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O. V. Pavlenko https://orcid.org/0000-0003-2097-4286
V. V. Pehnyo https://orcid.org/0000-0002-0075-6225
R. G. Osnach https://orcid.org/0000-0002-2132-398X

LITERATURE REVIEW ON THE USE OF FRONTAL DEPROGRAMMERS OF THE MASTICATORY MUSCLES IN THE TREATMENT OF TEMPOROMANDIBULAR DISORDERS AND METHODS FOR THEIR IMPROVEMENT

Shupyk National Healthcare University of Ukraine, Kyiv, Ukraine.

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The **Aim** of this study is to analyze modern sources of literature on the use of deprogramming devices, their design and to propose a simpler way to make it.

Materials and methods. In this article we describe the results of a literature review sources on the use of deprogramming devices. Based on the analysis of literature sources, the common properties of all deprogramming devices were revealed, their shortcomings were identified, and their comparison was carried out.

Results. It has been established that deprogramming device work on the basis of the "closing axis of the lower jaw", which is a line from the center of the condyle to the cutting edge of the lower incisor.

Occlusive and deprogramming devices, particular anterior median splints, effectively reduce muscle tension by influencing proprioceptive sensitivity and neuromuscular coordination of the dentoalveolar system, which contributes to both the diagnosis and treatment of temporomandibular disorders (TMD). The use of deprogramming devices ensures accurate recording of jaw ratios and promotes muscle relaxation, using packaging composite materials eliminates the need for laboratory steps, optimizing the rehabilitation process and accelerating clinical results. The author's proposal for a frontal deprogrammer can be as a method of choice to optimize and accelerate the results of the rehabilitation process for a patient with TMD by eliminating the need for laboratory steps.

Keywords: TMD, occlusal devices, occlusal splint, deprogramming of the jaw muscles.

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О. В. Павленко, В. В. Пехньо, Р. Г. Оснач

ЛІТЕРАТУРНИЙ ОГЛЯД З ВИКОРИСТАННЯ ФРОНТАЛЬНИХ ДЕПРОГРАМАТОРІВ ЖУВАЛЬНИХ М'ЯЗІВ ПІД ЧАС ЛІКУВАННЯ РОЗЛАДІВ СКРОНЕВО-НИЖНЬОЩЕЛЕПНИХ СУГЛОБІВ ТА МЕТОДИ ЇХ УДОСКОНАЛЕННЯ

Національний університет охорони здоров'я України імені П. Л. Шупика, Київ, Україна

У статті представлені результати огляду джерел літератури щодо використання депрограмуючих пристроїв. Встановлено, що депрограмуючі пристрої працюють на основі «замикаючої вісі нижньої щелепи», що є уявною лінією від центру суглобової голівки до ріжучого краю нижнього різця. Оклюзійні та депрограмуючі пристрої, зокрема передні серединні шини, ефективно знижують м'язову напругу через вплив на пропріоцептивну чутливість та нейром'язову координацію зубощелепної системи, що сприяє як діагностиці, так і лікуванню розладів скронево-нижньощелепних суглобів (СНЩС). Використання депрограмуючих пристроїв забезпечує точну реєстрацію щелепних співвідношень і сприяє м'язовій релаксації, а застосування пакувальних композитних матеріалів усуває необхідність лабораторних етапів, оптимізуючи реабілітаційний процес та прискорюючи клінічні результати.

Ключові слова: СНЩС, оклюзійні пристрої, оклюзійні шини, депрограмування жувальних м'язів.

Introduction

TMD or craniomandibular disorders (CMD) refer to conditions that cause abnormal, incomplete or impaired function of the temporomandibular joint(s) (TMJ) and masticatory muscles [1]. Common signs and symptoms of TMD are such as joint noise, pain, limited or asymmetrical jaw movements, which impairs the from of life.

Zhong Y., Luo F., Li X., Zeng S., et al. noted that among the 280 women examined, 75.0% had temporomandibular disorders – distributed as 19.6% with pain-related, 23.9% with intra-articular, and 31.4% with combined (pain-related

and intra-articular) forms – while 25.0% of the participants comprised the control group without temporomandibular disorders. This distribution indicates a predominance of combined clinical manifestations among the affected women [2].

In response to the action of the etiological factor (chronic trauma, malocclusion, acute trauma of the dentoalveolar apparatus), one of the first elements to be activated are the lateral pterygoid muscles (often, its upper velly), temporal muscles and the masticatory muscles themselves, which is determined by a clinical examination of the patient. Prosthodontic rehabilitation of patients with TMD is an interdisciplinary area that offers step-by-step quality treatment to improve patients' condition. To date, treatments such as occlusal splints, physiotherapy, pharmacotherapy, surgical treatment and a combination of the above have proven themselves well, among which the most common treatment option is occlusive splint therapy [3].

The **aim** of the present study is to analyze modern literature sources devoted to the use of deprogramming devices, their design and proposal for a simpler way of its manufacture.

Materials and methods

To analyze modern scientific data, we have used bibliometric databases such as Wiley Online Library, Web of Science, and Google Scholar for over the past years. The following keywords were applied: "muscle deprogramming", "muscle tensor deprogramming", "periodontal ligament receptors", and "deprogramming splint". The objectives of the study were to compare modern methods of muscle deprogramming in the treatment of patients with TMD, analyze their effectiveness and propose to improve the manufacture of a frontal deprogrammer.

Results and discussion

The following types of occlusive devices, also called anterior median contact splints, have been described and widely distributed in the literature, the main principle of which is a design that allows disocclusion of all teeth, except for incisors: Front bite plate; Lucia's jig; NTI-bus; Howley's anterior bite plate; V-splint (bruxism).

It has considered that the anterior bite plates contribute to the deprogramming of the lateral pterygoid muscles, the masticatory muscles and the contractile muscles, in such a way as to reduce the existing occlusive supracontacts and allow the articular heads of the lower jaw to be centered and to take the correct position in the central ratio of the jaws [4].

Front bite plate. The front bite plate is a hard acrylic splint that is worn on the upper teeth and provides contact only with the front teeth of the lower jaw, without contact with the back teeth when closed. It is usually flat and parallel to the occlusal plane. Front jig, Lucia jig, Howley plate, front deprogramming device, and Swedish plate [5] are types of front deprogramming device. They should only be used for short periods under constant medical supervision. Their main purpose is to abduct the posterior teeth by no more than 3 mm to establish neuromuscular deprogramming and thereby eliminate their effect on the function or dysfunction of the masticatory system. This contributes to the relaxation of the muscles (lateral pterygoid muscle), which leads to their deprogramming and finding the central ratio of the jaws [6].

Lucia jig. Lucia jig is a neuromuscular deprogramming device. It is a type of modification of the anterior bite plate located between the upper and lower incisors. It works by deprogramming the proprioceptive receptors of normal contact between the teeth (engram), changing the jaw closure pattern, and allowing the cheekbones to take the highest position [7]. The aim of this device is to use a standard device with a flat plane that is perpendicular to the axis of the lower incisor. The problem with this device is that the dentist cannot reduce the jig, so after fixing the centric ratio, hypercorrection of the lower face may occur (Fig. 1) [8; 9].

NTI splint. The NTI-splint device is a modified front common horizontal plane that is narrower than the normal front common horizontal plane. It covers only the two central incisors of the upper (or lower) jaw. This is also known as a "miniature front common horizontal instrument" (Figure 2) [10; 11].

The NTI-splint has a "disconnecting element" that is in contact with the two central incisors of the lower jaw when closed. NTI-splint primarily functions to relax the muscles involved in squeezing, increasing proprioceptive stimulation. When using keys, NTI should only touch 1 or 2 lower front teeth to the occlusal platform, resulting in reflexive relaxation of the masticatory muscles. However, there are some drawbacks to the use of anterior middle deprogramming devices that involve occlusal changes, including intrusion or protrusion of the anterior teeth, or even an open bite [12, 13].

Howley's anterior plate. Howley's anterior plate is a typical orthodontic device used to treat TMD. It is a

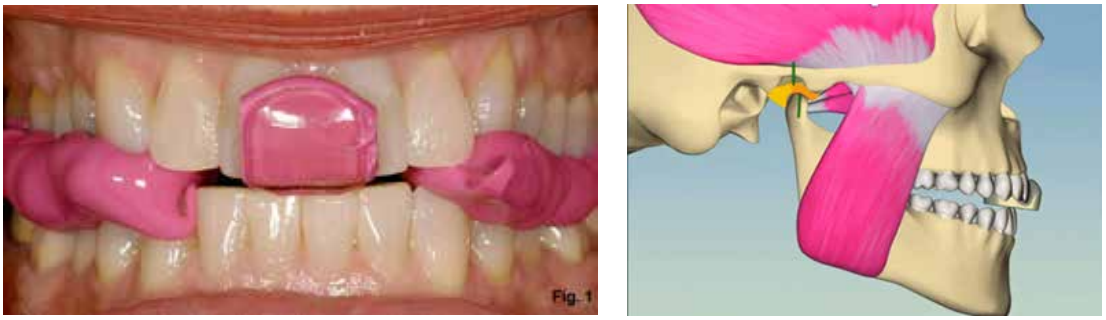

Fig. 1. Example of a standard Lucia jig

Fig. 2. Example of a manufactured NTI-splint

removable orthodontic device that consists of an acrylic base plate covering the palate and ball-shaped clasps that adhere to the teeth, providing stability and hold. Part of the front common horizontal plane of the device is made of acrylic and covers the front teeth. The main purpose of the anterior Howley plate in the treatment of TMD is to provide stabilization and support for the TMJ and near-articular structures, especially during sleep, when bruxism and compression may occur. By creating a stable occlusive connection between the upper and lower teeth, the device aims to reduce muscle tension and stress on TMD, mitigate pain and discomfort, and prevent further damage to the joint and near-articular tissues. Howley's anterior plate is usually prescribed and installed by a dentist or orthodontist. The device can be individually made to fit the patient's specific tooth structure and bite ratio. Patients are generally advised to wear the device while sleeping. Although Howley's anterior plate may be effective in providing symptomatic relief, its effectiveness may vary depending on the underlying cause and severity of the disease. It is often used as part of a comprehensive treatment approach, which may include other interventions such as physical therapy, medication, and more [14].

The principle of using deprogramming devices. The process of obtaining an accurate central jaw ratio or occlusal record requires the use of a sheet calibrator or other oral occlusive devices. A deprogramming device is then inserted at an upward angle between the incisors, so that when the patient opens and closes the jaw (rotacin or translational occurs) until the incisors do not come into contact with the leaf grip of sufficient thickness for all other teeth to be in disocclusion. Deprogramming with a list calibrator or deprogramming device is the process of achieving the TMJ in a relaxed or comfortable neuromuscular position (central relation) by interrupting or canceling the proprioceptors surrounding the teeth in the periodontal ligaments. These proprioceptors would otherwise automatically or subconsciously direct the jaw to the normal or acquired interdental position. Anterior muscle deprogramming is usually performed in 10-15 minutes by inserting something between the front teeth (such as a puff calibrator, Lucia jig jig guide device) during which the patient abducts the jaw and slightly compresses the centered anterior support point (center point). Thus, the jaw has a tripod (stabilized by two large and two small large points of contact) with the help of proprioceptive and muscular rearrangement. After that, the patient cannot instantly direct the jaw to an acquired or forced position, since the teeth cannot send signals to the central nervous system from the proprioceptors in the separated teeth. Otherwise, the teeth can cause the jaw to shift forward from the position of the central ratio of the jaws. The back teeth must remain separated for a few minutes for deprogramming device to occur. After it happens, the patient will feel as if the back teeth are mating (contacting) incorrectly or in a strange way (with deformed contacts). In some cases, deprogramming device will not occur until the patient has worn an occlusive device for several weeks and maintains a stable and comfortable jaw position for at least 1 week [15]. Also, the physiology of muscle deprogramming is to make a flat occlusive surface that is parallel to the Cr-In line (MLin) and perpendicular to the axis of the lower incisor (Fig. 3) in order to determine the release of the lateral pterygoid muscle when closing (Table 1).

Our analysis of literature sources, understanding the principles of deprogramming devices (or occlusive devices), we propose the following – after a clinical

Table 1

Comparative characteristics of the main literature sources whose results were used in the article

	Author (-s)	Name	Year	Study Type	Aim	Results were used in the article
1	2	3	4	5	6	7
1.	Orzeszek, S., Waliszewska-Prosol, M., Ettlin, D., Seweryn, P., Straburzyński, M., Martelletti, P., Jenca, Jr. A., Wieckiewicz, M.	Efficiency of occlusal splint therapy on orofacial muscle pain reduction: a systematic review	2023	Review	Assess the effectiveness of occlusal splints (OSs) in managing orofacial myalgia and myofascial pain (MP) compared to no treatment or other interventions	The review found insufficient evidence to conclude that OS therapy offers an advantage over other treatments or no treatment. All included studies demonstrated a high risk of bias

Continuation of table 1

1	2	3	4	5	6	7
2.	Wilisowski, D., Smok-Wilisowska, A.	A Case report on the application of selected methods of muscle deprogramming to achieve repetitive positioning of the mandibular joint heads in the treatment of disorders of the stomatognathic system using pharmacological agents	2022	Case report	To explore the efficacy of muscle deprogramming techniques combined with pharmacological interventions in the management of TMD	The proposed approach gives increased mandibular movement range, reduction or elimination of pain and joint sounds, relaxation of the masticatory muscles, normalization of muscle tone, and restoration of movement symmetry, indicating stable and repeatable correct positioning of the joint heads
3.	Al-Moraissi E.A., Farea R., Qasem K.A., Al-Wadeai M.S., Al-Sabahi M.E., Al-Iryani G.M.	Effectiveness of occlusal splint therapy in the management of temporomandibular disorders: network meta-analysis of randomized controlled trials	2020	Meta-analysis	to evaluate and rank the effectiveness of various occlusal splints in treating TMD	Specifically, anterior repositioning splints and combined counselling therapy with hard stabilization splints were more respectively effective for arthrogenous and myogenous TMDs. Additionally, was found that longer daily wear and treatment duration improved efficacy
4.	Aksakalli, S., Temucin, F., Pamukcu, A., Ezirganlı, S., OguzKazancioglu, H., Malkoc, M. A.	Effectiveness of Two Different Splints to Treat Temporomandibular Disorders	2015	Rando-mized Control Trial	Compare the effects of soft and hard splints for TMD management	Both splints were effective, but soft splints showed faster symptom relief
5.	Grymak, A., Aarts, J. M., Ma, S., Waddell, J. N., Cho, J. J. E.	Comparison of hardness and polishability of various occlusal splint materials	2020	Original Research	Evaluate and compare the hardness and polishability of different occlusal splint materials	3D-printed occlusal splint materials exhibited the highest gloss and the lowest surface roughness before polishing,. In contrast, other materials demonstrated varying degrees of hardness and polishability
6.	Gray, R. J., Davies, S. J.	Stabilisation splint therapy for temporomandibular pain dysfunction syndrome	2016	Review	Discuss the use of various occlusal splints for TMDs	Different splints have specific uses based on diagnosis
7.	Hasanoglu Erbasar, G. N., Alpaslan, C., Eroglu Inan, G.	Can an NTI-tss Device Be Effective as a First-Line Therapy in Patients with TMD Myofascial Pain?	2017	Rando-mized Control Trial	Compare the efficacy of NTI-tss combined with behavioral therapy to behavioral therapy alone for TMD myofascial	NTI-tss did not show significant improvement over behavioral therapy alone
8.	Zhong, Y., Luo, F., Li, X., Zeng, S., Zhang, S., Si, J., Xiong, X., Fang, S.	Associations between oral behaviors, temporomandibular disorder subtypes and psychological distress in adult women:	2024	Original Research	To investigate the relationship between various oral behaviors and different temporomandibular disorder (TMD) subgroups, considering psychological distress, in adult women	Oral behavior scores were higher in all TMD subgroups compared to controls, especially in those with pain-related or combined TMD and psychological distress. Sleep-related oral behaviors were elevated in all TMD groups regardless of psychological status
9.	García, M., Cabrera, J. A., Bataller, A., Vila, J., Mayoral, P.	Mandibular Movement Analysis by Means of a Kinematic Model Applied to the Design of Oral Appliances for the Treatment of Obstructive Sleep Apne	2020	Experi-mental Study	Apply a kinematic model to the design of oral appliances for OSA treatment	Kinematic model successfully used to improve appliance design for OSA treatment

End of table 1

1	2	3	4	5	6	7
10.	Lukic, N., Saxer, T., Hou, M. Y.	Short-term effects of NTI-tss and Michigan splint on nocturnal jaw muscle activity: A pilot study	2021	A pilot study	Evaluate the NTI-tss device in managing bruxism, TMD, and headaches	NTI-tss showed mixed results for reducing symptoms of bruxism and TMD
11.	Layton, D. M., Morgano, S. M., Att, W., Freilich, M. A.	The Glossary of Prosthodontic Terms 2023: Tenth Edition	2023	Descrip-tive	Standardization of terms used in prosthodontics	Provides a framework for terminology in TMJ and occlusal splint discussions
12.	Di Paolo, C., Qorri, E., Falisi, G., Gatto, R., Tari, S. R., Scarano, A., Rastelli, S., Inchingolo, F., Di Giacomo, P.	RA.DI.CA. Splint Therapy in the Management of Temporomandibular Joint Displacement without Reduction	2023	Clinical Study	Evaluate the RA.DI. CA. splint for TMJ displacement management	RA.DI.CA. splints effectively managed TMJ displacement

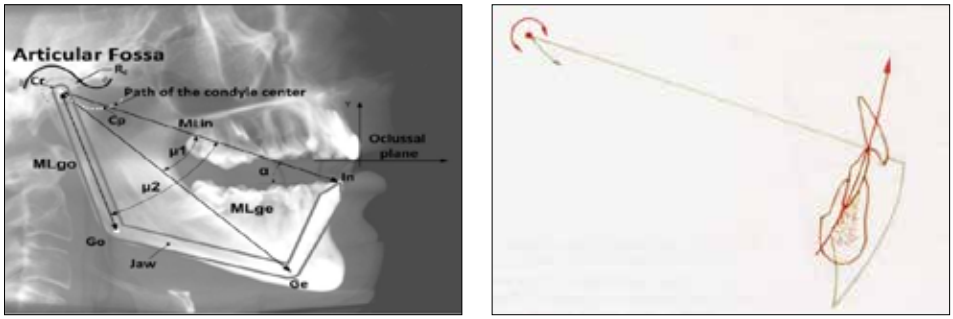

Fig. 3. Cephalometric explanation of deprogramming devices (according to the ideas of M. García [16] (left) and R. Slavicek [17] (right))

Fig. 4. A frontal deprogramming device in the oral cavity (created directly with a composite material)

examination, the dentist can create an anterior deprogramming device directly in the patient's oral cavity, using a packaging composite material, on the basis that the deprogrammer must increase the interdental distance (interalveolar ratio), so that the contact is only in the area on the lower front teeth. By applying a composite material, after isolating the palatine surface of the teeth, a deprogrammer can be created that will be held due to the mechanical properties and relief of the palatine surface of the upper anterior group of teeth and perform the same functions as the methods proposed by different authors. This proposal looks quite promising because it allows for similar clinical results and also reduces rehabilitation time, since the manufacture of the deprogramming devices does not require laboratory steps, an example of use is presented in Fig. 4.

Conclusions

Occlusive and deprogramming devices, by modulating dental proprioception and promoting neuromuscular relaxation, effectively relieve muscle tension, establish stable occlusal relationships and improve jaw function, serving both diagnostic and therapeutic purposes.

The proposed frontal deprogrammer – manufactured from packaging composite materials without laboratory steps – streamlines the rehabilitation process for TMD patients, ensuring clinical efficacy while accelerating treatment outcomes.

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