Precision Rehabilitation of Facial Palsy with Artificial Intelligence Assisted Virtual Reality and EMG: A Case series

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INTRODUCTION

Facial palsy (FP) is a neurological condition that can affect patients of all ages and can significantly impact their quality of life. While many patients recover from facial palsy, some may have persistent problems with their facial movements, leading to emotional and social difficulties. Current rehabilitation approaches for facial palsy are limited in their effectiveness, and there is a need for innovative and personalized interventions that can address individual patient needs. In this study, we aimed to investigate the provision of precision rehabilitation for facial palsy by utilizing an Artificial Intelligence (AI) controlled immersive VR system with EMG analysis in the evaluation and rehabilitation of facial palsy patients.

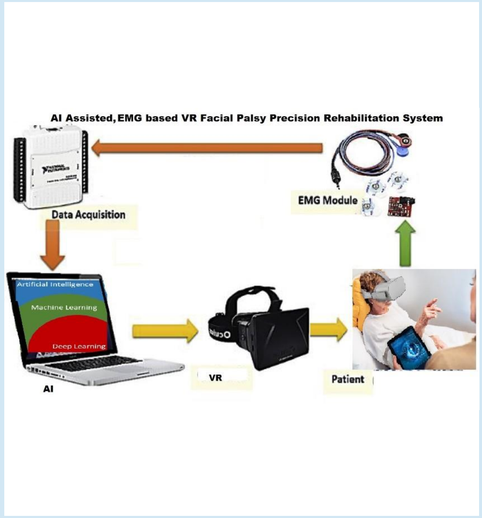
METHODS

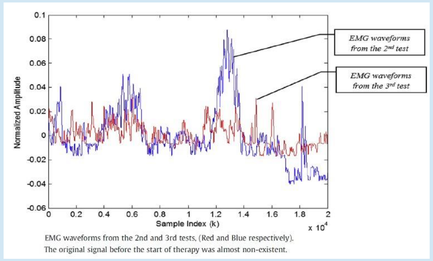
We conducted a case series study involving 3 patients aged 25, 28, and 36 years, all diagnosed with facial palsy but recovered their acute difficulties. The patients were enrolled in a 10-day exercise program (Days 2-11) utilizing an immersive AI controlled VR device. The exercise program was designed and progressed based on EMG findings, utilizing AI algorithms for automated modification of the program. The VR system propagated virtually animated white balls generated and controlled by the AI based on the inputs received from the EMG analysis. The EMG patterns corresponding to the facial upper quadrant were taken as a outcome measures at baseline, post-intervention, and at follow-up.

The Facial Clinimetric Evaluation (FaCE) scale was used as the Patient-reported outcome measures. FaCE is an FP-related self-assessment questionnaire comprising 15 questions that evaluates the intensity and frequency of physical and psychosocial impairments in 6 domains of facial function: facial movement, facial comfort, eye comfort, oral function, lacrimal control and social function. Transformed total and domain scores are calculated on a scale that ranges from 0 (worst) to 100 (best).

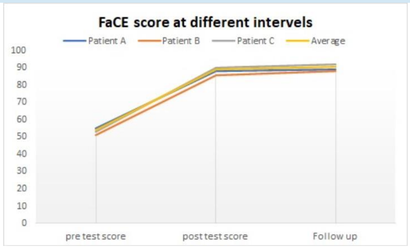
RESULTS

All three patients showed significant improvements in facial muscle activation, as demonstrated by the EMG recordings. The FaCE scale also showed significant improvements in the emotional expression and quality of life. The AI-assisted exercise design using VR combined with EMG may offer promising a and cost-effective approach to facial palsy rehabilitation, offering personalized and remotely controlled treatment. Furthermore, the AI-assisted approach enabled precise and objective evaluation and progression of the exercise program, based on the EMG findings, making it a precision rehabilitation approach.





EMG waveforms from the 2nd and 3rd tests, (Red and Blue respectively).
The original signal before the start of therapy was almost non-existent.



The FaCE scale score analysis showed a significant improvement in facial function, with the average FaCE score increasing from 54 (indicating a significant degree of facial dysfunction) to 89 (a significant improvement) at post-test. This represents a percentage improvement of 64.8%. The improvement was sustained at the follow-up assessment, where the average FaCE score was 90.5, an improvement of 67.6% from the pre-test.

DISCUSSION & CONCLUSION

Discussion: This case series study provides preliminary evidence for the feasibility and effectiveness of AI-assisted precision rehabilitation of facial palsy with VR, and EMG. The AI algorithms allowed for personalized and objective exercise progression, based on the EMG findings, enabling a precision rehabilitation approach. The VR system allowed for an immersive and engaging environment that kept the patients motivated and challenged throughout the program, contributing to the effectiveness of the intervention.

Limitations of this study include the small sample size and the lack of a control group. Further studies with larger sample sizes and randomized controlled trials are needed to confirm these findings and investigate the long-term effects of this approach.

Conclusion: This case series study suggests that AI-assisted precision rehabilitation with VR and EMG may be a promising and cost-effective approach to facial palsy rehabilitation. The AI algorithms allowed for personalized and objective exercise progression, while the VR system provided an immersive and engaging environment that kept the patients motivated and challenged throughout the program. Moreover, the remotely controlled and automated exercise program design and modification facilitated the accessibility and cost-effectiveness of the intervention. Further studies are needed to confirm these findings and investigate the long-term effects of this approach, but our results suggest that it may offer a personalized and precise intervention for patients with facial palsy.

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