial palsy patients.[15]

Case study of a 38 old year patient with Bell's palsy evaluated the effects of evidence based Physiotherapy on condition. Patient received treatment for 6 weeks comprising of Transcutaneous Electrical Nerve Stimulation, home exercises plan, Proprioceptive Neuromuscular Facilitation stretching, facial NMR and mirror therapy. Results demonstrated improvements in facial expressions and facial symmetry. Results showed decrease in pain scores and improvement in synkinesis. These finding are concurrent with our study.[16]

Another retrospective study found similar results as the current study. The study reviewed 15 patients with Bell's palsy who received mirror book treatment in combination with standard facial rehabilitation. These 15 patients were compared 10 patients who only received conventional facial rehabilitation therapy without mirror book. Facial Grading System (FGS) and FDI social and physical scores were used to evaluate the improvement of interventions. Measurements were taken pre-treatment and post-treatment. Results showed significant improvements in mirror book therapy group for both FGS and FDI. Thus, the effectiveness of mirror therapy in peripheral facial palsy patients is supported.[17]

A study was conducted to determine relationship between depression and severity of symptoms and societal integration in patients with peripheral nerve palsy. Results demonstrated a positive correlation of depression with severe physical symptoms and societal integration.[18] This was a possible relationship which could have existed in current study. But, we didn't use any depression scale as an outcome measure to examine the effect of our intervention on depression levels of patients with Bell's palsy.

Another research was conducted on effects of facial exercises on neuromuscular facilitation in facial palsy patients. 26 patients of facial palsy were recruited in the research. All subjects enrolled underwent western-oriental medical treatment. Patients were allocated in two groups. Treatment group performed facial exercises in front of mirror and control group underwent alone western-oriental medical treatment. Patient's facial function was evaluated by use of the Yanagihara's Unweighted Grading System and HBS before and after treatment. Patients received mirror therapy for 4 weeks. Results demonstrated improvement in both groups. But, mirror therapy treatment group showed more improvement than western-oriental medical treatment control group. Thus, this research also supports the findings of our research by showing improvement in HBS scores after giving mirror therapy as a treatment in patients with peripheral facial palsy.[19]

Current study showed the effectiveness of mirror therapy for Bell's palsy. Another review had found mirror therapy effective for other diseases. Results of review demonstrated improvement of outcome measures for different conditions including stroke, phantom limb pain, fracture rehabilitation, cerebral palsy and complex regional pain syndrome.[20]

Benefits of using mirror therapy on Bell's palsy patients have theoretical and scientific grounds. A review article on the clinical aspects of mirror therapy in rehabilitation explains the underlying mechanism of action of mirror therapy. Mirror therapy works by stimulating mirror neurons. Activation of mirror neurons also occurs during observing others performing movements and during mental imagery of motor tasks. Mirror neurons are located in ventral and inferior premotor cortex area of brain.[21] Mirror mechanism reinforces the development of motor memories. Effectiveness of the mirror therapy is explained by the fact that it induces plasticity in the motor cortex. Plasticity occurs either through suppressing the motor activity on the normal side or by enhancing motor activity on paretic side.[22]

Conclusion:

Current study concluded that both treatments are found effective in improving Facial Disability Index and House Brackmann Scale scores. But, NMR with MVF is found more effective in enhancing the symmetry and movement of face and in decreasing the functional disability on 3rd and 7th week follow up than NMR used alone in Bell's palsy patients.

References:

1. Eviston TJ, Croxson GR, Kennedy PG, Hadlock T, Krishnan AV. Bell's palsy: aetiology, clinical features and multidisciplinary care. J. Neurol. Neurosurg. Psychiatry. 2015;86(12):1356-61.

2. Monini S, Iacolucci CM, Di Traglia M, Lazzarino AI, Barbara M. Role of Kabat rehabilitation in facial nerve palsy: a randomised study on severe cases of Bell's palsy. Acta Otorhinolaryngologica Italica. 2016;36(4):282.

3. Gonçalves-Coêlho TD, Pinheiro CN, Ferraz EV, Alonso-Nieto JL. Clusters of Bell's palsy. Arquivos de neuro-psiquiatria. 1997;55(4):722-7.

4. Liston SL, Kleid MS. Histopathology of Bell's palsy. Laryngoscope. 1989;99(1):23-6.

5. Nakamura K, Toda N, Sakamaki K, Kashima K, Takeda N. Biofeedback rehabilitation for prevention of synkinesis after facial palsy. Otolaryngol. Head Neck Surg. 2003;128(4):539-43.

6. Pourmomeny AA, Asadi S. Management of synkinesis and asymmetry in facial nerve palsy: a review article. Iran J Otorhinolaryngol. 2014;26(77):251.

7. Ferreira M, Santos PC, Duarte J. Idiopathic facial palsy and physical therapy: an intervention proposal following a review of practice. Phys. Ther. Rev. 2011;16(4):237-43.

8. Kumar C, Bagga TK. Comparison between proprioceptive neuromuscular facilitation and neuromuscular re-education for reducing facial disability and synkinesis in patients with Bell's palsy: A randomized clinical trial. Int J Phys Med Rehabil. 2015;3(4):1-8.

9. Dalla Toffola E, Tinelli C, Lozza A, Bejor M, Pavese C, Degli Agosti I, et al. Choosing the best rehabilitation treatment for Bell's palsy. Eur J Phys Rehabil Med. 2012;48(4):635-42.

10. Campbell KE, Brundage JF. Effects of climate, latitude, and season on the incidence of Bell's palsy in the US Armed Forces, October 1997 to September 1999. Am. J. Epidemiol. 2002;156(1):32-9.

11. Riga M, Kefalidis G, Danielides V. The role of diabetes mellitus in the clinical presentation and prognosis of Bell palsy. JABPEJ. 2012;25(6):819-26.

12. Kim HY. Statistical notes for clinical researchers: assessing normal distribution (2) using skewness and kurtosis. Restor Dent Endod. 2013;38(1):52-4.

13. Cramer D, Howitt DL. The Sage dictionary of statistics: a practical resource for students in the social sciences. Sage; 2004.

14. Doane DP, Seward LE. Measuring skewness: a forgotten statistic? J. Educ. Stat. 2011;19(2):41-46.

15. Bernd E, Kukuk M, Holtmann L, Stettner M, Mattheis S, Lang S, et al. Newly developed biofeedback program for facial muscle training in patients with facial paralysis. HNO. 2018;66(9):686-92.

16. Mohammad Habibur R, Islam I, Rahman E, Samena Akter K, Farjana S. Physiotherapy for a 38 years old man with Bell s palsy: A case report. Edorium j. disabil. rehabil. 2017;3(1):25-9.

17. Paolucci T, Cardarola A, Colonnelli P, Ferracuti G, Gonnella R, Murgia M, et al. Give me a kiss! An integrative rehabilitative training program with motor imagery and mirror therapy for recovery of facial palsy. European journal of physical and rehabilitation medicine. 2019.

18. Muhammad Kassim N, Abdullahi A, Usman JS. Relationship Between Psychological Symptoms, Age, Severity of Symptoms, and Societal Integration in Patients With Facial Nerve Paralysis. Iranian Rehabilitation Journal. 2019;17(3):235-40.

19. Kim JH, Kim MY, Lee JU, Lee JA, Yoon NM, Hwang BY, et al. The effects of symmetrical self-performed facial muscle exercises on the neuromuscular facilitation of patients with facial palsy. J. Phys. Ther. Sci. 2011;23(4):543-7.

20. Najiha A, Alagesan J, Rathod VJ, Paranthaman P. Mirror therapy: a review of evidences. Int. J. Physiother. 2015;3(3):1086-90.

21. Rothgangel AS, Braun SM, Beurskens AJ, Seitz RJ, Wade DT. The clinical aspects of mirror therapy in rehabilitation: a systematic review of the literature. Int J Rehabil Res. 2011;34(1):1-3.

22. Venables V, Neville C, Gwynn T, Kannan RY, Nduka C. Impact of lower motor neurone facial palsy on oro-motor function and its remediation. Journal of Plastic, Reconstructive & Aesthetic Surgery. 2019;72(9):1570-5.