INTEGRATED CLINICAL-NEUROPHYSIOLOGICAL AND DIGITAL MODEL FOR PERSONALIZED MANAGEMENT OF FACIAL NERVE NEUROPATHY

Haydarov Nodirjon Kadirovich
DSc, Professor of the "Neurology and folk medicine" department of Tashkent State Medical university
Aripova Maftuna Khurramovna
PhD, Associate Professor of the "Neurology and folk medicine" department of Tashkent State Medical university
Yokubova Fotima Zokir kizi., Abdurazzokova Shakhlo Ilkhom kizi
first-year resident of the "Neurology and folk medicine" department of Tashkent State Medical university

Annotation. Peripheral facial nerve palsy affects up to 40 per 100,000 people annually, with 15–20% developing long-term functional and psychosocial sequelae. Conventional management relies on subjective scales such as House-Brackmann at isolated time points, limiting detection of early reinnervation and coordination of stage-specific rehabilitation. This review substantiates a time-integrated, personalized framework combining etiological diagnosis, neurophysiological monitoring, quantitative computer-vision kinematics, and patient-reported outcomes. Biomedical databases were analyzed, prioritizing guidelines, systematic reviews, cohort studies, and trials on electrodiagnosis, automated facial movement recognition, targeted rehabilitation, and quality of life. ENMG showed optimal prognostic value between Day 3 and Week 3; early R1 response in blink reflex increased complete recovery from 57.6% to 85.0% and accelerated recovery 2.21-fold. Automated 2D/3D analysis reflected clinical dynamics in 85% of paired observations but requires local validation. For severe axonotmesis, physical therapy plus botulinum toxin A improved favorable

outcomes to 80% versus 45% with exercise alone (p = 0.023). Standardized scales and ENMG are used in only 28.5% and 38.4% of practices, respectively. Personalized care should shift from single-point grading to a dynamic protocol aligning ENMG, digital movement tracking, eye protection, and targeted botulinum toxin when synkinesis emerges. Prospective regional validation is needed to improve recovery and quality of life.

Keywords: Facial nerve palsy, Bell's palsy, electroneuromyography, blink reflex, synkinesis, quantitative facial analysis, personalized medicine, rehabilitation.

INTRODUCTION

Peripheral facial nerve palsy affects up to 40 per 100,000 individuals annually, leaving 15–20% of patients with long-term functional and psychosocial sequelae, including synkinesis, contractures, and severe social anxiety. Conventional management heavily relies on subjective clinical scales (e.g., House-Brackmann) applied at isolated time points, failing to capture subtle kinetic trajectories or detect early reinnervation patterns. Furthermore, there is a disconnect between acute pharmacological intervention and long-term stage-specific rehabilitation. This review aims to substantiate a time-integrated, personalized framework combining etiological identification, neurophysiological monitoring, quantitative computer-vision kinematics, and patient-reported functional outcomes.

MATERIALS AND METHODS

A structured analysis of biomedical databases (PubMed/MEDLINE, Cochrane Library, Russian Science Citation Index, Scientific Electronic Library, and open archives of medical journals in Uzbekistan) was conducted. Selection criteria prioritized clinical practice guidelines, systematic reviews, observational cohort studies, and trials focusing on electrodiagnosis, automated facial movement recognition, targeted rehabilitation, and quality-of-life assessment. Data were synthesized to map physiological milestones against clinical decision-making.

RESULTS

Electroneuromyography (ENMG) exhibits optimal prognostic validity between Day 3 and the end of Week 3 post-onset. In a cohort of 796 patients, the early presence of the R1 response in blink reflex testing increased the probability of achieving complete recovery (House-Brackmann Grade I) from 57.6% to 85.0% ($p < 0.05$) and accelerated recovery rates by 2.21-fold. Needle EMG and blink reflex testing provided critical prognostic value at later stages.

Automated 2D/3D video/photographic analysis reflected clinical dynamics in 85% of paired observations, offering high sensitivity to micro-movements. However, algorithms are vulnerable to bilateral immobility and require strict external validation on local populations to avoid misinterpreting symmetric weakness as full recovery.

Stage-specific rehabilitation proved essential. For severe axonotmesis (>90% M-response amplitude reduction across multiple branches), combining tailored physical therapy with targeted botulinum toxin type A administration improved favorable outcomes to 80%, compared to 45% with exercise alone ($p = 0.023$).

Surveys reveal that standardized grading scales and diagnostic ENMG are routinely utilized in only 28.5% and 38.4% of clinical practices, respectively. Regional studies in Uzbekistan confirm distinct age- and etiology-dependent phenotypes (vascular, otogenic, idiopathic), highlighting a lack of multi-center prospective studies incorporating digital kinesiology.

CONCLUSION

Personalized management of facial nerve neuropathy must transition from single-point subjective grading to a dynamic, synchronized clinical protocol. Optimal care requires aligning the timeline of nerve degeneration and reinnervation with serial ENMG, quantitative digital movement tracking, early eye protection, and targeted chemo-denervation (botulinum toxin) when synkinesis emerges. Prospective validation

of this integrated model in regional healthcare settings represents a crucial step toward optimizing functional recovery and patient quality of life.