Chapter 5
Adding Technology to Diagnostic Methods

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ABSTRACT
Adding technology to clinical diagnosis improves patient care, because objective measurements enhance the patient’s report of symptoms and the observations made during an examination. The combination of multiple tests has universally been acknowledged to improve diagnostic sensitivity and specificity, as well as add value to treatment effectiveness monitoring and treatment outcomes. This chapter discusses four dental technologies that objectively measure differing masticatory functions: Surface Electromyography, Magnet-Based 3-Dimensional Electrognathography, Temporomandibular Joint Vibration Analysis, and T-Scan Computerized Occlusal Analysis. Each technology is presented with examples of its output data recorded from both an asymptomatic patient and one demonstrating masticatory system dysfunction. An included case report illustrates how combining these technologies can therapeutically improve a symptomatic Occluso-Muscle Disorder patient’s diagnosis and treatment. Finally, recommendations are made that Dental Medicine accept these technologies as an indispensable part of modern clinical practice, so that resistance to their implementation will no longer inhibit their use.

INTRODUCTION
There are three types of data collection methods used in healthcare to gather information for research, for diagnostic purposes, or to monitor treatment outcomes. They are:

- Self Report (Patient History).
  - Type of data: Subjective
- Observation (Clinical Examination).
  - Type of data: Subjective/Objective
- Bio-Physiologic Measurement (BPM).
  - Type of data: Objective/Subjective (Interpretation)

Of the above three methods, BiophysioLogic Measurement is the most quantifiable (e.g. blood pressure, heart rate, range of motion), since it incorporates modern measurement equipment, and currently takes full advantage of the latest advances in computer technology. Despite the advantages of incorporating digital technology
in dental practice, resistance within the dental community discounts the application of technology to dental diagnosis and treatment monitoring (Reid and Greene, 2013; Greene, Klasser & Epstein, 2010; Greene, 2010a; Greene, 2010b). In the 21st century, this resistance is surprising especially considering that there exists a myriad of evidence-based information, published studies, and extensive dental literature, that demonstrate the efficacy of various technologies for specific dental applications.

However, a closer inspection of some published literature that appeared in 1969, proposed a psychosocial and stress-related theoretical epidemiology of what was termed “Myofascial Pain Dysfunction Syndrome” (MPDS), that to date, has long fueled the debate as to the need, or lack thereof, to employ measurement technology when diagnosing Temporomandibular Disorders (TMD) (Greene, Lerman, Sutcher & Laskin, 1969). The biopsychosocial etiology minimizes the role that the breakdown of masticatory structures plays in the appearance of Temporomandibular Disorder symptoms, thereby eliminating the need to measure physical and structural function. This stress-related epidemiologic theory was further perpetuated into the early 1990s, when the so-called “Research Diagnostic Criteria” was first postulated as a valid method to diagnose TMD (Dworkin & LeResche, 1992). The ongoing belief within the dental profession that TMD is caused by emotional stress, explains why some clinicians and authors still resist using any bio-physiological measurements in clinical diagnosis. The “biopsychosocial” theorists’ rejection of virtually all physical diagnostic measurement, is based in their (incorrect) assumption that TMD has no causative physical structural basis. It is interesting to note that resistance to technology-aided TMD diagnosis is maintained philosophically, despite there being a complete lack of reproducible physical data to support these biopsychosocial theories. Alternatively, the dental literature does contain many studies that detail the benefits that technology offers to patients who present with Temporomandibular Disorders, some of which will be described within this chapter. While scientific honesty requires acknowledging conflicting or competing theories, it can be a difficult pill to swallow.

**Biophysiologic Measurements**

In some cases BPM does require some interpretation (e.g. MRI Images), which adds a degree of subjectivity. However, *Observation* is far less quantifiable. For example there is no quantification obtained when stating, “you look sad and appear to have a rash”, or when asking “are you just too warm?” (Carr, 1994; Pollack & Panacek, 2000) While some observations can be objective (e.g. a missing tooth), much of what is observed is highly subjective (e.g. muscle palpation). Thus, BPM is the most objective and *Observation* is the least objective, but BPM can also potentially be physically intrusive (e.g. ionizing radiation). Self-report falls somewhere in between, being less quantifiable, less objective, but also somewhat less intrusive than BPM. The analysis of a patient’s history and/or examination data, due to the subjectivity of those methods, sometimes combines a number of variables into a scale or index in an attempt to mitigate this shortcoming (Helkimo, 1974).

Biophysiologic measurements are rarely applied in medicine or dentistry with the idea of arriving at a diagnosis in a vacuum (without an included history or clinical examination). Often, only a partial diagnosis is determined (e.g., an “arthritic condyle” is not a complete diagnosis for the typical TMD patient). It would be considered unusual to draw blood without taking a patient’s oral disease history, examining the patient, and establishing a rationale for drawing the patient’s blood. The objective measurements of physiologic parameters are routinely combined with the history and clinical findings to enhance the preliminary diagnosis, without eliminating their diagnostic need. Expecting technology to replace the need