# Preliminary Longitudinal Report on Symptom Outcomes in Symptomatic and Asymptomatic Women with Imaging Evidence of Temporomandibular Joint Arthritic Changes

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***Purpose:*** The objectives of this preliminary, longitudinal, and explorative cohort study were to assess changes in and the onset of osteoarthrosis (OA)-related pain in the temporomandibular joint (TMJ) and to address factors that might impact the development or reduction of associated pain symptoms. ***Materials and Methods:*** In this sex-matched study, 60 women were recruited (30 asymptomatic with a magnetic resonance imaging [MRI] diagnosis of OA-related TMJ changes, 30 symptomatic with accompanying MRI evidence of OA of the TMJ). All subjects underwent a baseline clinical examination and MRI assessment and were subsequently referred to a dental practitioner, who was informed of the diagnosis and further treatment where required. Not all subjects underwent dental treatment interventions. Following a mean 4-year period, subjects were reexamined clinically. Spearman rank correlation and Mann-Whitney *U* tests were used to evaluate possible correlations in reported pain level changes with the number of posterior occlusal contacts and new dental restorations placed between baseline and recall appointments. ***Results:*** The dropout rate was 28% (6.7% for symptomatic, 50% for asymptomatic). OA-related TMJ pain in symptomatic subjects decreased with time (pain reduction: −3.6 ± 3.4 on a 0 to 10 numeric rating scale); asymptomatic patients rarely developed pain. ***Conclusion:*** These preliminary results suggest that factors other than dental occlusion might play a role in the reduction of pain. *Int J Prosthodont 2010;23:544–551.*

A range of morphologic changes in the temporomandibular joint (TMJ) are frequently encountered during both routine and specialized imaging assessments. While the changes are understandably described as arthritic ones in radiologic reports, their clinical dental interpretation is not always as explicit. In fact, numerous clinical constituencies reserve a specific osteoarthritis (OA) diagnosis for TMJ changes accompanied by painful symptoms and regard asymptomatic changes as morphologic adaptations that may or may not have the potential for developing into a frank arthritic diagnosis. Moreover, accompanying joint sounds and altered mandibular movement may also occur with or without pain and challenge a clinician's perception regarding the need for an explicit diagnosis and treatment intervention.[1] While a noninterventionist dental care approach seems to be a prudent management strategy for most asymptomatic patients,[2] some clinicians still regard the presence of clinical signs and images as potentially ominous. The latter group's mindset readily endorses a radiologist's interpretation of the TMJ images as an OA condition, and they often assume a correlation between a patient's occlusal and TMJ morphology. This appears to be more likely whenever a shortened dental arch or compromised posterior vertical dimension of occlusion are present, especially with a history of parafunction.

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Generally speaking, morphologic joint changes are presumed to be influenced by sex, genetics, ethnicity, behavior, and time-dependent wear and tear outcomes, as reported in major texts that cite the etiologic contributors of OA.[3] In fact, while several studies have assessed the aspects of OA of the knee and other joints through use of imaging methods,[3,4] little is known about the precise longitudinal development of OA or the asymptomatic morphologic changes in the TMJ. Consequently, subtle but profound differences between a relatively innocuous diagnosis of adaptive morphologic TMJ changes and an overtly painful OA remain a source of controversy in routine dental practice. It is also unknown why some subjects develop pain and others do not. It has to be conceded that the dental literature is far from rigorous when it comes to automatically assuming an etiologic role for occlusal changes and associated parafunctional activity in TMJ morphologic changes, let alone an arthritic diagnosis. Reports on the natural history of TMJ OA[5,6] suggest a natural burn-out occurring in the joints and that treatment beyond time-dependent palliative measures therefore may be unnecessary. However, the accompanying presence of pain would demand dental treatment initiatives, in addition to a traditional arthritis management strategy that goes beyond pharmacologic and physical therapy. Specific dental interventions would include restoration or replacement of missing posterior teeth, increasing a patient's vertical dimension of occlusion, and prescribing a stabilization appliance to control parafunctional occlusal stresses.

On the other hand, prosthodontic patients frequently present with adverse occlusal challenges that are unaccompanied by pain symptoms. In such situations, particularly if TMJ images are available and demonstrate joint changes, the clinician may be tempted to justify a therapeutic intervention on the premise that such treatment would prevent additional long-term morphologic adaptation that might spill over into frank OA.

The objective of this preliminary longitudinal study was to compare two sex-matched and numerically equal patient groups—a symptomatic one with a clinical diagnosis of OA and an asymptomatic one with demonstrated TMJ morphologic changes—over a fixed period of time while recording their patterns of symptom development and resolution. It was hypothesized that the format could provide valuable clinical information regarding the outcome of morphologically changed TMJs in the presence or absence of original or sustaining pain symptoms.

## Materials and Methods

### *Study Population*

Between 2002 and 2003, 60 women were recruited for this sex-matched study from the Department of Prosthodontics, University of Heidelberg, Heidelberg, Germany. The study was approved by the local review board, and subjects signed an informed consent form.

Participants were examined at baseline ($t_0$) both by use of a standardized clinical examination procedure (Research Diagnostic Criteria for Temporomandibular Disorders [RDC/TMD]) and magnetic resonance imaging (MRI). Thirty subjects were volunteers recruited from the patients attending the dental school for a checkup and had neither acute TMJ pain nor a history of TMJ pain, but showed clinical signs indicating the presence of OA (eg, fine or coarse crepitus but no pain). These subjects were informed about the screening process, were subsequently screened using MRI, and, if signs of OA of the TMJ were present in the MRI, were included in the study. Thirty subjects were TMD patients with both clinical signs of OA in the TMJ (pain) and an MRI-confirmed presence of OA (Fig 1). Most of these patients were referred to the dental school by dental practitioners. The inclusion criteria for both groups were as follows: 18 to 80 years old, signed consent form, no factors impeding MRI (cardiac pacemaker, insulin pump, etc), OA of the TMJ apparent in the MRI, no rheumatism or other systemic joint diseases (assessed using a questionnaire), and no signs of trauma. To find 60 participants meeting the requirements of the study, 198 subjects had to be examined. After a mean period of 4 years ($t_1$), participants were examined again using the same standardized clinical examination procedure as that used at $t_0$.

### *Clinical Assessment and Questionnaires*

Patients were examined by calibrated investigators[7] in accordance with the German version of the RDC/TMD.[8] This examination consisted of two parts: a physical examination (mandibular movements, joint sounds, pain on palpation) and a psychosocial assessment.

In the present study, the somatization score[9] (somatization is the tendency to experience and communicate somatic distress in response to psychosocial stress and to seek medical help for it[10]) and the pain intensity score, part of the Graded Chronic Pain Scale,[11] were included in the assessment. The examination procedure is described in more detail elsewhere,[8] but included assessment of the presence or absence of joint sounds and pain, palpation of the intraoral and extraoral masticatory muscles with use

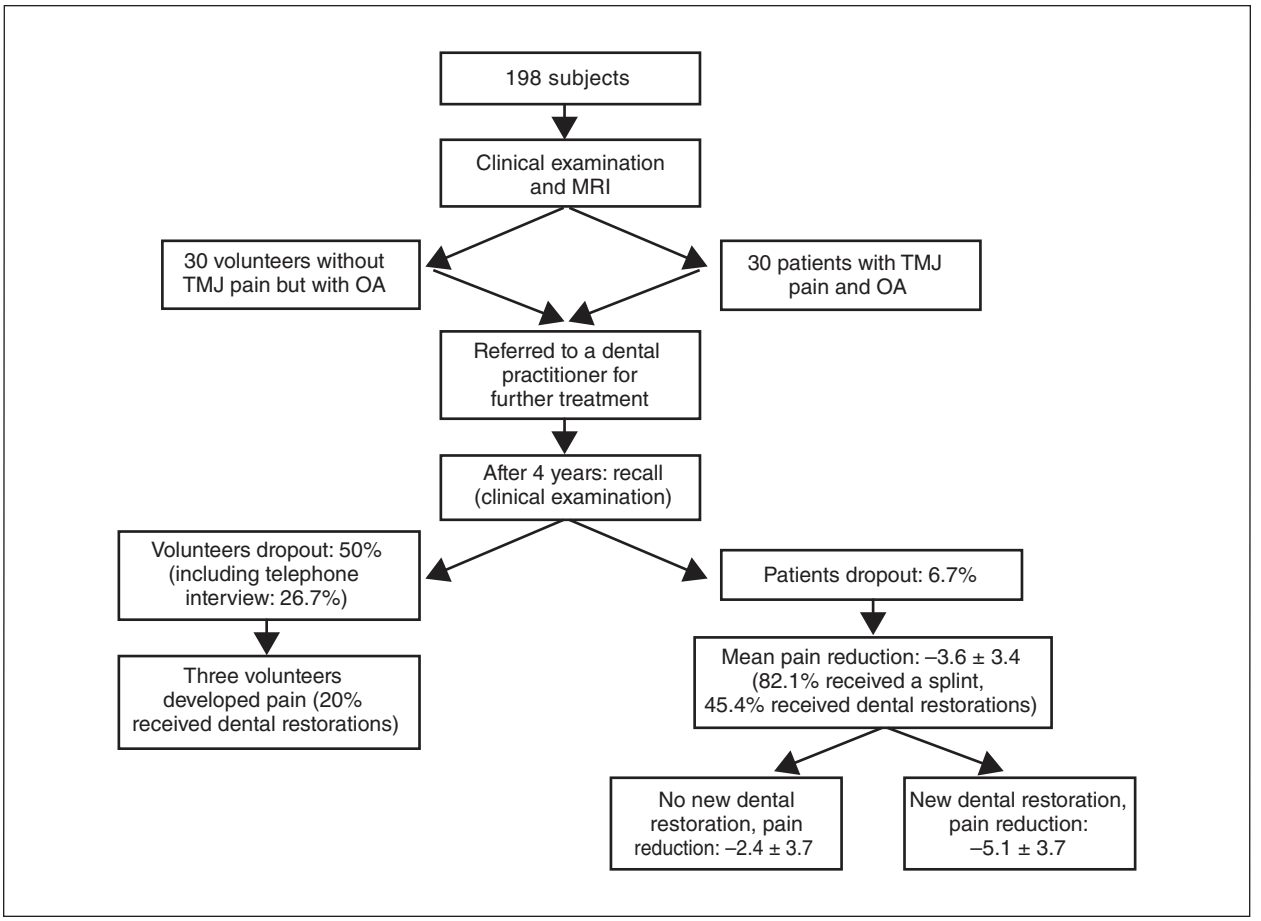


**Fig 1** Flow chart of subject recruitment.

of defined pressure, and measurement of the range of mandibular motion. This procedure yields defined cut-off limits for muscle- and joint-related diagnoses. The results from the physical examination were used to classify subjects into the two study groups. A protocol of occlusion (number of occluding pairs of posterior teeth, number of teeth with occlusal fillings) and an oral examination (number of teeth with fixed dental prostheses, presence of a removable dental prostheses) were also recorded. In addition to demographic and anamnestic data (age, history of TMD, history of rheumatism), therapeutic intervention during the follow-up (fixed dental prostheses, removable dental prostheses, splint therapy, occlusal fillings, number of appointments at a dentist) was assessed by use of a questionnaire and a clinical examination.

### *MRI Protocol*

Topical MRI was performed at most 3 weeks after clinical examination by means of a 1.5-Tesla scanner (Symphony Scanner) equipped with TMJ surface coils. The imaging procedure consisted of two pilots (to locate the condyle in the open-mouth and closed-mouth positions), one bilateral T1Flash2D sagittal-oblique image, one bilateral T1Flash2D coronal-oblique image in the closed-mouth position, and one T1Flash2D sagittal-oblique image in the open-mouth position. The settings used for the sagittal-oblique images and the coronal-oblique image were: time of repetition (208 ms), field of view (120 mm × 120 mm), time of echo (10.2 ms), slice thickness (3.0 mm), voxel-matrix (256 × 256), number

**Table 1** Pain at Baseline and Follow-up*

| | Volunteers (n = 15) | Patients (n = 28) |
|---|---|---|
| Baseline | | |
| Mean ± SD | 0.0 | 6.9 ± 1.5 |
| Median (range) | 0.0 | 7.0 (4.0–10.0) |
| Follow-up | | |
| Mean ± SD | 0.9 ± 1.8 | 3.3 ± 3.1 |
| Median | 0.0 (0.0–6.0) | 2.0 (0.0–9.0) |

SD = standard deviation.
*Pain level was assessed by the Graded Chronic Pain Scale (numeric rating scale: 0 = no pain, 10 = maximum pain level).

of excitations (three), and acquisition time (319 s). To avoid movement artifacts of the mandible, the maximum open-mouth position was stabilized during imaging by use of a mechanical mouth spreader (Burnett BiDirectional TMJ Device, Medrad). Two pilots were used to identify the TMJ: one each in the closed-mouth and open-mouth positions. Subsequently, five sagittal-oblique slices were obtained (one at the lateral edge of the condyle, one at the medial edge of the condyle, and three between the lateral and medial edges of the condyle). All sagittal slices were oriented perpendicular to the axis of the condyle. The sagittal-oblique images were used as locators for coronal-oblique imaging, as described by Hollender et al.[12] Five coronal slices were taken perpendicular to the axis of the disc (one through the posterior end of the disc, one behind this point, and three anterior to this point).

The MRI images were interpreted by two clinicians (one dentist and one radiologist) unaware of the RDC/TMD diagnoses; these clinicians did not know the subjects and solely rated the images. To avoid the inclusion of subjects with anatomical variations of the condyle other than OA, MRI diagnosis of TMJ OA was defined as the presence of flattening, subchondral sclerosis, surface irregularities, and erosion of the condyle or presence of condylar deformities associated with flattening, subchondral sclerosis, surface irregularities, erosion, or osteophytes.[13] The clinicians were calibrated previously during a 5-hour training session (criteria for assessing the status of the TMJ were determined, and 20 MRIs of the TMJ were rated together until consensus was reached). A subsequent reliability assessment, including 50 images, demonstrated that agreement was acceptable (mean $\kappa = 0.7$).[14] In the event of a disagreement, a consensus diagnosis was obtained; this was necessary for only two subjects.

### *Therapy Between $t_0$ and $t_1$*

After baseline examination, patients were referred back to dental practitioners who were informed of the joint-related diagnoses. Thus, all therapy (including splints, new fillings, new dental prostheses, medication, and acupuncture) was conducted by different dental practitioners without standardization or calibration. This potential confounder was acceptable, however, because it has been demonstrated[15] that there is no significant difference between the treatment outcomes of different clinicians.

### *Statistical Analysis*

Since the recruitment of patients in the present study was challenging, no sample size calculation was performed, but a sample of convenience was recruited.

Distributions of continuous data or score values are given as mean and standard deviation or as median, interquartile range (IQR), and range. Count data are described by absolute and relative frequencies. Since graphic analysis using histograms indicated that no normal distribution was present, the Mann-Whitney *U* test was used to compare distributions of continuous or ordinal variables between volunteers and patients. Spearman rank correlation was calculated to describe the association between ordinal values. The Mann-Whitney *U* test was used for analysis of the correlation between the change in pain level and dichotomous status with regard to receipt of dental restorations or new splints within the follow-up period. For repeated measurement, the Wilcoxon signed rank test for matched pairs was used. All statistical tests were two-sided. A result with a $P$ value $< .05$ was regarded as statistically significant. Statistical analysis was performed using SAS version 9.1 for Windows (SAS Institute).

**Table 2** Baseline Findings

| | Volunteers | Patients | *P* |
|---|---|---|---|
| Age (y) | (n = 15) | (n = 28) | .760 |
| Mean ± SD | 46.7 ± 16.8 | 46.8 ± 16.0 | |
| Range | 24.0–76.0 | 20.0–79.0 | |
| Occluding pairs of posterior teeth (n) | (n = 13) | (n = 25) | .031 |
| Median | 7.0 | 5.0 | |
| IQR | 6.0–8.0 | 3.0–6.0 | |
| Range | 1.0–8.0 | 0.0–8.0 | |
| No. of teeth with occlusal fillings | (n = 13) | (n = 28) | .049 |
| 0 | 1 | 1 | |
| 2 | 1 | 2 | |
| 3 | 1 | 3 | |
| 4 | 1 | — | |
| 6 | 2 | — | |
| 7 | 1 | 1 | |
| 9 | — | 3 | |
| ≥ 10 | 6 | 18 | |
| No. of teeth with fixed dental prostheses (crowns, etc) | (n = 13) | (n = 28) | .280 |
| 0 | 9 | 13 | |
| 1 | 2 | 9 | |
| 2 | — | 1 | |
| 3 | 1 | 4 | |
| ≥ 4 | 1 | 1 | |
| Removable partial denture? | (n = 13) | (n = 28) | .849 |
| No | 12 | 25 | |
| Yes | 1 | 3 | |
| Somatization score | (n = 10 ) | (n = 24) | .047 |
| Median | 6.5 | 12.0 | |
| IQR | 3.0–18.0 | 8.5–32.5 | |
| Range | 3.0–37.0 | 1.0–45.0 | |

SD = standard deviation; IQR = interquartile range.

## Results

The mean time between baseline examination and recall was 55.8 ± 9.4 months (volunteers: 62.0 ± 5.6 months, patients: 52.7 ± 9.5 months).

### *Baseline Findings ($t_0$)*

The mean age of participants in both groups was similar (volunteers: 46.9 ± 17.4 years, patients: 46.8 ± 16.0 years; $P = .81$). Assessment of pain intensity using the Graded Chronic Pain Scale revealed a mean TMJ pain level of 6.9 ± 1.5 for patients (Table 1). For volunteers, the pain level was 0 at baseline.

Analysis of occlusion revealed median values for occluding pairs of posterior teeth (first premolar to last molar) were 7.0 (IQR: 6.0 to 8.0) in volunteers and 5.0 (IQR: 3.0 to 6.0) in patients. This difference was statistically significant ($P = .031$, Table 2). Median somatization scores were 6.5 (IQR: 3.0 to 18.0) for volunteers and 12.0 (IQR: 8.5 to 32.5) for patients, which was also a statistically significant difference ($P = .047$, Table 2).

**Table 3** Changes Between Baseline and Recall

| | Volunteers | Patients |
|---|---|---|
| Change in pain level | (n = 15) | (n = 28) |
| Median | 0.0 | −4.5 |
| IQR | 0.0–0.0 | −6.0–0.0 |
| Range | 0.0–6.0 | −10.0–3.0 |
| Change in no. of occluding pairs of posterior teeth | (n = 13) | (n = 25) |
| Median | 0.0 | 1.0 |
| IQR | −1.0–0.0 | 0.0–3.0 |
| Range | −3.0–6.0 | −2.0–6.0 |
| Change in somatization score | (n = 8) | (n = 23) |
| Median | −1.5 | 0.0 |
| IQR | −4.0–1.0 | −4.0–5.0 |
| Range | −5.0–5.0 | −13.0–16.0 |

IQR = interquartile range.

### *Dropout*

Twenty-eight of 30 patients with painful OA at baseline were reexamined at follow-up. One patient died between baseline and recall, and 1 patient suffered from a severe illness and could no longer participate.

Of the 30 volunteers, however, only 15 accepted the invitation to the follow-up visit. The addresses of 8 volunteers were unknown, and 7 subjects did not agree to further participation. In telephone interviews, however, these 7 subjects reported that they had not developed pain in the TMJ.

### *Recall Findings ($t_1$)*

Pain level decreased in 71.4% of OA patients suffering from pain at $t_0$ (baseline: 6.9 ± 1.5, recall: 3.3 ± 3.1; $P < .001$). Therefore, the mean pain reduction was −3.6 ± 3.4. Analysis of occlusion revealed that the number of occluding pairs of posterior teeth increased in patients (median: 1, IQR: 0 to 3), whereas the number was almost stable in volunteers (median: 0, IQR: −1 to 0). The somatization score almost remained the same in both volunteers and patients (Table 3).

When asked for a history of visits to their dentist and the different forms and amounts of treatment received within the follow-up period because of TMJ problems, 3 volunteers and 19 patients reported at least one visit. The 3 volunteers had developed pain in the TMJ. Occlusal splints were the most common treatment option; 82.1% of patients used different types of occlusal splints between baseline and follow-up. Pain reduction was comparable for patients with (mean pain reduction: −3.8 ± 3.5) and without splints (mean pain reduction: −3.6 ± 3.4; $P = .691$).

Regarding volunteers, 80% did not obtain new dental restorations and 20% obtained new fixed restorations (new occlusal fillings, crowns, or fixed partial dentures); no volunteer obtained a removable partial or complete denture. In contrast, in the patient group, 53.6% did not receive a new restoration, but 42.9% obtained a new dental restoration in the posterior region and one patient (3.5%) obtained a removable partial denture. Pain reduction was significant in both groups but more pronounced for patients receiving a new dental restoration (−5.1 ± 3.7; Wilcoxon signed rank test for matched pairs, $P = .002$) than patients who did not (−2.4 ± 3.7; Wilcoxon signed rank test for matched pairs, $P = .005$) (Fig 2). However, the change in the number of occlusal contacts in the posterior region was not correlated with pain reduction (−0.23; Spearman rank correlation, $P = .248$).

Only three patients took temporary medication, and one patient reported receiving acupuncture.

## Discussion

The course of TMJ pain in patients with OA of the TMJ has not been assessed previously. Thus, little is known about the onset and course of TMJ-related pain in TMJs with OA. Furthermore, the importance of occlusion[16] and somatization in this context is still unresolved. This explorative study showed that in symptom-free OA subjects, the probability of developing pain is quite low, and in OA patients with pain, the pain decreases with time. The results indicate that besides dental factors, other factors could have an effect on pain reduction, and because of the number of uncontrolled confounders and the exploratory nature of this study, the results cannot be interpreted in a

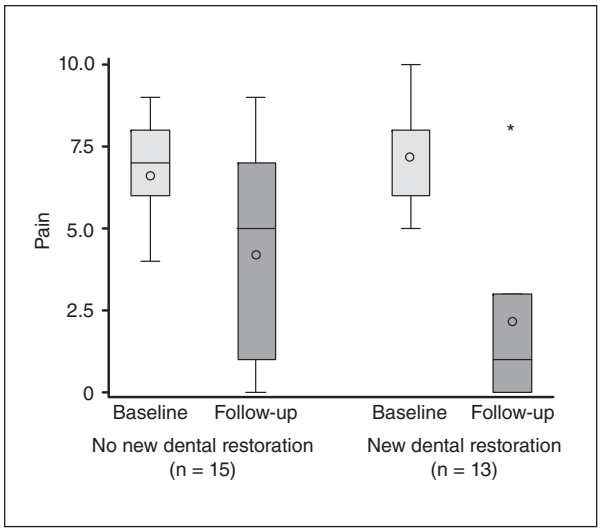


**Fig 2** Differences in pain between baseline and follow-up for patients receiving and not receiving a new dental restoration in the posterior area. *Outlier.

confirmatory sense but merely give hints about which factors might affect the change in pain. The results must thus be interpreted as a trend only.

It is known that moderate or severe radiographic OA is often present without clinical signs in the joints.[3] Thus, a clinical examination alone might not reveal the presence of degenerative TMJ diseases,[17] emphasizing the need to use imaging methods. Ostergaard and Szkudlarek[18] justified the use of the MRI imaging method for assessment of rheumatoid arthritis. This is supported by other studies.[19] Although an attempt was made to define OA in MRI as precisely as possible, the possibility that the study included some subjects with anatomical variations instead of OA cannot be excluded. This is, however, true for both groups (volunteers and patients) and therefore might be acceptable.

Because OA has sex-related aspects,[4] only women were included in this study to avoid bias. Age was not controlled in the design stage but in the analysis, taking into consideration that no significant difference was found for age. In this study, most subjects with painful OA of the TMJ reported reduced pain at the recall examination, and three volunteers reported the onset of pain. Although the dropout rate was high in volunteers, seven dropout subjects were interviewed by telephone and did not report the onset of TMJ-related pain. Thus, information regarding pain status was obtained for 73.3% of subjects, which seems acceptable.[20]

The main reason for improvement of posterior tooth contacts might be that some clinicians may have been tempted to justify a therapeutic intervention in the patient group and inserted new dental restorations between $t_0$ and $t_1$. Some studies indicate that there might be a relationship between missing posterior occlusal support and the risk of pain and joint sounds[21]; others have failed to confirm these findings.[22] In this study, however, the change in the number of posterior contacts and the pain reduction was not correlated, although insertion of a new dental restoration seemed to have some effect (Fig 2). Additionally, pain reduction was comparable for patients with and without splints. One reason for these possibly contradictory results might be the small sample size of this explorative study. Furthermore, the placebo effect must also be discussed critically in this context because current knowledge suggests that every treatment for pain contains a placebo component.[23] Additionally, this result indicates that other factors might also play a role in the reduction of pain symptoms.

Since several studies have found that somatization is associated with TMD,[24] this variable was included in the analysis. It was shown that levels of somatization were lower in volunteers than in patients. This was observed at both $t_0$ and $t_1$. No significant correlation between the change of somatization and the change in pain level could be observed in the patient group. However, somatization scores for patients and volunteers (see Table 2) were below the threshold value for women (24). Some studies also indicate that somatization might be important in subjects with myofacial pain but not in subjects with joint-related TMD.[24,25]

In this study, clinicians selected the therapy received between $t_0$ and $t_1$; most patients received splints and many obtained new dental restorations. This resulted in a large number of potentially confounding variables, which may bias the results of the study (ie, patients with pain might have sought more therapy). Also, clinicians might be biased toward restoration to regain a full complement of posterior teeth

in patients with pain. This approach, which also confounded the implementation of randomization, was necessary for ethical reasons. Consequently, the results of this study must be interpreted with caution, and the explorative character of the study must be kept in mind. The results show, nevertheless, that the pain level decreased more in some patients than in others. This is not surprising because the onset and perpetuation of TMD is multifactorial,[8,26] and consequently, no single variable can often be isolated. Furthermore, pain perception is individual, and the large mean variation of pain perception in this study becomes explainable. This aspect also must be considered when the results are interpreted.

## Conclusions

Within the limitations and the duration of this study, the following observations were made: The pain associated with a diagnosis of OA appeared to decrease, while asymptomatic subjects with morphologic TMJ changes that simulated OA rarely developed painful symptoms.

## Acknowledgment

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