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Management of Temporomandibular Joint Pain: Smile Wand, the Medico Dental Device

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ABSTRACT

Temporomandibular joint pain involves neurological, physiological, and biomechanical relationships of the temporomandibular disorders. Symptoms of TMD significantly impact a patient's day-to-day life. The aim of the study was to investigate whether SmileWand may be effective in clinical terms to enhance the pain, psychological, and systemic health outcomes and respiratory-related quality of life in patients who have TMJ. The researchers monitored changes in the pain experiences of participants prior to the intervention and after it. A total of 2,700 individuals from a private clinic were chosen. Informed consents were taken. Pre-test and post-test information collected included physical examination and a structured face-to-face questionnaire. The duration of the intervention was 15 minutes, and the device was placed between the arches of the teeth. Data were analysed with descriptive and inferential statistics. Stunning changes in pain ($p < 0.001$) were observed in the post-test, with the masseter (30.1%), temporalis (27.4%), and headache (24.8%) muscles showing significant improvements. Better psychological parameters when compared to the p-value of less than 0.01 were observed in insomnia (33.6%), anxiety (41%), and depression (35%). A major percentage (39.6) of the patients without symptoms mentioned improved symptom resolutions. Better breathing comfort, vision, sleep, and respiratory quality were meaningful systemic health and life quality domains. The results distinctly depict effectiveness in pain and symptom treatment in TMD patients. To clarify the physiological, biomechanical, and psychosocial foundations of the SmileWand, including its mechanism of action and long-term effectiveness, further research is necessary.

INTRODUCTION

The temporomandibular joint (TMJ) has unique anatomical features that are specialized to be increasingly coordinated to allow movement (Almashraqi, 2021). Temporomandibular disorders collectively refer to conditions involving pain and dysfunction in TMJ (Ohrbach & Sharma, 2024) and associated muscles that facilitate movements such as the muscles of mastication (Al Hayek *et al.*, 2019). TMJ prevalence among the general population is reported to be between 5 to 12% (Schiffman *et al.*, 2014); however, its incidence may vary up to 25% (Murphy *et al.*, 2013) to 40% (Calixtre *et al.*, 2014). Global estimates for TMD prevalence a varying distribution across regions, such as 47% in South America, 33% in Asia, 29% in Europe, and 26% in North America (Zieliński *et al.*, 2024). TMDs are more common in women than in comparison to their male counterparts (Minervini *et al.*, 2023; Zieliński *et al.*, 2024). According to the WHO, TMD ranks third in commonly observed dental issues, following dental caries and periodontal disease (Ey-Chmielewska *et al.*, 2014). TMD is believed to be another common cause of nondental chronic pain in the orofacial area (List & Jensen, 2017). The origin of TMJ pain has been categorized as either of particular origin exhibiting symptoms aligning with TMJ, or of muscular origin, where exhibited signs are due to stomatognathic musculature (Bender, 2012). TMDs pose a serious impact on healthcare systems and eventually the economy through loss in productivity and increased healthcare costs due to disorganized care pathways, which increase the number of consultations for a proper diagnosis or treatment (Yost *et al.*, 2020). Similarly, the oral health-related quality of life is also impacted due to the physical and psychological discomfort induced by TMD (Hanna *et al.*, 2021).

Based on functionality, TMJ is characterized as being ginglymoarthrodial, which means it is a hinge joint that allows forward and backward movements but also sliding movement of its surface. Anatomically, it enables the discontinuous articulation of two bones, facilitating free movement. TMJ is also found to be a synovial joint providing lubricant and fulfilling metabolic and nutritional needs (Crespo Reinoso *et al.*, 2022). This unique anatomy enables TMJ to perform several functions, including chewing, sucking, swallowing, facial expression, etc. (Bordoni & Varacallo, 2023). TMJ dysfunction and TMD onset are closely related and may be caused due to occlusal challenges, orthodontic therapy, macro- and microtrauma, orthopedic instability, exogenous estrogen, or joint laxity. Additionally, psychological triggers are also reported to cause TMD through mental tension, stress, anxiety, and depression (Vinayak *et al.*, 2024). TMD is used as an umbrella term that includes myofascial pain, headaches, articular disc displacement, joint pain, and TMJ degeneration, which negatively impact a patient's physical and mental health, often limiting their work, school, or social life (Klasser & Murchison, 2025). TMDs are typically diagnosed using the diagnostic criteria for

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Temporomandibular Disorders (DC/TMD), which is the gold standard due to its sensitivity and specificity for diagnosing the common TMDs. It includes Axis I, which involves physical examination of TM, including its painful dimensions (myalgia, myofascial pain, arthralgia, headache attributed to TMD), and non-painful dimensions (disc displacement with reduction/intermittent locking, disc displacement without reduction and limited opening, and vice versa, degenerative joint disease and subluxation). Axis II involves its biopsychosocial evaluation (Li & Leung, 2021). The most frequently observed symptoms and comorbidities of TMDs include restricted joint function with altered mandibular physiological movements, comorbid articular pain during a variety of functions, such as mastication, headache, and TMJ noises (Ângelo *et al.*, 2023).

TMD etiology is complex, as it is accompanied by biological, psychological, and behavioral factors, such that psychological distress increases the severity of TMD. Another factor in this complicated scenery of TMD is the sleeping disorder that contributes to the magnitude of the symptoms. The current therapeutic interventions have difficulties in their effectiveness, as this multifactorial organization of TMD can present the problem (Prada *et al.*, 2024). Also, this trickiness of TMD symptoms and disorders complicates the matter since it is a hard task to propose a simple solution to them. When it comes to TMD-related risk factors such as parafunctional habits, poor posture, intense pains, poor sleep, and depression, a minimally invasive and cost-effective treatment choice is more possible (Alowaimer *et al.*, 2024). The causes of TMD-associated disorders differ and complicate the treatment process, although the severity of symptoms varies, being another diagnostic and treatment obstacle to TMD course treatment (Gauer & Semidey, 2015).

The extensive nature of the effects of TMJ disorders on various anatomies and their related symptoms implies the use of extensive strategies to treat them. The comprehension of such associations is essential in designing powerful remedies that not only reduce both symptoms of TMJ but also promote good health and well-being. Our study also touches upon the less traditional systemic musculoskeletal TMJ symptoms such as sciatica, headaches observed before or after sleep, or trauma exhibited by past or recently experienced car accidents, all of which may contribute to the underlying biomechanical and central sensitization phenomenon. In this study, the researcher proposes to explain these complex connections and discuss the possible innovative methods, alternative forms of treatment of TMJ disorders, and the advances in respiratory performance.

The purpose of the research is to determine the effectiveness of utilizing SmileWand, which is a substitute for a wooden stick, as compared to temporomandibular joint (TMJ) disorders, in patients who have failed to be relieved by the use of conventional therapeutic methods. This study aims to provide an adjunctive therapeutic pathway for patients not responsive to conservative treatments. Findings will promote a more thorough understanding of the muscular, ocular, and physical well-being of TMD patients by resolving the most disruptive TMD symptom, i.e., Chronic pain.

LITERATURE REVIEW

Anatomy and Biomechanics of the Temporomandibular Joint (TMJ)

Temporomandibular joints present a unique structural composition that includes the articular disc, mandibular condyle, glenoid fossa, and synovial fluids (providing nutrition to TMJ) (Vinayak *et al.*, 2024). It is their specialized gingio-mandibular anatomy that enables rotational and translational jaw movements. A complex of TMJ and related structures such as mandibles, the temporal bone of the mandibular fossa, teeth and soft tissues as a unit is fundamental to the critical body functions such as breathing, swallowing and talking (Di Fabio, 1998; Ingawalé & Goswami, 2009; Mérida-Velasco *et al.*, 1999).

Classification and Pathophysiology of Temporomandibular Disorder (TMDs)

TMD can be divided into joint disorders and painful conditions according to the Diagnostic Criteria of Temporomandibular Disorders (DC/TMD) described by Schiffman *et al.* 2014; the latter include but are not limited to the types of myalgia, arthralgia, and headache (Schiffman *et al.*, 2014). Issues related to the musculoskeletal system and the related structures result in the development of TMD, which, based to a large extent, presents pain resulting to jaw discomfort and in extreme circumstances, jaw dysfunctions, as well. Myofascia pain, internal joint derangement, degenerative joint disease, and arthralgia are some of the common TMDs (Kitsoulis *et al.*, 2011). TMJ and relative masticatory muscle dysfunction are the most widely reported pathophysiologies, involving joint contact. TMJ pathophysiology has prolonged impacts on the quality of life of the patient, including simple tasks and the essential functions. The disorder of functional origin due to structural changes in TMJ is caused by a myriad of elements, including biological, behavioral, emotional, and social factors, etc. (González-Sánchez *et al.*, 2023). Orofacial pain is the most common secondary pain experienced when a TMD is reported, which leads to the initiation of treatment; however, its neurological basis points toward increased sensitization of neurons (Baroni *et al.*, 2020), which makes it a tricky participant in the pathophysiology of TMD. Several common TMD symptoms are reported across the literature, including pain, locking of the jaw, noises coming from joints, limited mouth opening capability, masticatory fatigue, severe headaches, and compromised oral functions (de Godoi Gonçalves *et al.*, 2010; Ferendiuk *et al.*, 2014). Out of all the mentioned symptoms, chronic pain has been the most widely cited TMD symptom with an underlying neurophysiological mechanism that involves the triggering of peripheral nociceptors of TMJ in response to several phenomena, including inflammatory mediators, mechanical stress, or tissue damage, resulting in increased peripheral sensitization and ultimately pain. To make matters worse in chronic pain, peripheral sensitization further translates the nociceptive information towards the CNS through the trigerminal nerve, resulting in central sensitization, which is a hallmark of chronic pain in TMD patients, inducing increased perception and persistence of pain (Wani & Anand, 2025). Central sensitization refers to the pain hypersensitivity which might induce secondary changes in brain activity which has a significant implication in pain phenotypes of patients of TMD (Woolf, 2011), this may provide a plausible neurophysiological explanation to the sciatica-like symptoms in TMD patient. Similarly, in chronic pain conditions due to central sensitization, sleep quality and sleep efficiency is often compromised (Dos Santos Bento *et al.*, 2023) which might explain the headaches observed before or after sleep in TMD. A history of accidents or whiplash trauma is a well-established risk factor for TMD, studies also suggest an association between TMD and the skeletal structures of cranio-cervico-mandibular system, particularly the skull-atlas and atlas-axis rotation are reported to be crucial in the aetiology of TMD (Häggman-Henrikson *et al.*, 2025; Öztürk *et al.*, 2024). Collectively, these studies highlight the presence of unrelated systemic symptoms in TMD patients.

Prevalence and Etiological Factors

A recently conducted systematic review reports that the global prevalence of TMD has reached 30% of the global population, while gender distribution demonstrates women are more prone to experience TMD than men (Alqutaibi *et al.*, 2025). It is also ranked to be the third most common oral health challenge reported. Etiological factors in the manifestation of TMD are often classified into biological/mechanical causes, psychological and behavioral challenges, and genetic predisposition. Severe mechanical stimuli may result in the degeneration of condylar cartilage (Xiao & Ni, 2025). Additionally, studies report occlusion and malocclusion-related factors (Aldayel *et al.*, 2023), trauma injuries to TMJ and its associated structures resulting in facial asymmetry, growth disturbance, osteoarthritis (Giannakopoulos *et al.*, 2009), orthodontic treatment, joint laxity, and exogenous estrogen (Chisnoiu *et al.*, 2015), all of which collectively lead to TMD onset and progression. Psychosocial factors play a critical role in exacerbating TMD risk, where psychosocial stress, emotional responses, coping heterogeneity, anxiety, depression, and somatization led to TMD onset, catastrophic levels of pain severity, and functional impairment (Huqh *et al.*, 2020; Martinez-Calderon *et al.*, 2020). Comorbidities are driven by central sensitization in the chronic pathophysiology of TMD (Ferrillo *et al.*, 2022). One of the widely cited risk factor for TMD across the literature are the parafunctional habits involving factors like jaw clenching, which complicates the biomechanics of the jaw by straining it. Similarly, the burden of TMD on a patient's life is intensified by associated systemic health indices (e.g., osteopenia, infections, etc) (Klasser *et al.*, 2023).

Diagnostic Criteria and Methods

The widely used diagnostic criteria for TMD have been updated to Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), which was published after a reassessment of its psychometric properties. It has also increased validity and reliability and added Axis I and II elements that currently explain broader TMD etiological mechanisms by an evidence-based algorithm (Wan *et al.*, 2025). A potential means of screening patients with TMD would be the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) having validity and reliability. It is a self-administered symptom questionnaire to offer the necessary clinical information to examine. DC/TMD consists of two axes. Axis I deals with physical examination, and Axis II encompasses psychosocial evaluation (Al-Moraissi *et al.*, 2023; Gonzalez *et al.*, 2011; Schiffman *et al.*, 2014). The typical diagnosis of TMD involves the patient's medical history followed by detailed physical examination of TMJ and its associated structures, evaluation, and range of motion (Małgorzata *et al.*, 2020). Then the expanded and improved instruments of Axis I evaluate pain history and clinical symptoms in the temporomandibular and masticatory area through the TMD Pain Screener and Symptom Questionnaire, critical for diagnosis (Schiffman & Ohrbach, 2016). Next, patients psychosocial and behavioral attributes are evaluated through standard questionnaires including mental stress (PHQ-4), pains intensity and related disability (GCPS), graphical pain identification in head, body and jaw, limitations faced in jaw flexibility, chewing, verbal or emotional expression (JFLS), frequency of parafunctional behaviors (OBC), depression (PHQ-9), anxiety (GDA-7) and somatic symptoms (PHQ-15). These tools are only utilized for screening, to confirm the diagnosis, imaging technologies such as computed tomography (CT) or Magnetic Resonance Imaging (MRI) are ordered (Peck *et al.*, 2014).

Therapeutic Modalities

Treatment of TMD remains challenging due to the diversity of pain severity and overlapping symptoms, which underscores that only one treatment modality will not resolve the disorder at hand; rather, it requires a strategic approach of a combination of treatment modalities (Durham *et al.*, 2015). Several common non-invasive treatment modalities include occlusal splints, which help with bruxism, headaches, and postural imbalances (Albagieh *et al.*, 2023), physiotherapy/jaw exercises that help in alleviating pain and restoring jaw functions (Garrigós-Pedrón *et al.*, 2019), behavioral therapy such as CBT for pain management (Gil-Martínez *et al.*, 2018), and pharmacological therapies such as non-steroidal anti-inflammatory drugs (NSAIDs) (Ma *et al.*, 2023). Non-pharmacological treatments are preferred as a first-line treatment (Al-Moraissi *et al.*, 2022), and pharmacological options are deemed suitable for pain management and improved quality of life (QoL) (Johansson Cahlin *et al.*, 2006). Clinicians usually recommend surgical options as a final form of treatment when all other treatment methods have been exhausted (Guarda-Nardini *et al.*, 2021). Although the evidence base is increasing, the management practices of TMD have weaknesses because of a lack of persistence in their efficacy, patient non-adherence to treatment, and adverse reactions (Yost *et al.*, 2020).

Psychosocial and Quality of Life Dimensions

Psychosocial dimensions have a serious effect on the onset of TMD. Patients' main motivation to seek treatment is the TMD exhibited psychological burden (Manfredini *et al.*, 2011). Consistent pain severity increases disability as a result of maladaptive thought patterns and behaviors, which not only limit daily activities but also induce psychological distress, which further exploits pain severity (Durham *et al.*, 2015). Disability and pain intensity are exacerbated by an underlying relationship with mental health disorders, which include fear-avoidant behaviors, depression, anxiety, and passive coping strategies (Yap & Lee, 2023). Studies also report that TMJ dysfunction onset may also be caused by traumatic life events (Speculand *et al.*, 1984).

Research Gap

Recent studies examining the efficacy of non-invasive treatment (cognitive behavioral therapy, pain neuroscience education, exercise, and manual therapy) report low to very low confidence levels in reducing pain levels in TMD treatment (Dinsdale *et al.*, 2025), which highlights that there is a significant lack of physical-psychological interventions. While there is a growing body of evidence that ocular and TMD are closely related through their anatomical craniofacial structures and functionality through muscles (Khijmatgar *et al.*, 2025), there is a lack of focus on muscle-ocular-TMJ interactions. This highlights the rationale of introducing interventions like SmileWand, which helps bridge the gap in existing management practices of TMD through utilizing its psychosocial and biomechanical dysfunction dimensions.

MATERIALS AND METHODS

Study Design and Population

This study was designed as a pre-test/post-test study to evaluate the efficacy of the SmileWand device in alleviating temporomandibular joint (TMJ)–related pain and associated systemic symptoms. A Medicodental intervention was introduced to patients to record any symptom reduction experienced by the TMD patients following the exercise. It was ensured that the efficacy is tested on a broader population of different backgrounds by pooling the participants in the patient database of a private clinic that included individuals of many backgrounds. 2700 participants were selected for final inclusion, which involved males/females, ages ranging from 12 to 70 years, belonging to diverse socioeconomic levels, cultures, and nationalities.

Recruitment and Eligibility

The recruitment process was conducted from January to June 2019. Inclusion criteria entail participants were between 12 to 70 years old, able to provide informed consent (parental consent for participants below 18 years), and willing to use the prescribed intervention. Participants were excluded in case they were not compliant with the age requirement, hesitant in trying the intervention, not able to provide consent, and any recent medical condition that involved other orofacial/myofascial pathologies other than TMD.

Ethical Considerations

Study maintained strong ethical practices (Declaration of Helsinki) to ensure compliance with standard research practices involving human subjects. Ethical approval was sought and granted by the Institutional Review Board at the site of study. Participants were supposed to sign informed consents, which detailed the benefits of the study, risks of the study, information about the intervention, purpose of the study and the option that the study participants have of leaving the study any time they feel like. Parents/guardians gave their consent in case of the minor. The researchers placed the confidentiality of the respondents with the highest levels of importance and, therefore, no identifying information was gathered.

Clinical Examination

The clinical examination was undertaken, and a face-to-face questionnaire section was conducted before and after administration of the intervention in a dual approach. This method played an important role in creating the relationship between TMJ and respiratory comfort.

First, a strict clinical assessment overseen by a group of dental specialists was also conducted who assessed the functional, pain-related, and systemic aspects of TMJ. TMJ and musculature tenderness, noises, and range of movements, and parafunctional habits such as bruxism were evaluated with the help of functional examinations. The site or origin of pain and its severity and the lack of pain were determined by using a visual analog scale. The measures of the systemic index included headaches, neck and shoulder pain, trapezius, occipital pain, dizziness and insomnia. In addition, an extended symptom checklist was used to capture broader musculoskeletal, systemic, sleep-related, and trauma-associated complaints, including sciatica, headache during or after sleep, intermittent or flexible sleep disturbance, and any history of old or recent accidents.

One of the secondary aims of the research is to evaluate any evolution in respiratory quality of patients during which face-to-face structured questionnaire between the dental professional and the patients occurs. The patients were examined with relation to breathing issues and they are breathing discomfort, mouth-dependent breathing, nasal congestion and frequency of snoring.

The calibration of dental professionals was conducted prior to the beginning of the study to reduce the possibility of biasness, and the relationship between inter-raters was controlled during the process.

The intervention exercise involved the participants being supervised and trained properly in the initial stages of the intervention on its placement, the duration of time it was to be performed and how to stop it (where necessary). A one-to-one design was assigned to every participant, and it guaranteed adherence to intervention schemes. A duration of 15 minutes of exercise was done wherein the participants were asked to insert the device between the upper and lower teeth (specifically) behind the canines. Most participants did not complain of discomfort but a lesser percentage in 7 to 8 minutes of exercise complained of headache, nausea, and light-headedness. All these were not serious enough to terminate the exercise. Participants were found to have satisfactory improvement on the severity of their pains, TMJ mobility, muscle relaxation as well as visual quality of the images at the end of the exercise.

Data Collection and Management

The key variables that were collected were demographic features, symptoms prior to and after intervention, levels of pain, and respiratory quality. Prior to the intervention data was gathered to give a baseline to make measurements and afterwards to capture the effectiveness that the exercise will produce. To verify hearty data gathering, standardized information forms of patients were used, which were in turn verified and checked on accuracy and to ensure privacy these data were stored in password information database that could only be accessed by the research team. Besides, the digitalization of the forms, correctness of data input and absence of information were established by thorough checking of the quality.

Statistical Analysis

Data was analyzed using IDM SPSS statistics. Variables were also categorized broadly into two variables namely the presence/absence of pain into the nominal category and the severity of the pain in different evaluators into the numerical variables.

To assess the demographic data, pre and post intervention scores, and baseline symptom interventions, descriptive statistics was used. The continuous variables such as age, pain severity among others were examined by using means and standard deviations. The frequencies were used in presenting the symptoms such as clicking of the jaw, noises or psychological situations such as insomnia. The Shapiro Wilk test was used to verify the fulfillment of the normality of continuous variables.

For within-group comparisons of pre- and post-intervention outcomes, paired t-tests were applied when normality assumptions were satisfied, and Wilcoxon signed-rank tests were used for non-parametric distributions. Between-group comparisons (Group A: symptomatic vs. Group B: asymptomatic) were performed using independent t-tests or Mann–Whitney U tests, depending on distribution. Associations between categorical variables (e.g., improvement in TMJ pain and breathing quality) were examined using chi-square tests. Effect sizes were calculated to complement significance testing, with Cohen's d reported for continuous outcomes and Cramer's V for categorical outcomes. Ninety-five percent confidence intervals were computed for all key effect estimates. Statistical significance was established at $p < 0.05$. In addition, exploratory subgroup analyses were conducted to examine whether age group (adolescent vs. adult vs. older participants) or gender modified the observed effects.

RESULTS AND DISCUSSION

Participant Demographics

Participants pooled for the study (n = 2700) were allocated into two groups equally (n = 1350 per group) for a comparison perspective, depending on their presence and absence of symptoms, where Group A accounts for symptomatic individuals with characteristic TMJ pain and Group B incorporates asymptomatic individuals. Overall demographic distribution reports a mean age of 36.2 years (SD = 12.7) among participants, where a major proportion of the pool was dominated by females (58%). Statistically, both groups were deemed comparable, as there were no significant differences observed in either age or gender distribution ($p > 0.05$).

Baseline Symptom Prevalence

The TMD prevalence rates among the entire study population (n = 1889) were high (70% of the total population reported at least one symptom of TMJ dysfunction). Most of the Group A have developed musculoskeletal pain related to TMD with most common pain-related symptom being the most repeat patterns in 72.2 and 69.5 percent of the TMD victims of the masseter and the temporalis muscle respectively. Additional symptoms of pain were headaches (67.7%), shoulder pain (64.8%), back discomfort (48.3), and anterior occipital (64.1).

Increased rates of psychological symptoms were also observed as follows in Group A including insomnia (57.8%), bruxism (40.7%), anxiety (22.9%), and depression (33.7%). Also, some statistically significant and minor symptoms were also found, such as dizziness (16.7%), nausea (13.9%), and visual difficulties like blurred or foggy vision (35.9%). Importantly, several extended systemic symptoms were also documented, including intermittent or flexible sleep disturbance (61.1%), headache during or after sleep (50.0%), a history of old or recent accidents (26.3%), and sciatica (6.3%).

Such results indicate the multifaceted etiology of TMD, implicit of more than restricted local joint or muscle disorders, with the consideration of a mixture of correlated health results.

Table 1: Summarizes the Distribution of Complaints across the Study Population

Symptom	Group A (n = 1350)	Group B (n = 1350)	Total (N = 2700)
Pain in hands (between index & middle fingers)	1850	0	1850
Pain in tendons of extensor digitorum longus	1750	0	1750
Pain in bicep femoris / arm joint pain	1180	0	1180
Pain in deltoid muscles	1855	0	1855
Pain in masseter muscle	1950	0	1950
Pain in temporalis capitis muscle	187	0	187
Pain in posterior occipital skull	1730	0	1730
Pain in back plate (trapezoid)	1303	0	1303
TMJ clicking	1350	0	1350
Headache	1827	0	1827
Neck pain	1570	0	1570
Shoulder pain	1750	0	1750
Nausea	375	0	375
Pain in lateral pterygoid muscle	1540	0	1540
Abdominal pain	722	0	722
Dizziness	450	0	450
Pressure behind eyes / facial heaviness	817	0	817
Choking or gasping (day or during sleep)	570	0	570
Intermittent sleep / flexible sleep	1650	0	1650
Body imbalance	350	0	350
Increased heart rate (rest or sleep)	560	0	560
Night sweats	431	0	431
Tooth grinding (bruxism)	1100	0	1100
Dry mouth / wheezing during sleep	680	0	680
Nervousness	760	0	760
Sunlight sensitivity	1550	0	1550
Hesitation in decision-making	750	0	750
Forgetfulness	970	0	970
Obsessive-compulsive disorder	570	0	570
Gastroesophageal reflux	230	0	230
Withdrawal from work	250	0	250
Introversion / lack of confidence	680	0	680
Anxiety	309	0	309
Depression	910	0	910
Insomnia	1560	0	1560
Difficulty opening mouth / sleep discomfort	109	0	109
Jaw muscle tension	1220	0	1220
Headache during sleep or after sleep	1350	0	1350
Itchy ear	50	0	50
Burning sensation in TMJ / ear	50	0	50
Old or recent accident history	709	0	709
Foggy / blurry vision	970	0	970
Sciatica	170	0	170
Pain relieved by analgesics	250	0	250

***By design, Group B consisted of asymptomatic participants at baseline; therefore, no symptoms were recorded in this cohort.*

Although no significant differences were observed in Group B (Table 1), it was evident that the sample population had subjective improvements that were pronounced as exhibited in Table 2. There were significant gains made in the craniofacial and neck musculature, nasal breathing and visual index.

Table 2: Post-Intervention Outcomes in Asymptomatic Participants (Group B, n = 1350)

Outcome	n	% of Group B
Relaxation in craniofacial/ neck muscles	420	31.1%
Improved breathing comfort	535	39.6%
Enhanced visual clarity	280	20.7%
General sense of systemic relaxation	350	25.9%

Post-Intervention Outcomes

Altogether, the post-intervention outcomes showed considerable pain reductions, besides the increased symptom profiles, and the decreased pain intensity in the major anatomical pain targets. The prevalence rate of pain decreased significantly in headache (24.8) and was statistically significant ($p < 0.001$) following the intervention exercise. It was immediately followed by pain on the temporalis muscle (27.4) and neck pain (19.5). In addition to the pain symptoms, the psychological improvement was also realized and a significant reduction in insomnia to be 33.6% ($p < 0.01$). Also, the anxiety and depressive symptoms were decreased by 41 and 35% respectively.

Such results place the efficacy of SmileWand at the level of musculoskeletal pain management, and further on the aspects of respiratory and ocular symptoms. Participants also indicated improvement in breathing, regained nasal congestion, and this led to a decrease in the use of the mouth to breathe. In the same way, post-exercise results involved participants stating an improved ocular quality, citing improved sharpness and reduced fogginess. Moreover, the other improvement that was frequently reported is muscle relaxation.

Outcomes in Asymptomatic Participants

The improved physical comfort among the asymptomatic patients (Group B, n = 535) is equally interesting (39.6%), which suggests that SmileWand efficacy goes beyond the remediation of baseline symptom prevalence. It was observed that improvements were made in relaxed craniofacial and neck muscles, as well as breathing comfort. The results highlight the importance of the intervention in enhancing the overall health of the patients, although no TMD-related symptom has been evident in the patient, and this effect is on a large scale in the context of the apparently healthy patients, which can be considered another advantage of the device.

Statistical Analyses

The improvements in clinical data interpretation are further corroborated by the statistical assessments done on within-group and between-group data. The statistical significance of the within-group comparisons was determined using paired t-tests, which established that a reduction in headache, masseter muscle pain, and temporalis muscle pain was all valid since they were determined by calculating p-values that were less than 0.001. The overall visual analogs decrease in masseter pain means -3.1 (95% Confidence Richter: -3.4 to -2.7), anaesthetic in temporalis pain means -2.9 (95% CI: -3.3 to -2.5). The frequency of headaches reduced by -2.6 units (95% CI: -3.0 -2.2).

The between-group analysis by using an independent t-test revealed the values of pain alleviation were very significant and impressive, especially the ones experienced by headache effects ($p < 0.01$) and the craniofacial musculature relaxation ($p < 0.05$) but the prevalence in Group A was quite high at the end of the interventions, which highlights the conclusion that Group A was quite relaxed.

The results of the Cohen Effect size indicated much on the fact that the main results obtained were substantially valid that the intervention was effective among the entire population. These involve the effect sizes of headache (0.82), reduction of masseter muscle pain (0.88), that are relevant to symptom minimization of meaningful consideration. On the same note, construction on the reduction of insomnia showed an effect of 0.56 which also offers further validation grounds on systemic health outcomes enhancement. Lastly, the chi-square tests were highly significant ($p <0.05$) to distinguish the intrinsic relationship between TMJ pain scores and enhanced respiratory comfort and supported our hypothesis on whether there is a relationship between muscle reprogramming and enhancement of functionality.

Quality of Life Impact

Besides the numerical outcomes, the intervention also proved to have the subjective benefits that were highly relevant to the quality of life of the respondents. Many of the Group A individuals said they were better able to resume normal operations with reduced disruptions to sleep, felt better in general and their interpersonal functioning. Part of the participants reported that they felt more energetic and focused with the intervention due to the combined pain relief and reduction in their associated symptoms, including insomnia and headaches. In Case group B, the benefits were considered less impressive, but they were nonetheless directed to indicate a better overall state and relaxation, which once again supports the idea that the SmileWand can be used both as a treating and preventive tool.

Discussion

In this study, the effect of SmileWand was evaluated, and the interesting outcomes were reported in the majority of the articles that entailed the positive results of the intervention not only for the reduction of physical pain but also in psychological, systemic, and life-quality aspects. Incident amounts to an inherent relation amidst TMJ and its musculature and their neurophysiological, biomechanical, and pathological bases. This highlights that SmileWand has the potential to reduce the TMD-associated symptom burden on patients' quality of life.

Principal Findings and Interpretation

A major life-restricting symptom of TMD is its musculoskeletal pain. The post-test reduction observed in findings was statistically positive ($p < 0.001$) for masseter (72.2% → 30.1%), temporalis (69.5% → 27.4%), head (67.7% → 24.8%), and neck (58.1% → 19.5). This confirms a widely reported phenomenon, which entails majority of TMD-associated symptoms arise from muscular origin (myofascial pathology) (Schiffman *et al*., 2014). The underlying mechanism of SmileWand encompasses principles of neuromuscular and biomechanical reprogramming. Situating the mandible in a physiologically aligned resting state will help relieve the hypertonicity of the masticatory muscles, which will alleviate the pressure from the craniocervical muscular chain. This mechanism deals with the peripheral nociceptor basis of the pain transmission cycle (Wani & Anand, 2025).

Another noteworthy finding of this study was the substantial relief reported in systemic and psychosocial dimensions of TMD, where anxiety (reduction up to 40%; $p < 0.01$), depression (reduction up to 35%; $p < 0.01$), and insomnia (reduction up to 36%; $p < 0.01$) were the widely cited improved symptoms. Psychological distress is the main reason reported across the literature that influences chronic TMD pain (Durham *et al*., 2015; Yap & Lee, 2023). The proposed intervention played a crucial role in enhancing the subjective experiences by instantaneously alleviating the physical pain and muscular discomfort by preventing the progression of the chronic pain cycle, which leads to the improvement of mental health outcomes and sleep quality among patients.

These results show that the effectiveness of SmileWands is reflective of the biopsychosocial nature of TMD, which involves the solution of associated underlying pathology and psychology of TMD, which finally alters the psychological state of patients. Additionally, our study also establishes the positive impact of intervention on the secondary symptoms like sciatica, sleep related headaches, and patients with car accident history, pointing toward de-escalating the burden of central sensitization and pain in TMD. At this point, it must be noted that our results also mention that 39.6% of asymptomatic patients have improved significantly. These areas have been provided with improvements such as relaxed craniofacial muscles (↑ 31.1%), easy breathing (↑ 39.6%), and clarity of vision (↑ 20.7%). The modern lifestyle changes have recently become the critical confounding factor in defining TMD in the patients with no symptoms. This highlights the effect extension of SmileWands to the overall wellbeing rather than addressing the underlying etiological parameter.

Comparison with Existing Literature and Mechanistic Hypotheses

While considered an effective strategy for TMD management, the non-conservative route bears its fair share of limitations, which halt the complete symptom resolution for patients (Al-Moraissi *et al*., 2022; Garrigós-Pedrón *et al*., 2019; Gil-Martínez *et al*., 2018). This is necessary because the findings need to be put into context with the current tendencies in the TMJ pain treatment in terms of the efficiency of SmileWand as an alternative that is proven to be effective. To rise above these limitations that traditional types of treatments have attached themselves to, SmileWand is a great one-session treatment that is easily administrable, as well as its effectiveness and instant ability to counter a complicated set of multifaceted challenges underlying TMD. This demonstrated efficacy makes SmileWand a potential intervention that addresses physical as well as psychological dimensions of the TMD pain mechanism (Dinsdale *et al*., 2025). Additionally, our findings demonstrated postural influences exhibited by TMD. This is supported by studies that TMD patients exhibit postural deviations in pelvis (posterior rotation), lumbar and thoracic spine (hyperlordosis/ rectification), head (deviation to the right) and mandible (deviations to the left when mouth is open) (Saito *et al*., 2009). The postural disorders in TMD patients are considered according to their anatomical contexts due to biokinematics chains which encompass a description of posture in relation to the position of mandible or teeth (Garstka *et al*., 2022).

Furthermore, Similar craniofacial anatomy and neural settings between TMD, ocular, and muscular factors are so far the best hypothesized reason to explain the ocular clarity observed in our findings (Khijmatgar *et al*., 2025). These findings provide a more plausible explanation that craniofacial muscles of temporalis or other similar muscles, when under stress, may exhibit their influence on the ocular muscles. Since SmileWand provides substantial muscle relaxation, this provides a theoretical ground for the assumption of its utility in improving vision; however, it needs to be further examined in future studies.

The discussion of our findings and contextualizing them with broader literature leads to presenting a theoretical foundation for explaining the mechanism of action of SmileWand, which encompasses biomechanical, neurophysiological, and respiratory effects. The biomechanical foundations of SmileWand may encompass its ability to relieve strain from TMJ and craniofacial muscles, including masticatory and suprahyoid, by readjusting the mandible in its resting posture. SmileWand demonstrates the resolution of the neurophysiological basis of TMD due to the process of peripheral sensitization reduction, which in its turn serves as the suppression of pain recurrence. All these are useful in reducing the potential of central sensitization which was mentioned before and is also a crucial etiological phenomenon linked to the pain in the TMJ (Ferrillo *et al*., 2022). The fact that the participants reported having improved respiratory quality through better nasal breathing after the intervention represents the extent to which SmileWand can be expanded that reflects the incorporation of oropharyngeal bases as well.

CONCLUSION

SmileWand is a special Medicodental device that was evaluated on its effectiveness in treatment of TMD pain and potential respiratory effects. The result was statistically significant among the variables considered such as physiological, psychological and systemic health indices. Change in TMJ musculature (masseter and temporalis), cervical (headache, neck pain), and psychological distress (anxiety, insomnia, depression) was applied, which, in turn, confirms the impacts of intervention on the biomechanical component of TMJ, eliminating craniofacial sensitization and neurologic burden. There were also observed increased life quality factors which included ease of breathing, clarity of the eyes and quality of sleep. All these findings have a bearing on the potential of SmileWand to mitigating the burden and symptoms associated with TMJ-pain and thus is an alternative or possible adjunct therapy modality in the management of TMD. The study has limitations associated with it although its results are promising. Self-reporting may introduce recall bias or social desirability bias and non-blinding of both participants and clinicians may introduce observational bias. Absence of a control group with a sham device is also one of the limitations in the assessment of intervention efficacy in the long term after the immediate effects. Future studies need RCTs with strict protocols such as blinding to test the effectiveness and long-term viability of intervention. Furthermore, oropharyngeal factors associated with intervention need further exploration.

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