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Electromyography evaluation of masseter and temporalis muscles in patients with temporomandibular joint dysfunction

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Abstract

Aim: Temporomandibular disorders (TMD) are composed of heterogeneous masticatory disorders which include muscle and joint disorders ،Major precipitating factors are occlusal, traumatic, psychosocial and systemic factors. The symptoms associated with this syndrome are due to hyper function and/or dysfunction of the masticatory muscles, rather than to degenerative or inflammatory changes of the TMJ .Various attempts have been made to demonstrate this hyperactivity via EMG recordings of the masticatory muscles . The aim of this investigation was to determine possible altered muscular function in patients with TMD, as well as to determine the need for EMG application in TMD diagnosis.

Methods: Thirty adults participated in this study :20 subjects with signs and symptoms of TMD and 10 asymptomatic subjects .Surface EMG recordings were obtained from left and right anterior temporal muscle, left and right masseter muscle.

Results: of this investigation showed the presence of altered masticatory muscle activity in TMD patients and confirmed the use of electromyography in TMD diagnosis.

Conclusion: The investigation has confirmed that EMG is a useful and non-invasive method in TMD diagnosis.

Key words: TMJ, Temporomandibular disorders, Electromyography,

Introduction

Anatomy of the Temporomandibular Joint (TMJ): Temporomandibular joint is a unique joint characterized by the followings:

1-it is a craniomandibular articulation with the joint of one side cannot function without movement of the contralateral joint [1].

2-An articular disc divides the joint into upper and lower compartments . Functionally there is a hinge movement that predominates in the lower compartment while a gliding movement is a feature of the upper one [2, 3].

3-Unlike most synovial joints in which the articular surfaces are composed of hyaline cartilage, those of the TMJ are covered by fibrocartilage [4, 5].

4-It is the only joint system with a rigid end point of closure-specifically, the calcified occlusal surfaces of teeth .The nature

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of the occlusion may, therefore, influence the joint's function [6].

The meniscus**:** The condylar head is separated from the glenoid fossa by the meniscus .This consists of a posterior band approximately 3-mm thick which lies, when the posterior teeth are in contact, between the transverse ridge of the condyle and the highest concavity of the glenoid fossa.

Anterior to this is a thinner anterior band, and separating the two bands is a thin intermediate zone .Both bands merge medially and laterally to be inserted rigidly into the poles of the condyle, below the articular surface.

The upper joint space is completed by a loose capsule inserted into the skull base anterior to the articular eminence .The lower joint space, beneath the meniscus, is completed anteriorly by a lax capsule of fibrous tissue which is attached to the neck of the condyle just above the insertion of the lateral pterygoid muscle .The capsule is lined by synovium [7].

Physiology: The position of the meniscus as described above is that seen when the teeth are in the centric relation [8]. All normal mandibular excursions from this position are accompanied by a combination of condylar rotation and forward translation from the glenoid fossa with meniscus interposed. As the condylar moves forward during mouth opening the meniscus follows it. Thus, on opening the mouth both condylar and meniscus move forward but the meniscus being slower moves posteriorly in relation to the condyle in effect it rotates around its lateral insertions into the condyle the transvers axis starting from the position where the posterior band lies or the transvers ridge in centric relation and finishing in the wide open or protrusive position with the condylar head in front of the anterior band.

On closing the condylar head runs once more beneath the anterior band until its position in centric relation is achieved again. In the position where power strokes of mastication are applied, with the teeth apart and condyle little forward, the head move upwards and backwards across posteriorly-facing slope of the articular eminence rotating at the same time.

During these movements the transvers ridge of the condyle lies under the intermediate zone between the posterior and anterior bands, the bands functioning to spread the load from the condyle across this surface[9].

TMJ dysfunction: Temporomandibular disorders (TMD) are composed of heterogeneous masticatory disorders which include muscle and joint disorders [10, 11, 12, 13, 14, 15]. Injury or trauma account for somewhere around 10 %to, at the very most, 30 %of TMD patients [16]. Polyarthritis disease manifestations in the TMJ may account for another 5% [17]. Depending on the criteria used, generalized joint hypermobility (*i.e.*, laxity) accounts for between 3% and 25%of the TMD population [18]; while another 10 %to 30 %of TMD patients have significant evidence of bruxism [19, 20, 21, 22]. Taking the lower end of the above estimates for these other conditions, it is possible that as many as 72 %of TMD patients have what could be described as a stress induced dysfunction of the musculoskeletal system. Psychological factors are complex and not so easily identified, which is the major reason this etiologic agent has been relatively overlooked by clinical dentists.

This does not, however, imply that all TMD patients require a full psychological and psychometric examination, since psychological abnormality (*i.e.*, high depression and/or anxiety levels) based on normative data from psychological

tests exists in only 24% to 38%of TMJ clinic patients. In other words, a majority of patients can and do get TMD without showing evidence of substantial psychological disturbance[23].

EMG**:** According to Yemm [24], Egermark-Erikson, Carlsson and Magnusson [25], Bowley and Gale [26] the symptoms associated with this syndrome are due to hyper function and/or dysfunction of the masticatory muscles, rather than to degenerative or inflammatory changes of the TMJ, or inadequate occlusion of the teeth

The aim of such electromyographic investigations is to obtain an objective criterion by means of which the neuromuscular basis of orofacial pain complaints of different origin may be determined, to estimate the degree of disturbance of neuromuscular activity, or to assess the success of certain therapeutic treatments[27,28,29].

EMG assessment has been applied also to study differences between asymptomatic subjects and those suffering from various forms of craniofacial muscle-related dysfunctional symptoms e.g .muscle hyperactivity, bruxism, temporomandibular disorders (TMD) and/or craniofacial pain [30].

Materials and methods

Subjects:Thirty young adults participated in this study .The symptomatic group(S)consisted of 20 subjects mean age (mean age 29.75years; sd10.33). They were chosen among the patients referred to the Alwasity Hospital for Reconstructive Surgery, because of TMD problems.

Patients were clinically examined according to the following study protocol:

(a) pain in the preauricular, facial and cranial area,
(b) Joint noises during mandibular movements,
(c) Disturbance of mandibular movement [27].

The asymptomatic, control group (C) consisted of 10 healthy subjects (mean age27.5 years; SD 5.14). They were selected from the employee of Alwasity Hospital .To be included in this group, each subject had to be free of signs and symptoms of myoarthropathies of the masticatory system.

Methods:

EMG recording and procedure:

Electromyography device: Micromed (ISO 1008 EP) integrated stimulator amplifier, 220 V, 50/60 Hz, 8 Channels. The electrodes are silver 1cm in diameter figures (1, 2, and 3).

Surface EMG recordings were obtained from left and right anterior temporal muscle, left and right masseter muscle .The conductivity of the electrode-skin interface was increased using conductive gel after thorough cleaning of the skin with alcohol. The electrodes for the myoelectrical registration from masseter and anterior temporal muscle were placed 2 cm apart using electrolytic gel figure (4 and 5). The common ground electrode was clipped to the left wrist

Experimental procedure: The examination included EMG registrations with Maximum Voluntary Contraction (MVC) in the position of maximal intercuspation of teeth.

The registrations included two readings with about four hour's separation between the two readings .

The power spectrum of the EMG signal is the summation of the spectral characteristics of the Motor Unit Action Potential (MUAPs) which comprise the signal. So the spectral

analysis of each reading was recorded figure (3, 4).

Statistical analysis: Statistical analysis was made using the statistical software SPSS 17.0 (Statistical Package for Social Science) for Windows. The measured values were analyzed by means of descriptive statistic (SD, SE). The evaluation of statistical significant differences between the symptomatic and asymptomatic group was made using t-test for independent samples.

Results

By comparing the readings of controlled with affected Temporalis muscles and controlled with affected Masseter muscles, statistically significant differences were found; for Temporalis ($t=9.242$, $p<0.001$) and for Masseter ($t=13.972$, $p<0.001$).

Measuring the mean value of the readings of the affected and controlled masseter and express the result on a histogram show the significant deference between Group S and group C.

Also the mean values for the temporalis muscles for both group (S and C) show a significant deference.

15 patients of the S group have missing more than one of their first molar tooth and eleven of those fifteen patients have the missing first molar on the affected side.

On the other hand no one of the subjects in group C have missing first molar and only two subjects had missing second premolar.

Two patients follow the instruction of the treatment; one was treated by conservative treatment by changing the habit of eating and uses antidepressants (impramin 10mg single dose a day), sedation (valium 5mg single dose a day) and muscle relaxant (orphenadrin 35mg with paracetamol 450mg three doses per day);

The second patient was treated by night guard (occlusal stent) for about two months.

The thickness of the stent was reducing gradually each two weeks until the normal occlusion was restored and then it was discarded.

Both patients exhibit relief of symptoms; pain, tenderness and limitation in the mouth opening.

EMG reading was made for both patients after the treatment; their readings were similar to the readings of the control group.

Discussion

This investigation results showed that in both groups in the position of maximal intercuspation of teeth, the masseter muscle was the most active muscle [1,2]. Our patients showed higher EMG activity of the masseter and temporalis muscles than healthy control subjects.

It should be borne in mind that perception, tolerance and expression of pain depend on a number of physiological and pathophysiological mechanisms. First, there is both clinical and experimental evidence to suggest that an ongoing activation of the nociceptive system leads, at peripheral and central levels, to an alteration of the processing of stimuli [27, 28, 29], which in turn results in altered pain perception. In addition, chronic pain and suffering may affect other brain functions, as there is a close relationship between pain and anxiety, and also between pain and depression Anxiety and depression, developed as conditioned reactions to pain, may themselves modulate pain tolerance and pain reactions

With regard to the involvement of anxiety in the TMJ syndrome, we found that among TMJ patients there were more subjects with an anxiety condition than was the case among

healthy control subjects. Again it should be stressed that not all TMJ patients showed anxiety.

The extremely high EMG amplitudes found in some of the patients reflected serious bruxism habits in these patients. Bruxism may result into hypertrophic masticatory muscles with concomitant high EMG amplitudes [30, 31].

Conclusion

This investigation points out that changes in EMG activity pattern could indicate the possible functional alteration in patients with TMD. The results obtained in this study emphasize the value of electromyographical recordings in the investigation of problems of clinical interest,

This investigation has confirmed that EMG is a useful and non-invasive method in TMD diagnosis. However, EMG is not sufficient if applied alone, but together with other methods it forms a complementary approach in TMD diagnosis.

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