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ORIGINAL RESEARCH ARTICLE

KABAT INTERVENTIONS INTEGRATED WITH FACIAL EXPRESSIVE AND FUNCTIONAL EXERCISES FOR BETTER AND SPEEDY RECOVERY IN BELL'S PALSY; A PRE-POST DESIGN

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ABSTRACT

Background: Bell's palsy (BP) is an acute and idiopathic paralysis of the seventh cranial nerve, which has higher incidence rate in Asian countries compared to the western world. Different contemporary physiotherapy interventions have been used in treatment of impairments and functional limitations caused due to the BP. However, traditional usual care is still in practice in context like Nepal, which has to be shifted to evidence-based treatment. Therefore, present study investigated effectiveness of Kabat intervention integrated with facial expressive and functional exercises in Bell's palsy.

Methods: This pre-post comparative study recruited eight participants of age 22 to 52 years with acute and sub-acute, unilateral, idiopathic BP by purposive sampling. A physiotherapist administered the Kabat intervention integrated with facial expressive and functional exercises for four weeks. Another physiotherapists assessed before as well as after two and four weeks of the treatment using Sunny Brook Facial Grading, House-Brackmann grading, lip-length measurement, facial disability and patients' satisfaction measures. One-way ANOVA with repeated measures was used to analyze data across three points of time.

Results: Eight participants with mean age 41.38 years (10.66) completed the study. Significant improvement with high effect sizes (0.82 – 0.95) was found on both outcome measures across the time. There was significant improvement on lip measurement as well. The participants' satisfaction level was 8.5 (±1.20)/10 with the intervention.

Conclusions: The Kabat intervention integrated with facial expressive and functional exercises demonstrated significant improvement in impairments and functional level. Large effect sizes and high level of participants' satisfaction indicated clinical relevance of the intervention.

INTRODUCTION

Bell's palsy (BP) is an acute, idiopathic, and usually unilateral paralysis of the seventh cranial nerve[1] which is a common mono-neuropathy (60 -70% of all).[2] Asian countries like Japan has higher incidence rate compared to the western world, (USA and UK).[3, 4] The lifetime risk is 1 in 60.[2] The highest incidence rate of BP is in 15 to 45 years population.[5] BP leads to partial or complete inability to voluntarily move facial muscles on the affected side of the face.[6] Synkinesis is one of the most uncomfortable sequelae that reduce the patients' quality of life.[7] Patients having facial nerve dysfunction significantly suffer from serious functional, cosmetic and psychological problems and have great impact on interpersonal communication and social interaction.[8]

Bell's palsy is typically self-limiting but at times it results into residual impairments. The synkinesis may deteriorate from 6th month after the onset without appropriate physical rehabilitation.[9] Different Physiotherapy interventions are being used in clinical practice such as Kabat rehabilitation,[10, 11] electrical stimulation[12, 13] Massage with exercises or mime therapy or just facial exercises.[14] A proprioceptive neuromuscular facilitation known as Kabat rehabilitation or Kabat concept has been widely used because of its good evidence and high patients' satisfaction level.[15] However, massage, electrical stimulation have been still used as dominating interventions in clinical practice in context like Nepal which has to be shifted to evidence–based interventions. Therefore, this study investigated effectiveness of Kabat intervention integrated with facial expressive and functional exercises in Nepalese participants.

METHODS

In this one group pretest-posttest design, eight participants were recruited using purposive sampling technique. The study was conducted among individuals with Bell's palsy. The inclusion criteria consisted of; a) unilateral idiopathic Bell's palsy (confirmed from both medical and physiotherapy diagnosis) for the first time[1] b) paresis or paralysis of forehead, eyelid, mouth and check muscles,[1] c) either gender with age: 15 to 60 years[5] and d) acute and sub-acute cases (onset duration: ≤ 2 weeks).[6] Those individuals with pregnancy, severe preeclampsia, obesity, hypertension, diabetes as well as upper respiratory tract infection[6], and who were not able to speak and understand regular conversation in Nepali language were excluded from the study. The procedure of the study is shown in **Figure 1**. The

participants were recruited from the outpatient department of Physiotherapy at Dhulikhel hospital. This hospital is a tertiary referral hospital that provides services to both rural and urban population of the surrounding districts.

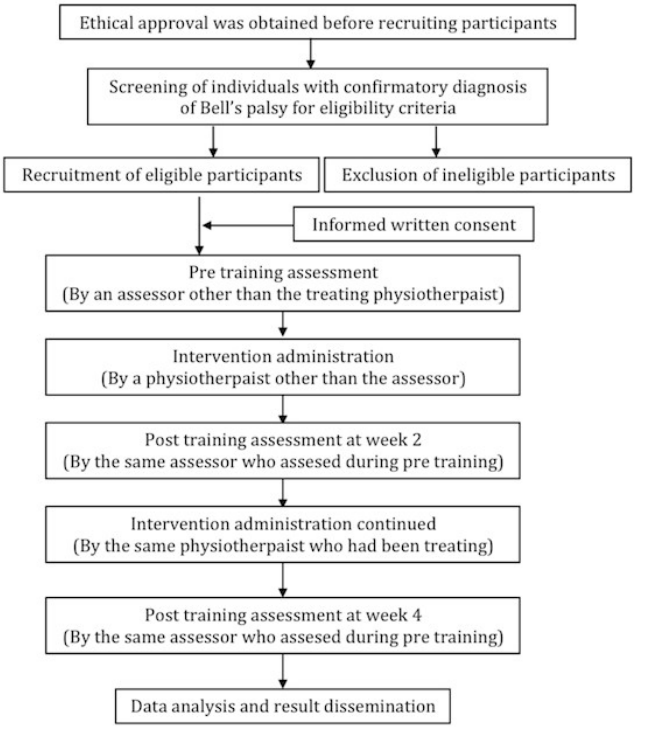

Figure 1: Flow chart of the procedure

Interventions

Kabat Intervention integrated with Facial Expressive and Functional Exercises (KI-FEFE). This intervention has already been applied in a case study.[16] Present article upgrades the evidence from the case study. The structured KI-FEFE to each individual was as follows.

Component I: Kabat intervention (Physiotherapist-administered intervention)**:** This intervention was to facilitate impaired muscles through global pattern of an entire muscle that is resisted, irradiated. The proprioceptive stimulation was applied through stretching, resistance and reciprocal inhibition with multisensory inputs. The intervening was administered based on Monini et al., 2016 and 2017, as follows[10, 11]: In upper fulcrum (forehead and eyes): The activation of frontal, corrugators and orbicularis muscles was carried out by their upward or downward traction in a vertical plane. In the intermediate fulcrum (nose): The common elevator muscle of the ala nasi and the upper lip was activated using traction movements in a vertical line. For the lower fulcrum (mimic – chewing - articulatory): Activation of risorium and orbicularis oris was carried out in horizontal plane, and that of mental muscle in vertical plane. Administration sequence: Stretching of one muscle at one fulcrum at a time followed by stretch, resistance and reciprocal inhibition induced facilitation of the weak muscle. Then, another week muscle was facilitated at another fulcrum and so on in a circuit training fashion (with the same parameters for all techniques. Patients' active involvement during Kabat intervention were; smiling without opening the mouth, then using fingers to resist the movement for 5 seconds, pursing the lips as in whistling and then applying resistance using the fingers for 5 seconds, lifting the angle of mouth, and then applying resistance using the fingers for 5 seconds, lowering the lower lip, and then applying resistance using the fingers for 5 seconds, opening the mouth wide (with the head upright) and then applying resistance using the fingers for 5 seconds, sticking the tongue upward to try to touch the tip to the nose and holding for 5 seconds, sticking the tongue downward to try to touch the tip to the chin and holding for 5 seconds. **Dose:** 3-5 repetitions/muscle for 2-3 sets on each of stretching, and stretch, resistance and reciprocal inhibition induced facilitation. Exercise: rest = 1:1 (to avoid fatigue since they are small muscles), one session per day for 30 minutes, for six days a week for four weeks

Component II: Facial expressive exercises (Physiotherapist-supervised training): Kabat intervention was followed by the facial expressive exercises. Some examples of facial expressive exercises were: Gentle eye closure/opening and forced eye closure/opening, raising eyebrows, smiling, snarling and flaring of nose, forehead wrinkling, and lips puckering/pouting.[17] Participants were trained to perform these exercises with varied amplitude and speed using a mirror for the feedback. It was ensured that the involuntary movements of other unwanted muscles were avoided. Once, participants learned appropriately, this used to be home prescription. Therapist demonstrated video was provided to the participants to carry out the exercises at home. **Dose:** 5-10 repetitions for each exercise, 3 times a day / 7 days a week for 4 weeks

Component III: Functional exercises (home prescription): Literature also termed 'mime therapy' for integrated facial expressive and functional exercises of specific muscles.[18] Some examples of functional exercises[17, 19] were; sucking cheeks between the teeth, blowing paper (different thickness at various distance), sucking water or air using straws of various diameter and length, making sustained "fff" sound and pronouncing vowels (like a, e, i, o) and consonants (like p, b). **Dose:** 5-10 repetitions for each exercise, 3 times a day/7 days a week for 4 weeks

Component IV: Education to the patient or caregiver: When edema persisted, caregivers were trained to do soft tissue manipulation (stroking, kneading along with effleurage.[17, 18] A list of tips were provided[12] to the patient to wear glasses or eye shield, to maintain oral hygiene, to prevent or minimize the occurrence of synkinesis and to adhere to the prescribed exercise. All participants were suggested to continue drug therapy as per physician's prescription.

Outcome measures

1. Sunny Brook Facial Grading System (SBFGS): The Sunnybrook facial grading system[20] takes into consideration the resting symmetry of the face and the degree of voluntary movement. It also grades synkinesis regionally. The SBFGS is a valid and reliable measure which is sensitive to changes following thera-

peutic intervention compared to House-Brackmann Scale.[21] The score varies from 0 to 100, where 0 stands for total paralysis and 100 for normal facial function. The composite score is generated as a continuous scale.[20] The house-Brachmann scale cannot be used to distinguish finer differences in facial nerve dysfunction and fails to distinguish subtle differences in facial nerve recovery which will be addressed with SBFGS.[22] Total score < 70 indicates non-recovery.[23] The SBFGS has good to excellent inter-rater reliability (0.85 – 97), excellent intra-rater reliability (0.97 – 0.99) and good correlation with House –Brackmann.[20, 21, 24]

2. House-Brackmann grading system (HBGS): The HBGS grading system is a valid tool to evaluate and quantify facial nerve functional recovery. It is recommended as the universal standard, most reliable, and easily administered outcome measure for assessing the degree of face palsy. This scale includes six grades where the grade one represents the normal and grade six represents total paralysis.[25] The HBGS has excellent inter-rater reliability (>0.80), intra-rater reliability: (0.85 - 0.86) and inter-observer reliability (0.96).[19] It has adequate correlation with Sunnybrook facial grading (0.84) and has excellent agreement (Kappa: 0.85).[19]

3. Lip-length (LL) measurements: It was measured in two ways: by pulling the corners of the mouth apart as far as possible (smiling) and by pushing the corners together (pouting). The distance from the midline of the lips (center point from the nasal septum) to the either side of the corners of the lips was measured and difference between sound and affected sides was calculated. Lower the difference better was the recovery.[26, 27]

4. Facial disability in terms of function: Facial disability was measured for four fields; eating, drinking, and speaking with reference to the facial disability index through a quantitative patient's judgment in a scale of 1 to 10 (1 = most difficult and 10 = no difficult at all) and eye closure – gentle and full eye closure (0 = incomplete and 10 = complete) in reference to the professional graded facial functional scale.[19, 28]

5. Patients' satisfaction: It was measured through visual analogue scale; VAS (0 = no satisfaction, 10 = complete satisfaction) which is a feasible and easily quantifying method.

Descriptive statistics were used to analyze demographic and clinical data. Shapiro-Wilk test, due to small sample size, was used to analyze distribution of the data. One-way ANOVA with repeated measures (time) was used to analyze the data across the time within the group. When Sphericity was not achieved during Mauchly's test ($p < 0.05$), Greenhouse-Geisser factor was applied. Multiple comparisons with Bonferroni correction were done across three points of time. Paired and unpaired t-tests were used to compare within and between groups respectively.

Ethical approval was obtained from the Kathmandu University School of Medical Sciences (KUSMS IRC: 120/19). Written informed consent was obtained from all the participants before the recruitment.

RESULTS

Eight participants with mean age 41.38 years (10.66) completed the study. As shown in **Table 1**, male and female participants were equal. Majority of participants had left sided BP (62.5%). The mean duration of onset was 6.38 days (5.18). All participants had taken medicine as per their physician's prescription (1-2 weeks, tapering dose). None of the participants received alternative treatment.

Table 1: Demographic and clinical information of the participants (n = 8)

Participants	Age(Years)	Gender	Duration since onset (days)	Side	Medicine taken	Alternative treatment
1	52	F	8	L	Yes	No
2	30	M	14	R	Yes	No
3	22	M	6	R	Yes	No
4	52	M	14	L	Yes	No
5	39	F	2	L	Yes	No
6	48	M	2	L	Yes	No
7	45	F	3	R	Yes	No
8	43	F	2	L	Yes	No
Mean (SD) / Number (%)	41.38 (10.66)	M: 4 (50%) F: 4 (50%)	6.38 (5.18)	R: 3 (37.5%) L: 5 (62.5%)	Yes: 8 (100%)	No: 8 (100%)

In the table: M: Male. F: Female, L: Left. R: Right. SD: Standard Deviation

As depicted in **Table 2**, a repeated measure ANOVA demonstrated significant improvement on all variables across three time points. The SBFGS, HBGS and all functional variables demonstrated high effect size (0.82 – 0.95). All variables related to lip length measurement demonstrated relatively low effect size (0.4 – 0.65).

As shown in **Table 3**, multiple comparisons with Bonferroni correction revealed that all variables except lip length measurement of lower lip during pout, demonstrated significant improvement from pre training to post training week 4. The SBFGS total score, HBGS, eating and drinking variables showed significant difference between all three comparisons. All functional variables demonstrated significance difference between pre training to post training week 2. There is significant correlation between SBFGS and HBGS at pre training ($r = -0.84$, $p = 0.008$), post training 1 ($r = -0.87$, $p = 0.005$) and post training 2 ($r = -0.82$, $p = 0.01$). The negative correlation indicated that when total score in SBFGS increases, the grade in HBGS decreases.

Table 2: Comparison using one-way ANOVA with repeated measures (n = 8)

Variables	Mean (SD)			F	p-value	Effect size
	Pre training	Post training 1	Post training 2			
SBFGS score	36.63 (14.73)	62.25 (20.61)	77.38 (24.34	61.50	< 0.0001*	0.89
HBGS grades	3.13 (0.84)	2.5 (0.76)	1.63 (0.74)	40.16	< 0.0001*	0.85
Right-left difference of upper lip length from midline at pout	0.71 (0.45)	0.33 (0.25)	0.08 (0.18)	10.48	0.002*	0.60
Right-left difference of lower lip length from midline at pout	1.39 (1.55)	0.30 (0.35)	0.14 (0.26)	4.63	0.03*	0.40
Right-left difference of upper lip length from midline at smile	0.63 (0.34)	0.34 (0.23)	0.09 (0.16)	12.23	0.001*	0.64
Right-left difference of lower lip length from midline at smile	0.46 (0.18)	0.28 (0.24)	0.11 (0.21)	13.09	0.001*	0.65
Eating	4.63 (0.92)	6.75 (1.17)	9.00 (1.20)	131.29	< 0.0001*	0.95
Drinking	5.00 (2.14)	7.5 (2.07)	9.13 (0.99)	50.46	< 0.0001*	0.88
Speaking	5.63 (1.19)	7.88 (1.80)	9.13 (1.13)	32.03	< 0.0001*	0.82
Gentle eye closure	4.13 (0.64)	7.13 (1.25)	9.12 (1.13)	38.00	< 0.0001*	0.84
Effortful eye closure	5.25 (1.49)	8.00 (1.31)	9.50 (0.76)	38.07	< 0.0001*	0.85

In the table: SD: Standard Deviation, * indicates significant at p < 0.05, ANOVA: Analysis of Variance, N: total sample size, HBGS: House-Brackmann grading system, SBFGS: Sunny Brook Facial Grading System

Table 3: Multiple comparisons between three points of time with Bonferroni adjustment (n = 8)

Variables	p-value		
	Post training 1 – Pre training	Post- training 2 – Pre training	Post training 2 – Post training 1
SBFGS score	0.001*	< 0.0001*	0.003*
HBGS grades	0.03*	< 0.0001*	0.001*
Right-left difference of upper lip length from midline at pout	0.12	0.02*	0.08
Right-left difference of lower lip length from midline at pout	0.23	0.18	0.18
Right-left difference of upper lip length from midline at smile	0.06	0.02*	0.05
Right-left difference of lower lip length from midline at smile	0.11	0.002*	0.18
Eating	< 0.0001*	< 0.0001*	< 0.0001*
Drinking	< 0.0001*	< 0.0001*	0.04*
Speaking	0.005*	< 0.0001*	0.16
Gentle eye closure	0.002*	< 0.0001*	0.06
Effortful eye closure	< 0.0001*	< 0.0001*	0.08

In the table: * indicates significant at p < 0.05, N: total sample size, HBGS: House-Brackmann grading system, SBFGS: Sunny Brook Facial Grading System

The satisfaction level, when measured in VAS, was fair (5.63 ± 2.88) and very high (8.5 ± 1.20) at post training week 2 and post training week 4 respectively with the treatment. There was significant difference (mean difference: 2.88 ± 2.03, p = 0.005) between post training week 2 and week 4 in satisfaction level which is shown in **Figure 2**.

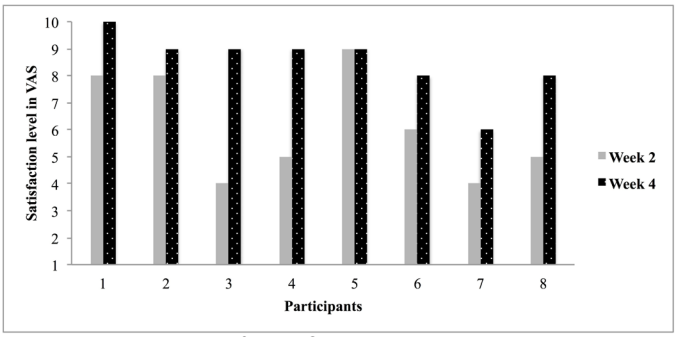

Figure 2: Participants' satisfaction level with treatment and its outcome

DISCUSSION

The significant changes and high effect size achieved with the intervention in the present study indicated that KI-FE-FE promoted muscle reeducation, improved impairments and enhanced quality of the facial functions. Participants demonstrated high level of satisfaction with the treatment.

The participants in present study were heterogenous in terms of gender, age and side involved. The clinic-demographic characteristics of the participants were comparable with the participants of other studies.[12, 18, 29]

The improvement in the SBFGS and HBGS indicated that the KI-FEFE was effective and the result was clinically relevant. The raw data showed improvement in all domains (resting symmetry, voluntary movement and synkinesis). Lip-length measurement demonstrated recovery in both upper and lower lips specific to the muscles or group of muscles responsible for specific functions. Similarly, there was significant improvement in drinking, speaking, eating, as well as eyes closure. The high effect size in the SBFGS and HBGS as well as functional domains (> 0.8)[18] indicated that the intervention of present study yielded improvement in functional as well as impairment level. We can argue that the improvement achieved was due to therapeutic effect rather than spontaneous recovery because it takes 3-5

months to show the detectable improvement through spontaneous recovery.[5]

The improvement was found during first two weeks as well as 2nd two weeks, which could be due to the integration of functional exercises within the intervention. This was consistence with the findings from a study by Monini et al.,[11] and Barbara et al.,[29] who demonstrated better and speedy recovery with two weeks of rehabilitation. Initiating physiotherapy intervention during acute and sub-acute phase and administering intensive physiotherapy interventions during first 4 weeks after onset of BP was thus important and this period could be considered as golden period for faster and speed recovery and prevent residual impairments in BP. The FEFE components integrated with KI in present study might have further enhanced the outcome in comparison with the Kabat rehabilitation alone.[29]

None of the participants in present study complained adverse effect or discomfort with the intervention. Thus, with the support of the evidence,[29] it could be concluded that KI-FEFE was safe and feasible in acute and sub-acute stages of BP. Participants demonstrated good satisfaction in terms of intervention at second week, which was significantly increased at fourth week. This could be a first study to show patients' satisfaction with the KI-FEFE.

This study demonstrated good positive outcome of KI-FEFE. Now further studies are warranted to compare the effectiveness of the KI-FEFE intervention with other conventional and electrical stimulation to establish an effective intervention that is evidence-based and is pain free. The use of the conventional electrical stimulation now can be a question mark to use in the early stages of BP due to not only being painful for the participants, but also interfering with neural regeneration, mass action that reinforce abnormal motor pattern.[11, 30] The KI-FEFE could be an intervention of choice to overcome such issues that come with conventional interventions.

All participants in this study had taken medicines as per physician's prescription. The corticosteroids reduce inflammatory processes in BP.[30] This might have facilitated re-myelination of the facial nerve and thus the drugs might have enhances recovery while combining with physiotherapy intervention in this study.[11, 30] We claim that the combination yielded the outcome because Barbara et al found no signs of clinical recovery after 2 weeks of exclusive medical treatment alone.[29]

The strength in this study was the formulation of evidence–based physiotherapy intervention. All components that had significant evidence[11, 18, 26, 30] were integrated to develop a structured intervention. This could be the first study to demonstrate patients' satisfaction level in treatment of BP. This study also highlighted the component that has to be administered by the therapist, the component that has to be performed by the participants under therapist's close supervision and the component for home prescription. Small sample size and lack of a comparable control group are major limitations of this study. Large-scale studies would be necessary to establish the findings.

CONCLUSION

The Kabat intervention integrated with facial expressive and functional exercises demonstrated significant improvement in impairment and functional level in BP. The effect sizes achieved were large and therefore the result is clinically relevant. The satisfaction level of the participants with the intervention was very high. Therefore, this intervention is effective, feasible and safe in acute as well as sub-acute stages of BP. However, large scaled studies with comparable control group and longer follow-ups are recommended.

CONFLICT OF INTEREST: None

FINANCIAL DISCLOSURE: None

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