

# Simultaneous and wireless recording of EMG and EEG for the study of craniomandibular function and dysfunction. A methodological study.

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**Abstract**— This paper presents a methodological technique for wireless recording of EMG and EEG signals for the study of craniomandibular function and dysfunction. We integrated a custom-made EEG recording device and a commercially available EMG recording device during an experimental standardized setting that included recordings of clenching at a regular interval while keeping eyes closed.

## I. INTRODUCTION

A survey of the prevalence of craniomandibular (CM) disorders and bruxism has revealed that more than half of the adult population in Uruguay is affected [1]. Paradoxically, it is a subject little studied and, in general, not contemplated in public or private health care services. The multifactorial etiology of these dysfunctions, their tendency to chronicity, and the non-existence of objective diagnostic methods of high sensitivity and specificity are some factors that have determined that this problem has not yet been fully addressed to this day. Likewise, various high prevalence sleep disorders such as bruxism and obstructive sleep apnea are immersed in this problem and the global trend is to cover them in an interdisciplinary way. The electromyogram (EMG) has been used for more than 20 years to study the electrical activity of the CM muscles to obtain information about their functioning. However, nowadays we do not have recording techniques with high diagnostic validity in the field. There are efforts in this direction, mainly to develop sensitive instruments for the diagnosis and monitoring of CM disorders, but development is scarce in general, and particularly in the area of wireless systems. On the other hand, EEG (Electroencephalography) is the gold standard to record brain activity during sleep and is necessary to determine all different states of sleep. The aim of this study was to develop a new experimental setting for the simultaneous recording of wireless CM EMG and also EEG.

## II. MATERIALS AND METHODS

The wireless surface EMG recording device used in this study is Delsys “Trigno Wireless System”. Its 16 analog channels can record signals in the range of 20 to 450 Hz, with a sampling rate of 2 ksamples/sec. The transmission range is 20 m and its rechargeable battery lasts a minimum of 7 hours. The WiFi EEG recording device used in this study [2] is capable of acquiring 21 EEG channels with a programmable high-pass frequency from 0.1 Hz to 100 Hz, and a low-pass frequency from 15 Hz to 1 kHz (and a 50 Hz Notch filter). The sampling frequency can be set up to 2.1 kHz, and the device autonomy is more than 24 hours.

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We propose a technique comprising the following. The EMG recording device is used to evaluate muscle activity in the masseter and temporal muscles (both bilaterally). The EMG signal amplitude is normalized according to the maximum voluntary contraction (MVC). Simultaneously, the EEG recording device is connected to the patient according to the international standard 10–20 system. Synchronization is achieved by introducing an artifact in both signals. A standardized experimental setting is developed in order to record both functional (swallowing) and parafunctional (awake bruxism) activity. As a first proof of concept, the following simpler experiment was done: we recorded EMG and EEG in a subject that was only clenching at a regular interval while keeping her eyes closed.

## III. RESULTS

Fig. 1 presents a simultaneous recording of unilateral EMG (right temporal and masseter muscles) and EEG signals (O1 and O2, occipital region). In Fig. 1 (left side) the subject was clenching while keeping her eyes closed (this is confirmed by alpha waves activity in the occipital region). In the right side of Fig. 1, the subject was resting while keeping her eyes closed. The EEG signals were acquired using a referential montage (using FPZ as the reference) and bandpass filtered between 0.5 Hz and 15 Hz.

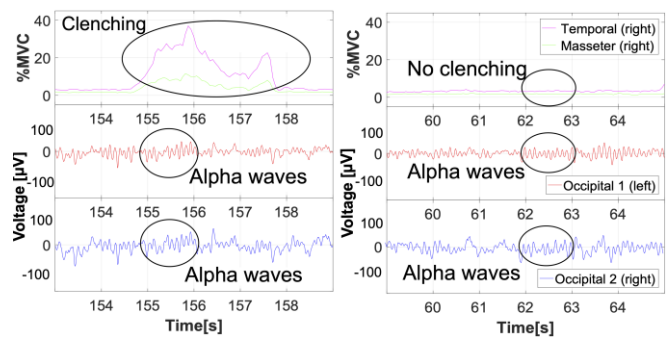


Figure 1. Simultaneous EMG and EEG recording.

## IV. DISCUSSION & CONCLUSIONS

The proposed set up records and displays simultaneous signals of EEG and CM EMG. It was possible to acquire and filter the signals. These preliminary results are encouraging to further develop this technique.

## V. REFERENCES

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