IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

# EFFECT OF PHYSIOTHERAPY TREATMENT IN BELL'S PALSY

**[1]Kartic prasad, [1]Loneh umbrey,[2]Dr Shivpriya sharma**

[1]Bachelor of physiotherapy, [2]Assistant professor

[1,2]Department of physiotherapy, [1,2]Sharda university,Greater Noida,India.

## ABSTRACT

Bell's Palsy, also known as facial nerve paralysis, is a condition that leads to weakness or paralysis on one side of the face. The common symptoms include ipsilateral drooping of eyelid, dry eyes, drooping of mouth corner, dry mouth slavering etc. physiotherapy intervention to improve healing, increase function and prevent the complication. The objective of this review was to investigate the effect of various physiotherapy techniques on the treatment and improvement of symptoms of bell's palsy. We searched all the data base from 2019 – 2023, For studies on the effect of different physiotherapy on bell's palsy.Conclusion: The improvement in facial functions, particularly proprioceptive neuromuscular method [PNF] or Kabat technique and rTMS. While the massage and taping and TENS helps to lower the severity of the symptoms.

## INTRODUCTION

Bell's palsy often known as Idiopathic facial nerve palsy is a condition that causes weakness or paralysis on one side of the face[1].Bell's palsy is the lower motor neurons disorder. The weakening of facial muscles can either be partial or total, and it could be accompanied by slight discomfort, numbness, sensitivity to sound, and changed in taste[2].Understanding the concept of intra-axonal signal molecules and the molecular processes behind Wallerian degeneration, as well as in-vitro searches of virus-axon interactions, may help to better define its pathogenesis[3]. The facial nerve has branches that run along the intracranial, intratemporal, and extratemporal planes, the anterior 2/3 of the tongue get sensations from the facial nerve and it has a parasympathetic and motor functions, It also regulates the lacrimal and salivary glands. The upper and lower facial muscles are controlled by the peripheral facial nerve as a consequence, the diagnosis of BP calls for careful consideration of the strength of the forehead muscles. Affected patients develop unilateral facial paralysis over two to three days with forehead involvement[2].It is more commonly seen in diabetic patients. Although significant studies, the precise pathology of Bell's palsy remains unknown. Infection (herpes simplex type 1), nerve compression, and autoimmune may all have a role, although the exact sequencing and extent of these effects is undetermined[3].

## ETIOLOGY

The exact etiology of BP is unknown but a reactivated herpes simplex virus (HSV-1) infection emphasizing on the geniculate ganglion has been proposed as one possible reason[4].Vasospasms may result in primary ischemia, resulting in facial nerve neuropathy and inflammation-induced demyelination of the facial nerve[5].

## PATHOPHYSIOLOGY

It is believed that the 7$^{th}$ cranial nerve gets compressed at geniculate ganglion. This usually happens in the narrowest part of the facial canal, which is called the labyrinthine segment, Inflammation cause compression and ischemia of nerve. The most common sign of bell's palsy is weakness on unilateral of the face, including the forehead muscles etc[2].The

ipsilateral drooping of the eyelid, dry eyes, excessive crying, drooping of the mouth corner, post-auricular pain, and loss of taste sensation in the anterior two thirds of tongue, gastrointestinal issues, dry mouth, slavering, altered feeling, and hyperacusis all are the signs and symptoms of BP[3].

## RISK FACTORS

Risk factors includes-pregnancy, diabetes, psychological factors, obesity, preeclampsia, lymes disease, people with upper respiratory tract infection, radiation exposure, cold exposure, hypertension, migraine, glucose metabolism abnormalities[1,6].

## EPIDEMIOLOGY

Bell's palsy is commonly cause of facial nerve palsy with prevalence between 11.5-40.2 cases for 100,000 people[5].It's incident is higher in 15-45 age group and there is reoccurence rate of 8-12% and 70% recoverd without treatment[1]. It has been seen that physiotherapy techniques such as therapeutic exercise, patient feedback,muscle stimulator,facial massage,kinesiotaping,wet cupping,SWD,low level laser,PNF,patient feedback etc have shown hasten recovery, enhance facial functioning and minimise signs and symptoms[1].

"It has been found that drug treatment involving seven days administration of Tab Acyclovir 800mg five times a day,along with a tapering course of Prednisone has been observed to effectively reduce symptoms when initiated within three days of the onset of the symptoms[7]" .

The aim of this literature review was to study in the modern literature the effect of different physiotherapy interventions to treat and improve the symptoms of BP.

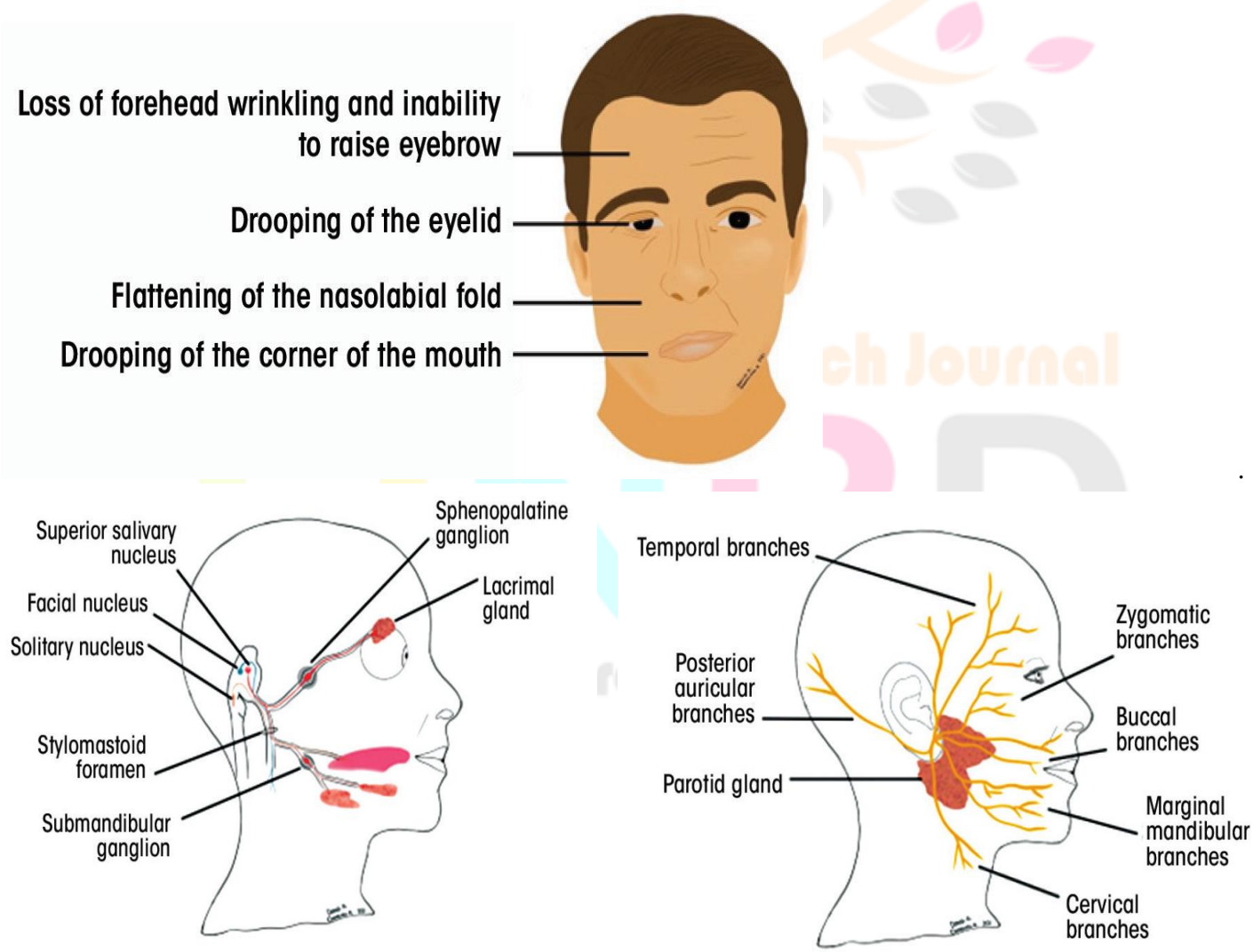


Fig- *Can Dent Assoc* 2 022;88:m8[5]

| AUTHOR | SAMPLE SIZE | STUDY DESIGN | THERAPEUTIC INTERVENTIONS | OUTCOME MEASURES | FINDINGS |
|---|---|---|---|---|---|
| Parthasarathy et al., 2019[8] | 20 patients | Pilot trial | Electroacupuncture at orbicularis oculi,zygomaticus major,levator labii superioris,electrical stimulation of 10 Hz then increased to 20Hz(35 min for 7 days at a gap of 5-6 days) | House-Brackmann scale(HBS) | Electro acupuncture administered at certain sites in conjunction with steroid and antiviral medications is effective in achieving the desired outcome of muscle healing. |
| Adhikari et al., 2019[9] | A 60 year old male patient | Case study | Kabat rehabilitation - Stretch, resistance, and reciprocal inhibition exercises each require 2-3 sets of 3-5 repetitions per muscle. Exercise on a circuit. Exercise: One session each day at 1:1 rest: exercise,1 session / day for 30 min,6 days a week for 21 days. | House-Brackmann scale and sunnybrook scale. | This case study showed that KR with FEFE in BP led to a faster and better recovery.(After the treatment,eye closing,face symmetry and defined facial expressions.) |
| Abdelatief et al., 2020[10] | 196 Patients | RCT | Tens- Pulse rate 100Hz, stimulate time 30 seconds, polarity +, sweep-1Hz, sweep time 1second,<br><br>ramp up- off, ramp down- off and time rest.<br><br>Faradic current stimulation with these<br><br>Parameters-Pulse rate-100Hz, time-10sec,<br><br>Polarity-+, ramp up- 3 seconds, ramp down-3 sec,<br><br>pulse time- 100 µs, pause time-1ms.<br><br>Followed by massage,vibration, | House brackman (HB)scale | Grades IV, V, and VI of the HB scale are significantly impacted by TENS from at least a month following application, although other groups had uneven effects.<br><br>The study also came to the view that using TENS rather than faradic current alone or in combination with it appears to be a safer way to treat Bell's palsy since it lowers the severity of its symptoms, especially in the beginning. |

| | | | | | |
|---|---|---|---|---|---|
| | | | infrared. | | |
| Alshareef et al., 2020[11] | 15 patients | Interventional study | Wet cupping(2-10 sessions). | Facial disability index.(FDI) | The findings of this study show that, as compared to the pre-cupping state, wet cupping enhanced the physical, social, and combined physical and social scores in Bell's palsy patients |
| Marotta et al., 2020[12] | 20 patient(who received 5months of conventional therapy) with unrecovered bell's palsy. | RCT | SWD(8-12W;2.2MHz frequency)-Two waveform(monophasic triangular and rectangular)<br><br>NMES(80Hz for 700ms) | Sunnybrook scale<br><br>And Kinovea(movement analyse software) | Significant improvement was evident for symmetry of voluntary movement. |
| Digra et al., 2020[13] | A 32 year male patient of RTA suffering from speech difficulty with tingling and numbness. | A case report | The PNF technique(Rhythmic initiation,repeated stretch)-3 sessions per week | House brackmann scale. | It was found that PNF has positive effect in strengthening of weak facial muscles.<br><br>(function status improved from grade 5 to 2 on HBG scale) |
| Kandakurti et al., 2020[14] | 120 people having idiopathic bell's palsy(divided in 3 groups) | RCT | A low level laser(LP-1000 gallium arsenide diode) with 795nm wavelengths,1w power.<br>1st group-1J/cm$^2$ (4J) over 8 points of facial nerve course for 3 days in per week for 6 weeks<br>2nd group-Interrupted galvanic electrical impulse for 3-30 ms for 3 per week for 6 weeks.<br>3rd group-corticosteroids with facial exercises,mirror feedback twice a day for 6 weeks. | House Brackmann scale and Facial disability scale | There was lack of evidence for complete functional recovery. |
| Morishima et al., 2020[15] | 39 patients | Single blinded RCT | MS group-muscle strengthening intervention and selective muscle contraction intervention(SCMI | Sunnybrook facial grading(SFG) | The findings suggested that in people with less axonal degeneration, training certain muscles could assist to restore |

| | | | | | |
|---|---|---|---|---|---|
| | | | ) Non MS group-eye opening exercises. Both group-mirror biofeedback,prohibition of maximum effort movement,stretching. | | paralysis without exacerbating synkinesis. |
| Sadio et al., 2020[16] | 40 patients | RCT | Facial taping combined with Kabat rehabilitation. The neuro muscular can be Activated by Kabat therapy for association taping | ADS assessment | It is effective reducing flaccid effectiveness. Bells palsy patients who used facial tape in conjunction with Kabat rehabilitation experienced a faster recovery and better result |
| Ton et al., 2021[17] | 32 patients | Double blind,randomized,sham controlled clinical study | Laser acupuncture treatment-supplied as gallium-aluminum-arsenide, applied for 40/80 seconds, 3/6 Joules in pulsed-wave per local or distal sites, respectively, at an intensity of 150 mw/cm2, at an infrared wavelength of 810 nm. | Facial disability index score,House-brackmann scale and sunnybrook scale | significant difference in the HB score (P=0.0438), marginally significant difference was seen in the SB and stiffness values (P= 0.0598 and P= 0.0980, respectively). The FDI score did not alter significantly between week 6 and baseline. |
| Mughal et al., 2021[18] | 64 patients(divided in 2 groups) | RCT | Group 1-Mirror visual feedback(MVF)+ Neuromuscuar reeducation(NMR) Group 2-only neuromscular reeducation(NMR) | House brackmann scale and FDI | There was no differences in FDI-S, FDI-P, and HBS scores in both two groups (p values of 0.321, 0.893, and 0.317 respectively) . At the 3rd and and 7th weeks of follow-up, there was a substantial variance in FDI-P, FDI-S, and HBS. |
| Liu et al., 2022[19] | 65 patients | RCT | rTMS combined with routine rehabilitation-once a day,5 times a week for 2 weeks. | House-brackmann scale,sunnybrook facial grading and Modified Portmann scale(MPS) | Shows significant speed up recovery of facial nerve function and that rTMS is both save and effective for treating Bell's Palsy |
| Martineau et | 40 | RCT with 1 | MEPP- 4 in- | House | Improvement on |

| | | | | | |
|---|---|---|---|---|---|
| al., 2022[20] | patients(n=20/grp) with moderately severe to total palsy within14 days of onset. | year follow-up. | clinic sessions in first 2 weeks ,then 1 per month.<br><br>-Facial exerises - 2 times daily till recovery (15 min) | brackmann 2.0 mean and Sunny brook global scores | facial symmetry scale(House-Brackmann scale)<br><br>-No group change found in perceived speech intelligibility. |
| Rahayu et al., 2022[21] | 18 year old student | RCT | Neuromuscular taping,elastic tape.The tapes help with venous and lymphatic drainage Blood circulation, venous return and relief as they create wrinkles and lift the skin. | The numerical pain rating scale (NRS) And The Ugo Fisch scale. | It shows quick recovery from the pain and sensory issues in the left ear and neck.<br>-Restores symmetry in the face |
| Hamed et al., 2022[22] | 30 children | RCT | Kabat motor re-education (includes visual cues, verbal cues, tactile cues) Last 20 min per session 3 times a week for 6 week. | Electroneurography(ENOG0 and Sunnybrook facial grading. | Show significant increase in SFGs. |
| Cheng et al., 2022[23] | 14 studies | Systematic review. | Laser therapy over the area of the injury or lesion, red and near-infrared light having wavelengths between 600 and 1000 nm. | House Brackman Scale, Facial Disability Index (FDI) and Sunnybrook Facial grading system | Laser therapy have direct impact on the improvement of peripheral nerve regeneration.<br>-There was decrease in pro-inflammatory cytokines and an increase in anti-inflammatory cytokines was seen. |
| Alharbi et al., 2023[24] | 62 Participants | RCT | Facial neural mobilisation addition with Facial acupressure shortwave Diathermy, Neuromuscular re-education, electrical stimulation and pharmacological drugs. | Sunny brook Scale and Kinovea movement analysis software. | -Reduction of radiculopathic pain of upper limb decrease (3 weeks and session of NM)<br>H-reflex latency of the flexor carpi radialis muscle is improved. |

## METHOD AND MATERIAL

In order to conduct this literature review, we searched Google Scholar,PubMed,Medscape,WebMD,the Cochrane Database and a few standard textbooks for relevant literature on Bell's palsy. We used the complex search feature while searching through multiple databases, taking into account all relevant articles from 2019 to 2023. We used the terms Bell's palsy,facial palsy,systematic review idiopathic facial palsy,physiotherapy effect,rehabilitation,modern interventions etc.

## RECENT ADVANCEMENT

Modern medicine has gained prominence and widespread acceptance as the preferred method of curing disease.The advancement in modern medicine have made clearer the physical and psychological causes behind various disease.These recent studies have made significant contribution to Promote the quality of life for those struggling with BP.

The recent review of Zhong et al.[25] suggests that acupuncture is effective in treating Bell's palsy. The LSCI technology enables acupuncturists to accurately assess changes in face blood flow, and manipulative acupuncture stimulation enhanced blood perfusion and accelerated recovery. At the screening stage, patients within the ages of 18 - 70 years,who had been detected with BP (within 14 days) were considered for participation in this study. Each patient was evaluated using the HB scale , and patients classified IV-VI were eligible for this investigation.Patients were randomly assigned to receive either basic acupuncture or manipulative acupuncture with LSCI using a randomization method.The use of basic acupoints for both acupuncture and manipulative acupuncture has been shown to significantly improve the HB scale categorization of severe BP. This led to a higher recovery rate at 8 weeks and six months after the onset of facial palsy. Additionally, less procedures were required to restore grade 1 facial nerve function following impairment.According to the findings of this study, manipulative acupuncture is a suitable treatment for patients with BP to enhance facial blood circulation and facial nerve performance by HB grade, leading to in enhanced efficacy and rate of recovery and that require less therapy for recovery from diminished facial nerve performance to HB scale grade I. As a result, more testing using larger scale patients involvement and partnering hospitals is necessary.

Another recent study by Darware et al.[26] in which they compares traditional physiotherapy to video self modelling to determine how effective it is for bell palsy patients. In this study visual self-modeling with Kinect Azure to examine Bell's palsy intervention. With 10 participants in each group, the study was a single-blinded randomized controlled trial of the Kinect Azure for people with bell's palsy. The participants were divided into two groups: Group A received traditional physiotherapy, and Group B received conventional physiotherapy supplemented with video self modelling. For two weeks, Group A received one hour per day of traditional physiotherapy, while Group B received 30 minutes per day, five days per week, of video self-modeling. After watching the tapes for two weeks, the acts was evaluated. One of the primary outcome measures used was the House-Brackman Scale, which measures the degree of facial paralysis and The Facial Disability Index was utilized as both a preliminary evaluation tool and as a monitoring tool to evaluate the effectiveness of interventions. It was observed that recovery of facial symmetry, 0.6-grade reduction in paresis severity on the HB scale, and synkinesis control all appeared to be improved by rehabilitation and Improved Facial Disability Index scores. Our research backs up these rehabilitation methods for improving facial nerve palsy. The Kinect platform can be used to provide inexpensive methods for objectively measuring movement features. Future therapeutic applications and research and development opportunities for the Kinect are extensive. This will facilitate the production of diagnostic and prognostic evaluations.

In another latest study by Walker et al.[27] who presented something new in the medical field that is wearable motor-sensory module prototype by utilising 3D printing for facial rehabilitation with a focus on facial paralysis.

A generic actuator-sensor pair with a system of feedback controls was created for augmented physiotherapy to transmit signals from smiling on the normal side of the face (particularly the temporal and zygomatic branch) to activation on the affected side of the face. During the silicone printing process,multicomponent wearable is created by combining fabric material and sensor liquid. little postprocessing to be ready for use. The actuators force and vertical constriction of the actuators at loads of 0.98 and 1.96 N are adequate to create grins ranging from 1 to 7 N.Because it is difficult to accurately evaluate the force and contraction ratio based on soft surfaces, a unique modular surface was created to mimic the movement of both bone and skin using 3D produced solid plastic (bone) and sheet of silicone.The results reveal that the use of actuator strength varies based on the shape and toughness of the facial surface.The actuator is put through its paces on four distinct repetitive and standardised surface morphologies.The complete apparatus is exhibited upon the face as a proof-of-concept while pressure and sensor data are collected. This promotes potential applications in the rapid customization of extremely specialised squishy orthotics, prosthetics, and rehab equipment. This specific actuator-sensor combination may have further benefits for wearable due to its adaptability, closed-loop operation, and separate "grounding" trial system.

Another recent work on Telerehabilitation by Sire et al.[28] on the use of neuromuscular electrical stimulation and short-wave diathermy and combined to face PNF rehab in unrecovered facial paralysis during COVID-19 pandemic.This kind of treatment was a game changer in the COVID-19 epidemic. During the COVID-19 pandemic, the vast majority of patients were happy with telerehabilitation and had no difficulty managing their symptoms from afar. Patients with more severe psychosocial and expressive impairment rated these novel systems much higher. More research on telerehabilitation is needed to advise best practises, with an emphasis on varied diagnoses, ages, and techniques..These above advancement are few of the modern interventions, further more studies are going on by various researcher around the globe to enhance the life of BP patients.

## DISCUSSION

According to the study of the 12 researches,we reviewed in the current literature, physiotherapy interventions seems to be effective factor that may reduce symptoms of BP.

Our findings demonstrated that in order to get the desired result of muscle repair, electro acupuncture applied at specific muscles with electrical stimulation for average of 35 min for 7 days at a gap of 5-6 days in combination with steroid and antiviral drugs is effective in helping muscles recover as needed,our findings are in support with Parthasarathyet et al[5].
The study of Abdelatief et al.[7] had a noticeable effect on the HB scale's Grades IV, V, and VI starting at least a month after administration, however other groups experienced uneven outcomes.
The study of Marotta et al.[9] tried to evaluate the effectiveness of NMES and SWD therapy,the electrical stimulation was given total 5 sessions were given per week each of 30 min,combined with therapeutic massage,breathing and relaxing exercise. There was noticeable change in the symmetry of voluntary facial movement.It was also noticed that resting assymetry,facial paralysis and synkinesis persisted or slightly improved.Our findings are in accordance with Marotta et al.[9]
The studies of Adhikari et al.[6], Digra et al.[10] and Hamed et al.[16] concluded in their studies that facial symmetry of patients who followed either a programme using the PNF technique for 6 weeks or the Kabat technique for 3 weeks in combination with nerve stimulation including stretching, reciprocal inhibition, rhythmic initiation, repetitive stretching, tactile signals,visual cues and verbal cues facilitate strengthening facial muscles that are weak and helps in quick recovery.
Our research has demonstrated that electrotherapy minimise the symptoms of BP and significantly shows improvement in HBS, SFG, FDI grading scales also symmetry of voluntary movement of face which aids in an earlier and quicker recovery the above findings support our review[7 11 13 14 15 16 18 21 23] .
Still, it's unclear from the available research which factors (intensity, pulse duration, treatment time, or number of sessions) should be used to achieve the greatest outcomes.

## CONCLUSION

The results of studies have shown a significant improvement in facial function and a quicker recovery.Additionally, it lowers the severity of its symptoms, especially in the initial stages to strengthens weak facial muscles, increases facial nerve function, and recovers facial symmetry.Also wet cupping combined with facial exercises three to five session in total have shown better social and functional score.Also recent study
On facial nerve mobilisation together with traditional therapies are more effective in improving symmetry of face in people with acute Bell's palsy,The findings on neural facial mobilisation in acute ell's palsy therapy might help in early recovery and reduce facial muscle paralysis.
Further more research is needed to measure or discover optimal physiotherapy methods that produce the best benefits.

## FUTURE SCOPE

The future scope of physiotherapy in Bell's palsy is promising, with ongoing research and development of new treatment approaches to help patients achieve optimal recovery.
To find new treatment modalities, enhance current methods, also to enhance patient treatment results, more research is required in the field of physiotherapy for Bell's palsy.
Future potential is being investigated,while physiotherapy can be a beneficial treatment for BP, it is important to consider the limitations and individualize treatment plans accordingly.

## REFERENCES

1. Gatidou, A.M., Kottaras, A., Lytras, D., Gatidou, C., Iakovidis, P. and Kottaras, I., 2021. Physiotherapy management of Bell's palsy-A review of evidenced based physiotherapy practice. *International Journal of Advances in Medicine*, *3*(1), pp.402-

2.https://www.ncbi.nlm.nih.gov/books/NBK482290/

3.Holland, N.J. and Bernstein, J.M., 2014. Bell's palsy. *BMJ clinical evidence*, *2014*.

4.Eviston, T.J., Croxson, G.R., Kennedy, P.G., Hadlock, T. and Krishnan, A.V., 2015. Bell's palsy: aetiology, clinical features and multidisciplinary care. *Journal of Neurology, Neurosurgery & Psychiatry*, *86*(12), pp.1356-1361.

*5.J Can Dent Assoc* 2022;88:m8

6.Zhang, W., Xu, L., Luo, T., Wu, F., Zhao, B. and Li, X., 2020. The etiology of Bell's palsy: a review. *Journal of Neurology*, *267*, pp.1896-1905.

7.Sthapit, P.R., Kaiti, R., Khanal, K. and Shrestha, P., 2017. Ocular manifestations in cases of Bell's Palsy. *Pain*, *10*, pp.14-5.

8.Parthasarathy, S. and Hanifah, M., 2019. Efficacy of Electro Acupuncture in Bell's Palsy–A Clinical Interventional Pilot Trial in Indian Patients. *Inter J Contemporary Med Res*, *6*(6), pp.F15-8.

9..Adhikari, S.P., Shrestha, J.N. and Subedi, M., 2019. Effectiveness of Kabat Rehabilitation Combined with Facial Expressive and Functional Exercises in Treatment of Bell's Palsy: A Case Study. *Nepal Journal of Neuroscience*, *16*(3), pp.65-67.

10.Abdelatief, E.E.M., 2020. Effect of transcutaneous electrical nerve stimulation and faradic current stimulation on the recovery of Bell's palsy. *International Journal of Human Movement and Sports Sciences*, *8*(6), pp.369-380.

11.Alshareef, A.A. and Obeid, A., 2020. Wet cupping therapy improved the quality of life in chronic Bell's palsy patients. *Medical Science*, *24*(104), pp.2373-2381.

12.Marotta, N., Demeco, A., Inzitari, M.T., Caruso, M.G. and Ammendolia, A., 2020. Neuromuscular electrical stimulation and shortwave diathermy in unrecovered Bell palsy: A randomized controlled study. *Medicine*, *99*(8).

13.Digra, P.K., Bharti, R. and Singh, N., 2020. Proprioceptive neuromuscular facilitation in LMN facial palsy: a case report. *Indian Journal of Physiotherapy & Occupational Therapy Print-(ISSN 0973-5666) and Electronic–(ISSN 0973-5674)*, *14*(3), pp.171-174.

14.Kandakurti, P.K., Shanmugam, S., Basha, S.A., Amaravadi, S.K., Suganthirababu, P., Gopal, K. and George, G.S., 2020. The effectiveness of low-level laser therapy combined with facial expression exercises in patients with moderate-to-severe Bell's palsy: A study protocol for a randomised controlled trial. *International Journal of Surgery Protocols*, *24*, pp.39-44.

15. Morishima, N., Kamiya, T., Naito, Y., Morisaka, A., Ishikawa, T., Tachibana, K. and Murakami, S., 2020. Effect of muscle strengthening on peripheral facial palsy: A randomized controlled trial. *Physical Therapy Research*, *23*(1), pp.59-65.

16. Di Stadio, A., Gambacorta, V., Ralli, M., Pagliari, J., Longari, F., Greco, A. and Ricci, G., 2021. Facial taping as biofeedback to improve the outcomes of physical rehab in Bell's palsy: preliminary results of a randomized case–control study. *European Archives of Oto-Rhino-Laryngology*, *278*, pp.1693-1698.

17.Ton, G., Lee, L.W., Ho, W.C., Tu, C.H., Chen, Y.H. and Lee, Y.C., 2021. Effects of laser acupuncture therapy for patients with inadequate recovery from bell's palsy: preliminary results from randomized, double-blind, sham-controlled study. *Journal of Lasers in Medical Sciences*, *12*

18.Mughal, S., Shoukat, F., Munawar, A. and Tahir, R., 2021. Effectiveness of Facial Neuromuscular Retraining with and without Mirror Visual Feedback in Patients with Bell's Palsy. *Annals of King Edward Medical University*, *27*(Special Issue (Jul-Sep)), pp.407-412.

19.Liu, Z., Xie, D., Wen, X., Wang, R., Yang, Q., Liu, H., Shao, Y. and Liu, T., 2022. Peripheral Repetitive Transcranial Magnetic Stimulation (rTMS) for Idiopathic Facial Nerve Palsy: A Prospective, Randomized Controlled Trial. *Neural Plasticity*, *2022*.

20.Martineau, S., Rahal, A., Piette, E., Moubayed, S. and Marcotte, K., 2022. The "Mirror Effect Plus Protocol" for acute Bell's palsy: A randomized controlled trial with 1-year follow-up. *Clinical Rehabilitation*, *36*(10), pp.1292-1304.

21.Rahayu, U.B., Ratnawati, W. and Blow, D., Neurosurgery and Neurology Research: OPEN ACCESS| Volume 1-Issue 1-2020 ISSN No:| Journal DOI.

22.Hamed, S.A., Mahmoud, L.S.E.D., ElMeligie, M.M. and Zoheiry, I.M., 2023. Electrophysiological responses to Kabat motor control re-education on Bell's Palsy: A randomized controlled study. *Journal of Musculoskeletal & Neuronal Interactions*, *23*(1), p.90.

23.Cheng, L.Y.J., Lung, T.H.A. and Ng, S.Y., Management of Bell's Palsy with Phototherapy.

24.Alharbi, R., Kashoo, F.Z., Ahmed, M., Alqahtani, M., Aloyuni, S., Alzhrani, M., Alanazi, A.D., Sidiq, M., Alharbi, B.H. and Nambi, G., 2023. Effect of neural mobilisation in Bell's palsy: A randomised controlled trial. *Hong Kong Physiotherapy Journal*, pp.1-11.

25.Zhong, W., Yu, H., Rao, X., Wu, J., Gou, Y., Cui, H., Huang, X. and Wang, L., 2020. Efficacy of manipulative acupuncture therapy monitored by LSCI technology in patients with severe Bell's palsy: a randomized controlled trial. *Evidence-Based Complementary and Alternative Medicine*, *2020*.

26.Darware, M.R. and Jethwani, D., 2021. Video Self Modelling-An Intervention to Study Bell's Palsy through Kinect Azure: A Research Protocol. *Indian Journal of Forensic Medicine & Toxicology*, *15*(1), pp.1886-1891.

27. Walker, S., Firouzeh, A., Robertson, M., Mengüç, Y. and Paik, J., 2022. 3D Printed Motor-Sensory Module Prototype for Facial Rehabilitation. *Soft Robotics*, *9*(2), pp.354-363.

28. de Sire, A., Marotta, N., Agostini, F., Drago Ferrante, V., Demeco, A., Ferrillo, M., Inzitari, M.T., Pellegrino, R., Russo, I., Ozyemisci Taskiran, O. and Bernetti, A., 2022. A telerehabilitation approach to chronic facial paralysis in the COVID-19 pandemic scenario: what role for electromyography assessment?. *Journal of Personalized Medicine*, *12*(3), p.497.