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Clinical study of splint therapeutic efficacy for the relief of temporomandibular joint discomfort

Yoko Hasegawa ^{a, b, *}, Naoya Kakimoto ^{c, 1}, Seiki Tomita ^c, Masanori Fujiwara ^a,
Reichi Ishikura ^d, Hiromitsu Kishimoto ^a, Kosuke Honda ^a

^a Department of Dentistry and Oral Surgery, Hyogo College of Medicine, 1-1 Mukogawa-cho, Nishinomiya, Hyogo 663-8501, Japan

^b Division of Oromaxillofacial Regeneration, Osaka University Graduate School of Dentistry, Osaka 565-0871, Japan

^c Department of Oral and Maxillofacial Radiology, Osaka University Graduate School of Dentistry, Osaka 565-0871, Japan

^d Department of Radiology, Hyogo College of Medicine, 1-1 Mukogawa-cho, Nishinomiya, Hyogo 663-8501, Japan

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ABSTRACT

Purpose: This study aimed to evaluate the relationship between displacement of the mandibular condyle/disc due to occlusal splint insertion with splint therapy and changes in discomfort of the temporomandibular joint (TMJ), and to clarify the relationships between the outcomes over time of temporomandibular discomfort and TMJ magnetic resonance imaging (MRI) findings at the initiation of splint therapy.

Materials and methods: A total of 75 patients admitted to hospital with discomfort around the TMJ were evaluated. A visual analogue scale for TMJ discomfort was administered during visits for approximately 3 months following the initiation of splint therapy. At the start of splint therapy, magnetic resonance imaging (MRI) was performed with and without splint insertion, and condyle and disc movements were evaluated. Disc balance, disc position and function, disc configuration, joint effusion, osteoarthritis, and bone marrow were evaluated. Linear regression and multiple regression analyses were used to clarify relationships between changes in discomfort and the factors evaluated.

Results: There was no significant correlation between TMJ discomfort and condyle/disc movement with splint insertion. TMJ discomfort was significantly relieved by splint therapy regardless of temporomandibular MRI findings. Unilateral anterior disc displacement and marked or extensive joint effusion fluid were significantly improved with splint therapy.

Conclusion: Discomfort tended to remit with splint therapy regardless of temporomandibular MRI findings. Improvement of TMJ discomfort appears more likely to occur in patients with unilateral anterior disc displacement and with an apparent organic disorder, such as a joint effusion.

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1. Introduction

An occlusal splint (splint) is known to be an effective treatment for many temporomandibular disorders (TMDs) (Dao and Lavigne, 1998; Dao et al., 1994; Wenneberg et al., 1988). Splint therapy is a reversible nonsurgical option for management of TMD (Dylina, 2001) and can reduce pathologic symptoms around the

temporomandibular joint (TMJ) caused by excessive occlusal pressure on the TMJ by external forces. In this manner, the splint restores blood circulation to the TMJ by maintaining a wide gap between the mandibular condyle (condyle) and the mandibular fossa (Ettlin et al., 2008; Moncayo, 1994). We previously evaluated deviation of the condyle position and articular disc (disc) on magnetic resonance imaging (MRI) performed at initiation of splint therapy, and we found that the condyle deviates anteroinferiorly and rotates counterclockwise with splint insertion. Additionally, such a pattern of joint movement in wearing the splint has been associated with relief of joint pain (Hasegawa et al., 2011). This study showed that splint therapy might be an effective treatment for TMJ disc derangement manifesting as joint pain.

* Corresponding author. Department of Dentistry and Oral Surgery, Hyogo College of Medicine, 1-1, Mukogawa-cho, Nishinomiya, Hyogo 663-8501, Japan.
Fax: +81 798 45 6679.

E-mail address: cem17150@hyo-med.ac.jp (Y. Hasegawa).

¹ Co-first author.

However, it cannot be confirmed that splint therapy reduces symptoms of joint discomfort other than pain, such as a catching sensation with condyle movement or functional limitation due to TMJ disc derangement. TMJ discomfort, which is subjective, is associated with joint pain, joint sounds with functional movements, restricted range of motion, and/or changes in the movement pattern of the mandible, hypertonus of jaw muscles, and so on (Manfredini et al., 2011). Factors that cause discomfort are intertwined in a complex manner, and clinicians may be puzzled over the appropriate therapy for patients with TMJ discomfort. The possibility exists that the development of joint pain accompanied with some TMJ discomfort cannot be prevented by splint therapy, because patients who continue to experience TMJ symptoms are most likely suffering from an associated dysfunction in autonomic activity (Maixner et al., 2011). Namely, manifestations of TMJ discomfort vary, depending on many subjective symptoms (Dao et al., 1994). However, the fact is that splint therapies are overwhelmingly selected for various forms of TMJ discomfort, as well as TMJ pain. We previously reported that splint-related anterior movement of the condyle was associated with TMJ pain, and that splint therapy was not likely to be successful for any kind of TMJ abnormalities (bone marrow abnormalities and biconvex disc) (Hasegawa et al., 2017). On the other hand, the target symptoms did not involve joint discomfort in that study.

The present study was carried out to evaluate the role of splint therapy in the treatment of TMJ symptoms accompanied by discomfort. To put it more concretely, the objectives of the present study were to clarify: 1) the relationship between displacement of the condyle/disc due to occlusal splint insertion and changes in TMJ discomfort with splint therapy; and 2) the relationship between the long-term prognosis of discomfort around the TMJ and MRI findings at the start of splint therapy.

2. Materials and methods

2.1. Subjects

Patients with a history of clicking, catching, or restricted mouth opening and unilateral or bilateral joint pain, and complaints of some subjective symptoms around the TMJ who had been referred to Osaka University Dental Hospital and Hyogo College of Medicine Hospital from February 2009 to January 2013 and who provided informed consent were enrolled. The subjects of this study are the same as those of our previous report (Hasegawa et al., 2017). The present study was performed with the approval of the ethics committee of Osaka University School of Dentistry (H21-E4) and Hyogo College of Medicine (H22-887).

Patients were instructed to insert the splint only during sleep, and they visited the hospital 1 week, 1 month, 2 months, and 3 months following initiation of splint therapy, during which they underwent treatment for TMJ symptoms. Regarding treatment, patients were instructed to use the splint continuously for 6 months if symptoms around the TMJ continued for 3 months following the start of splint therapy. Pharmacotherapy (nonsteroidal anti-inflammatory drugs and muscle relaxants) was provided as needed after the first medical examination. Patients who complained of pathologic symptoms during splint therapy and those who wanted to stop therapy were withdrawn.

2.2. Data recording

Splints are typically used only during sleep. Therefore, MRI scans and splint adjustments were performed with patients in the supine position. The occlusal splint was fabricated using the method reported previously (Hasegawa et al., 2011). The splints

were adjusted such that the functional cusp uniformly contacted the splint at each visit. The occlusal vertical dimension was maintained at 5 mm between the central incisors of the maxilla and mandible, as in our previous report (Hasegawa et al., 2017; Hasegawa, et al., 2011). A prosthodontic specialist responsible for adjusting the splint adjusted the occlusion contact point as necessary at each visit.

On the day that the splints were set, patients were assessed by MRI with and without splints. MRI was performed with a 1.5-T MR scanner using TMJ surface coils. Proton density-weighted images (repetition time (TR) (msec)/echo time (TE) (msec)/number of excitations (NEX) = 2500/20/2) with the fast spin echo sequence were obtained in the oblique sagittal plane in the closed mouth position with or without a splint in place. When the splint was in place, patients were asked to make light contact with the splint using their teeth. Other proton density-weighted images (TR/TE/NEX = 800/24/2) with the fast spin echo sequence were obtained in the sagittal plane in the closed and opened mouth positions to assess disc reduction. The field of view was 10 cm × 10 cm, slice thickness was 3 mm with 0.5-mm inter-slice spacing, and matrix size was 256 × 160. Two oral and maxillofacial radiologists (N.K. and S.T.) interpreted the MR images and performed the analyses.

2.3. Data analysis

The same image analysis of anteroposterior movement, vertical movement, and the rotational angle with respect to the condyle/disc as previously reported was performed (Hasegawa et al., 2011; Hasegawa et al., 2017). Two oral and maxillofacial radiologists classified the subjects into one of three groups according to the position of the disc (balance of the discs) on MRI: the bilateral normal disc group, the unilateral anterior disc displacement (ADD) group, and the bilateral ADD group. In this study, the TMJ disc position criteria described by Tasaki and Westesson (1993) and by Larheim et al. (2001c) were used with some modifications. Disc position and function were classified into five categories, as reported by Tasaki et al. (1996), with some modifications, including normal superior, partial ADD with reduction (PADDWR), partial ADD without reduction (PADDWOR), ADD with reduction (ADDWR), and ADD without reduction (ADDWOR) on closed and open mouth position sagittal proton density-weighted MR images. Disc configuration was classified into five categories, as reported by Murakami et al. (1993), including biconcave, biplanar, hemiconvex, biconvex, and folded. Joint effusions were classified into three categories according to Larheim et al. (2001c): none or minimal fluid, moderate fluid, and marked or extensive fluid. Osteoarthritis, as demonstrated by condylar osteophytes or erosion, as noted by Kirk (1994), was classified into two categories: negative or positive. Bone marrow abnormalities of the condyle in the form of oedema or osteonecrosis, as described by Larheim et al. (1999), were classified into two categories: negative or positive.

2.4. Evaluation of discomfort

A visual analogue scale (VAS) was used to evaluate subjective symptoms in the TMJ region at each visit. Discomfort was evaluated by the patient's answer to "How is the level of discomfort in daily life caused by TMJ symptoms?" with a VAS level of 0 being "nothing" and 100 being "maximum." The VAS value at initiation of splint therapy is indicated as VAS_{pre}, and that at the end of the splint therapy is shown as VAS_{post}.

Discomfort was evaluated with the calculated relative change (RC) as follows:

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