TEMPOROMANDIBULAR JOINT DISORDER: A REVIEW OF NEW FUTURISTIC APPROACH.

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ABSTRACT: The varied etiologies and path physiology of TMJ problems make them challenging to detect and treat. The majority of current TMJ condition therapies are palliative. Only when the etiologies, risk factors, and pathophysiology of TMJ illnesses are thoroughly understood can definitive and logical diagnoses or therapies be made. We are starting to get a glimpse of future advancements in the diagnosis and treatment of TMJ disorders thanks to recent advances in biology, imaging, and computer technology. With the development of technology like artificial intelligence, it has the potential to make ground-breaking improvements in health education and dental care, boosting business for dental offices and providing top-notch treatment to a bigger population that now has restricted access to it.

Key words: Temporomandibular joint, Artificial Intelligence, Biomedicine, Tissue engineering, Orthopedics, Imaging, Neuropathic pain, Orofacial pain, Diagnosis and therapeutics, Gene therapy.

INTRODUCTION:

The aetiologies and pathophysiology of temporomandibular joint illnesses are poorly known, making them challenging to detect and treat. Temporomandibular disorders (TMDs) are conditions that affect how well the temporomandibular joints (TMJ) work and the neuro-muscular system that is connected to them, which can lead to discomfort from TMDs [1]. Dr. James B. Costen, an otolaryngologist in Saint Louis, Missouri, identified what are now known as temporomandibular disorders (TMD) for the first time in 1934 [2]. TMDs are exceedingly difficult to diagnose since the symptoms are so subjective, and patients frequently seek out care from medical professionals other than dentists (e.g. neurologist, otolaryngologist or ophthalmologist).

Masticatory Pain Dysfunction Syndrome (MPDS) is a term used to describe masticatory system anomalies, including pain brought on by tensed masticatory muscles [3].

As a result of the psychological components of TMJ disease, Laskin eventually proposed the Myofascial Pain Dysfunction Syndrome (MPDS) theory in 1969 [4], which assumed a psychological stress-related origin. The word "TMDs" is not diagnostic but rather a general phrase that covers a variety of disease entities, including discomfort in the masticatory muscles and temporomandibular joints, headaches, problems with the jaw's movements, and clicking or popping sounds when opening and closing the mouth.

TMDs are a collection of disorders that affect how well the temporomandibular joints and accompanying muscles work, which can painfully impede the stomatognathic system's ability to function [5]. The fact that the TMJ is used between 1500 and 2000 times per day demonstrates how seriously uncomfortable jaw movement disorders are [6]. The majority of patients experience discomfort in addition to intraoral symptoms of masticatory dysfunction, such as teeth that are more sensitive due to abfraction and pathological attrition, gingival recessions, teeth that are more mobile, and loss of bone support [3]. The tongue and the linea alba (of the cheek mucosa) are two other soft tissues where teeth impressions are seen [7].

TMD Diagnosis Aiding Technologies:

There are only three sources of information can be used to make a diagnosis: the patient's medical history, the clinical examination, and various physical measurements.

It has been demonstrated in the past that a history and clinical examination alone are frequently insufficiently exact to identify every problem a TMD patient may be experiencing [8–10].
Electromyography (EMG) equipment, jaw movement trackers, and joint sound recorders are the three primary categories of apparatus (sonography or vibratography).

The oral physician and maxillofacial surgeons who treat intracapsular TMJ disorders use the sonography or vibratography machines to record TMJ noises that may be of particular diagnostic value and interest.

The description of particular sound patterns, frequencies, and wavelengths as characteristics of particular diseases [11] can help with the differential diagnosis of such conditions.

Jaw tracking:

Several different types of recording devices have been created to measure the movement of the complete mandible in relation to the maxilla, in addition to pantography and axiography devices that track jaw motions at the condylar level [3].

Balkhi and Tallents 1979 shown that these tools routinely underestimated big mandibular motions, which inexorably results in the false positive diagnosis of limited mandibular mobility and may lead to overtreatment of healthy individuals.

Because the output from such equipment is assumed to be quantitative and objective, electromyography: Surface EMG of the muscles of mastication has been promoted by some dentists as a current scientific method to the diagnosis and treatment of patients who have TMDs.

Based on the presumption that aberrant masticatory muscle activity can be used to identify some pathologic or dysfunctional states [3], EMG sensors are used to measure electrical activity in the brain.

Imaging and other TMJ-related technologies are frequently required when a patient's TMJs are obviously symptomatic but are typically not routinely included in screening examinations for TMD. Some contend that imaging ought to be used only when "advised." The dental literature as a whole does not include any common "indications" or criteria for when imaging is actually necessary.

Panoramic X-rays, magnetic resonance imaging, and computerized tomography scanning are some of the imaging modalities used in TMD screening.

Electrognathography is a piece of technology that can assess movement problems.

Movement disorders can be caused by systemic malfunction (such as ALS, Parkinson's disease, etc.) or by dysfunction in a specific bodily part. The movement of the mandible is a major concern in dentistry, particularly when it is restricted or includes abnormalities.

The following three measurements are the most popular:

1) The mandibular range of motion (ROM) when it is fully opened
2) Lateral excursions to the left and right, and
3) protrusion.

Electromyography is a technology that can assess muscular abnormalities (EMG). When a muscle contracts, electromyography captures the electrical activity from the muscle. Due to the extremely low voltage (measured in microvolts, or millionths of a volt), a specialized differential amplifier is needed to record it.

Orthopedic stability, intraoral appliances, behavioral therapy, placebo, and drug therapy including analgesics, muscle relaxants, and antidepressants are just a few of the many therapies for TMDs that have been suggested. Transcutaneous Electric Nerve Stimulation (TENS) is a different approach to management [11].

TENS is a technique for treating pain that involves applying an electronic device that emits pulsed, biphasic electrical waves through electrodes positioned on the skin's surface. The use of electrical stimulation on the skin to treat pain is known as TENS. It is a well-known type of physical therapy that helps with pain management. It eliminates the potential side effects of other pain relief techniques and is a quick, non-invasive, safe way of analgesia. [12].

Cryotherapy is frequently used in the treatment of temporomandibular disorders (TMDs) when the patient exhibits painful symptoms. It is indicated for the treatment of pain caused by traumatic and/or inflammatory musculoskeletal diseases, especially acute ones. It also helps to reduce swelling and induce muscle relaxation.

Low-level laser therapy: Helps with healing and pain management. There isn't much data to support the effectiveness of this physical therapy, which is used to treat musculoskeletal diseases, in treating TMD.

A contemporary method for TMD diagnosis and therapy is neuromuscular dentistry. In order to create a neuromuscular occlusion, which is based on the ideal relationship between the mandible and the skull, it objectively assesses the complicated interplay between teeth, masticatory muscles, temporomandibular joints, and cranial nerves. Electromyography (EMG), joint vibration analysis (JVA), electro-sonography (ESG), and computerised mandibular scanning (CMS) are some of the computerized

instruments used in neuromuscular dentistry to assess the patient's jaw movements, muscle activity, and temporomandibular joint sounds [14].

The truth is that there aren't enough randomised double-blind clinical studies available right now to help objectively choose the best technique of diagnosing and treating TMD, while those researches may in the future help to solve the mystery surrounding temporomandibular disorders [15].

ARTIFICIAL INTELLIGENCE:

In the world of health care, what formerly appeared like science fiction is now a reality[16]. Fast-evolving technology known as artificial intelligence (AI) enables machines to carry out jobs that were previously only performed by humans. John McCarthy first used the term artificial intelligence in 1956. The goal of AI, a subfield of computer science, is to comprehend and create intelligent creatures, which are frequently realized as software programmes [17]. The present applications of AI in dentistry include the detection of healthy and unhealthy structures, disease diagnosis, and treatment result prediction [16–18]. The biological nervous system serves as the inspiration for the majority of common AI analytical methods used for picture processing.

ARTIFICIAL INTELLIGENCE IN ORTHOPEDICS:

The use of artificial intelligence (AI) in orthopedic surgery is gaining popularity. In the previous few decades, new technologies have been rapidly adopted in a variety of fields, including orthopedics [19], power tools, novel implants, CAD-CAM design, additive manufacturing, and 3-D printing.

Large datasets suited for the creation of AI algorithms are provided by the rise in digital medical imaging and the data gathered in databases and orthopedic registries. These could enhance patient care on a variety of fronts, such as diagnosis, management, research, and systems. AI algorithms that have been created to analyze registry data retroactively could be utilized to create prospective research.

ARTIFICIAL INTELLIGENCE IN TMD's:

One of the most difficult challenges in the post-genomic era is identifying disease genes from a large amount of genetic data [1]. "Complex diseases and disorders" involving the mouth, teeth, and head and neck Osteoporosis, osteoarthritis, and temporomandibular joint illnesses are conditions brought on by a combination of environmental factors and various gene alterations.

The temporomandibular joint is a tiny, very painful joint. One joint receives all of the dentist's attention, and it is commonly ignored. Temporomandibular disorders (TMDs) are frequent painful craniofacial anomalies that affect the masticatory muscles and temporomandibular joint [20–22]. They are the second most prevalent musculoskeletal condition after back pain [23]. It might be difficult to treat temporomandibular joint issues because to their numerous aetiologies and pathophysiology. Due to the very diverse genotype of temporomandibular joint problems, it is challenging to establish biological markers; as a result, patients frequently endure treatment delays, missed diagnoses, and over-the-counter medicine. Isolating the disease-causing genes from a vast amount of genetic data is one of the most challenging issues in the post-genomic era.

In the post-genomic era, mapping often entails genome sequencing, analysis of the resulting sequence using computational methods that enable gene identification, and gene identification. The advantages AI models offer for processing large amounts of complex biomedical data has enormous potential to speed up genetic medicine advances.

BIOMEDICAL APPROACHES TO DIAGNOSE, ALLEVIATE, OR PREVENT JOINT DEGENERATION:

SYSTEMIC AND LOCAL BIOMARKERS OF DISEASE:

A widely sought-after strategy for the early diagnosis of various disorders and for assessing the effectiveness of treatment modalities is the use of disease-specific biomarkers. Although a "gold standard" biomarker for TMJ problems has yet to be discovered, advanced new technologies like microarrays on tissue, synovial fluid, or serum samples may one day make it possible to find sensitive and precise TMJ disease biomarkers. With very little material, microarrays enable the investigation of the expression of thousands of genes. Thus, new genes or gene combinations that are predictive of TMDs may be found using microarrays on blood samples from patients with TMJ disorders [15].

Nine genes thought to be predictive of knee osteoarthritis were discovered in a recent study [24] by microarray analysis of 3,543 genes in blood samples from patients with moderate knee osteoarthritis and non-symptomatic controls. It is probable that tests based on the results of such studies will be made commercially available in the upcoming few years as useful tools to help the physician in the early and precise diagnosis of a variety of joint problems, including thoseinvolving the TMJ.

USING TECHNOLOGY AND BIOMEDICINE TO ENGINEER THE TMJ:

Surgery to repair the mandibular condyle is still the sole treatment for people with severe and excruciating TMJ degenerative disorders. Autogenous tissue grafting, such as from the rib, or the use of alloplastic materials were the two main techniques used to reconstruct the TMJ up until recently; nevertheless, neither was particularly well suited for the job and occasionally had highly negative results [21–22]. A bioengineered TMJ replacement that is compatible with a host, biologically viable, and able to endure the physiologic pressures required of this joint may soon be successfully reconstructed thanks to recent developments in the

understanding of stem cell biology and biomaterials.

FUTURE PERSPECTIVES:

A dynamic field of macromolecules, natural products, and innovative functional materials have replaced routinely used small compounds in the last 25 years as treatment options for TMDs and related diseases. Based on the study of the pathogenic mechanism of TMDs, tissue engineering has substantially influenced the translation of novel therapeutic techniques. This field has made significant strides in the successful therapy of inflammatory disorders, pain, and novel attempts at TMD prevention using regenerative medicine.

Growing evidence suggests that adaptive reconstruction of the TMJ can be successfully used in preclinical and clinical research as a result of these efforts, which may ultimately result in pleased clinical outcomes. A more effective and individualized treatment for TMD patients may eventually be made possible through therapeutic techniques[15].

CONCLUSION:

Technologies based on computers and advances in biology hold significant potential for treating people who are predisposed to or currently have TMJ problems. These technological advancements will improve diagnostic capacities and logical therapeutic or preventive approaches. The range and specificity of diagnostic and treatment techniques for TMJ illnesses are anticipated to be expanded by genetic analysis, biomarkers, imaging, and tissue engineering. The advancements in biomedicine, imaging, and computer technology also indicate the necessity for academicians, researchers, and the healthcare industry to properly train and prepare future physicians to benefit from these developments.

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