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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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OBSERVATION ON THE CURATIVE EFFECT OF FACIAL PNF TECHNOLOGY COMBINED WITH MIRROR THERAPY IN THE TREATMENT OF PERIPHERAL FACIAL PARALYSIS

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Abstract.

Objective: This study aimed to evaluate the clinical efficacy and safety of facial proprioceptive neuromuscular facilitation (PNF) combined with mirror therapy (MT) in the treatment of acute peripheral facial paralysis (PFP).

Methods: A single-center, randomized controlled trial (RCT) was conducted between December 2022 and June 2024 at Ziyang Central Hospital. A total of 34 patients with acute PFP (disease duration ≤7 days) were randomly assigned to the experimental group (n=17) or the control group (n=17) in a 1:1 ratio. Both groups received standardized conventional treatment (pharmacotherapy + acupuncture + intermediate-frequency pulse electrical stimulation + ultrashort wave therapy) and facial PNF training. The key of drug treatment is to use intravenous dexamethasone 10 mg as early as possible, once a day, and gradually reduce the dose after 5 days of continuous use, and then stop the drug, with a total course of 10 days. Additionally, the experimental group underwent mirror therapy synchronously. The primary outcome was the Facial Clinimetric Evaluation (FaCE) scale score at 4 weeks post-treatment. Secondary outcomes included House-Brackmann (HB) grading (assessed at baseline, 2 weeks, 4 weeks, and full recovery) and Clinical Recovery Time.

Results: Baseline characteristics were well-balanced between the two groups (all P>0.05). At 4 weeks, the median (IQR) FaCE score in the experimental group [67 (62, 71)] was significantly higher than that in the control group [39 (30, 47)] (W=249.50, P<0.001). The experimental group also achieved a significantly shorter mean ± SD Clinical Recovery Time (32±8 days vs. 47±8 days, t=-5.19, P<0.001) and a higher proportion of HB Grade I (normal function) at 4 weeks (52.94% vs. 5.88%, P=0.015) compared with the control group. At full recovery, the experimental group maintained a higher FaCE score (P=0.015) and a trend toward more patients achieving HB Grade I (64.71% vs. 35.29%, P=0.086). No adverse events were reported in either group.

Conclusion: Facial PNF combined with mirror therapy significantly improves facial function, shortens recovery time, and exhibits good safety in patients with acute PFP, making it a promising rehabilitation strategy.

Key words. Peripheral facial paralysis, proprioceptive neuromuscular facilitation, mirror therapy, rehabilitation, randomized controlled trial.

Introduction.

Peripheral facial paralysis (PFP), also known as idiopathic facial paralysis or Bell's palsy, arises from facial nerve edema and mechanical compression due to nonspecific inflammation within the stylomastoid foramen [1], causing paralysis of facial expression muscles innervated by the nerve. While most prevalent in adults aged 30–45 years, it can occur across all age groups [2]. Epidemiological data show a global annual incidence of 5–50 cases per 100,000 population [3], with risk factors including diabetes, pregnancy, hypertension, immunosuppression, influenza, and other upper respiratory tract infections [4]. Despite optimal initial management, up to 30% of patients fail to regain full facial nerve function [5], indicating unmet therapeutic needs. As the primary basis for social recognition and emotional expression, facial motor dysfunction leads to functional deficits (e.g., incomplete eyelid closure, drooling, dysphagia) and impaired social participation [6], severely affecting mental health and activities of daily living.

Core treatment goals for PFP include early resolution of local inflammation/edema, corneal/conjunctival protection, and facial nerve function restoration [7]. Rehabilitation plays a pivotal role: traditional acupuncture [8] modulates local qi-blood circulation, dispels wind, unblocks collaterals, and enhances perineural perfusion; physical modalities (e.g., infrared radiation, ultrashort wave diathermy) [9] alleviate nerve edema and promote repair; and combining neuromuscular electrical stimulation with shortwave diathermy improves muscle strength, prevents atrophy/synkinesis, and restores facial symmetry in chronic cases [10]. Facial functional training and exercise therapy—key components of rehabilitation—enhance facial blood circulation, muscle strength, and motor function [11,12]. Proprioceptive Neuromuscular Facilitation (PNF), whose safety and efficacy for application in the acute phase have been verified, is a primary movement therapy for PFP, and the combination of PNF with standardized electrical stimulation is an intervention that can significantly reduce the incidence of synkinesis [13]. Mirror therapy (MT)—initially used for stroke-related hemiplegia and phantom limb pain [14]—promotes nerve recovery via action observation or motor imagery, with proven efficacy in peripheral nerve injuries [15]. Thus, this study combined facial PNF with MT to evaluate a more effective rehabilitation strategy for PFP.

Methods.

Study design: This was a single-center, randomized controlled trial (RCT) conducted at Ziyang Central Hospital (West China Hospital of Sichuan University-Ziyang Hospital) between December 2022 and June 2024. The study was approved by the hospital's Ethics Committee and adhered to the ethical principles of the Declaration of Helsinki for research involving human participants. All eligible patients provided written informed consent prior to enrollment.

Participants:

Patients with acute PFP were recruited from the Departments of Rehabilitation Medicine and Neurology of Ziyang Central Hospital. Key enrollment criteria included: (1) confirmation of PFP diagnosis in accordance with established guidelines [16]; (2) first episode of unilateral PFP; (3) disease duration ≤7 days; (4) good compliance with treatment and follow-up; and (5) voluntary signing of the informed consent form.

Exclusion criteria were: (1) PFP secondary to central facial palsy, nerve injury, tumors, or other underlying diseases; (2) history of mental illness, alcohol dependence, or drug dependence; (3) pregnancy or lactation; (4) high myopia; and (5) poor compliance precluding completion of the study protocol.

Sample Size Calculation:

Sample size was estimated using PASS statistical software, with parameters strictly grounded in evidence from a published clinical study focusing on rehabilitation outcomes in patients with Bell's palsy (peripheral facial paralysis, PFP) [Prem Kumar BN, Hitha Sherin U. Comparative Study on Effect of Proprioceptive Neuromuscular Facilitation and Facial Motor Imagery Techniques on Bell's Palsy. RGUHS Journal of Physiotherapy. 2022;2 (1):0-0. doi:10.26463/rjpt.2_1_3]. This cited study adopted the Facial Clinimetric Evaluation (FaCE) scale as the core outcome measure—consistent with the primary endpoint of our research—and reported FaCE score improvements in two parallel intervention groups. Based on the standard deviation (SD) range of FaCE score changes provided in this study, a pooled SD of 8.5 was calculated for sample size estimation. To ensure the detection of a clinically meaningful treatment effect, we predefined a between-group difference in FaCE scores that aligns with the minimal improvement perceived as functionally relevant for PFP patients in clinical practice [1]. Additionally, we set a statistical power of 0.9, a significance level (α) of 0.05, and accounted for a 15% non-response rate to address potential follow-up loss in real-world clinical settings. The final estimation indicated that 17 participants per group were required to achieve sufficient statistical power. Thus, a total of 34 patients were enrolled in the study to meet the methodological requirements of the randomized controlled trial.

Randomization and Group Allocation:

Eligible patients were randomly assigned to the control group or the experimental group in a 1:1 ratio using a random number table. Randomization was performed by an independent researcher not involved in patient recruitment or outcome assessment to ensure allocation concealment.

Interventions:

Both groups received standardized conventional treatment, including pharmacotherapy and conventional rehabilitation, with identical protocols to ensure baseline intervention consistency between groups. The key of drug treatment is to use intravenous dexamethasone 10 mg as early as possible, once a day, and gradually reduce the dose after 5 days of continuous use, and then stop the drug, with a total course of 10 days.

Pharmacological therapy [17]: Corticosteroids: Administered as prednisolone at an initial dose of 60 mg/day (prednisolone equivalent) for the first 5 days, followed by a tapering schedule: 40 mg/day on day 6–7, 20 mg/day on day 8–9, and 10 mg/day on day 10–11, with complete discontinuation on day 12. This regimen was standardized for all eligible patients to reduce facial nerve edema and stabilize cell membranes/nerve sheaths. Antiviral therapy: Acyclovir (800 mg, five times daily for 7 days) was prescribed for patients with suspected neurotropic virus infection (e.g., herpes simplex virus). Neurotrophic support: Vitamin B1 (10 mg, three times daily) and methylcobalamin (500 μg, three times daily) were administered throughout the treatment course. Ocular protection: Tobramycin eye drops (one drop, four times daily) and erythromycin ointment (applied before bedtime) were provided for patients with incomplete eyelid closure to prevent exposure keratitis.

Conventional rehabilitation [18-20]: Acupuncture, intermediate-frequency pulse electrical stimulation, and ultrashort wave therapy were administered in accordance with clinical practice guidelines for PFP:

Acupuncture: 30 minutes per session, targeting acupoints including Yangbai (GB14), Sibai (ST2), Dicang (ST4), Jiache (ST6), and Hegu (LI4), performed once daily. Intermediate-frequency pulse electrical stimulation: Applied to facial paralysis-affected muscles with a frequency of 2–10 kHz, intensity adjusted to patient tolerance (avoiding facial spasm), 20 minutes per session, once daily. Ultrashort wave therapy: Wavelength of 11 cm, output power of 40–60 W, non-contact application over the parotid gland region, 15 minutes per session, once daily.

Additional facial function training was provided as follows:

Control group: Facial PNF training alone. Patients were placed in a supine position with the head slightly elevated (30°). Therapists used standardized verbal cues to guide resistance training for all facial expression muscles (frontalis, corrugator supercilii, orbicularis oculi, levator palpebrae superioris, depressor glabellae, zygomaticus major, orbicularis oris, levator labii superioris, depressor labii inferioris, mentalis, levator anguli oris, depressor anguli oris, triangularis, buccinator, temporalis, and masseter). For each muscle group, the training followed a "contract–relax" cycle: 3 seconds of active muscle contraction against manual resistance (applied by the therapist at the muscle insertion site), 2 seconds of relaxation, and 1 second of rest, with 3 sets of 10 repetitions per muscle group. The total duration of PNF training was 30 minutes per session, once daily.

Experimental group: Facial PNF training combined with synchronous mirror therapy. The PNF training protocol (muscle

groups targeted, contraction–relax cycle, resistance application, and duration) was identical to the control group. Mirror therapy was integrated synchronously as follows: A 15 cm × 21 cm flat mirror was positioned vertically 25–35 cm above the patient's face, aligned such that the patient's unaffected side was reflected in the mirror (covering the visual field of the affected side). Prior to training, the therapist instructed the patient to focus on the mirror reflection of the unaffected side, mentally associating the observed movements with the intended contraction of the affected side (sensory-motor integration guidance). During PNF resistance training: For each muscle group, the patient first observed the unaffected side's movement in the mirror (e.g., raising the eyebrow with the unaffected frontalis), then attempted to replicate the movement with the affected side while the therapist applied manual resistance to the affected muscle. The therapist provided real-time verbal feedback to align the affected side's movement with the mirror reflection (e.g., "Adjust the affected eyebrow to match the height of the reflected unaffected eyebrow"). The synchronous combination of PNF resistance training and mirror visual feedback was maintained throughout the 30-minute session, with the therapist ensuring consistent resistance intensity and mirror alignment.

All interventions were performed by two certified rehabilitation therapists with ≥5 years of experience in PFP management, who received standardized training on the study protocols to minimize inter-operator variability.

Outcome Measures:

Outcome assessments were conducted by trained researchers blinded to group allocation at baseline, 2 weeks, 4 weeks, and at the time of full recovery.

Primary outcome: FaCE scale [21], a PFP-specific quality-of-life instrument assessing facial movement, sensation, oral function, eye sensation, tear secretion, and social function. Evaluations were performed at baseline and 4 weeks.

Secondary outcomes: House-Brackmann (HB) grading scale [22], a validated tool for facial nerve function assessment (Grades I–VI, with Grade I indicating normal function and Grade VI severe paralysis). Assessments were conducted at baseline, 2 weeks, 4 weeks, and full recovery.

Clinical Recovery Time: clinical recovery is defined as achieving HB Grade I (complete recovery) or Grade II (significant functional improvement), where HB Grade II is characterized by "mild facial asymmetry only during maximal effort, no functional deficits (e.g., complete eyelid closure, no drooling, normal swallowing), and restoration of daily living and social participation capacity". (De Almeida J.R., Guyatt G.H., Sud S., et al. Management of Bell Palsy: Clinical Practice Guideline. Cmaj. 2014;186:917-922).

Statistical Analysis:

The analysis included measures such as mean (standard deviation) for normally distributed variables and median (IQR) for non-normally distributed variables for continuous variables, and frequencies and percentages for categorical variables. Normality tests and QQ plots were used to assess the distribution of the data, and appropriate descriptive statistics methods were applied to both normally and non-normally distributed variables. Group comparisons for continuous variables with normal distribution were performed using Welch's t-test or ANOVA, and non-normally distributed variables were compared using the Wilcoxon rank-sum test or Kruskal-Wallis test. For comparison between groups of categorical data, we used the Fisher exact test for expected frequencies <5; otherwise, we used the Chi-squared test.

Results.

Baseline Characteristics:

A total of 34 patients with acute peripheral facial paralysis were enrolled between December 2022 and June 2024, and randomly assigned to the experimental group (n=17) or control group (n=17). All participants completed the full course of treatment and follow-up without dropout. Baseline characteristics were well-balanced between the two groups, with no statistically significant differences (all P>0.05; Table 1). Briefly: the proportion of males was 52.94% in the experimental group and 35.29% in the control group (χ^2=1.07, P=0.300); the mean age was 48±14 years and 47±18 years, respectively (t=0.10, P=0.923); the median (IQR) baseline FaCE score was 21.0 (17.0, 24.0) and 18.0 (18.0, 20.0) (W=174.00, P=0.314); and the distribution of baseline House-Brackmann (HB) grades (IV, V, VI) was comparable between groups (P=0.800) (Table 1).

FaCE Scale Scores:

At baseline, there was no significant difference in FaCE scores between the two groups (P=0.314). After 4 weeks of treatment, the median (IQR) FaCE score in the experimental group significantly improved to 67 (62, 71), which was substantially higher than that in the control group [39 (30, 47)] (W=249.50, P<0.001). At the time of full recovery, the experimental group maintained a higher median (IQR) FaCE score [71.0 (67.0, 74.0)] compared with the control group [66.0 (61.0, 68.0)], and the difference remained statistically significant (W=215.50, P=0.015); (Table 2 and Figure 1).

Clinical Recovery Time:

The mean ± SD Clinical Recovery Time was significantly shorter in the experimental group (32±8 days) than in the control group (47±8 days) (t=-5.19, P<0.001), indicating a faster recovery in the combined intervention group (Table 2 and Figure 1).

House-Brackmann (HB) Grading:

Baseline HB grade distribution was similar between groups (P=0.800). At the 2-week follow-up, no statistically significant difference in overall grade distribution was observed (P=0.159); however, a higher proportion of patients in the experimental group achieved HB Grade II (29.41% vs. 11.76%) and Grade III (35.29% vs. 17.65%), while 17.65% of the control group remained at Grade V (vs. 0% in the experimental group). By 4 weeks, the between-group difference in HB grade distribution became statistically significant (P=0.015): 52.94% of the experimental group achieved Grade I (normal function), compared with only 5.88% in the control group. At full recovery, 64.71% of the experimental group and 35.29% of the control group had recovered to Grade I, with the difference approaching but not reaching statistical significance (χ^2=2.94, P=0.086) (Table 3 and Figure 2).

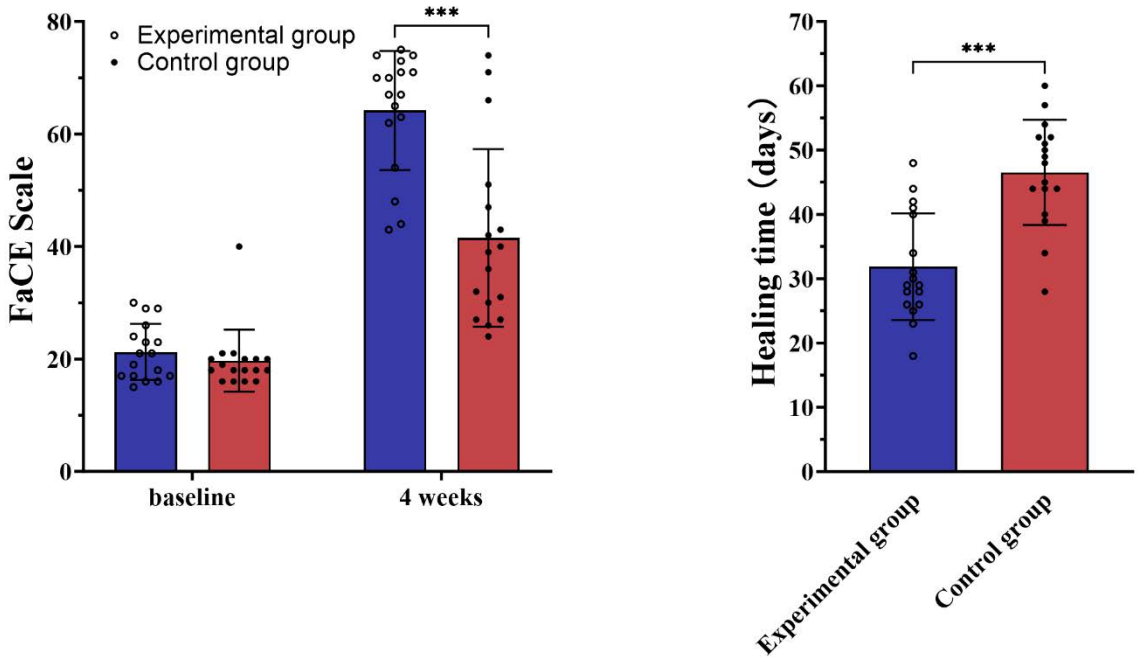

Figure 1. *Patient FaCE and Clinical Recovery Time graph before and after treatment.*

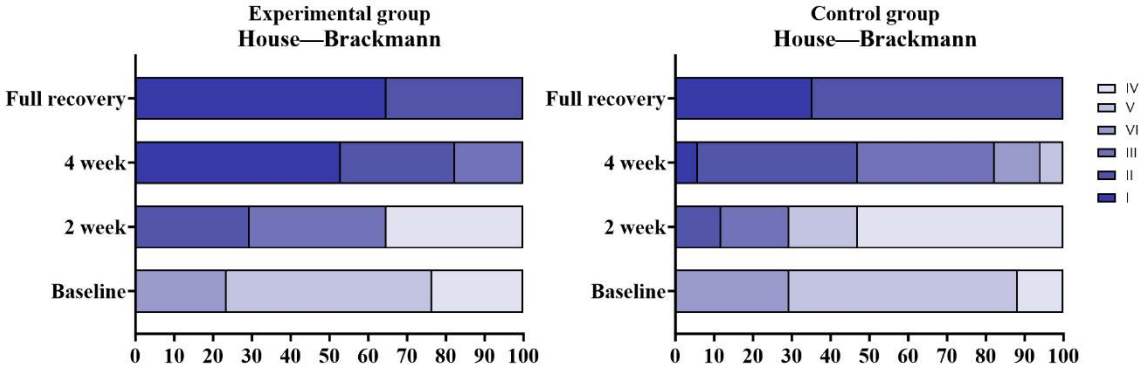

Figure 2. *Patient House - Brackmann's cumulative graph before and after treatment.*

Table 1. *Patient demographics and baseline characteristics.*

Characteristic	**Experimental group N = 17**	**Control group N = 17**	**Statistic**	**p-value**
Gender, n (%)			$\chi^2 = 1.07$	0.300[1]
male	9 (52.94%)	6 (35.29%)		
female	8 (47.06%)	11 (64.71%)		
Years, Mean ± SD	48 ± 14	47 ± 18	t = 0.10	0.923[2]
FaCE, Median (Q1, Q3)	21.0 (17.0, 24.0)	18.0 (18.0, 20.0)	W = 174.00	0.314[3]
House—Brackmann, n (%)				0.800[4]
VI	4 (23.53%)	5 (29.41%)		
V	9 (52.94%)	10 (58.82%)		
IV	4 (23.53%)	2 (11.76%)		
[1]Pearson's Chi-squared test				
[2]Welch Two Sample t-test				
[3]Wilcoxon rank sum test				
[4]Fisher's exact test				

Table 2. *Patient FaCE Changes Before and After Treatment.*

Characteristic	Experimental group N = 17	Control group N = 17	Statistic	p-value
FaCE baseline, Median (Q1, Q3)	21.0 (17.0, 24.0)	18.0 (18.0, 20.0)	W = 174.00	0.314[1]
FaCE at 4 weeks, Median (Q1, Q3)	67 (62, 71)	39 (30, 47)	W = 249.50	<0.001[1]
FaCE at full recovery, Median (Q1, Q3)	71.0 (67.0, 74.0)	66.0 (61.0, 68.0)	W = 215.50	0.015[1]
Clinical Recovery Time (days), Mean ± SD	32 ± 8	47 ± 8	t = -5.19	<0.001[2]
[1]Wilcoxon rank sum test				
[2]Welch Two Sample t-test				

Table 3. *Patient House - Brackmann Changes Before and After Treatment.*

Characteristic	Experimental group N = 17	Control group N = 17	Statistic	p-value
House—Brackmann baseline, n (%)				0.800[1]
VI	4 (23.53%)	5 (29.41%)		
V	9 (52.94%)	10 (58.82%)		
IV	4 (23.53%)	2 (11.76%)		
House—Brackmann at 2 weeks, n (%)				0.159[1]
II	5 (29.41%)	2 (11.76%)		
III	6 (35.29%)	3 (17.65%)		
V	0 (0.00%)	3 (17.65%)		
IV	6 (35.29%)	9 (52.94%)		
House—Brackmann at 4 weeks, n (%)				0.015[1]
I	9 (52.94%)	1 (5.88%)		
II	5 (29.41%)	7 (41.18%)		
III	3 (17.65%)	6 (35.29%)		
IV	0 (0.00%)	2 (11.76%)		
V	0 (0.00%)	1 (5.88%)		
House—Brackmann at full recovery, n (%)			$\chi^2 = 2.94$	0.086[2]
I	11 (64.71%)	6 (35.29%)		
II	6 (35.29%)	11 (64.71%)		
[1]Fisher's exact test				
[2]Pearson's Chi-squared test				

Safety:

No adverse events were reported in either group during the entire treatment and follow-up period, confirming the safety of both intervention regimens.

Discussion.

Most PFP patients have a favourable prognosis with active medical management, but some develop sequelae that impair mental health, social functioning, and quality of life [23]. Traditional rehabilitation (e.g., physical therapy, acupuncture) is insufficient for rapid, optimal recovery, highlighting the need for novel strategies to improve outcomes. Herein, we combined facial PNF with MT and assessed its efficacy in PFP rehabilitation, finding significant therapeutic benefits that offer a novel approach to modern rehabilitation.

PNF [24] stimulates proprioceptors to enhance neuromuscular responses and muscle contraction, while regulating sensory nerve excitability to normalize muscle tension and movement patterns. It has been shown to improve trunk control and balance in stroke hemiplegia [25], and efficacy in movement disorders associated with osteoarthropathy, soft tissue injuries, and cerebral palsy [26,27]. Consistent with prior research, PNF effectively promoted PFP recovery in our study, accelerating rehabilitation and shortening treatment duration. A systematic review further confirmed that early PNF improves quality of life, facial movement, and compound muscle action potential (CMAP), while reducing complication rates [13].

MT [28] (mirror visual feedback therapy) is grounded in mirror neuron theory—neurons that map others' actions, emotions, and intentions in the observer's brain. Increasingly used for peripheral nerve injuries, MT reduces visual-motor mismatch in PFP and preserves cortical facial movement patterns [15]. Martineau et al. [29] developed a modified MT protocol that improved facial symmetry in early severe idiopathic PFP. In our study, combining MT with PNF significantly enhanced facial nerve function, shortened Clinical Recovery Time, and achieved superior outcomes. The control group received only PNF plus conventional rehabilitation. Although this regimen improved facial muscle contraction coordination and strength, its efficacy was inferior to that of the experimental group. The core reason for this difference lies in the absence of the central regulatory effect of MT: MT activates the mirror neuron system, and through visual feedback of symmetric movements from the unaffected side, it precisely regulates motor cortex remodelling of the affected side, thereby accelerating the recovery of patients' facial nerve function. Notably, one control group patient achieved early clinical cure (FaCE score: 74) on day 28, attributed to individual differences and a more favourable baseline condition [30].

This study has certain limitations. First, the efficacy evaluation primarily focused on the short-term recovery of facial nerve function, but pathological synkinesis was not incorporated as a long-term prognostic indicator. The relatively short follow-up duration also precluded a comprehensive assessment of the impact of acute-phase interventions on the long-term risk of synkinesis. In subsequent studies, we will extend the follow-up period to 3–6 months and include pathological synkinesis as an assessment indicator to further verify the long-term efficacy and safety of the intervention. Additionally, the small sample size restricts generalizability, and larger-scale trials are needed. Incorporating objective indicators (e.g., electromyography) in future research will further strengthen the reliability of efficacy assessments.

Conclusion.

In conclusion, combining facial PNF with MT effectively promotes facial nerve function recovery and shortens Clinical Recovery Time in PFP. This combination represents a promising novel approach for modern PFP rehabilitation.

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