Abstract

Temporo-mandibular joint (TMJ) pathology presents with crepitation at the joint level during lifting and lowering movements of the mandible. Besides the TMJ, when performing these movements the mobilizing muscles of the mandible are also involved. These two systems, muscles and joints, enhance their activity and interrelate. This study aims to correlate the joint crepitations with the muscular pathology. Regarding the muscular pathology, we focused on investigating the muscular spasms, muscular fatigue, and tone changes with the help of the K7 system (electromyography). We conducted an observational study in an analytical sample of 46 subjects aged between 16 and 76 years, out of 63 that were initially included in this study in order to detect the presence of joint noises. We recorded muscular activity during rest, revealing the existing changes. On the paraclinical exam, a larger number of subjects having these types of changes were recorded compared those who initially reported the presence of these symptoms.

Keywords: Joint Noises, K7, Electromyography

INTRODUCTION

The precise positioning of the mandible and the status of muscle at rest or while performing its functions is of great importance in achieving the functions of the stomatognate system and they experience coordination between joint elements with the muscle for a harmonious activity, and this is why an accurate and complete diagnosis of joint dysfunctions requires, besides a careful analysis of the joint elements and their integration in the stomatognate system, an analysis of the neuro-muscular system (1). Joint noises are the most common sign of joint dysfunction discovered at more and more patients, but they are not unique and often their are associated with signs and symptoms of dysfunction of the other systemic elements (muscles, teeth, periodontal, bones), and also of other signs and symptoms associated with joint damage (pain, constriction of mouth opening, sub-contortion, contortion, ankylosis, etc.). (2)

Joint dysfunction may be associated with a dysfunction materialized in changes regarding the muscular tone (hypotonia or hypertonia), changes in the muscle mass (hypotrophy or hypertrophy), uncoordinated muscle contractions, asymmetric muscle spasm, muscular fatigue and constraint of mandible movements. (3) The changes in the muscle activity are reflected in the execution of asymmetric muscle contractions (of the upper muscle to the lower muscles, or from right to left), associated to the signs and symptoms of joints.

On the clinical evaluation, changes of the static position of the mandible to the skull are being observed, but also changes in the relationship between the electrical activity in upper and lower muscles, with effects on both short and long term, both at muscular and joint level, but the joint meniscus is the most affected by these changes. As immediate effects of changes that result from these imbalances we remind: the tone changes that occur in manducatory muscles observed in the general body scheme through postural changes, the appearance of noise or joint pain, and psycho-emotional harm. (1) The disturbance of the reflexes that regulate the muscle contraction induces disturbances in the coordination of the mandible dynamic with the contraction of the mandible motion amplitude without tooth contact in particular, imbuing these movements with a chaotic, disorganized, unsystematic character. (4) Therefore, we considered necessary to study the joint noises regarding the factors and the muscular determinant.
The muscle dysfunction may be present with the following symptoms: muscle pain, hypertonia or hypotonia, muscular spasm, hypertrophy or muscle weakness, muscular fatigue, limited mandible exploration, changes of the trajectory regarding the mandible dynamics(5).

**THE AIM OF THE STUDY**

Starting from the consideration that joint noises are not singular but combined with disfunctions of the neuro-muscular system, we aim to correlate the articular noises with the muscular pathology. Within the muscle pathology, we focused on investigating muscular spasms, fatigue and muscle tone changes, all of which can be evaluated using paraclinical K7 system through electromyography.

**MATERIALS AND METHOD**

To materialize the intended purpose we conducted an observational study in an analytical sample of 52 subjects aged between 16 and 76 years, out of 63 that were initially included in the study to detect the presence of joint noises, who came voluntarily at the Dental Prosthetic Clinics of the Faculty of Medical Dentistry, “Gr T. Popa” University, Iasi, between January 1, 2004 – May 1, 2007. The participation of the subjects was made on voluntary basis, their consent being obtained, while their selection was randomly made, depending on their clinical presentation.

We conducted a prospective longitudinal study and the following methods were used: the questionnaire, anamnesis for the subjective elements that may be related to the noises, clinical and paraclinical evaluation that aimed to investigate the muscular spasms, muscular fatigue, and change of tone with the help of the electromyography of K7 system.

The K7 system has an electromyographic recording capacity, which monitors eight channels (four muscle groups) simultaneously. Data were obtained from the patient by electrodes with a silver-silver surface of a high quality. The system amplifies, filters, rectifies, digitizes and stores information from each muscle. Afterwards, the data are displayed in unprocessed form or they might be processed. Data may be displayed at any purchase price without having to repeat the test. In order to record the mandible, the EMG data are obtained during rest or while exercising their functions, adding important information for process evaluation. K7 system displays the data on a color monitor with high resolution, and stores data on a hard disk drive for reviewing and analysis.

We applied the electrodes parallel to the muscular fibers that we wanted to examine. We preferred the assessment of the muscular biopotential by recording them with surface electrodes (depth electrodes give accurate information but their use has not been accepted by several subjects, which made us renounce at this type of evaluation to have a common base review applied to all subjects). We placed electrodes on these main groups with sufficient muscular mass (masseter, temporal, symmetric), and they were the most affected muscles by dysfunctions; recordings were made in relation to posture and inter-cuspid maximum, the patient was installed in a semi-seated position. Also, the great amount of muscle mass allowed a proper placement of the surface electrodes in order to achieve a better recording of their action potentials. We used surface electrodes with 18 mm diameter, which were implemented through a skin adhesive substance placed on the internal support portion of the electrode, after degreasing and pre-drying (Fig. 1).

Figure 1 - The aspect of the electrodes used for electromyography recordings and their placement at the level of the muscular groups connected to preamplifier.
Moreover, the internal face of the electrode was impregnated by the manufacturer with a chemical substance that is a good conductor of electricity. Placing electrodes on the surface was parallel to the investigated muscle fibers; the highest value in such examination had the simultaneous investigation of various muscle groups on the right side versus left side. We offered the best conditions of temperature, humidity, lighting while the records were made to assure a high comfort to the patient, avoiding any intense stimuli. The ambient temperature influences the body temperature and the latter influences the good progress of the neuromuscular activity.

The room was kept quiet for the patient, in order not to look back to the sound source (the doctor who gives indications of registration), and in order to avoid recording amplified or erroneous levels, the patient’s mental relaxation is a basic condition, the psychical pressure increases the neuromuscular pressure, leading to abnormal values. The mental and emotional stress occurs at the onset of neuromuscular disorders.

In addition, for a complete relaxation we preferred not to allow subjects to view the records, asking them to keep their eyes closed to relax. To induce the position of postural relation we asked the subjects to perform a swallowing while the recordings were made afterwards. The biocurrents gathered through the electrodes were directed to an amplifier level where their amplitude is increased without amending the curve of variation so that they become accessible to our senses through displaying on the computer screen.

RESULTS AND DISCUSSION

We recorded the muscle activity at rest by using a scan (scan 9) that allows this. Although we were able to record 8 channels of 4 pairs of muscles groups we preferred the examination of the upper mandible muscles that have a greater muscular volume, which makes them more easily accessible.

The recording was done by asking the subjects to relax and close their eyes during the recording (15 seconds), avoiding any teeth contact.

For example, a recording of the postural relationship and of muscle relaxation is shown in Figure 2. In the left side are listed the muscle groups and the value of the contact wave recorded in micro volts.

It is considered of normal value those below 2 microV, what exceeds this value underscore, in fact, a muscular contraction and not the relaxation potential (Figure 2).

We’ve observed that the presence of electrical activity at rest, the asymmetry of electrical activity between the different muscular groups, the increased amplitude of bioelectric discharges, high above the usual average on 31 subjects. On the right side of the recording are listed the recorded average values of the electrical potential, whatever exceeds 2 microV is considered pathological.

![Figure 2 - The presence of electrical activity at rest on a recording of the bioelectrical routes without signal processing](image)

It is possible to exemplify for the patient the areas or muscle group that need to be relaxed, Figure 3.

We were also able to have muscle electrical potentials recorded by a functional test of muscle contraction, asking subjects to perform two muscle contractions, Figure 4. The test revealed this time as well the asymmetry of muscle contractions with the possibility of direct analysis of potential duplication of records from homonymous muscle groups, please see Figure 5.
Figure 3 - Color illustration of different gradients of the muscular tone on an image offered by the software that is used to educate the patients in biofeedback.

Figure 4 - The analysis of electrical potentials collected during voluntary muscle contractions of 2 seconds that are valid proof of the asymmetry of contraction on homonymous muscle groups.

Also Figure 5 shows the differences between the contraction without the interposition between the arcades and the interposition of a compress on the last two picks of the routes. Recorded tracks for the muscles on the right side are different from those on the left side, with no noticeable perfect symmetry in any subject.

We evaluated the presence of muscle spasms associated with the presence of joint noises and saw on the resting tracks the electric potential of muscle contraction without the patient actually performing the contraction, please see Figures 6, 7 (the muscle contraction is visible in the green circle).

Figure 5 - Graphical aspects of voluntary muscle contraction (the first two and last performed on the tooth structure by interposing between the two arches rolls of cotton wool). To view the asymmetries, the software allows automatic duplication of records for symmetrical muscle groups.

Figure 6 - The graphics Illustration of muscle spasm

The measurement of muscle fatigue as a symptom experienced by some of the subjects was assessed by recording action potentials during a sustained muscle contraction of about 10 seconds. As with all other previous records, we have noticed significant differences in the mag-
The electromyographic recordings come to graphically confirm the muscle fatigue in 23 subjects, not 13 subjects as 13 were those subjects who have noticed the symptom and declared it in the questionnaire, while the presence of muscle spasm in 14 subjects was confirmed, not in 12 of the subjects of the experimental group, with changes in muscle tonus meaning the increase / elevation of it in 18 of the subjects (as compared to only 7 subjects as we had had initially noticed) and no decrease in it (Table 1).

Of the total of 52 patients that complained of noises of the temporo-mandibular joint, 23 (44%) have muscle fatigue, that occurring especially in patients complaining of bilateral crepitus (57%). Muscle spasms are present in 27% of patients with joint noises, the lowest percentage occurring in patients with bilateral crackments/jaw clicking (20%). Increased muscle tone was recorded at 37% of patients with noises from the TMJ, not present in any patients with unilateral crepitus (maybe also due to the fact that the number of these patients was small, only 3 out of 52) (Table 1).

**CONCLUSIONS**

1. The electromyographic investigation confirms the muscle disorders associated with joint noises, directly related to cranio-mandibular malrelations.
2. The electromyographic manifestations have amplitudes, durations and different frequencies higher than normal as a result of muscle spasms, with out of phase contractions determined and as a result of the asymmetry caused by the occlusal contact.
3. We found asymmetrical values of the initiation of the muscle activity, the measurement of muscle force and in the study of muscle fatigue.
4. After paraclinical investigation we have found an increase in the number of patients were muscle spasms were present, the muscle fatigue and the increase in the muscle tonus, in the questionnaire a smaller number of patients accusing these symptoms.

5. The paraclinical investigation by electromyography brings additional data needed for a better clinical examination, supplementing them, helping to establish a complete and accurate diagnosis and appropriate treatment for the muscular disorder in the context of joint damage.

6. Of the 52 patients who had a noise of the TMJ type, we recorded 44% muscular fatigue, while in 27% muscle spasms were found and in 37% we have noticed hypertonia.

References: