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Original article

Effect of stabilization splint therapy on glenoid fossa remodeling in temporomandibular joint osteoarthritis

Soo-Min Ok PhD[a,b], Sung-Hee Jeong PhD[a], Yong-Woo Ahn PhD[a], Yong-Il Kim PhD[b,c,d,*]

[a] Department of Oral Medicine, School of Dentistry, Pusan National University, Busan, South Korea
[b] Dental Research Institute, Pusan National University Dental Hospital, Geumoro 20, Mulgeumeup, Yangsan 626 787, South Korea
[c] Department of Orthodontics, Institute of Translational Dental Sciences, Pusan National University, Busan, South Korea
[d] Biomedical Research Institute, Pusan National University Hospital, Busan, South Korea

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ABSTRACT

Purpose: The aim of this study was to evaluate, by CBCT superimposition, bone changes (cortical bone intactness, sclerosis and subchondral cyst) in the glenoid fossa related to stabilization splint (SS) therapy for temporomandibular joint osteoarthritis (TMJ OA) patients and to compare the effects for two groups, one that had undergone SS therapy and the other that had not.

Methods: This case–control study included 36 TMJ OA patients, 10 that had undergone SS therapy (the SS group) compared with 26 that had not (the non-SS group). Osseous changes in the glenoid fossa were evaluated based on superimposed CBCT images before and after treatment.

Results: Improvements ranging from 57.5 to 100% were achieved in cortical bone integrity, sclerosis, and subchondral cyst for both groups, SS and non-SS. However, there were no statistically significant difference between the two groups ($p > 0.05$). The non-SS group showed a significant decrease in the distances from the point of inflexion and the lowest point of the articular eminence to the reference line ($p < 0.05$). On the other hand, the SS group showed an increase for the point of inflexion. The other measures showed no statistically significant differences in distance before treatment and after treatment, even though the average distance after treatment showed an overall increasing tendency.

Conclusion: SS therapy relieved excessive loading on the TMJ in the TMD OA patients, who showed, via CBCT superimposition, less bone resorption in the glenoid fossa.

* *Corresponding author at*: Department of Orthodontics, Institute of Translational Dental Sciences, Pusan National University, Busan, South Korea. Tel.: +82 55 360 5156; fax: +82 55 360 5153.
E-mail address: kimyongil@pusan.ac.kr (Y.-I. Kim).

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1. Introduction

Temporomandibular joint osteoarthritis (TMJ OA) is the most common severe form of degenerative temporomandibular disorder with secondary inflammation. Excessive mechanical stress, inflammation, abnormal remodeling of subchondral bone, chondrocyte apoptosis, as well as genetic and hormonal factors can cause imbalanced bone formation, which ultimately can lead to degenerative change of the articular surface and subsequent cortical destruction of the TMJ [1–3].

Diagnosis of TMJ OA is based mainly on clinical symptoms and radiographic features of the condyle, including erosive resorption, sclerosis, attrition, osteophyte formation, and cyst-like change [4]. Therapeutic protocols such as physiotherapy, medication, splint therapy, and intra-articular injection are the well established approaches for conservative treatment of TMJ OA [5–7]. Among these, splint therapy has been clinically confirmed to effectively protect the TMJ against overloading and to relieve excessive muscular tension in the case of bruxism [3]. Kuttila et al. [8] found that the use of splint therapy improved the clinical symptoms of severe TMJ arthralgia, Al-Ani et al. [9] subsequently reporting its positive effect in alleviating pain related to TMJ disorder. However, its effect on OA has not been fully investigated, despite its increasing clinical use.

Previous assessment of TMJ OA treatment outcomes has been performed mainly by observation of clinical symptoms and radiographic findings [4]. Palconet et al. [10] reported that their CBCT findings were not consistent with their subjects' TMJ signs and symptoms or condylar bony change. However, Ok et al. [11] reported that stabilization splint (SS) therapy induced favorable bone remodeling in the anterior division of the condylar head and that the CBCT superimposition method showed effectiveness in TMJ OA assessment. It should be stressed, therefore, that along with evaluation of clinical symptoms and radiographic findings, it is important to evaluate, by superimposed radiography before and after treatment, the extents of relevant bone formation and resorption. Functional loading and other mechanical loading occur on the anterior surface of the glenoid fossa as well as the condylar head. These loads can affect the morphology, and indeed alter the shape, of the glenoid fossa [12]. Elgüy et al. [13] reported a significant relation between a TMJ OA patient's sagittal change of mandibular condyle and glenoid fossa roof thickness. However, there was no study to investigate bone changes (cortical bone integrity, sclerosis and subchondral cyst) of the glenoid fossa in TMJ OA patients who had undergone SS therapy. The aim of the present study, therefore, was to evaluate, by CBCT superimposition, bone changes (cortical bone integrity, sclerosis and subchondral cyst) of the glenoid fossa in TMJ OA patients who had undergone SS therapy and to compare the effects for two groups, one that had undergone SS therapy and the other that had not.

2. Materials and methods

2.1. Samples

This was case–control study. It included 36 TMJ OA patients (6 males, 30 females 30.97 ± 13.39 years) presenting to the Department of Oral Medicine, 000 Dental Hospital. Based on clinical signs and symptoms, subsequent CBCT examination (Zenith 3D; Vatech Co., Seoul, Korea) was used to confirm osseous change (cortical bone integrity, sclerosis and subchondral cyst) in the glenoid fossa and articular eminence (slope). The samples were divided into two different groups according to the receipt (or not) of SS therapy. Patients whose treatment plans included SS therapy were designated the SS group (2 males, 8 females 28.04 ± 9.07 years), and those who had been treated with the same conventional therapeutic TMJ OA protocol as the SS group but without SS therapy were designated the non-SS group (4 males, 22 females 31.96 ± 13.48 years). SS group was instructed to wear the splint at night for treatment period. The exclusion criterion for the subject selection were a history of trauma or syndrome, orthodontic treatment, and edentulous dentition. All of the patients in both groups received both physical and cognitive behavior therapy. This study was reviewed and approved by the Institutional Review Board of 000 Dental Hospital (PNUDH-2015-032).

2.2. CBCT evaluation

CBCT images were obtained both before treatment (T0) and after (T1, 10.9 ± 4.4 months after T0). Treatment period of SS and non-SS group were 10.5 ± 2.4 months and 10.7 ± 3.9 months, respectively. These T0 and T1 images were superimposed (using the anterior cranial base as the registration area) for evaluation of osseous changes in the glenoid fossa (Fig. 1). The changes were investigated in the following ways.

- Radiographic image interpretation: The glenoid fossa and slope were assessed with respect to (1) cortical bone integrity from the T0 to the T1 stage (an area of decreased cortical bone density), (2) sclerosis (an area of increased cortical bone density extending into the bone marrow) and (3) subchondral cyst (a well-circumscribed adjacent osteolytic subcortical bone area without cortical destruction) [10]. Bone changes at the T1 relative to the T0: visibly apparent increase in the volume = ''bone formation''; visibly apparent decrease in the volume = ''bone resorption'' (Fig. 2).
- Linear measurements: The distances from the point of inflexion and the lowest point of the articular eminence were measured from the Frankfort horizontal plane at the T0 and T1 stages, respectively, to quantify the osseous changes of the glenoid fossa and articular eminence [14] (Fig. 3).

2.3. Statistical analysis

The data for the CBCT superimposition assessment were summarized according to the frequencies and percentages of the osseous changes. To compare the frequencies between the groups, the chi-square test was performed using SPSS (ver. 18.0 for Windows; SPSS Inc., Chicago, IL, USA). For intra-group and inter-group linear-measurement comparisons, the Mann–Whitney *U* test and Wilcoxon rank test also were run. Statistical significance was determined based on a *P* value of 0.05. Two separate reproducibility-test re-evaluations using

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