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Efficacy of Laser Photobiomodulation in the Management of Bell's Palsy: A Systematic Review

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Abstract

Objective: The objective of this systematic review was to summarize the effectiveness of laser photobiomodulation in improving recovery rates in patients with facial palsy**. Review Method:** Literature search included three databases, namely Medline (via PubMed), EMBASE, and Google Scholar involving studies done till February2023. All articles that reported treatment to patients with facial palsy using low level laser therapy (Laser photobiomodulation)alone and as an adjunct therapy with conventional treatment (facial exercises and facial massage) were reviewed. The Physiotherapy Evidence Database (PEDro) scale, The National Institutes of Health (NIH) quality assessment tool, The Methodological item for non-randomized studies (MINORS) tool and The Joanna Briggs Institute (JBI) Critical Appraisal Checklist were used to assess methodological quality of studies**.** Sixteen studies were selected for review based on the eligibility criteria. Laser photobiomodulation was effective in treating facial nerve palsy in all the studies except for one study where its effect was comparable to conventional therapy. In majority of studies, laser therapy used as an adjunctive therapy along with Steroid, pharmacotherapy, Magnetic field therapy and facial exercises/massage was effective in treating facial palsy. Facial palsy recovery rates improved in patients with co-existing conditions, like diabetes. **Conclusion**: Laser photobiomodulation alone and as an adjuvant therapy with conventional treatment is a novel, safe, user friendly and non-invasive treatment modality for the management of facial nerve palsy.

Keywords: Facial paralysis, Photobiomodulation, Low level laser, Bell’s Palsy

Key Message: Laser photobiomodulation alone and as an adjuvant therapy with conventional treatment is a novel, safe, user friendly and non-invasive treatment modality for improvement of treatment outcomes in patients with Bell’s palsy.

Introduction: Bell's palsy is the most frequent acute mono-neuropathy and the most prevalent facial nerve paresis or paralysis. It is a rare disorder that affects people of all ages and genders, with incidence rates ranging from 11.5 to 53.3 per 100,000 person years in different populations.[1]Dryness of the eye, xerostomia, taste disturbance or loss, hyperacusis, sagging of the eyelid or corner of the mouth, Ipsilateral pain around the ear or on the face are common symptoms of Bell’s palsy.[1]Pregnancy,obesity, hypertension, respiratory problems, diabetes,

postsurgicalinsult, viral infections, benign or malignant tumours and temporal bone damage are some of the common risk factors for Bell's palsy. [2]Approximately 70% of patients are treated within 6 months, however the remaining 30% do not receive complete treatment, resulting in facial deformity, contracture, and synkinesis.[3]Facial paralysis has a significant impact on a patient's appearance, and psychological well-being, hence, treatment is immediately started in an attempt to reduce the chances of an incomplete recovery and improve quality of life. Corticosteroids and antivirals are most frequently prescribed drugs. Physical therapy, static and dynamic surgical reanimation treatments and injectables are common options for treating facial movement dysfunction. The therapies are planned based on the severity of the face zone's malfunction.[4]Laser photobiomodulation is a novel, non-invasive, painless and patient friendly therapeutic approach for facial palsy. Diode laser radiation has been shown to have anti-inflammatory, anti-edemigenic, and antalgic properties, validating its usage for treating Bell's palsy. [5]In certain case reports, case series, clinical trials, and randomized controlled trials, photobiomodulation has been used as an adjunctive treatment with conventional treatment for recovery of facial palsy. This review aims to summarise evidence for the effectiveness of laser photobiomodulation in improving recovery rates in patients with facial palsy.

Methodology:

Registration: The systematic review was registered in PROSPERO database with reference ID CRD42022358429.

Search strategy for article identification: The Cochrane Handbook for Systematic Reviews of Interventions and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement guidelines were followed for review.[6,7] The Population, Intervention, Comparison, Outcome, and Study design method as applicable is presented in Figure 1. An extensive electronic search for in vivo studies via three databases, namely Medline (via PubMed), Google Scholar and EMBASE till October 2022 was done. Search was focused on Medical Subject Headings (MeSH) terms such as "Low-level laser" OR "photobiomodulation" OR "phototherapy" AND "Bell's palsy" OR "facial palsy" OR "facial paralysis" OR "facial nerve injury". Electronic search strategy was supplemented by hand searching of eligible studies. In addition, reviews on the topic were searched and reference lists were extracted to identify potentially eligible studies that may have been missed through other

methods. There were no language restrictions. The studies were managed within the Review Manager (RevMan) [Computer program]. Version 5.4, The Cochrane Collaboration, 2020.

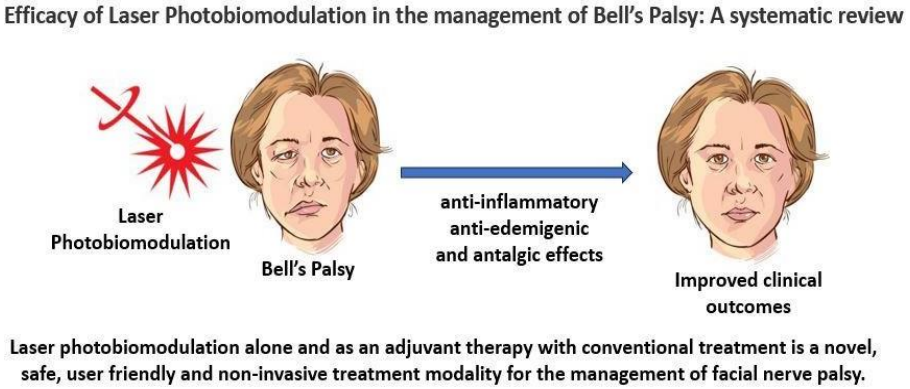
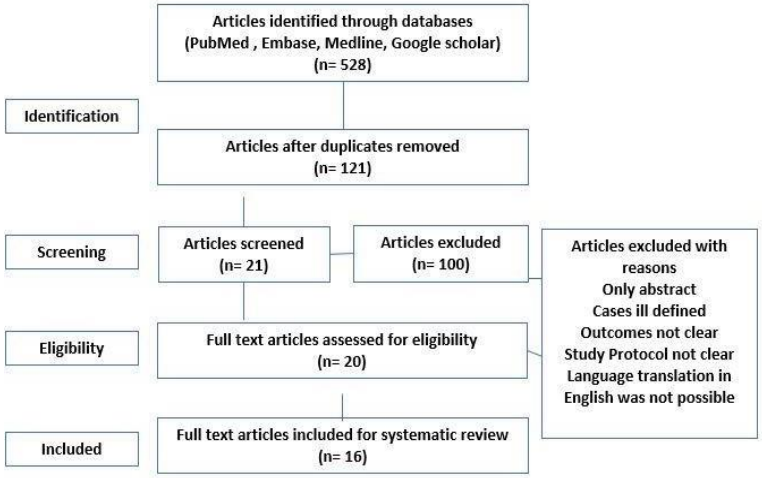


Figure 1: Flow Diagram Of Review Methodology



Selection criteria of studies: All articles that reported in-vivo trials where facial palsy were treated with low level laser therapy (Laser photobiomodulation) were included for review. Trials testing Laser therapy as an adjunct therapy along with conventional therapy (facial exercises and facial massage) were also included. Trials testing other therapies, such as dry needling, electric stimulation, acupuncture, moxibustion were excluded.

Data extraction: Two authors searched the studies, screened the titles and abstracts of each study based on the criteria, and extracted data. Two authors reviewed the full text of the screened studies. Any disagreement between the two authors, was resolved by a third reviewer. Data collected for each study included information pertaining to year and place of publication, author, sample size in interventional group, study characteristics like interventional details, laser parameters, comparison groups, follow-up period, examination methods, outcomes and results.

Assessment of Methodological Quality of included Studies: Each study was critically evaluated for quality using relevant methodological quality assessment tools like The Physiotherapy Evidence Database (PEDro) scale for randomized controlled trials, The National Institutes of Health (NIH) quality assessment tool for case-series studies, The Methodological item for non-randomized studies (MINORS) tool and The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Case Reports.[8]

Table 1: Patient, Intervention, Comparison, Outcome and Study design format for identification of studies

Patient	Patients with Bell's palsy (Unilateral/Bilateral, Acute/Chronic)
Intervention	Laser Photobiomodulation and Laser photobiomodulation along with other therapies.
Comparison	Steroids, Vitamin B complex and steroids, facial massage, facial expression exercises, magnetic field therapy and trans electrical nerve stimulation
Outcome	House Brackmann Scale, Sunnybrook facial grading system, physical facial disability index (PFDI) scores, social facial disability index (SFDI) scores, recovery rates, pain Scores (Visual Analogue scale), speech, muscular pain and chewing ability.
Study design	Randomized controlled/ clinical controlled trials, Case reports, Case series

Results

Studies selection and description: The search methodology and results are presented in Figure 1.Through the literature search, 528 studies were identified, including 121 duplicates. Twenty articles were identified after excluding duplications. A total of sixteen full-text articles were selected for systematic review.

Study characteristics: Sixteen relevant studies published between 1993 to 2022 (October) were considered for review. Six studies were reported from Asia, eight from America and two from Europe. All included studies were in vivo. Five studies were randomized controlled trials, three were non randomized trials, one was case series and seven were case reports. Intervention was carried out among adults except study by Fontana et al.[12] and Marina et al,[18] where in therapy was given to a child and adolescent respectively. In the majority of studies, patients had unilateral complete or partial peripheral facial nerve palsy. Ten studies involved patients with acute palsy,[9,10,12-18,24] whereas in six studies patients suffered from chronic palsy.[12-18,24]Assessment of facial palsy was done based on House Brackmann Scale, Sunnybrook facial grading system, physical facial disability index (PFDI) scores, social facial disability index (SFDI) scores, recovery rates, pain Scores (Visual Analogue scale), speech, muscular pain and chewing ability. In comparative groups the therapies were Steroids,[9]Vitamin B complex and steroids,[10]facial massage, facial expression exercises [13-14,16-17]magnetic field therapy [14] and trans electrical nerve stimulation.[19,22,24] Assessment of outcomes was done between 2 weeks to 6 months across studies.(Table 2)

Table 2: Study characteristics of articles included for systematic review

Sl no	Author, Place	Year	Study Design	Patients treated	Age of patient (in years)	Type of palsy	Duration of palsy	Parameters assessed
1	Yamada et al,.[9] Japan	1993	NRT	7	45.1±14.0	IPFP	Acute	Degree of Facial palsy assessment scale by facial nerve research group of Japan
2	Yoshida et al,.[10] Japan	2010	CR	14	48	IPFP	Acute	Yanagihara's Facial Palsy recovery rates
3	Alfaya et al,.[11] Rio de Janerio	2012	CR	1	29	IPFP, Unilateral (right side)	Chronic 3 years	Severity of paralysis, trismus, chewing, muscular pain assessment (VAS)
4	Fontana et al,.[12] Brazil	2012	CR	1	3	IPFP, Unilateral (right side)	Acute	HBS
5	Macías-Hernández et al,.[13] Mexico	2012	RCT	11	38	IPFP	Acute	Manual muscle testing, Recovery rate
6	Delgado Castillo et al,.[14] Cuba	2013	RCT	38	NM	IPFP	Acute	HBS
7	Rubis et al,.[15] USA	2013	CR	1	40	IPFP Unilateral Left Side	Acute	HBS

8	Alayat et al,.[16] Saudi Arabia	2014	RCT	15	43.3±10.1	IPFP Unilateral	Acute	PFDI , SFDI
9	Ordahan et al,.[17] Turkey	2017	RCT	23	44.7 ± 4.5	IPFP Unilateral	Acute	PFDI , SFDI
10	Marina et al,.[18] Brazil	2018	CR	1	13	IPFP Unilateral	Acute	Severity of paralysis, speech, chewing, muscular pain assessment
11	Alyassiri et al,.[19] Iraq	2019	NRT	80	43.6 ± 15.6	IPFP	Chronic	Van Swearingen and Brach (HSB), 1996 grading of Bell's palsy.
12	Agamohandi et al,.[20] Iran	2020	NRT	30	40.66±13.67	IPFP	Chronic	HBS ENMG, Nerve Conduction Velocity
13	Rodrigues et al,.[21] Brazil	2020	CR	1	25	IPFP	Chronic	HBS and ENMG
14	Tanganeli et al,.[22] Brazil	2020	CR	1	72	IPFP Unilateral	Chronic	HBS
15	Claudio Pasquale et al,.[23] Italy	2021	CS	14	56.07±15.21	IPFP Unilateral	Chronic	HBS
16	Jaseel et al,.[24] India	2021	RCT	12	40.33 ± 10.16	IPFP Unilateral	Acute	SBFG, Toassess facial symmetry and PFDI

RCT-Randomized Controlled Trial, CR-Case Report, CS-Case Series, NRT-Non-Randomized trial, IPFP-idiopathic peripheral *facial palsy,* HBS-House Brackmann Scale, PFDI -facial disability index physical, SFDI - facial disability index social, SBFG - Sunnybrook facial grading system, ENMG - Electroneuromyography values

Interventional details: All studies used diode lasers with wavelength ranging from 660-1064 nm in contact and continuous mode. Majority used 810-830 nm wavelengths. The points treated were along the course of facial nerve over the facial muscles, stylomastoid foramen and stellate ganglion. Laser light dose applied per point ranged between 3.3- 10 J. (Table 3)

Table 3: Interventional details of studies included for systematic review

Sl no	**Author**	**Intervention**	**Laser parameters**		**Intervention Details**			**Comparison group**
			Type /Wavelength /Mode	**Power / Total Dose/Energy density/Time/point**	**Duration of Treatment (Number of sessions)**	**Total points treated**	**Location of points**	

						/session		
1	Yamada et al,[9]	LLLT	Diode,,830nm, CW, CM	At area of Paralysis 150mW, 127 J/cm^2 (36J per point for 10 mins) At area of stylomastoid foramen, 150mW, 38.2 J/cm^2 (10.8J per point for 3 mins) At area of Stellate ganglion 150mW, 63.7 J/cm^2 (18J per point for 3 mins)	34.4 sessions across 21-66 days	3	Area of Paralysis, stylomastoid foramen, stellate ganglion	LLLT +Steroids,
2	Yoshida et al[10]	LLLT + Pharmaco therapy (Vitamin B complex, steroids)	Diode,1064nm, CW, CM	300mW, 10-15 mins per point	2 sessions/week over a period of 6 months	2	Skin over the approximate area of the stellate ganglion and foramen stylomastoid on the distal side	-
3	Alfaya et al,.[11]	LLLT +ST+FE	Diode, 795nm , CW,CM	120mW, 4J per point	13 sessions across 2 months	NM	Region of innervation of facial nerve	-
4	Fontana et al,.[12]	LLLT	Diode,660,780nm, CW,CM	780nm, 70mW, (17.5 J per point for 10 s) 660nm, 40-60mW, (10J per point for 10 s)	2 sessions/week for 2 weeks and 3 sessions in 3rd week	80	Area of all the facial muscles and nerves of the lower part of the face or frontalis and points around the eyes, mouth, maxilla, and other areas penetrated by the facial	-

							nerve.	
5	Macías-Hernández et al[13]	LLLT +FM+FE	Diode,830nm, PW, CW	100mW, 40 J/cm^2 (14J per point for 10-15 s)	15 sessions across 7 weeks	NM	Points of exit of facial nerve	Sham LLLT +FM+FE
6	Delgado Castillo et al[14]	LLLT +FM+FE+MFE	Diode,670nm, PW, CM	100mW, 40 J/cm^2 (14J per point for 10-15 s)	20 with 5/week for 4 weeks	NM	Through the course of facial nerve with 1.5-cm space between two points and extra point at nerve exit locale	LLLT+FM+FE MFE
7	Rubis et al,.[15]	FM+FE +LLLT	Diode,910nm, CW, CM	1W, 47.6 J/cm^2 (10J per point for 30s)	3 sessions spread across 1 week	6	Mastoid area at the stylomastoid foramen, along the course of	--
8	Alayat et al,.[16]	LLLT +FM+FE	Diode,980nm, CW, CM	100mW, 80 J/cm^2 (10J per point for 5 s)	18 sessions spread across 6 weeks	8	Superficial roots of facial nerve on affected side	FM+FE+ Sham LLLT
9	Ordahan et al,.[17]	LLLT +FE	Diode,830nm, CW, CM	100mW, 80 J/cm^2 (10J per point for 120 s) 5	18 sessions (3 sessions per week for 6 weeks)	8	Superficial roots of facial nerve	FE
10	Marina et al,.[18]	LLLT	Diode,830nm, CW	100mW, 100 J/cm^2 (5.6 J per point) 28s/point	3 sessions spread across 3 weeks	2	Origin and insertion of the right superficial masseter muscle and course of facial nerve	-
11	Alyassiri et al,.[19]	LLLT	NM	NM	NM	NM	NM	TENS
12	Agamohandi et al,.[20]	LLLT	Diode, 980nm, CW	334mW, 16 J/cm^2 (5 J per point)	12 sessions (3/ week)	9	Mastoid process Course of facial nerve branches	-
13	Rodrigues et al,.[21]	LLLT	Diode,660, 808nm,CW,CM	1W, 40.65 J/cm^2 (4 J per point) and 60.97 J/cm2 (6 J per point for 1min)	24 sessions (18 sessions with 3 sessions per week,	59	59 points evenly spread across right side of the face	-

					with at least a 48-h interval between sessions. 6 sessions with 48-h interval between sessions; during each session the energy density was 60.97 J/cm2 (6 J per point, 59 points).			
14	Tanganeli et al,.[22]	LLLT+TENS	Diode, 810nm, CW, CM	100mW, 120 J/cm^2 (3.3J per point for 10 s) 3.3 J per point (120 J/cm2), 10 seconds each, in contact with the skin	10 sessions (one session every 48 hours; after the fifth session, two weekly sessions)	10	Facial muscles (Frontal, temporal, zygomatic, buccinator, lip elevator orbicularis, lip depressor, masseter	-
15	Claudio Pasquale et al[23]	LLLT	Diode, 808 nm, CW,CM	1W, 60 J/cm^2 (8.57 J per point) 1min/point	7-20 sessions	7	NM	-
16	Jaseel et al,.[24]	LLLT +FM +FE	Diode, 830nm, CW, CM	NM, 80 J/cm^2 (10J per point for 40s)	12 sessions spread across 2 weeks	8	Superficial roots of facial nerve	TENS

LLLT-Low level laser therapy (laser photobiomodulation), CW-Continuous wave, PW-Pulsed wave, CM-Contact mode, T ENS-Trans electrical nerve stimulation, FE-Myofacial exercises ,FM-Facial Massage , NM-Not mentioned								

Methodological quality of included studies: The methodological quality of randomized controlled trials included in review was good with total score ranging between 7-10 on PEDro scale. (Table 4). The MINORS scale total scores of non randomized trials ranged between 11-16 indicating good quality. (Table 5) Critical appraisal of case reports and case series using JBI and NIH quality assessment tools respectively indicated good methodological quality. (Tables 5,6)

Table 4: Methodological Quality assessment of Randomized controlled trials

Physiotherapy Evidence Database (PEDro) scale	**Studies**				
Components	**Macías-Hernández et al [13] (2012)**	**Delgado Castillo et al [14] (2013)**	**Alayat et al[16] (2014)**	**Ordahan et al [17] (2017)**	**Jaseel et al [24] (2021)**
1. Eligibility criteria were specified	Yes	Yes	Yes	Yes	Yes
2. Random Allocation was done	Yes	Yes	Yes	Yes	Yes
3. Allocation was concealed	No	No	Yes	Yes	No
4. Groups similarity at baseline achieved	Yes	Yes	Yes	Yes	Yes
5. blinding of subjects	Yes	No	Yes	No	No
6. blinding of therapists	No	No	Yes	No	No
7. blinding of assessors	Yes	No	No	No	No
8. outcome measures were obtained from more than 85% of the subjects	Yes	Yes	Yes	Yes	Yes
9. Intention to treat analysis was done	Yes	Yes	Yes	Yes	Yes
10. between-group statistical comparisons reported	Yes	Yes	Yes	Yes	Yes

11. point measures and measures of variability reported	No	Yes	No	Yes	Yes
Total	8	7	10	8	7

Table 5: Methodological Quality assessment of Case series and non-Randomized studies

The National Institutes of Health (NIH) quality assessment tool for case-series study	**Claudio Pascale [23]**	**The Methodological item for non-randomized studies (MINORS) tool**	**Yamada et al [9]**	**Allyasiri et al [19]**	**Agamohodi et al[20]**
Components		Major Components			
1. study question or objective clearly stated	No	1. A clearly stated aim	1	0	1
2. study population clearly described	yes	2. Inclusion of consecutive patients	2	1	2
3. cases were consecutive	yes	3. Prospective collection of data	2	2	2
4. subjects comparable	yes	4. Endpoints appropriate to the aim of the study	1	1	2
5. intervention clearly described	yes	5. Unbiased assessment of the study endpoint	1	1	2
6. outcome measures clearly defined	yes	6. Follow-up period appropriate	1	1	2
7. length of follow-up adequate	yes	7. Loss to follow up less than 5%	2	2	2
8. statistical methods well-described	No	8. Prospective calculation of the study size	0	0	0
9.results well-described?	Yes	9. An adequate control group	2	2	NA
Quality Rating	**Good**	10. Contemporary groups	1	1	NA
		11. Baseline equivalence of groups	1	1	NA
		12. Adequate statistical analyses	1	1	NA
		Total Score	**16**	**14**	**11**
0-not reported, 1- reported but inadequate, 2- Reported and adequate, A-Not applicable because of no control group					

Table 6: Methodological Quality assessment of Case Reports

The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Case Reports	**Studies**						
Components	**Yoshida et al[10]**	**Alfaya et al[11]**	**Fontana et al[12]**	**Rubis et al[15]**	**Maria et al [18]**	**Rodrigues et al [21]**	**Tanganeli et al [22]**
Patient's demographic characteristics clearly described	yes	yes	yes	yes	yes	yes	yes
Patient's history clearly described	yes	yes	yes	yes	yes	yes	yes
Clinical condition of the patient clearly described	yes	yes	yes	yes	no	yes	yes
diagnostic tests , assessment methods and the results clearly described	yes	yes	yes	yes	yes	yes	yes
intervention(s) or treatment procedure(s) clearly described	yes	yes	yes	No	yes	yes	yes
post-intervention clinical condition clearly described	yes	yes	yes	No	yes	yes	yes
adverse events (harms) or unanticipated events identified and described	no	no	No	No	no	no	yes
case report provides takeaway lessons	yes	yes	yes	yes	yes	yes	yes

Table 7: Results of studies included for systematic review

Sl no	**Author,**	**Time of assessment of outcome**	**Results**	**Conclusion**
1	Yamada et al,.[9]	2 weeks post treatment	Paralysis score at Baseline, 2 weeks and final improvement was 10.1±6.9 ,14.6±9.3,33.3±8.0 in LLLT group and in Steroid + LLLT group it was 9.3± 7.2 ,23.4±12.7,36.9±3.6.	LLLT + Steroid group was better than LLLT alone

2	Yoshida et al,.[10]	After 2 weeks,2 months and 6 months	Recovery rate was more (100%) in LLLT + Pharmacotherapy group compared to LLLT group (78.6%)	Laser photobiomodulation along with pharmacotherapy was more effective than LLLT alone.
3	Alfaya et al,.[11]	2 months	After two months, the patient reported no pain. Although the complete recovery of physiological movements in the patient's facial movements was not evidenced, the small motor improvement was satisfactory for the patient, allowing an improvement in his quality of life.	LLLT was effective
4	Fontana et al,.[12]	After 2 and 3 weeks	Complete recovery (From Grade V to Grade I HB score after 3 weeks (11 sessions)	LLLT was effective
5	Macías-Hernández et al,.[13]	60 days post treatment	Laser group achieved recovery of 94.84% compared to 87.83% in the control group	LLLT was effective
6	Delgado Castillo et al,.[14]	4 weeks, 12 weeks	Recovery rates were highest in steroid +laser+Magnetic field group at 4 and 12 weeks with greatest improvement at 12 weeks	Combined treatment with steroid +laser+MF (Magnetic field therapy) was more beneficial than the separate combination of each one of these two physical agents with corticosteroids
7	Rubis et al,.[15]	After 4 days and 1 week	70% to 80% improvement of facial movement after 4 days and 100% control of facial movements at 1 week with no relapse after 4 years of treatment	LLLT was effective
8	Alayat et al,.[16]	3 weeks and 6 weeks post treatment	Mean FDPI scores at week 3 and 6 (25.53 ,21.8) in LLLT was significantly low ($p<0.001$) compared to HILT (37.41 ,39.74) group	High intensity Laser therapy was better than LLLT ..
9	Ordahan et al,.[17]	3 weeks and 6 weeks post treatment	Mean FDPI scores at week 3 and 6 (25.41 ± 13.12, 29.06 ± 11.09) in exercise group was significantly low ($p<0.001$) compared to Laser ±exercise group (37.42 ± 8.13, 39.21 ± 9.08)	Laser with facial exercise was more effective than LLLT alone.

10	Marina et al,.[18]	Every week for 3 weeks	patient presented complete regression of paralysis, improvement of speech and chewing, and absence of muscular pain	LLLT was effective
11	Alyassiri et al,.[19]	4 months	Post treatment, 5 patients with grade III , 11 patients with grade IV and 20 patients with grade V improved to Grade I score in LLLT group according to the House Brackmann Scale. In the control group no patients recovered to Grade I from Grade II,III,IV and V .	LLLT was effective
12	Agamohandi et al,.[20]	3 months	After 12 sessions of low-level laser therapy (LLLT), we could observe complete recovery in 18 patients and partial recovery in 6 patients after 3 months	LLLT was effective
13	Rodrigues et al,.[21]	After 12th session After 24th session	HBS test showed 1^0 - 2^0 improvement in scores post treatment.ENMG test revealed a favourable amplitude of the motor conduction velocity post treatment	LLLT was effective
14	Tanganeli et al,.[22]	After 6 weeks of intervention	According to the HBS, after the fifth session, the patient's recovery was remarkable	LLLT was effective
15	Claudio Pasquale et al,.[23]	After 3rd session onwards	11 out of 14 patients completely recovered after treatment with PBM	LLLT was effective
16	Jaseel et al,.[24]	After 2 weeks of intervention	highly significant improvement in SFGS composite scores within the LLLT (P = 0.002, Z 146 = -3.059) however, no significant difference in post-intervention FDI composite scores between groups (P=0.423, Z = -0.87)	LLLT was effective
HBS-House Brackmann Scale, PFDI -facial disability index physical, SFDI - facial disability index social, SBFG - Sunnybrook facial grading system, ENMG - Electroneuromyography values, LLLT-Low level laser therapy (laser photobiomodulation), TENS-Trans electrical nerve stimulation, FE-Myofacial exercises, FM-Facial Massage,				

Results: In majority of studies Laser photobiomodulation was effective in treating facial nerve palsy. In few studies , laser therapy used as an adjunctive therapy along with Steroid, pharmacotherapy, Magnetic field therapy and facial excercises/massage was effective in treating facial palsy.[11,13-17,24].In few studies laser therapy used alone was effective in treatment of facial palsy.[9-10,12,18-23] However study by Delgado Castillo et

al showed no significant effect of Laser therapy in the management of facial palsy.[14]Facial palsy recovery rates improved in patients with co-existing conditions, like diabetes according to study done by Agamohadi et al.[20] Few study findings showed that laser photobiomodulation was effective in treating patients with chronic Bell's palsy and improved the physical and social well-being.[16,17,24] (Table 7)

Discussion: In most studies, red/near-infrared (NIR) light (600–1100 nm) is selected for nerve regeneration because it offers maximal tissue penetration within this wavelength range. This is due to the scattering and absorption by tissue chromophores such as myoglobin, melanin (in visible regions), tissue water content (in the infrared region), and haemoglobin.[25]Based on a systematic review by Rosso et al, the red spectrum (600–700 nm) was observed with excellent electrophysiological and morphological results, immunological variables, and tissue markers.[26] The photobiomodulatory effects are linked to photoreceptor absorption of photons accelerating mitochondrial activity through cytochrome oxidase leading to production of adenosine triphosphate (ATP) and transportation of intracellular Calcium; and the initiation of pathways mediated by reactive oxygen species (ROS) ,nitric oxide (NO) and cyclic adenosine monophosphate (cAMP).All these subsequently lead to stimulation of various transcription factors related to migration and cell proliferation, promoting tissue repair and regeneration. Photobiomodulation decreases inflammatory process, increases expression of neural growth factors, stimulates schwann cell proliferation and improves faster nerve functional recovery .[27]Based on systematic review of morpho-quantitative study of the axons and nerve fibres, photobiomodulation facilitates muscular reinnervation while fastening the process of nerve regeneration.[26] A study by Lee et al tested the influence of two wavelengths (633 and 804 nm) on functional and morphological recovery after facial nerve injury and found that 633-nm laser irradiation improved cell viability under oxidative stress, stimulated schwann cells activity, intiated axonal regeneration which led to faster functional recovery of the facial nerve.[25] Despite the similarities in the facial paralysis treated across various studies, there is a wide range of differences in the methods of applying photobiomodulation. These differences include variations in wavelengths from 660 to 1064 nm, a diverse range of energy levels and energy densities, as well as variations in the duration of application. This calls for systematic approach in reporting of laser parameters based on world association for laser therapy (WALT guidelines). The findings of the studies under review must be taken into account while evaluating the

studies' shortcomings. Improvising study design, use of sham laser, and perform blinding, allocation concealment, proper randomization, proper statistical analysis and electrophysiological outcome evaluation may perhaps provide a clear conclusion of results

Conclusion: Laser photobiomodulation alone and as an adjuvant therapy with conventional treatment is a novel, safe, user friendly and non-invasive treatment modality for the management of facial nerve palsy. Lack of consistency between studies included in the review restricted the use of meta-analysis to make a conclusive statement.

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