A Comparative Analysis of Proprioceptive Neuromuscular Facilitation Vs Rocabado Exercise on Pain and Posture Improvement in Muscular Temporomandibular Joint Disorder: An AI Based Evaluation

Ashfak Abdul Kader S[1], Ramana K[2*]

[1] Postgraduate Student, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India.

[2] Assistant Professor, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India.

ramana.scpt@saveetha.com

Abstract. Temporo-mandibular joint disorders (TMDs) are a multifaceted group of excruciating disorders which impact masticatory muscles along with temporo-mandibular joint. It is a collection of musculoskeletal conditions which affects the temporo-mandibular region. TMD symptoms include jaw pain, tenderness, and discomfort in the ear, difficulty chewing, agonizing facial pain, joint locking, and trouble opening and closing the mouth. Compared to male, females over the age of18 reported a greater incidence of TMD signs and symptoms. A unique AI software is used in this study. Convolutional neural networks, a type of artificial intelligence (AI), utilized to calculate the Cobb's angle in x-rays and of cervical spine. Methods: Based on the inclusion and exclusion criteria, patients were selected. They are divided into two groups at random. Proprioceptive Neuromuscular facilitation was given to the experimental group, while Rocabado exercises was given to the control group. Both groups were trained equally for 7 days a week for eight weeks. Pre – test and post- test measurements done with, Cobb's angle C2-C7with the help of AI software using x-ray, maximal mouth opening range, hand held algometer & Jaw Functional Limitation Scale. Result: Statistics reveals that experimental group which received Proprioceptive Neuromuscular Facilitation showed significant improvement by means of Cobb's angle, pain, maximal mouth opening, and functional ability in comparison to control group that received Rocabado exercises. Conclusion: The study has reported that Proprioceptive Neuromuscular Facilitation is more significant than the Rocabado exercise programme in improving pain, posture by means of Cobb's angle and functional ability in muscular TMDs.

Keywords: temporomandibular, Rocabado exercise, algometer, Proprioceptive Neuromuscular facilitation, artificial Intelligence.

1 Introduction

Temporo-mandibular joint disorders (TMDs) are a multifaceted group of excruciating conditions that impact the masticatory muscles along with the temporo-mandibular joint. It describes a collection of musculoskeletal disorders affecting the temporo-mandibular region. The temporo-mandibular joint, the masticatory muscles, or both can be affected with this disorder. TMD symptoms include jaw pain or tenderness, discomfort

S. Kannadhasan et al. (eds.), *Proceedings of the International Conference on Sustainability Innovation in Computing and Engineering (ICSICE 24)*, Advances in Computer Science Research 120,
https://doi.org/10.2991/978-94-6463-718-2_2

in the ear, difficulty chewing, agonizing facial pain, joint locking, and trouble opening and closing the mouth. The temporomandibular disorders has a Research Diagnostic Criteria (RDC/TMD) classification system. It was used to establish the incidence of muscular temporo-mandibular disorders for the population of Chennai city. The study population consisted of 3039 individuals. The findings indicate that mandibular deviation during mouth opening (42.1%) and clicking sounds (38.6%) constituted the highest proportions within the study sample (53.7%). Additionally, females over the age of 18 exhibited a higher incidence of temporo-mandibular disorder signs and symptoms compared to males. Myofascial pain dysfunction syndrome (MPDS) was observed in 0.8% of the population, 38.3% of internal derangement and 14.6% of osteoarthritis [1]. The temporomandibular disorders Diagnostic Criteria provides a taxonomy of TMDs by categorizing them as joint related disorders, mastication muscle disorders and related structural illnesses[2]. Masticatory muscular pain is classified as myalgia, tendinitis, myositis, and spasm among Axis I pain-related TMDs [2].The most common diagnosis is myalgia, which is also one of the main symptoms made by people with TMD [3]. Three subtypes of myalgia can be classified as myofascial pain, local myalgia and referral myofascial pain [2]. Some clinical reports state that the development of mild pressing muscular discomfort, which tends to worsen when stimulated, is a common feature of myalgia's presentation [4]. Masticatory function may make discomfort worse, which may ultimately result in trouble opening the mouth and intense pain [4]. Previous literatures has documented the decrease in life's quality. M-TMD concerning the severity of functional limitations, pain and psychosocial variables [5] [6]. Due to the masticatory system's involvement, determining how TMDs affects the quality of oral health which is crucial for assessing the impact of symptoms either directly or indirectly related to these conditions [7] [8].

Nonsurgical methods of treatment includes medications, physiotherapy, occlusal splints, and manual therapy. The primary treatment strategy is exercise like Rocabado exercise [9] [10]. However, Proprioceptive Neuromuscular Facilitation is a distinct technique, is not utilized for temporo-mandibular disorders up to this point. Proprioceptive Neuromuscular Facilitation (PNF) was created for those whose paralyzed muscles causes them discomfort. With this procedure, the patients' functions are improved by facilitating the body's movements easier through contractions with diagonal limb movements. [11]. PNF uses physical resistance to cause contractions in the strong body part to cautiously mobilize a weakened body part. In musculoskeletal rehabilitation, it is employed to enhance function, increase joint ROM and indirectly alleviates the pain [12] [13]. Cervical posture has an indirect relationship with the temporomandibular dysfunction. The position of the mandible in relation to the head, and the head in relation to the neck, are highly interdependent. Altering the position of one structure inevitably affects the position of the other. Direction of line of pull of muscles is also altered. So, postural assessment must be done for the patients with TMJ dysfunction. Forward neck posture stretches the muscle present in the anterior aspect of cervical spine. Tension in that area tends to pull the mandible posteriorly, which causes chronic mandibular Retrusion along with depression. Hence, this study also focuses on cervical curvature evaluation using Cobb's angle for C2-C7 measurement using the AI tool.
Artificial intelligence (AI) is the ability of a technology to learn, understand, interpret, and predict like a human. In physiotherapy, artificial intelligence (AI) holds significant potential as a diagnostic decision-support and outcome-measurement tool. Presenting

the applications and advantages of AI in TMDs while taking into account recent literature is the goal of this study. Takahito Fujimori et al. done a study on the lordotic curvature of the cervical spine on radiographs with the advancement of artificial intelligence for the automated evaluation and measurement. It includes 1645 patients and their 4546 cervical x-rays. They concluded that Compared to surgeons, cervical spine alignment was measured by AI model more accurately [14]. Artificial intelligence (AI) has applications in both normal medical care and large-scale image measurement studies [14]. Convolutional neural networks (CNNs) are used in AI models, and their neural networks provide greater image recognition skills [15] [16].

Through assessment of the entire spinal cord, the Cobb's angle has traditionally served as the standard method for assessing the degree of spinal curvature in patients with kyphosis and has been proven to be accurate in this regard [17]. Using radiographic pictures, the C2-C7 Cobb technique calculates the cervical spine's curvature [17]. According to this technique, a cervical curvature of 20° to 60° is considered normal [18].The Cobb approach is easy to use and widely applied, we utilized it to determine the C2–C7 angle [19] [20]. Usually, a right angle is made between the end plates of C2 and C7 vertebrae, and the Cobb's angle is determined by measuring the angle formed at the intersection of the rays originating from each perpendicular line. This AI tool has the ability to automatically assess the uploaded x-ray image and determines the Cobb's angle. This AI tools software is freely available for the public to use it for medical purpose.

One of the first PNF methods, Rhythmic Stabilisation (RS) is defined by isometric contractions performed in multiple directions against resistance applied manually. As resistance direction changes, the instructed person attempts to hold the position [21]. Its objectives include enhancing muscle strength, balance, and stability, increasing ROM (both passive and active) and alleviating pain [21] [22]. The Combination of Isotonics is an additional PNF technique for enhancing motor performance. This type of exercise involves isometric, concentric and eccentric contractions. It is utilized for addressing deficits in ROM and strength [23]. Rocabado's approach is a 6x6 exercise protocol that has proven effective for decreasing pain, improving functions of muscles of mastication and ROM of TMJ. In this study, we examined the effects of pain and maximal mouth opening in patients with TMJ disorders of previously unapplied PNF exercises as well as gold standard Rocabado exercises. The aim is to assess the effectiveness of PNF Vs Rocabado exercise on pain and posture improvement in muscular temporomandibular joint disorders.

1.1 Materials & methods

This is a comparative experimental study conducted with 104 individuals diagnosed with M-TMD. The study was done at Saveetha Medical College and Hospital. Patients were selected based on the established inclusion and exclusion criteria i)Patients who meets the RDC for M-TMJ dysfunction, ii) Patients with symptoms of clenching, grinding, joint sounds, iii) Patients with limited jaw movements, iv) Patients with age from 18 to 45, v)study includes both male and female participants. i) Patients having ortho-

paedic, neurological or haematological cervical disorders, ii) Patients receiving occlusive treatments, iii) Patients using functional appliances, iv) Patients with TMJ osteoarthritis, v) Patients with surgical history in the jaw, vi) Patients with vertigo, vii) Patients with maximum mouth opening <39mm, viii) Patients with headache associated with TMDs are excluded from the study. Subsequently, the patients were provided with a detailed explanation of the protocols and written informed consent was obtained. Subjects were randomly assigned to two groups with simple random sampling method. The Experimental group received PNF whereas control group received Rocabado exercises. Both the groups are trained for the duration of 8 weeks. Pain pressure threshold, maximal mouth opening, Jaw Functional Limitation Scale and Cobb's angle measure using AI tool are used as the outcome measures that was administered to find the progression in posture, pain, mandibular ROM and functional ability respectively.

1.2 Procedure

1.2.1 Experimental group

Exercises will be performed thirty minutes per day, seven days a week over a period of eight weeks. D1 is flexion with right side rotation and right side lateral flexion. Then do extension with left side rotation and left side lateral flexion. The D2 is flexion with left side rotation and left side lateral flexion and extension with right side rotation and right side lateral flexion of the head and neck patterns of PNF were applied [24]. In both diagonals, the following movements were performed: Retrusion of mandible, elevation of the tongue with neck flexion, and closing the mouth, protraction of mandible, opening of the mouth, tongue depression with neck extension. Individuals with TMD were initially taught exercises with rhythmic initiation and 15 repetitions were applied as warm-up period before techniques were applied [24].

1.2.2 Control group

Patient position. Patient sitting comfortably on a table. Arms resting on the thighs. Shoulder and neck should be relaxed

Steps. Exercises given for 6 reps - 3 sets per day for 7 days a week for 8 weeks. . Rocabado framed 6X6 exercise program for the TMJ disorders that has six fundamental variations. They are, tongue in Rest position, controlled temporo-mandibular joint rotation, stabilized head flexion, retraction of the lower cervical, and retraction of the Shoulder girdle [25].

2 Outcome measure

2.2 Pain pressure threshold

We used a hand held algometer for assessing the PPT for temporalis, masseter, sternocleidomastoid and trapezius. The instrument has a firm rubber tip with a diameter of 1 cm that is connected to a pressure force gauge's plunger. The algometer has a range of 0 to 10 kg and divisions of 0.1 kg. Its dial is measured in kg/cm^2 [26]. Previous studies

have demonstrated that pressure algometry's reliability can reach ICC=0.91 (95% confidence interval).

2.3 Cobb's angle

The X-ray images in the lateral view are taken before the beginning of the study and after 8 weeks of the study as a pre and post evaluation. The images are then uploaded in the AI tool which evaluates the C2-C7 cervical angle automatically and pre-post values are compared to denote the prognosis.

2.4 Maximal mouth opening

The space between the upper and lower incisors during maximal mouth opening is measured in millimetres (mm) with a ruler.

2.5 Jaw function limitation scale

The jaw movement, mastication, and linguistic and emotional expression limits are measured by the organ-specific JFLS instrument, which consists of three models for assessing the masticatory system's functioning state.

3 Statistical analysis

The paired t-test was employed to assess and compare the effects of the treatment based on the pre-test and post-test values within the same group. The unpaired t-test was utilized to compare the post-test outcomes between two groups. Statistical significance was determined when the p-value was less than 0.0001. The table1,2,3,4 and5 shows the post-test values of both the groups.

3.1 Pain pressure threshold for masseter

Table 1. Post-test values of both the groups.

Parameters	Experimental group	Control group
Sample size	52	52
Pretest mean	1.494	1.610
Posttest mean	5.925	3.881
Pretest SD	0.600	0.490
Posttest SD	0.791	0.636

3.2 Pain pressure threshold for temporalis

Table 2. Post-test values of both the groups

Parameters	Experimental group	Control group
Sample size	52	52

Pretest mean	1.860	2.002
Posttest mean	6.062	4.290
Pretest SD	0.646	0.550
Posttest SD	0.647	0.558

3.3 Pain pressure threshold for trapezius

Table 3. Post-test values of both the groups

Parameters	Experimental group	Control group
Sample size	52	52
Pretest mean	1.835	1.958
Posttest mean	4.92	4.027
Pretest SD	0.425	0.420
Posttest SD	0.482	0.556

3.4 Pain pressure threshold for sternocleidomastoid

Table 4. Post-test values of both the groups.

Parameters	Experimental group	Control group
Sample size	52	52
Pretest mean	1.756	1.748
Posttest mean	5.958	4.071
Pretest SD	0.465	0.454
Posttest SD	0.531	0.536

3.5 Maximal mouth opening

Table 5. Post-test values of both the groups.

Parameters	Experimental group	Control group
Sample size	52	52
Pretest mean	12.56	12.25
Posttest mean	32.52	27.38
Pretest SD	3.47	2.62
Posttest SD	3.68	2.86

3.6 Jaw function limittation scale

Table 6. Post-test values of both the groups.

Parameters	Experimental group	Control group
Sample size	52	52

Pretest mean	8.42	7.58
Posttest mean	17.81	14.48
Pretest SD	1.86	1.94
Posttest SD	1.39	1.63

3.7 Cobb's angle

Table 7. Post-test values of both the groups.

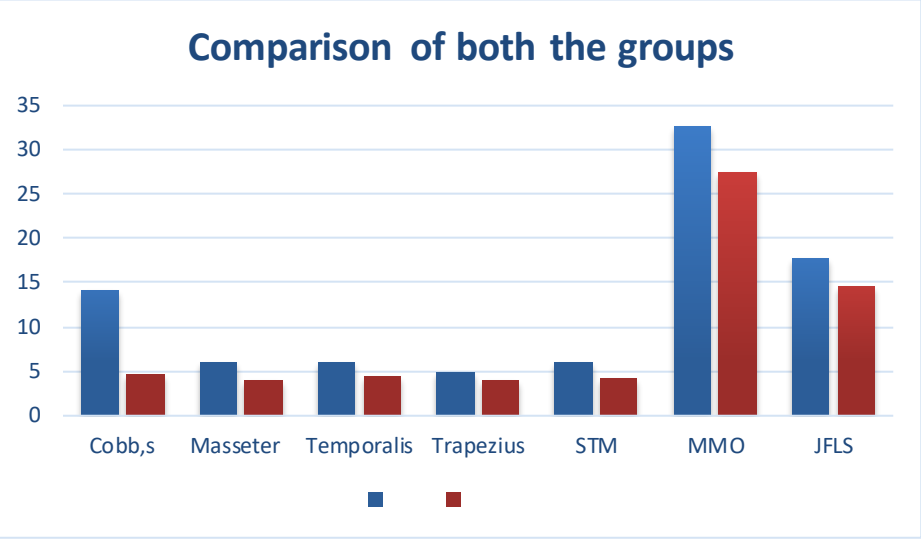
Parameters	Experimental group	Control group
Sample size	52	52
Pretest mean	-10.154	-9.827
Posttest mean	14.056	4.567
Pretest SD	12.084	10.047
Posttest SD	7.606	5.862

4 Result

Table 8. Post-test mean results of experimental and control group.

Parameters	Experimental group	Control group
Cobb's angle	14.056	4.567
masseter	5.925	3.881
Temporalis	6.062	4.290
Trapezius	4,92	4.027
Sternocleidomastoid	5.958	4.071
MMO	32.52	27.38
JFLS	17.81	14.48

On comparing the post-test mean values of both the groups, experimental group shows higher rate of improvements in the post tests. Thus, proprioceptive neuromuscular facilitation is shown to be more efficient than Rocabado exercise in enhancing cervical lordosis, maximal mouth opening, pain and functional ability in patients with muscular temporo-mandibular joint disorders.



5 Discussion

The goal of the study was to alleviate pain and to improve maximal mouth opening range and functional ability of the patients using PNF technique and Rocabado exercises. Chronic painful disorders, or TMDs, are defined by persistent pain that endures beyond the usual healing time [27]. About 20% of adults experience chronic pain ranging from moderate to severe severity, which has a significant negative impact on social and professional functioning [28]. Furthermore, M-TMDs have the potential to decrease quality of life, particularly in individuals who report high levels of pain or who catastrophize about their suffering [29]. Rumination, exaggeration, and powerlessness are examples of pain catastrophizing, which can ultimately result in kinesiophobia [29]. Given the connections between TMD, pain and pain related catastrophizing, it seems highly significant that patients with M-TMDs had higher chances with 8.673 times of decreased quality of life [30]. Furthermore, the masseter's functional pull aids in positioning the condyles during the closure, near the foot of articular eminence's posterior slopes in their supero-anterior position on the stabilizing appliance [31]. According to Okeson et al., TMD may cause the neck to distort or align abnormally [32]. This reasoning backs up Janda's theory that injuries to the locomotor system causes structural damage to the surrounding tissues [33]. De Wijer et al. proposed that in addition to treating stomatognathic system, the cervical spine should also be assessed and treated [34].efforts has been made to align the cervical spine through orofacial myofunctional therapy and to relax the TMJ muscles since tongue movement can create disruption in the TMJ [35] [36]. The concept of PNF focuses on enhancing activity level as well as improving body structures and functions by using a holistic and positive approach, in addition to treating physical issues that impede movement of the body [37]. Future research is advised to include long-term application, evaluation, and follow-up procedures. There are potential possibilities for this non-invasive technique to measure the cervical spinal cord curvature using the AI tool in the future researches.

Artificial Intelligence (AI) is a rapidly developing technology in the modern world. AI are used worldwide to ease the works of human within a blink of an eye. Physiotherapy is a field of rehabilitation which should be updated in order to meet the current trends of the world. It's our duty as a Physical therapist to ensure the advancement of our treatment techniques with new innovations and ideas.

6 Conclusion

The findings demonstrated that after eight weeks of therapy, both experimental and control group considerably improved on post-test values within the group. The results indicate that the group that received Proprioceptive Neuromuscular Facilitation showed significantly greater progressions than the group that underwent Rocabado exercise, according to the outcome measures.

Disclosure of interest. The authors have no competing interests to declare that are relevant to the content of this article.

Reference

1. Muthukrishnan, Arvind & Sekar, GowriShankar. Prevalence of temporomandibular disorders in Chennai population. Journal of Indian Academy of Oral Medicine and Radiology. 27. 508. 10.4103/0972-1363.188686 (2015).
2. Schiffman, E.; Ohrbach, R.; Truelove, E.; Look, J.; Anderson, G.; Goulet, J.P.; List, T.; Svensson, P.; Gonzalez, Y.; Lobbezoo, F.; et al. Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications: Recommendations of the International RDC/TMD Consortium Network* and Orofacial Pain Special Interest Group. J. Oral Facial Pain Headache, 28, 6–27 (2014)
3. Kuttila, M.; Niemi, P.M.; Kuttila, S.; Alanen, P.; Le Bell, Y. TMD treatment need in relation to age, gender, stress, and diagnostic subgroup. J. Orofac. Pain, 12, 67–74(1998)
4. Al-Moraissi, E.A.; Conti, P.C.R.; Alyahya, A.; Alkebsi, K.; Elsharkawy, A.; Christidis, N. he hierarchy of different treatments for myogenous temporomandibular disorders: A systematic review and network meta-analysis of randomized clinical trials. Oral Maxillofac. Surg. 2022, 26, 519–533, Erratum in Oral. Maxillofac. Surg, 26, 679 (2022)
5. John, M.T. Health Outcomes Reported by Dental Patients. J. Evid. Based Dent. Pract., 18, 332–335 (2018)
6. Dworkin, S.; LeResche, L. Research diagnostic criteria for temporomandibular disorders: Review, criteria, examinations and specifications, critique. J. Craniomand. Disord, 6, 301–355(1992)
7. Sischo, L.; Broder, H.L. Oral health-related quality of life: What, why, how, and future implications. J. Dent. Res, 90, 1264–1270 (. 2011)
8. Robinson, P.G.; Gibson, B.; Khan, F.A.; Birnbaum, W. Validity of two oral health-related quality of life measures. Community Dent. Oral Epidemiol., 31, 90–99(2003)
9. Orlando B, Manfredini D, Bosco M. Efficacy of physical therapy in the treatment of masticatory myofascial pain: a literature review. Minerva Stomatol.; 55: 355-66(2006)
10. Wieckiewicz M, Boening K, Wiland P. Reported concepts for the treatment modalities and pain management of temporomandibular disorders. J Headache Pain,; 16: 106-9(2015)
11. Kabat H, Knott M. Proprioceptive facilitation techniques for treatment of paralysis. Phys Ther Rev; 33: 5364(. 1953)

12. Voss DE. Proprioceptive neuromuscular facilitation. Am J Phys Med.; 46: 838-9 (1967)
13. Kofotolis N, Kellis E. Effects of two 4-week proprioceptive neuromuscular facilitation programs on muscle endurance, flexibility and functional performance in women with chronic low back pain. Phys Ther.; 86: 1001-12(2006)
14. Fujimori, T., Suzuki, Y., Takenaka, S. et al. Development of artificial intelligence for automated measurement of cervical lordosis on lateral radiographs. Sci Rep 12, 15732 (2022).
15. McKinney, S. M. et al. International evaluation of an AI system for breast cancer screening. Nature 577, 89–94. https://doi.org/10. 1038/s41586-019-1799-6 (2020)
16. Miura, M. et al. Automated detection of cervical ossifcation of the posterior longitudinal ligament in plain lateral radiographs of the cervical spine using a convolutional neural network. Sci. Rep. 11, 12702. https://doi.org/10.1038/s41598-021-92160-9 (2021)
17. Tanure MC, Pinheiro AP, Oliveira AS. Reliability assessment of Cobb angle measurements using manual and digital methods. Spine J. 2010; 10: 769-774
18. Papadopoulou S, Exarchakos G, Beris A, Ploumis A. Dysphagia associated with cervical spine and postural disorders. Dysphagia.; 28: 469-480(2013)
19. Scheer, J. K. et al. Cervical spine alignment, sagittal deformity, and clinical implications: A review. J. Neurosurg. Spine 19, 141–159. https://doi.org/10.3171/2013.4.SPINE12838 (2013).
20. Janusz, P., Tyrakowski, M., Yu, H. & Siemionow, K. Reliability of cervical lordosis measurement techniques on long-cassette radiographs. Eur. Spine J. 25, 3596–3601. https://doi.org/10.1007/s00586-015-4345-8 (2016).
21. Adler SS, Beckers D, Buck M: PNF in practice: An illustrated guide, 3rd ed. Heidelberg: Springer Medizin Verlag, (2008).
22. Kabath H, McLeod M, Holt C. The practical application of proprioceptive neuromuscular Physiotherapy,; 45: 87-92(1959)
23. Saliba V, Johnson GS, Wardlaw C. Proprioceptive neuromuscular facilitation. In: Basmajian JV, Nyberg RE, eds. Rational Manual Therapies. Baltimore, Md: Williams & Wilkins;: 243–284(1992)
24. Ergezen G, Atilgan E, Kilicaslan A.Immediate effect of proprioceptive neuromuscular facilitation on pain and maximal mouth opening in temporomandibular dysfunction: A pilot study. Rawal Med J;47:125(2022)
25. Pundkar S, Patil D, Naqvi W. Effectiveness of Rocabado approach and conventional physiotherapy on pain, ROM and QOL in patients with TMJ dysfunction: comparative study. J Crit Rev.;6(6):925(2019)
26. Chesterson LS, Sim J, Wright CC, et al. Inter-rater reliabilityof algometry in measuring pressure pain thresholds in healthyhumans, using multiple raters. Clin J Pain.;23:760–766(2007)
27. Moraes Ada, R.; Sanches, M.L.; Ribeiro, E.C.; Guimarães, A.S. Therapeutic exercises for the control of temporomandibular disorders. Dent. Press. J. Orthod., 18, 134–139(2013)
28. Ohrbach, R.; Turner, J.A.; Sherman, J.J.; Mancl, L.A.; Truelove, E.L.; Schiffman, E.L.; Dworkin, S.F. The Research Diagnostic Criteria for Temporomandibular Disorders. IV: Evaluation of psychometric properties of the Axis II measures. J. Orofac. Pain, 24, 48–62(2010)
29. Januzzi, M.S.; Neto, C.M.; Moreno, A.; Dos Santos, E.G.; de Caxias, F.P.; da Silva, E.V.; de Athayde, F.F.; Volce, A.S.; Rodrigues, A.S.; Dela Líbera, J.; et al. Relationship between self-reported pain, pain threshold, pain catastrophization and quality of life in patients with TMD. J. Clin. Exp. Dent. 2023, 15, e23–e31.
30. Breivik, H.; Collett, B.; Ventafridda, V.; Cohen, R.; Gallacher, D. Survey of chronic pain in Europe: Prevalence, impact on daily life, and treatment. Eur. J. Pain, 10, 287–333(2006)

31. Ito, T.; Gibbs, C.H.; Marguelles-Bonnet, R.; Lupkiewicz, S.M.; Young, H.M.; Lundeen, H.C.; Mahan, P.E. Loading on the temporomandibular joints with five occlusal conditions. J. Prosthet. Dent., 56, 478–484(1986)
32. Okeson JP. Evolution of occlusion and temporomandibular disorder in orthodontics: Past, present, and future. Am J Orthod Dentofacial Orthop.; 147: 216-23. 13(2015)
33. Morris CE, Greenman PE, Bullock MI, Basmajian JV, Kobesova A. Vladimir Janda, MD, DSc: tribute to a master of rehabilitation. Spine,; 31: 1060-64(2006)
34. de Wijer A, Steenks MH, de Leeuw JR, Bosman F, Helders PJ. Symptoms of the cervical spine in temporomandibular and cervical spine disorders. J Oral 128 Rehabil.; 23: 742-50(1996)
35. Yagi S, Fukuyama E, Soma K. Involvement of sensory input from anterior teeth in deglutitive tongue function. Dysphagia.; 23: 221-29(2008)
36. De Félicio CM, Freitas RL, Bataglion C. The effects of orofacial myofunctional therapy combined with an occlusal splint on signs and symptoms in a man with TMD – hypermobility: case study. Int J Orofacial Myology,; 33: 21-29(2007)
37. Angeli JM, Harpster KL, Hanson E, Sheehan A, Schwab SM. Patient- and caregiver-identified preferences: Dimensions of change in developmental therapy treatment goals. Dev Neurorehabil.; 22: 39-46(2019)