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M-Scan: A Simple EMG for Dentistry to Consider

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INTRODUCTION

Innovation in the technologies that dentistry enjoys, generally provide yields that include; 1) better patient care, 2) outcomes that are more predictable as well as 3) higher shared (between the patient and dentist) confidence levels. It is with these concepts in mind that a recent tool, the M-Scan, was introduced in 2011. M-Scan is a two lead EMG machine that allows the dentist to test the effectiveness of appliance therapy on their patients (Fig. 1). It also will, immediately and on a continuing basis, evaluate the success of appliance therapy for a patient, while reinforcing the usefulness of such therapy. It is reliable, inexpensive, and non-invasive and yields data immediately! An advantage for the dental team, M-Scan is a tool designed for data collection by a trained assistant and the data is read by the patient and the staff together (Fig. 2). Subsequently, the information may be transferred to the patient's chart for comparison at a later time.

EMG CONCEPTS IN DENTISTRY

Dr. James Boyd changed everything when he recognized that muscle tension headache may potentially be misdiagnosed as migraine and determined that interruption of the excessive muscle activity can be enhanced by an anterior-contact-only appliance. His innovation with this information was the nociceptive trigeminal inhibitory (NTI) appliance.¹ Dr. Barry Glassman had long been an advocate of parafunction as a major causative factor of many dental and muscle problems. He has taught (with his "think" or integrative style of instruction) that if we could reduce the night time parafunction of a patient having headaches or wear and damage to their teeth the patient could benefit in terms of quality of life. This approach could also be a more practical method of saving dentitions. To this end, Dr. Glassman taught biometrics that included the determination of muscle function generally in terms of overall activity, the condition of the temporomandibular joint in relation to the disc and the range of motion, including any limits of motion. From these measurements mastication is now qualitatively analyzed, kinetic studies are quickly and easily evaluated and even bite registration is measured and reproducible. The biometric group of instruments Dr. Barry Glassman has used and taught with is called the BioPAK Measurement System (BioResearch, Inc. Milwaukee, WI).² The EMG within that system is the foundation of the M-Scan.³⁻¹¹

Dr. Boyd shows in his teachings the two lead EMG studying Temporalis or Masseter muscle activity. It is this simplified visual aid that lead to the development of the M-Scan. In EMG studies the intensity of muscle activity or the muscles' ability to contract is measured by its electrical potentials in microvolts. The axiom is additive; or the greater the muscle contraction the greater the potentials. With the ability to measure activity from the surface we evaluate muscle activity generally in terms of the percentage of muscle contraction. Understanding that with no voluntary contraction there is only a small resting potential, we can show the amount of muscle contraction (recruitment) by comparing the summation of the contraction to the resting muscle. This is a qualitative test because the position of the electrodes is not exactly reproducible and we have no precise measure of acceptable symmetry or synergy. The anatomic variations that occur between individual patients are broad. However, relative intra-patient measurements can be very useful.

The muscle in contraction places forces on the teeth (and the muscles), potentially damaging teeth and/or the muscles. Repetitive forceful contractions may exhaust the muscles, resulting in a limited range of motion and/or pain. The NTI protects the teeth by not allowing posterior tooth contact and thereby reducing the recruitment (proprioception). Posterior tooth contact recruits far more muscle contraction in the elevator muscles. Limiting the occlusal contacts to only the anterior teeth inhibits contraction of the elevator muscles through proprioception. This is the reaction that reduces or shuts down the temporalis and masseter muscles. Other anterior appliances that produce similar results are used routinely and sometimes called anterior deprogramming appliances. The results of such appliances include the protection of teeth from excessive wear from nocturnal bruxism and forcing the elevator muscles of mastication to reduce their activity. Such appliances are generally prescribed for night time (sleep) use.¹²

THE VOCABULARY AND TERMINOLOGY OF ELECTROMYOGRAPHY IN DENTISTRY

The method of measuring muscle tension or contraction in dentistry utilizes surface electrodes and measures the electrical potentials produced in microvolts (μV). A muscle at rest will have a low background potential which produces less than 2 μV of average activity.¹³ The measurement of muscle potentials is called electromyography (EMG).

When muscles are recruited to apply forces together on the same side of the jaw (e.g. masseter and temporalis) they are contracting together in a synergistic fashion and we term this contraction measurement synergy. Note: With the appropriate software we can also see temporal recruitment and understand which muscle is firing first.

When the same muscles (e.g. left and right temporalis) contract bilaterally we can see the degree to which they produce a symmetric response. A symmetric response shows the muscles in the same quality of contraction in healthy states and that they are coordinated in time. This is referred to as indicating functional symmetry.

THE M-SCAN

The M-Scan is a two lead EMG. It is intended to be used on only two muscles at a time, recording symmetric contractions and comparing the results of the contractions in these muscles (e.g. L & R masseter or temporalis). The M-Scan may be used to summate muscle contraction only and is not used to evaluate temporal changes in muscle contraction or recruitment. It is a surface EMG using disposable electrodes that are applied directly over the muscle group in question bilaterally. There is a ground or reference lead that is applied at any convenient location, often at the base of the neck. The M-Scan is powered by one 9-volt battery. It includes simple recording instructions on the screen and as the steps of the screen progress the testing is completed and a summation screen is the result what is recorded. There is no method of transferring the data of the M-Scan to a computer or printer, thus all recordings must be recorded either by hand or with an image of the screen taken and placed in the patient's record.

Because EMG is also a biofeedback type of recording method, BioResearch has elected to make it possible to include the patient directly in the testing. This is accomplished by explaining the test to the patient and then asking the patient to hold the M-Scan, while electrodes are placed over the anterior bellies of the left and right temporalis muscles together with the reference electrode. The staff member then connects the leads to the electrodes and the M-Scan is turned on. The patient is told to only bite when prompted by the staff member administering the test. The test begins as the patient is asked to clench with maximum force on the back teeth. As the patient bites down a record of the contraction is made and recorded in μV s. Next, there is a message to cover the anterior teeth with an appliance, cotton roll, tongue depressor, etc. and the patient is again asked to bite down with maximum force onto it.

The test is complete and the two records are compared both in μ Vs and as a percentage. The calculation of the percentage allows the patient to witness the difference in contraction strength quantitatively. A photograph may be taken of the screen and placed in the patient chart or the results may simply be recorded manually.

The patient now has the ability to identify and witness the effectiveness of posterior disclusion in terms of reduced muscle recruitment. It is valuable to have photographs of the patient's anterior dentition to show the wear and damage that has occurred and allow the patient to attempt to place faceted teeth together to photograph. This exercise (placing faceted teeth together) is usually difficult, but it allows the dentist to build the case that the facets are the product of bruxing wear and damage that usually occurs at night. An anterior appliance can provide two important services; 1) protecting the dentition and 2) reducing harmful, excessive muscle activity. The M-Scan measures the effectiveness of the appliance directly by showing the extent that the muscle activity has been reduced.

The design of the anterior deprogrammer or the NTI is explained to the patient and the suggestion for night time wear to protect the teeth and allow rest for the muscles is explained using the M-Scan. The M-Scan is next used to check the fit and function of appliance therapy and again as the patient is re-appointed for follow-up or routine evaluation appointments in the future.

CONCLUSION

The M-Scan was developed as an adaptation of an existing biometric (BioEMG) to quickly evaluate the validity and efficacy of appliance therapy or another treatment. When a dentist invites a patient to consider preventative treatment, it is useful to have some method available to validate the need for it, as well as the ability to demonstrate the objective of such treatment. The M-Scan allows the dentist to demonstrate to the patient the need for preventative care as well as the efficacy of such treatment, while reinforcing the value of continuing treatment.

During appliance therapy the patient should return after 30 days of use for re-testing for a re-evaluation of the appliance's efficacy. As muscle tension is relieved there may be relief from frontal headache (muscle tension headache). At the re-evaluation appointment patients are asked (again) about their headache frequency (if they had headaches in the beginning). Their response is recorded in the patient chart with any comments regarding the amount of relief the patient indicates. The visual analogue scale (VAS) (pain scale) is the method used to record changes in the patient's headache pain.

The M-Scan is an instrument that is simple to use and intended as a quick measure for most pain patients who are routinely evaluated and maintenance cases, as well as new patients who are being evaluated for emergency care (toothache, broken teeth, pain, etc.). As an adjunct to conventional diagnostic methods, the M-Scan gives the patient the opportunity to understand the need, the process and the results of treatment directly. When the patient understands the underlying problems that exist, that cause pain, wear and damage and general degenerative changes in the total dental environment, the patient is more receptive to owning their problems and accepting optimum treatment. **OH**

Drs. Paul Mitsch and Rob Colt practice in Augusta Kansas. Dr. Mitsch is a graduate of Washington University in St. Louis (1977) while Dr. Colt graduated from the University of Colorado (2004). Dr. Colt and Dr. Mitsch met at the residency offered by The American Academy of Craniofacial Pain in 2006, where they subsequently were awarded Distinguished Fellowships from the Academy. Since that meeting and their partnership, in 2008, they have focused their general practice on complete care and utilize many new technologies including the BioPak from BioResearch. They are dedicated to biometrics and objective methods to identify and issues their patients present with. Their practice may be viewed at www.afdmitsch.com. They own and operate a training center, American Family Dentistry Training Center (afdtc.com) which is dedicated to core education for the general dentist.

Oral Health welcomes this original article.

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Photos

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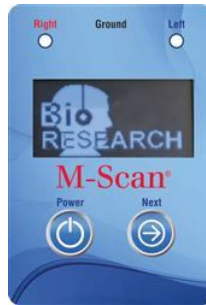
Caption: Figure 1. M-Scan applied to patient.



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Caption: Figure 2. M-Scan frontal view.



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Caption: Figure 3. M-Scan

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