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Temporomandibular Joint Internal Derangement: Association with Headache, Joint Effusion, Bruxism, and Joint Pain

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Aim: The aim of the present study was to assess the correlation of temporomandibular joint internal derangement (TMJ ID) in patients with the presence of headache, bruxism, and joint pain using magnetic resonance imaging (MRI).

Methods and Materials: This study evaluated 42 joints in 42 patients; 21 patients diagnosed with unilateral TMJ ID and a history of headaches and 21 patients diagnosed with unilateral TMD ID without a history of headaches. Signs of headache, bruxism, and joint pain were diagnosed clinically and were also obtained from the patient's history. Sixteen joints in 16 patients without signs or symptoms of TMD or headache were included as a control group. All patients underwent bilateral MRI of the TMJ to evaluate the disc position and the presence of joint effusion. Data were analyzed using Chi-square and Fischer's exact tests.

Results: Bruxing behavior was most frequently reported by patients with headaches ($p<0.0125$). Eighty-five percent of subjects with headaches also reported joint pain. A significant association was found between headache and TMJ effusion ($p<0.0125$). Patients with more severe disc displacement also had a higher frequency of effusion ($p=0.001$).

Conclusion: The results suggest joint effusion may have a role in the pathogenesis of headache in TMJ ID.

Clinical Significance: Temporomandibular joint effusion on MRI may serve as a biological marker of headache associated with TMD and could be helpful for diagnostic classification and treatment follow up.

Keywords: Temporomandibular joint internal derangement, Temporomandibular disorders, TMD, TMJ, headache, joint effusion, bruxism, joint pain

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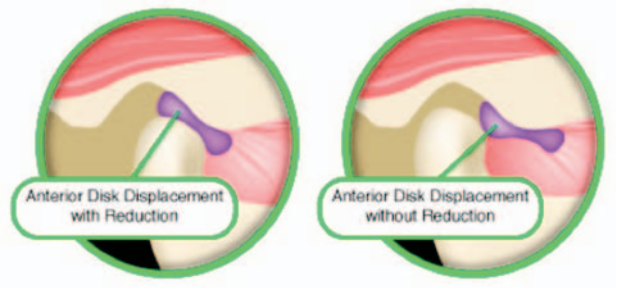
Introduction

Temporomandibular disorders (TMD) are frequent and widespread in the general population. The chief complaint is usually pain, which can manifest itself in different ways: headache, jaw ache, ear ache, and facial pain.[1-5] Seventy percent of TMD patients report headaches.[6,7] Headaches are, however, a common complaint in the adult population,[7] and the International Headache Society recognizes thirteen major headache categories with more than one hundred subdivisions.[8]

Several studies have shown an association between TMD and headaches, although a causal relationship has not been fully established. Some patients with headaches have signs and symptoms of TMD, while other patients with TMD report having headaches.[6,9-11] In addition, recurrent headaches are independent of the neurological diagnosis of the headache syndrome.[11] A possible explanation is TMD has common parafunctional habits, such as bruxing behavior, which could account for the headaches observed in those patients.[12,13]

TMJ internal derangement (TMJ ID) is the most frequent type of TMD and is characterized by several stages of dysfunction involving the condyle-disk relationship.[14,15] TMJ ID is considered to be a basic mechanism in the pathogenesis of TMJ dysfunction. Two types of derangements of the condyle-disk complex are commonly identified in sagittal magnetic resonance imaging (MRI): anterior disk displacement with reduction or anterior disk displacement without reduction. MRI studies have suggested headaches due to ID of the TMJ appear to be primarily inflammatory in origin due to stretching of the collateral diskal ligaments with subsequent anterior disk displacement.[16] Some studies also found a strong association between joint effusion and joint pain[11,17] and observed joint effusion is more often observed in more advanced stages of ID.[13,18]



The aim of the present study was to determine the correlation of TMJ ID in patients with the presence of headache, bruxism, and joint pain using MRI.

Methods and Materials

Subjects

Forty-two consecutive patients with TMJ ID and joint pain gave written informed consent to participate in this study which was approved by the Institutional Review Board of the University Hospital at UNICAMP. No subject in either the TMJ ID or control group refused to participate.

The study evaluated 42 joints in 42 patients (35 females, 7 males, age range 16-83 years) referred to the TMJ outpatient clinic of the Dentistry Service of the University Hospital at UNICAMP for evaluation of TMJ pain. Patients were divided into two groups: 21 patients with TMJ ID and headaches and 21 patients with TMJ ID without headaches. The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) was used to diagnose unilateral TMJ related TMD group II (disk displacement).[19] Examiners were dentists, trained and calibrated in these procedures, who assessed the presence of joint pain and bruxism. Patients were included with side-related TMJ pain and absence of splint therapy and/or history of facial trauma. Patients with headaches were evaluated by a neurologist, who reviewed the headache history, performed a neurological examination, and established the diagnosis.[8] No set time frame was established in regard to the presence of headaches. Instead, patients were asked if headaches interfered with their current lives or if they were using any analgesic medication regularly for headaches.

The control group was comprised of 16 TMJs of 16 subjects (11 women, 5 men, age range 26-37 years) who had no current or previous TMD symptoms and denied having headaches.

Data Acquisition

All subjects underwent MRI of the TMJ obtained by a 2 Tesla scanner (Elscint Prestige, Haifa, Israel) with surface coils. MRIs were corrected to the horizontal angulation of the long axis of the condyle. T1-weighted SE sagittal images (TR = 650 msec, TE = 22 msec, matrix = 316 x 240, flip 160º, slice thickness = 1.5 mm, field of view = 10 x 10, NEX 1) were acquired in open and closed mouth position. T2-weighted FSE sagittal images (TR = 5300 msec, TE = 90 msec, matrix = 216 x 216, flip 160º, slice thickness = 1.5 mm, field of view = 12 x 12, NEX 2) were acquired in closed mouth position.

Imaging Assessment of Articular Disc and Joint Effusion

A radiologist (ALFC) without prior knowledge of each subjects' condition established the radiological diagnosis. The position of the disc was determined according to previous established criteria20 using sagittal images in closed and open mouth position to evaluate disk reduction (anterior disk displacement with reduction or anterior disk displacement without reduction). Joint effusion was identified as an area of high signal intensity in the region of the upper and lower joint spaces on T2 weighted images.[17]

Data Analysis

The primary objective was to establish if MRI diagnostic findings correlated with the presence of headaches. A chi-square test or, when necessary, a Fisher's exact test was used to determine the association between the clinical and imaging findings. Significance level was established as $p<0.05$. A secondary analysis was conducted in patients with headaches and the presence of bruxing behavior, joint pain, and effusion. Due to multiple sequential comparisons, in this case, the p level was adjusted downwards to $p<0.0125$.

Results

Forty-two joints were evaluated. The headache diagnosis in the 21 affected patients were: 18 had migraine without aura; one had migraine without aura, but with a clear correlation between headache and TMD symptoms; and two had tension-type headaches. All patients with headaches had a normal neurological examination. None was in regular follow up with a neurologist or using preventive medicine. The only medications reported were over-the-counter analgesics.

Headache patients more frequently reported TMJ pain in their clinical history than TMJ patients without headaches. Eighteen (85%) patients with headaches reported joint pain, while only three (14.1%) patients did not ($p<0.0125$). Meanwhile, only nine (42.8%) patients without headaches had joint pain (Table 1). Bruxing behavior was also more frequently reported by patients with headaches. The frequency of bruxing among headache subjects was 71.4% ($p<0.0125$), three times higher than the headache free group (Table 2).

Table 1. Relation between headache and joint pain in TMD patients.

Headache	Joint Pain		Total
	Absent	Present	
Absent	12 (57%)	09 (42.8%)	21
Present	03 (14.1%)	18* (85%)	21
Total	15	17	42

*P values were obtained using chi-square test (P significant <0.0125). Numbers in parentheses represent the percent of each row.

Table 2. Relation between headache and bruxism behavior in TMD patients.

Headache	Bruxism Behavior		Total
	Absent	Present	
Absent	16 (76.1%)	05 (23.8%)	21
Present	06 (28.7%)	15* (71.4%)	21
Total	22	20	42

*P values were obtained using Fischer's exact test (P significant <0.0125). Numbers in parentheses represent the percent of each row.

Patients with headaches exhibited significantly more ID in the MRI than the control group (p<0.0125) (Table 3). Headaches occurred more frequently in patients with more severe TMJ ID and anterior disk displacement without reduction (Table 4). Joint effusion was more prevalent in headache patients, with 16 patients with headaches and joint effusion (p<0.0125) (Table 5). Patients with joint effusion had a higher prevalence of joint pain (p<0.005) (Table 6). Patients with more severe disc displacement also had a higher frequency of joint effusion (p<0.005) (Table 7).

In the control group only three subjects had ID of the disc and just one had associated joint effusion.

Table 3. Relation between MRI diagnoses of joints in study group and controls.

Headache	Internal Derangement		Total
	Absent	Present	
Absent	33 (56.9%)	09 (15.5%)	42
Present	03 (5.1%)	13* (22.5%)	16
Total	36	22	58

*P values were obtained using Fischer's exact test (P significant <0.0125). Numbers in parentheses represent the percent of total (n=58).

Table 4. Relation between MRI diagnoses of ID and headache in patients' group.

Headache	MRI Diagnostic of ID		Total
	ADDR	ADDWR	
Absent	12	02	14
Present	08	10*	18
Total	20	12	32

ID: Internal derangement
ADDR: Anterior disk displacement with reduction
ADDWR: Anterior disk displacement without reduction.
**P* values were obtained using Fischer's exact test (*P* significant <0.0125)

Table 5. Relation between joint effusion and headache in TMD patients.

Joint effusion	Headache		Total
	Absent	Present	
Absent	18 (42.8%)	05 (11.9%)	23
Present	03 (7.1%)	16* (38%)	19
Total	21	21	42

*P values were obtained using Fischer's exact test (P significant <0.0125). Numbers in parentheses represent the percent of total (n=42).

Table 6. Relation between joint pain and joint effusion in TMD patients.

Joint effusion	Joint Pain		Total
	Absent	Present	
Absent	14 (33.3%)	09 (21.4%)	23
Present	01 (2.3%)	18* (42.8%)	19
Total	15	27	42

**P* values were obtained using Fischer's exact test (*P* significant <0.0125). Numbers in parentheses represent the percent of total (n=42)

Table 7. Relation between MRI diagnosis of ID and joint effusion in TMJ ID patients and controls.

Joint effusion	MRI Diagnosis of ID		Total
	ADDR	ADDWR	
Absent	14	0	14
Present	7	12*	19
Total	21	12	33

ID: Internal derangement
ADDR: Anterior disk displacement with reduction
ADDWR: Anterior disk displacement without reduction.
*P values were obtained using Fischer's exact test (P significant <0.0125)

Discussion

The principal findings of this study are:

1. Bruxing behavior seems to be a risk factor for the development of headaches in TMJ
2. Headaches in TMD ID are associated with joint pain
3. Patients with joint pain had a higher prevalence of joint effusion in the MRI
4. Headaches were most frequently reported in patients with joint effusion and patients with more severe radiological diagnosis

TMD is widely accepted as a multifactorial disorder, while headaches are a nearly universal human experience representing the final common expression of a wide variety of assaults upon the human nervous system.[21] In this investigation the main objective was to understand the pathophysiology of TMJ ID in patients with headaches. Therefore, a control group free of signs and symptoms of TMD and headaches was selected to avoid the presence of heterogeneous pathology and confounding factors.

Previous studies of TMD and headaches reported tension-type headaches as the most frequent headaches associated with TMD.[22] In this sample, however, a much higher incidence of migraines was observed. This result may be due to the inclusion of a neurological assessment in the present study which in previous studies was not reported and may have led to misdiagnosis of the condition. Additionally, a hospital-based population was used in the present investigation which may have introduced a selection bias in this sample. Migraine is a primary headache, hence, it is not a symptom produced by another disorder but is in itself a disorder.[23,24] Nevertheless, recent evidence suggests patients with migraines have a higher prevalence of TMJ ID.[25] Headaches related to dental occlusion and dental parafunctions are able to mimic primary migraine headaches,[24] and treatment of the causative disorder can improve the headache.[24]

Results of a previous study[11] suggested patients with unexplained headaches should be considered for evaluation of the presence of ID and inflammation of the TMJ. There is a general agreement TMJ effusion represents an inflammatory response to a dysfunctional disk-condyle relationship[26-28] and more recurrent in painful non-reducing joints.[13] This study found joint effusion was more frequent in patients with anterior disk displacement without reduction. The present findings confirmed effusion is more frequently encountered in anterior disk displacement without reduction[26] and is associated with joint pain.[13]

TMJ pain and dysfunction may be caused by bruxism[13] and indirectly related to headaches.[16] It is well known minor changes in jaw position could result in large increases in the activity of masticatory muscles.[29] This modification causes articular pain and abnormal mechanical stresses within the joint, resulting in accumulation of irritating agents in the tissue fluid[13] and inflammatory changes in the retrodiskal tissue and

synovial membrane leading to subsequent joint effusion.[30] Effusion appeared in just one subject of the control group. In this study only the presence of effusion characterized by an area of high signal intensity along the articular surface was identified with no measure of the grade of this collection. It can be theorized the increase in levels of effusion leads to a susceptibility to headaches from accumulation of inflammatory mediators within the joint.

Arthroscopic analysis of synovial fluids in the articular joint demonstrated they are constituted by prostanoids,[31] proinflammatory cytokines,[32] and nitric oxide.[33] Takahashi and coworkers demonstrated nitric oxide concentration in ID is significantly higher than in normal joints.[34] Nitric oxide functions as a modulator of apoptosis[35,36] and apoptosis caused by oxidative stress is involved in inflammatory articular diseases.[37,38] It is also known to regulate blood pressure and vascular tone, as well as function in neural signaling.[39] High concentrations of nitric oxide may lead to a headache attack. One can hypothesize if joint effusion is present, the possibility of pain to be present is greater. If peripheral sensitization (pain in the joint) is present in chronic pain with central sensitization and migraine, this could be a trigger of the headache.

Conclusion

The results of this study suggest more severe pathology of the TMJ ID noted by MRI might increase the risk of headache in patients presenting to a dental clinic for the evaluation of TMJ symptoms. An interesting follow up study to confirm these findings would be to assess patients with primary headaches for TMD, including MRI, and assess how treatment of TMD in primary headache patients would affect the control of subsequent attacks in those patients.

Clinical Significance

Temporomandibular joint effusion on MRI may serve as a biological marker of headache associated with TMD and could be helpful for diagnostic classification and treatment follow up.

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