

THE INFLUENCE OF SELECTED FACTORS ON THE EFFICACY AND DURATION OF TREATMENT OF DISK DISPLACEMENT IN THE TEMPOROMANDIBULAR JOINT BY OCCLUSAL REPOSITIONING SPLINT

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ABSTRACT

INTRODUCTION: Temporomandibular disorders are characterised by the presence of discomfort in masticatory muscles, the temporomandibular joint (TMJ), and nearby structures of the head and neck region.

INTRODUCTION: The aim of the study was to evaluate the efficacy and duration of treatment with an occlusal repositioning splint in patients with disc displacement, with and without reduction in TMJ.

MATERIAL AND METHODS: A group of 40 patients, aged 16-55 years, was randomly selected for treatment using occlusal repositioning splints. Based on clinical and additional examinations, the therapeutic mandible position was established and an occlusal repositioning splint was produced. Clinical examinations, based on the Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD), were carried out before treatment and on each check-up visit (days 7 and 14, and every four weeks).

RESULTS: In the study group a statistically significant clinical improvement was observed after using an occlusal repositioning splint ($p < 0.05$). Termination of treatment was between 3 and 12 months of observation. The efficacy depended significantly on advancement and severity of disorders. There was no effect of advancement and severity of dysfunction, duration of symptoms, general diseases, or malocclusion on the duration of treatment. A slightly greater chance for shorter duration of splint usage was seen in patients with disc displacement without reduction, with manual repositioning before the splint usage, compared to patients with disc displacement with reduction (HR = 1.02, 95% confidence level [CL] = 0.42-2.47; $p = 0.9579$).

CONCLUSIONS: Treatment with an occlusal repositioning splint is effective in the elimination of signs and symptoms TMJ disk displacement. The improvement depends on disorder advancement and severity of symptoms. The time of treatment with the occlusal repositioning splint usage is highly individual

KEY WORDS: temporomandibular joint, disk displacement, repositioning occlusal splint.

J Stoma 2019; 72, 1: 23–28

DOI: <https://doi.org/10.5114/jos.2019.86491>

INTRODUCTION

Temporomandibular disorders (TMD) are characterised by the presence of discomfort in masticatory muscles, the temporomandibular joint (TMJ), and near-

by structures of the head and neck region [4, 6, 15, 18]. Symptoms occur in the masticatory muscle and TMJ, which significantly impairs both structures and leads to their dysfunction, giving rise to significant diagnostic and treatment problems [15]. Therefore, it is recom-

**JOURNAL OF
STOMATOLOGY**
CZASOPISMO STOMATOLOGICZNE

OFFICIAL JOURNAL OF THE POLISH DENTAL ASSOCIATION | ORGAN POLSKIEGO TOWARZYSTWA STOMATOLOGICZNEGO



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RECEIVED: 21.02.2019 • ACCEPTED: 31.03.2019 • PUBLISHED: 28.06.2019

mended that reversible and non-invasive methods be used in the first stage of treatment [2, 6, 7, 10, 14]. This is particularly important in view of the observed cases of spontaneous symptom regression and the significant influence of stress and the psycho-emotional state of the patient facing the disease [7]. Persistent symptoms of TMJ internal derangements associated with the displacement of the articular disc in habitual occlusion make it necessary to consider the implementation of the procedures for changing the position of the lower jaw relative to the upper jaw in order to achieve an orthopaedic balance within the masticatory organ [14]. By proper manipulation of the mandible (lower jaw changing position in three dimensions) an attempt is made to obtain the correct position of the head of the mandible in relation to the articular fossae and the disc so that the TMJ function can be improved [7, 14].

The therapeutic position of the mandible is stabilised by using occlusal repositioning splint. This type of splint is made of hard acrylic resin in the dental laboratory [8, 13]. It is recommended to use the splint for 24 h a day, to stabilise the intra-articular relationship during the tooth contact. However, one should bear in mind that the impact of a daily use of the repositioning splint will be exerted not only on the TMJ, but also on the contact of the teeth. That is why, in the case of internal derangements with disc displacement with and without reduction, the decision to use a repositioning splint should be preceded by preliminary therapeutic procedures (anti-inflammatory, relaxation of the masticatory muscles, and TMJ unloading) that can help to identify a possible need to change the position of the mandible followed by an occlusal reconstruction. Treatment with an occlusal repositioning splint is a difficult procedure, generally assumed as invasive and irreversible. The determination of the mandible position requires a dentist with considerable experience and depends on the severity of the disorders.

OBJECTIVES

The aim of the study was the evaluation of chosen factors on the efficacy and duration of the treatment by occlusal repositioning splint in patients with symptoms of TMJ disc displacement.

MATERIAL AND METHODS

A group of 40 patients (33 women and 7 men, aged 16-55 years, mean age 31.0 ± 9.0 years) after the first stage of TMD treatment were used as the material for the study. The group included patients suffering from the symptoms of TMJ internal derangements, related to disc displacement with and without reduction in the form of abnormal movements of the jaw, the symptom sound in the TMJ (clicking), pain within the TMJ and/or mas-

tatory muscles, intensified by the movements of the jaw with or without limitation according to the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) [4, 15, 18]. The subjects with reduced symptoms after the first stage of treatment (no pain), but without a sustainable improvement of the TMJ function (impaired movements, clicking in the TMJ during mandibular movement) and/or clinically evident disproportion between the position of the mandible in habitual occlusion and the position of the mandible decrease the symptoms of dysfunction, were eligible for the study. People who did not express their consent to participate in the study, those with known symptoms of TMJ osteoarthritis, without teeth, with psychiatric disorders, or addicted to alcohol and drugs were excluded from the study. The planned procedures consisted of clinical (according to the RDC/TMD axis I), dental, and additional (radiological – panoramic, magnetic resonance imaging [MRI]) examinations of the masticatory organ, establishing the therapeutic position of the jaw, occlusal repositioning splint performance, and check-up visits.

The patients qualified for the study, were informed about a possible need for post-treatment occlusal adjustments resulting from wearing the splint. All subjects had orthodontic consultation to determine the feasibility of a possible occlusion correction after completing the treatment of TMJ dysfunction.

The study was performed with the permission of the Bioethical Committee.

Clinical examinations were carried out according to the RDC/TMD before treatment and on each control visit. Pain complaints were assessed using a numerical rating scale (NRS), where 0 represents no pain and 10 represents maximal discomfort. Based on the medical history, previous and current symptoms were assessed, including the state of general health. The screening X-ray pictures (panoramic) were taken in all patients, and magnetic resonance imaging scans were performed in difficult cases with ambiguous symptoms in a clinical trial [1]. Based on the clinical and additional examinations, the therapeutic mandible position was established in each patient. If clinical signs of disc displacement without reduction were found, manual repositioning was attempted, according to generally accepted procedures [14]. The obtained repositioning of the joint disc resulted in bringing the mandible to the position that prevented disc displacement and allowed for the correct movement of the jaw, without pain or sound (clicking). This position was stabilised using the silicone impression material (putty body).

A positive result of the clinical trial using diagnostic tests (no pain, improvement of jaw movements – range, track, lack of sound symptoms during jaw movements), and of MRI examinations performed in cases with ambiguous symptoms in a clinical trial, justified the order to produce an acrylic lower occlusal repositioning splint. A splint covered the whole or a part of the dental arch so

as to provide contact with the teeth of the opposing jaw and assure a stable position of the mandible. The splints were recommended for use, except for the consumption of food. Control visits were planned after days 7 and 14 and then every four weeks.

STATISTICAL ANALYSIS

For the analysis of the occurrence of certain events (such as malocclusion, pathological tooth wear) in terms of the quality in the treatment groups, Fisher's exact test was used. Another group of analysed parameters was the elapsed time to complete treatment with occlusal repositioning splints. Given the nature of this variable the results were presented in the form of inverted curves using the Kaplan-Meier method to estimate the probable end of the treatment, depending on the studied factors (e.g. the type of intra-articular disorders, general diseases, malocclusion, duration of symptoms). Figures showing the curve also contained 95% confidence intervals. Comparison of patient groups in terms of the probability was based on a logarithmic rank test (Log-rank test), and the strength of the test compound was presented in the form of a hazard ratio (HR). The type of statistical analysis used was the logistic regression analysis, which was used to find, and then to determine, the strength of the association between variables of dichotomous nature. An example of such a search was striving to find the compound, for example, between the fact of movement of the locking disc and yielded improvement after treatment. The obtained strength compounds were expressed as odds ratios (OR).

All calculations were performed using the SAS system [16]. The procedures used were as follows: *FREQ* (to calculate the frequency of events and the McNemary test), *NPAR1WAY* (*U* Mann-Whitney test), *MEANS* (calculation of the average, median, and standard deviations), *LIFETEST* (Kaplan-Meier), *PHREG* (calculation quotients threats), *Genmod* (GEE models), and the *LOGISTIC* procedure (binary compounds of factors and calculate the odds ratio).

RESULTS

In the studied group of patients 25 (62.5%) had disk displacement with reduction (DDwR) and 15 people (37.5%) had disk displacement without reduction (DDw/oR) (Table 1). In 20 people (50.0%) pathological tooth wear was found, and malocclusion was observed in 31 (77.5%) patients. In this group of patients, the time of repositioning splint usage lasted from 3 to 12 months. The use of the splints resulted in the decrease or relief of dysfunction symptoms confirmed by subjective and objective examinations. Significantly decreased dysfunction symptoms were seen in all patients with DDwR ($p = 0.0003$), facial pain decreased

from 3.8 ± 3.2 to 0.8 ± 1.5 , the mandibular opening increased ($p = 0.003$), and an improved pattern of movement ($p = 0.04$) was seen in patients with disk locking (DDw/oR), which may indicate an improvement in the position of the structures within the temporomandibular joint – disk repositioning.

The impact of advancement of disorders (disc displacement with and without reduction), duration of the symptoms, general diseases, occlusion quality to achieve a state without signs and symptoms of TMD, and the possibility of ending the treatment with an occlusal repositioning splint were analysed based on clinical and additional examinations.

Assessment of the patient's therapeutic efficacy of the applied occlusal repositioning splints was significantly dependent on the dysfunction severity. The chance of getting better (pain decrease, improved mandibular mobility) after treatment was over six-fold greater in patients with DDwR compared to those who were found to be locked (DDw/oR) (OR = 6.63; 95% CL = 0.81-2.96; $p < 0.0006$). On the third control visit dysfunction symptoms were reduced already in 92% of patients with DDwR, while in patients with DDw/oR this improvement was observed in 40% of patients. Patients with displaced and locked disc, in whom the attempt to manually apply repositioning failed, showed mandible openings limited to 36 mm. The degree of opening of the mandible in these patients increased, but the deviation of the mandible in the final phase of opening pointed to the lack of complete repositioning of the disc. It was significantly less likely to restore proper intra-articular relations in these patients (OR = 0.13; 95% CL = -3.23 - (-0.80); $p < 0.001$).

Also, significantly less chance of regression of dysfunction symptoms was observed in patients who rated

TABLE 1. Patients' baseline characteristic

Factor	n = 40 (%)
Sex	
Male	7 (17.5)
Female	33 (82.5)
Mean age \pm SD (y)	31.0 \pm 9.0
General disorders	11 (27.5)
Malocclusion	
Angle's classification	
Class I	9 (22.5)
Class II	15 (37.5)
Class III	1 (2.5)
Deep bite	3 (7.5)
Lateral mandible displacement	15 (37.5)
Disc displacement with reduction	25 (62.5)
Disc displacement without reduction	15 (37.5)

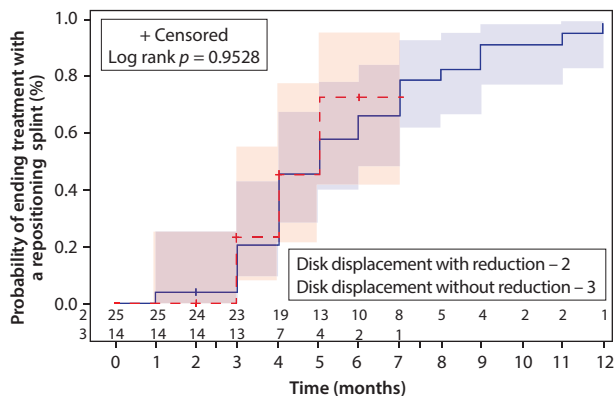


FIGURE 1. The probability of ending the treatment with an occlusal repositioning splint in the observed time, depending on the type of internal temporomandibular joint disorders (displacement of the disc with and without reduction)

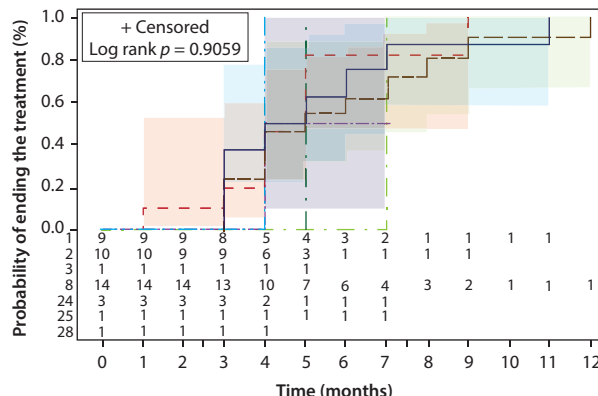


FIGURE 2. Probability of ending treatment with occlusal repositioning splint in the observed time, depending on the prevalence of malocclusion, where: 1, 2, 3 is Angle classes, 4 overbite, 5 open bite, and 8 lateral displacement of the mandible

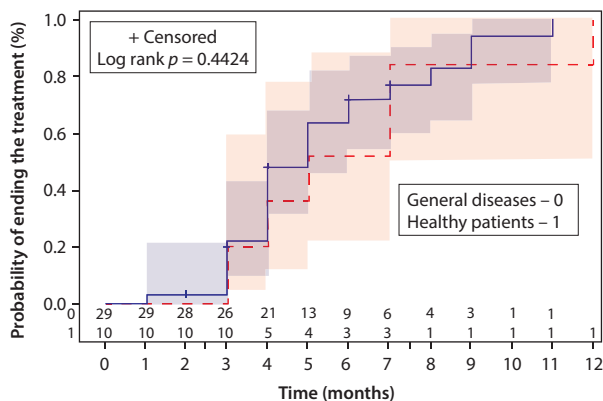


FIGURE 3. The probability of ending treatment with an occlusal repositioning splint at the observed time, depending on the general conditions of coexistence

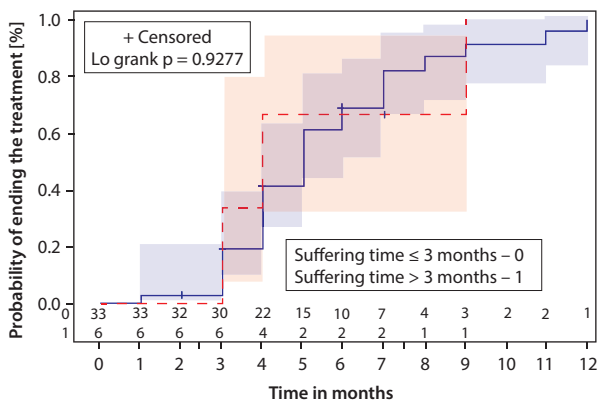


FIGURE 4. The probability of ending the treatment with an occlusal repositioning splint at the observed time depending on the duration of the dysfunction

their pain at more than 3 points on the 10-point scale (numeric rate scale – NRS). Those experiencing less severe pain had an almost four-times greater chance of alleviating the symptoms of disorders (OR = 3.82; 95% CL = 0.38-2.30; $p < 0.006$).

There was no effect of the number of tender points on palpation in the masticatory muscles or TMJ on the improvement following the applied treatment. Similarly, there was no effect of malocclusion diagnosed in the course of treatment (OR = 0.84; 95% CL = -1.13-0.80; $p = 0.74$).

Duration of the treatment using occlusal repositioning splints necessary to establish the stable intra-articular relation in TMJ was also rated. No effect of the type of internal TMJ disorders (DDwR, DDw/oR) on the length of time needed for the treatment with occlusal repositioning splints was observed (Figure 1). A few people with DDwR, having observed a very satisfactory TMJ function after a two-month use of occlusal repositioning splint in a fixed therapeutic position of the jaw, de-

cidated to have the orthodontic treatment implemented. However, after the third month of follow-up there was no significant difference between the number of people with DDwR and DDw/oR who completed the treatment using an occlusion repositioning splint ($p = 0.95$). It was also found that patients with DDw/oR who underwent the reposition of the articular disc before determining the therapeutic position of the jaw have a slightly greater chance for a shorter duration of splint usage compared with the DDwR (HR = 1.02, 95%, CL = 0.42-2.47; $p = 0.9579$).

Similarly, there was no correlation between the time of application of the splint and the type of occlusion diagnosed in patients (Figure 2). After a two-month treatment the orthodontic treatment was implemented in 10% of patients with Angle class II. In people with other bites the shortest duration of the treatment using splint was three months. The longest duration of the treatment with a repositioning splint was observed in patients with lateral displacement of the mandible, and in 90% of pa-

tients with this malocclusion it was decided to terminate the splint treatment after 11 months. Slightly less chance for a shorter duration of treatment with a repositioning splint was seen in people with malocclusion compared to people without it (Angle class I) (HR = 0.98; 95% CL = 0.92-1.03; $p = 0.4851$).

General diseases had no impact on stabilisation of the intra-articular disturbances and time for repositioning occlusal splint usage ($p = 0.44$) (Figure 3). There was no higher risk of failing to obtain the assumed results of treatment in this group of patients (HR = 0.73; 95% CL = 0.30-1.80; $p = 0.4952$). Similarly, there was no need to use the splint for a long time in patients who had reported dysfunction lasting for more than three months (HR = 1.04, 95% CI = 0.39-2.74; $p = 0.936$) (Figure 4).

Treatment with the use of occlusal repositioning splints resulted in a position of the mandible that made it possible to correct the occlusion and reconstruct occlusal contacts stabilising this position (96% of patients). Until now, in 18 (58.1%) people the reconstruction of the occlusion in the therapeutic position of the mandible was possible through the conservative-prosthetic treatment, and orthodontic treatment was implemented in 13 (41.9%) people.

DISCUSSION

The results of check-up visits after treatment with occlusal repositioning splints showed a statistically significant reduction in severity of symptoms and signs of TMJ dysfunction, regardless of the severity of the dysfunction, in people with disc displacement with and without reduction. It proves the efficacy of the clinical procedures used. Along with the subjective improvement reported by patients, a significant decrease was also reported in the prevalence of symptoms of dysfunction in clinical and additional examinations. Studies carried out by different authors indicate the efficacy of treatment with repositioning splints [1, 3, 5, 8-10, 12, 13, 17, 19]. Okeson [13] reported symptomatic relief of dysfunction in 80% of treated patients after eight weeks of observation. After finding the reduction or absence of clinical signs of dysfunction, occlusal splint was gradually adjusted to return to the patient's habitual occlusion. The author also showed that despite the lack of articular disc repositioning during the treatment, in 75% of patients the improvement was achieved and there was no need for further action. Similar observations were made in the presented study; even if the proper position of the articular disc was not restored in the defined time, there was no need to continue treatment with an occlusal repositioning splint. The achieved range of mandibular movement and the lack of pain satisfied the patient. However, in the end of treatment with an occlusal repositioning splint up to 96% of patients in

the study required the reconstruction of occlusal contact in the therapeutic position of the mandible. Most likely this was due to disturbances in the form of pathological tooth wear and/or malocclusion diagnosed prior to the treatment.

Similar observations were obtained by Davies *et al.* [3], who found 90% of the effectiveness of the treatment of dislocating the disc without locking after a sufficiently long treatment time, which allowed its ending without continuation using an occlusal reconstruction. Reconstruction of an occlusion after treatment with a repositionable bite splint is a complex problem [3, 9, 12, 13, 19]. The basis of this type of procedure is the evaluation of the masticatory organ movement system in the aspect of the possibility of achieving orthopaedic stabilisation after the completed stage of treatment using this type of occlusal splint, which in each case should be considered individually.

It should be emphasised that the identification of specific patients' needs is required because of their psychosocial characteristics [10], especially bearing in mind that a systematic review showed a possible effect of the therapeutic approach tailored to TMD patients' psychological interventions.

CONCLUSIONS

Treatment with an occlusal repositioning splint is effective in the elimination of TMJ dysfunction signs and symptoms.

The chance for improvement after use of an occlusal repositioning splint depends on disorder advancement (DDwR vs. DDw/oR) and severity of symptoms (more than 3 NRS points).

Malocclusion does not affect the chance of improvement during treatment with an occlusal repositioning splint. The time of treatment with the use of an occlusal repositioning splint does not depend on disorder advancement, duration of symptoms, severity of symptoms, malocclusion, or general disorders.

Further studies of TMJ internal derangements treatment efficacy with interventions based on the patients' psychosocial characteristics are necessary.

CONFLICT OF INTEREST

The authors declare no potential conflict of interests with respect to the authorship and/or publication of this article.

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