

# ELECTROMYOGRAPHY (EMG) BIOFEEDBACK FOR THE REHABILITATION OF STROKE PATIENTS

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## BACKGROUND

Stroke is India's 4<sup>th</sup> leading cause of death and the 5<sup>th</sup> leading cause of disability.<sup>1</sup> Complete functional recovery with conventional physiotherapy is less likely in stroke patients.<sup>2</sup>

## AIM

A case study of combining Electromyography (EMG) biofeedback therapy with neuro-physiotherapy to assess the improvement in movements and functional recovery.

## CASE PRESENTATION

A 42-year-old male working as a production manager complained of giddiness, and right-side weakness in October 2017. The patient was shifted to a hospital, and immediately CT investigation was carried out. His medical history included hypertension, type 2 diabetes, dyslipidemia, and he was not compliant with his medications.

## INVESTIGATION

The CT report showed intraparenchymal hemorrhage with surrounding edema in the left gangliocapsular region, extending into the ventricles.

## MANAGEMENT

The patient was admitted to the hospital and received medical management for stroke. He was discharged after ten days.

## FOLLOW UP

After discharge, the patient underwent conventional physiotherapy for a month, which helped him to lift his shoulder and move his elbow. The patient had difficulty holding a pen, could not write, and could not resume work. He also had a mild deficit in his walk.

The patient came to the Jogo biofeedback clinic in February 2020. The patient had involuntary movements of the right index, middle, and ring fingers, leading to difficulty holding a pen and writing (prehension activities).

On examination, his right shoulder was depressed, pronation of the forearm, partial flexion of the elbow to 15°, and wrist flexion to 5°. Wasting of the right posterior deltoid, infraspinatus, and supraspinatus muscles was observed. Lateral shift in the right pelvis observed, and the genu recurvatum of knee and ankle were in neutral position with toes flexed. His face had a left deviation with facial nerve weakness in the lower quadrant. The patient had a partial circumductory gait. His deep tendon reflexes on the right side were brisk, and the right-side plantar reflex response was an extension. The patient had grade 1 tone of the right upper and lower limb muscles evaluated by the Modified Ashworth Scale.

The patient was alert, oriented, and comprehending. The patient's attention and memory were good, and no perceptual deficit observed.

## BIOFEEDBACK THERAPY

Surface electromyographic biofeedback (EMG-BF) is an advanced treatment that uses sensory inputs to enable neuromuscular retraining. The EMG-BF sensors with a gamified visual representation of muscular activity and conventional therapy improve motor abilities through immediate muscle activity feedback and neuroplasticity. EMG-BF helps patients to 'visualize' the muscle activity, and the real-time feedback helps to relax a spastic muscle or to activate its antagonist.<sup>3,4</sup>

This patient's assessment showed increased resting potential of the right wrist and finger extensor (overactivity). The neuro evaluation included Brunnstrom grading, EMG readings, and Functional Independence Measure (FIM).

## PRIMARY OBJECTIVE

To enable the patient to get his job.

## SECONDARY OBJECTIVES

- To decrease the resting potential of right wrist extensor muscle from 40 MVS to <10 MVS
- To reduce the involuntary movements of the right index, middle, and ring fingers
- To improve the grasp from <10 counts to 70 counts

The intervention of neuro-physiotherapy with EMG-BF was given for a month (thrice weekly) and included relaxation for the right wrist.

## RESULTS

Brunnstrom grading for the upper limb improved from Stage 4 to 5; the grading for the hand improved from Stage 5 to 6. the FIM score improved from 30 to 39. On 24<sup>th</sup> February '2020, the resting potential of the right wrist extensor muscles was 39 MVS, which decreased to 17 MVS by March 16<sup>th</sup> '2020. (Fig 1). The reduction in the resting potential (tone) of extensor muscles from 40 MVS to 17 MVS is shown in Table 1, improving grasp and prehension. He had a near-normal reduction in the involuntary movement of his right fingers, and he was able to write.

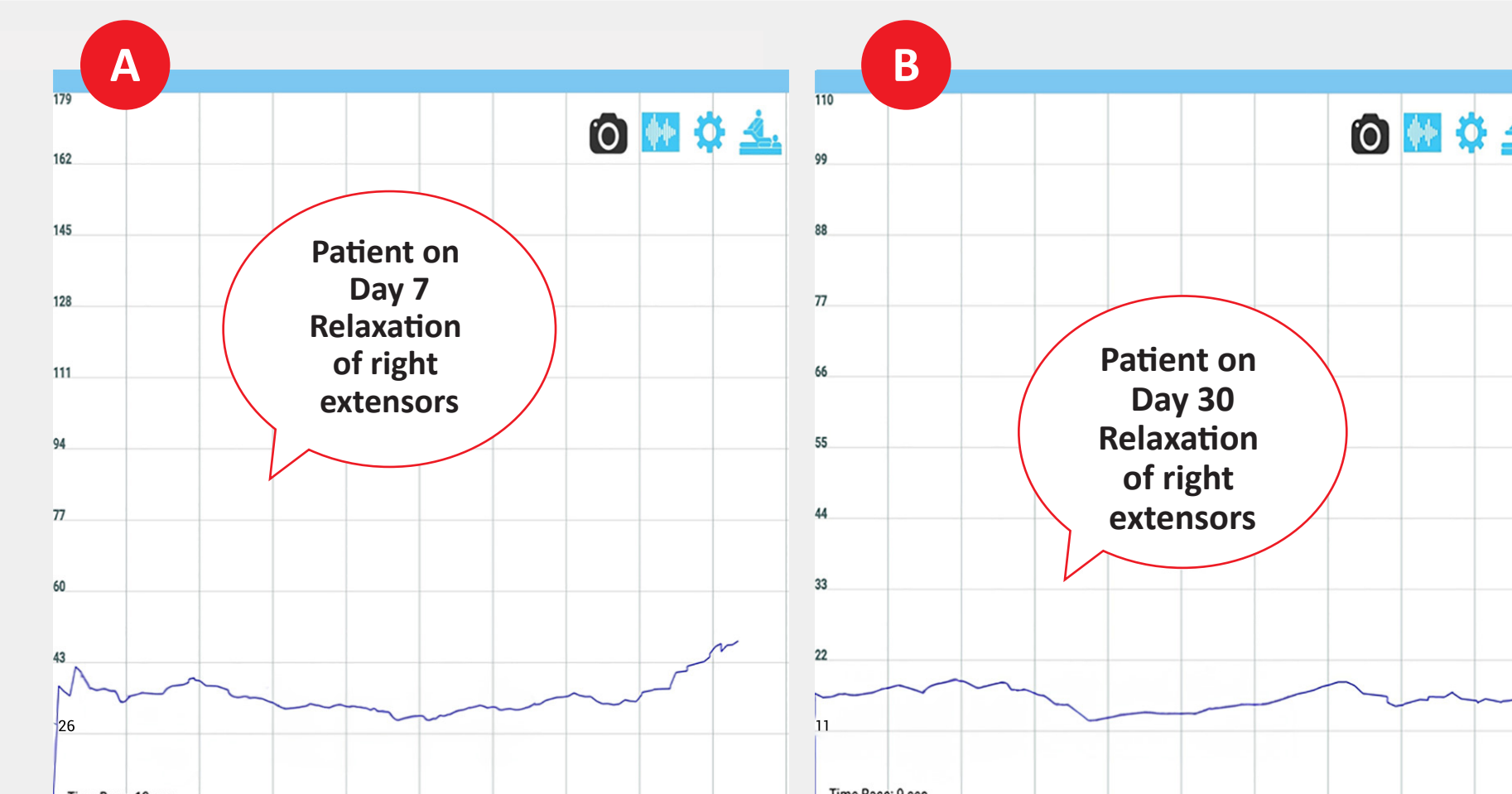


Figure 1 : A. Resting Potential at Day 7: 39 MVS. B. Resting Potential at Day 30 : 17 MVS

Table 1 : Motor Examination

Date of Biofeedback Session	Resting Potential of Muscles (MVS)
Day 1 (17.02.20)	Analysing of wrist extensors was done with peg board activity (greater than 40 MVS)
Day 7 (24.02.20)	39 MVS
Day 14 (02.03.20)	25 MVS
Day 24 (11.03.20)	20 MVS
Day 30 (16.03.20)	17 MVS

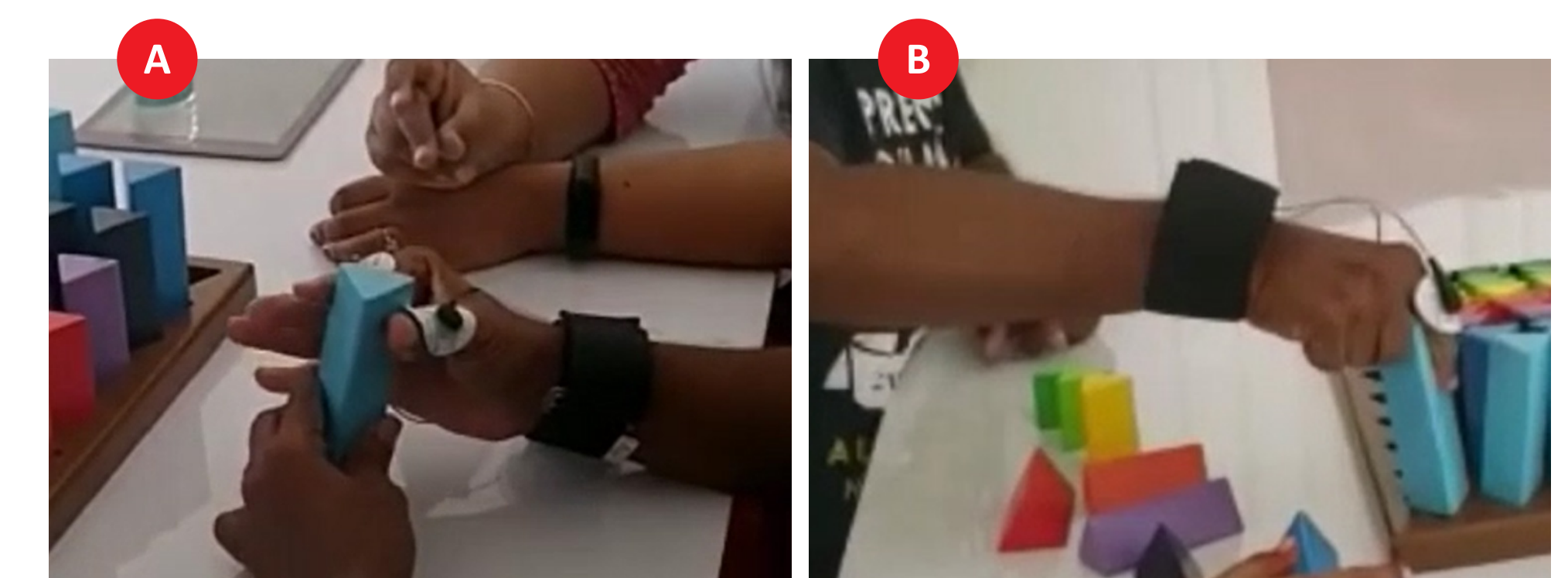


Figure 2 : A. Patient on Day 1 (Baseline), trying to place the object with left hand to right hand and able to hold it for less than 10 seconds B. Patient on Day 30 able to hold the object for about 50 seconds

## CONCLUSION

EMG biofeedback combined with neuro-physiotherapy helps stroke patients improve their movements and daily activities of living.

## Reference:

1. Jones SP, Baqai K, Clegg A, et al. Stroke in India: A systematic review of the incidence, prevalence, and case fatality. *International Journal of Stroke*. 2022;17(2):132-140. doi:10.1177/17474930211027834
2. Ernst E. A review of stroke rehabilitation and physiotherapy. *Stroke*. 1990;21(7):1081-1085. doi:10.1161/01.str.21.7.1081
3. Giggins OM, Persson UM, Caulfield B. Biofeedback in rehabilitation. *J Neuroeng Rehabil*. 2013;10:60. Published 2013 Jun 18. doi:10.1186/1743-0003-10-60
4. Kondo K, Noonan KM, Freeman M, Ayers C, Morasco BJ, Kansagara D. Efficacy of Biofeedback for Medical Conditions: an Evidence Map. *J Gen Intern Med*. 2019;34(12):2883-2893. doi:10.1007/s11606-019-05215-z

Scan to watch patient's video

