MEDICAL SCIENCES

THE ROLE OF COMPUTED TOMOGRAPHY OF THE TEMPOROMANDIBULAR JOINT IN THE COURSE OF LONG-TERM OCCLUSAL REHABILITATION

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Abstract

Computed tomography (CT) of the temporomandibular joint (TMJ) plays a crucial role in assessing changes in the contours of the bony structures of the articular eminence and the mandibular condyle, as well as in determining their spatial relationship. In the international classification of temporomandibular joint disorders, a separate classification or types of internal derangements are defined based solely on magnetic resonance imaging (MRI) of the TMJ. However, the analysis of treatment outcomes using two different imaging modalities simultaneously for the TMJ provides greater diagnostic value and prognostic accuracy.

Keywords: magnetic resonance imaging, temporomandibular joint, computed tomography

In studies devoted to the use of gnathological splints, measuring the size of the anterior and posterior joint spaces on both sides prior to treatment is a common diagnostic step. This approach allows for an analysis of whether the direction of mandibular displacement identified during clinical examination corresponds to changes observed on the computed tomography scan. This method makes it possible to determine whether the condylar head on the side of displacement is positioned more posteriorly than on the contralateral side [8, 13, 17, 18].

Treatment-related changes in the size of the anterior joint space often differ when comparing the right and left sides. This makes it a useful method for identifying correlations between clinical signs and symptoms of temporomandibular joint dysfunction and discrepancies in the dimensions of the superior joint space, which are altered during gnathological therapy [6, 12, 14, 17, 19]. It has been shown that the more severely the condylar process is displaced and the more complex the trajectory of mandibular deviation, the more pronounced the dysfunction.

Reports indicate that symptom reduction in musculo-articular dysfunction is more noticeable in patients whose superior joint space parameters were corrected, creating favorable conditions for ligament healing of the articular disc [5, 7]. In cases of TMJ dysfunction and mandibular asymmetry assessed by CT, the superior and posterior joint spaces were found to differ on the side of displacement compared to the opposite side. In cases of disc displacement without reposition, a reduced condylar head width was observed compared to control groups. The condylar process becomes narrower in the mediolateral dimension, often accompanied by resorption of the lateral pole [5, 7].

These changes result from asymmetric loading of the TMJ, indicating that not only the condylar process undergoes remodeling, but also the articular eminence, in order to maintain optimal alignment between the mandibular condyle and the articular eminence. This observation aligns with similar findings reported in earlier studies [3, 7, 8].

In a patient group with TMJ dysfunction but without mandibular asymmetry, this difference was minimal. Thus, the diagnostic value of CT in TMJ evaluation is confirmed by studies involving patients undergoing treatment with gnathological splints. A review of available literature aimed at identifying potential differences in joint space dimensions post-treatment based on disc positioning variants revealed a limited number of publications where findings from both MRI and CT scans of the TMJ were systematically analyzed together.

Objective:

To determine the specific features of the spatial relationship between bony elements of the temporomandibular joint (TMJ) based on computed tomography (CT) images obtained in the therapeutic jaw relationship.

Materials and Methods:

Fifty-five patients aged 18 to 34 years with TMJ pathology were examined. Inclusion criteria were: intact dentition, TMJ clicking during different phases of mouth opening and closing, and isolated limited mouth opening. Exclusion criteria included: disrupted integrity of the cortical plate of the mandibular condyle and condylar head lysis.

The clinical examination mandatorily included palpation of the lateral pole of the mandibular condyle during TMJ movements; identification of deflection — mandibular deviation to one side during mouth opening (with more noticeable midline shift during full opening); and measurement of the maximum interincisal distance during mouth opening. All 55 patients underwent MRI and CT imaging after muscle deprogramming in the constructive bite, i.e., the therapeutic jaw relationship.

On sagittal CT sections of the TMJ, the lengths of the anterior (C2–D1) and superior (A1–E) joint spaces were measured using the method described by Uzhumetskenė and Konnov (2001). Prior to imaging, masticatory muscle deprogramming was performed using a gnathological splint or an occlusal appliance, which patients wore for three months. If necessary, neuromuscular electrostimulation was additionally applied.

All 55 patients (100%) underwent MRI in the therapeutic jaw relationship using a bite block. The MRI results were analyzed according to the international DC/TMD classification. MRI scans were interpreted following the guidelines of the International RDC/TMD Consortium Network and the Orofacial Pain Special Interest Group [9].

During history-taking and interviews, it was found that TMJ clicking often preceded the onset of limited mouth opening. Among the examined patients, joint clicking was noted in 11 cases at the beginning of mouth opening, in 11 cases at the end of mouth closing, in 3 cases at the end of mouth opening, in 2 cases during both opening and closing, and in 1 case only while chewing food. During clinical examination, movement was assessed on the side exhibiting mediotrusion.

Before Treatment with a Gnathological Splint

Among the 26 patients with limited mouth opening and an interincisal distance of up to 35 mm at maximum opening, 13 individuals exhibited signs of deflection—i.e., during an attempt to open the mouth widely, the mandible deviated to one side.

Based on the analysis of TMJ computed tomography scans taken in the constructive bite position (therapeutic jaw relationship) recommended for further occlusal rehabilitation, the patients were divided into two groups:

- **Group 1** included 28 patients with a ratio of anterior to superior joint space ranging from 1:1.1 to 1:1.4.
- **Group 2** included 27 patients with a more pronounced discrepancy, showing a ratio between the anterior and superior joint space ranging from 1:1.5 to 1:3.0.

In the therapeutic jaw relationship (constructive bite), **disc reposition in the open-mouth position was observed in 78.1% of cases** (see Fig. 2), while **TMJ disc displacement without reposition and limited mouth opening** was noted in **21.8% of cases** (see Fig. 3).

The treatment results in patients with signs of deflection suggest that in **Group 2**, irreversible changes in the ligamentous structures of the TMJ—judged by MRI findings—occurred more frequently than in **Group 1**, and were not observed in patients who underwent deprogramming solely due to joint clicking.

MRI and CT scans revealed that, in the closed-mouth position, the length of the anterior joint space measured in the constructive bite was greater in patients whose disc position corresponded to successful reposition during mouth opening, compared to cases where **TMJ disc displacement without reposition and restricted mouth opening** was diagnosed.

Functional MRIs, obtained during likely unforced mouth opening in the range of **43–45 mm between the incisors**, in 11 patients who exhibited deflection prior to treatment, showed **disc displacement without reposition and limited opening**. These were characterized by condylar displacement relative to the articular eminence, whereas the **opposite side demonstrated symmetrical condylar position with full disc reposition**.

The Relationship Between Anterior and Superior Joint Spaces on Computed Tomography of the Temporomandibular Joint

The ratio between the anterior and superior joint spaces, as measured on TMJ computed tomography scans in the constructive bite position, made it possible to determine the nature of condyle-disc contact:

- In **Group 1**, **21 patients (38.1%)** had a flat (planar) contact between the condylar head and the disc, and **7 patients (12.7%)** showed point contact at the disc pole.
- In **Group 2**, **15 patients (27.2%)** had planar contact.

Non-invasive treatment of patients with limited mouth opening, deflection, and pain lasted **from 3 to 5 months** and required more attention compared to other types of dysfunctions, such as isolated TMJ clicking.

Among the patients in **Group 2**, 11 had MRI scans taken in the therapeutic jaw relationship. These were assessed as showing **disc displacement in closed-mouth position**—some with **reposition** during opening and others **without reposition**, accompanied by limited mouth opening.

Post-treatment CT analysis of patients with TMJ dysfunction manifesting as restricted mouth opening, treated with a **gnathological splint**, revealed that **5 patients with deflection signs** had **asymmetrical condylar head widths** when comparing the left and right sides.

A total of **9 patients (16.3%)** required masticatory muscle deprogramming and CT during long-term occlusal rehabilitation involving **fixed orthodontic appliances**, of which **8 patients (14.5%)** experienced clicking at the end of mouth closing.

Thus, **absence of pain and TMJ clicking during palpation**, and an **interincisal distance of 43–45 mm or more**, were key prerequisites for performing **CT and MRI** of the TMJ in the therapeutic bite using a bite block [Fig. 7(2)].

Long-term occlusal rehabilitation was carried out using **fixed appliances and occlusal overlays**, and **18 patients (32.7%)** underwent imaging at different stages of **bracket-based orthodontic treatment**. For patients with **incisor retrusion**, a key feature was that **CT and MRI** were considered valid in the constructive bite once a **noticeable normalization of incisor angulation** was achieved, typically starting from 0.018 archwires.

Conclusions

Temporomandibular joint (TMJ) dysfunction—such as clicking at the end of mouth closure—poses a high risk of gnathological relapse during the final stages of long-term occlusal rehabilitation.

A **joint space ratio of 1:1.5** between the anterior and superior compartments is **more favorable** compared to a ratio of **1:1.1–1.4**, in terms of **reducing the risk of relapse** throughout extended occlusal therapy.

Therefore, a **constructive bite** with a **joint space ratio ranging from 1:1.5 to 1:3.0** may be recommended for **planning and performing long-term occlusal rehabilitation**.

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