INDIAN JOURNAL OF DENTAL ADVANCEMENTS
Journal homepage: www.nacd.in

REVIEW

Electromyography- A clinical perspective

Vaishali M R[1], Roopashri G[2], Maria Priscilla David[3], Indira A P[4]

Department of Oral Medicine and Radiology
MR Ambedkar Dental College,
Bangalore

Senior lecturer [1 & 2]
Professor and HOD[3]
Professor[4]

Article Info
Received: July 10, 2010
Review Completed: August 12, 2010
Accepted: September 15, 2010
Available Online: October, 2010

ABSTRACT:

Electromyography is used for diagnostic purposes for recording electrical activity generated in the muscles. There are many applications of electromyography. It is used to study the action potentials in actively contracting masticatory muscles, to diagnose muscular diseases of the tongue and in treatment of temopormandibular joint disorders. It basically serves as a biofeedback mechanism.

Key words: ***Electromyography, biofeedback, masticatory muscle disorders, temporomandibular joint disorders.***

INTRODUCTION

Electromyography [EMG] is a technique for evaluating and recording the electrical activity produced by skeletal muscles. EMG is performed by using an instrument called electromyograph. The record is called an electromyogram. EMG detects the electrical potential generated by muscle cells, when these cells are electrically or neurologically activated. The signals can be analyzed to detect medical and dental abnormalities.[1,2]

HISTORY

The first documented experiments dealing with EMG started with Francesco Redi's works in 1966. Redi discovered a highly specialized muscle of electric ray fish generated electricity. The first actual recording of this electrical activity was made by Marey in 1890, who also introduced the term EMG. In 1922,Gasser and Erlanger used an oscilloscope to show the electrical signals from muscles. Clinical use of SURFACE EMG [SEMG] for the treatment of more specific disorders began in 1960's and was used by Hardyek.[1]

APPLICATIONS

Used in many clinical and biomedical applications.

Diagnostic tool for identifying neuromuscular diseases, disorders of motor control Kinesiology, also used as a control signal for prosthetic devices such as prosthetic hands, and lower limbs.[3]

EMG PREPARATION

No specific preparation is needed for the procedure.

EMG ELECTRODE PLACEMENT

Electrode should be placed between a motor point and tendon insertion or between two motor points and along the longitudinal midline of the muscle. The longitudinal axis of electrode should be parallel to the length of muscle fibers.

Email for correspondence:
vaishalitoshan@gmail.com

PROCEDURE

There are two kinds of EMG :-

1) Surface EMG.
2) Intramuscular EMG [needle and fine- wire]

SURFACE EMG

Surface EMG has been advocated as a "modern scientific approach" because the output from such devices is presumed to be both "quantitative" and "objective".

Surface EMG employs surface electrodes which are non-invasive and painless and they record the broad range of activity of entire muscle.[4,5]

INTRAMUSCULAR EMG

To perform intramuscular EMG, a needle electrode or a needle containing two fine—wire electrodes is inserted through the skin into the muscle tissue. The insertional activity provides valuable information about the state of the muscle and its innervating nerve. Normal muscles at rest make certain normal electrical sounds when the needle is inserted into them. Abnormal spontaneous activity might indicate some nerve or muscle damage. Then the patient is asked to contract the muscle smoothly. The shape, size and frequency of the resulting motor unit potentials are judged. Then the electrode is retracted a few millimeters, and again the activity is analyzed until at least 10-20 units have been collected. Each electrode track gives only a very local picture of the activity of the whole muscle, because skeletal muscle differs in the inner structure, the electrode has to be placed at various locations to obtain an accurate study. Intramuscular EMG may be considered too invasive, cause pain, which initially alters muscle function and they record the activity of few sarcomeres or cells which are in direct contact. Nerve conduction studies/testing is also often done at the same time as an EMG.[1,4]

ELECTRICAL CHARACTERISTICS

The electrical source is the muscle membrane potential of about -90mv. Measured EMG potentials range between less than 50microV and upto 20-30mv depending on the muscle under observation. Typical repetition rate of muscle motor unit firing is about 7-20HZ, depending on the size of muscle. Damage to the motor units can be expected at ranges between 450 and 780 mv.[1]

NORMAL RESULTS

Muscle tissue at rest is normally electrically inactive. After the electrical activity caused by needle insertion subsides, EMG should detect no abnormal spontaneous activity. When the muscle is voluntarily contracted, action potential begins to appear. As the strength of muscle contraction is increased, more and more muscle fibers produce action potentials. When the muscle is fully contracted, there should appear a disorderly group of action potentials of varying rates and amplitudes.[6]

ABNORMAL RESULTS

EMG is used to diagnose Neuropathies and Myopathies

Myopathies: -

EMG characteristics; A decrease in duration of action potential and reduction in the area to amplitude ratio of action potential

Neuropathies: -

EMG characteristics; An action potential amplitude that is twice normal due to increased number of fibers per motor unit because of reinnervation of denervated fibers. It also shows an increase in the duration of action potential and a decrease in the number of motor units.

Abnormal results on EMG may be seen in following medical conditions

Cervical spondylosis.
Dermatomyositis.
Myasthenia gravis.
Guillian barre syndrome.
Poliomyelitis.
Alcoholic neuropathy.

EMG SIGNAL DECOMPOSITION

EMG signals are essentially made up of superimposed motor unit action potentials [MUAP's] from several motor units. Measured EMG signals can be decomposed into their constituent MUAP's. MUAP size and shape depend on when the electrode is located with respect to the fibers.[1]

EMG IN DENTISTRY

- It provides an objective means by monitoring changes in muscle activity

- To study action potentials in actively contracting lingual and masticatory muscles.
- It is used in the treatment of Myofacial Pain Dysfunction where the procedure is called a Auditory or Visual electromyographic feedback, It supplies information to the patient concerning to the muscle activity.
- To study biomechanics of jaw and facial muscle functions.
- EMG is useful for identifying asymmetry of muscle action and particularly for judging the results of the therapy.
- Used for monitoring of nocturnal bruxism and jaw muscle tracking
- Can be used as one part of a full assessment protocol to determine if a patient has significant muscle asymmetries possible postural disturbances and significant muscle fatigue.[1-6]

ELECTROMYOGRAPHIC EXAMINATION OF MASTICATORY MUSCLES

Electromyographic examination of masticatory muscles may have confirming value for clinical diagnosis of myospasm which characteristically shows a marked increased in EMG activity. When the muscle is at rest EMG activity is known to be increased as a result of pain generated within muscle. [7]

SURFACE EMG IN DIAGNOSIS OF TMD

Surface EMG of muscles of mastication is used routinely as a part of diagnosis and treatment of TMD. The duration of temporary pause in ongoing EMG activity of jaw closing muscles during maximal clench has been found to be longer, on average in a group of TMD patients.

EMG FOR MASTICATORY FUNCTION

EMG for analyzing masticatory function utilizes self adhesives disposable silver chloride skin electrodes. They are usually placed bilaterally on the skin overlying the mid-masseter, anterior temporalis, posterior temporalis and anterior digastric muscle. Muscle activity is analysed in both rest and function by ultra-low frequency neural stimulation.[8]

JAW COMPUTERIZED ELECTROKINETIC TRACKING

It is accomplished by placing a tiny magnet with adhesive, non-intrusively within the lower lip vestibule beneath the teeth when they are in occlusion. A sensor array is anchored around face by an ear and nose frame that is secured behind the head by Velcro bands. Sensor array records incisor point movement in three dimensions by measuring magnetic field information is fed into the computer. [1]

EMG IN ORTHODONTICS

Moyers investigated electromyograms of children with class II division I malocclusion and found dysfunction of temporal muscle in habitual occlusion and at rest. He concluded that this dysfunction might be an etiologic factor of post normal occlusion

CONCLUSION

The information provided by electromyography as a diagnostic tool helps in providing many effective treatment approaches for many pain conditions. Pain is a complex behaviour and EMG as biofeedback mechanism is most beneficial for patients when used as one adjunctive component of an interdisciplinary pain management programme. The records of EMG activity before and after therapeutic intervention have been used to provide proof that the treatments were successful.

REFERENCES

1. Reaz MBI, Hussain MS, Yasin MF.Technique of EMG signal analysis: detection, processing classification and applications, biological procedure Online vol 8 issue 1, page 11-35 March 2006.
2. Carola Warfeild. Manual of pain management.Philadelphia pg 35.
3. Macleods clinical examination 12th edition Elsevier pg 302.
4. Norman D. Mohl et al.Devices for the diagnosis and treatment of temporomandibular disorders. Part-II: Electromyography and Sonography.J Prosthetic Dent 1990;**63**: 332-336
5. Laskin DM, Charles, Wiliams L Hylander Text Book of Teporomandibular joint disorders.An Evidence — Based Approach to Diagnosis And Treatment pg no 196-197.
6. Andreoli, Bennett, Carpenter, plum. Cecil essentials of medicine 4th edition pg 908-910
7. Welden E Bells.Teporomandibular joint disorders.3rd edition pg 217-218.
8. Basmajain Deluca JV. The functions revealed by electromyography. William and Wilkins Company: Baltimore,1984.