Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology

---

ORAL AND MAXILLOFACIAL RADIOLOGY   *Editor: Allan G. Farman*

Assessment of the reliability and validity of panoramic imaging for assessment of mandibular condyle morphology using both MRI and clinical examination as the gold standard

Marc Schmitter, DMD,[a] Olaf Gabbert, DDS,[b] Brigitte Ohlmann, DMD,[c] Alexander Hassel, DMD,[d]
Diana Wolff, DMD,[e] Peter Rammelsberg, DMD, PhD,[f] and Bodo Kress, DMD, PhD,[g]
Heidelberg, Germany
UNIVERSITY OF HEIDELBERG

Objectives. The purpose of this study was to evaluate both reliability and validity of the assessment of the shape of the mandibular condyle in panoramic images of the TMJ.

Study design. Forty subjects were included and were examined according to the Research Diagnostic Criteria for Temporomandibular Disorders. Panoramic radiographs (PRs) and magnetic resonance images (MRIs) were completed for all subjects. Both MRIs and PRs were rated by raters blinded to the clinical diagnosis. Kappa statistics were used to compare the results of the raters of the PRs. Additionally, the specificity and the sensitivity of the PRs were calculated for 2 scenarios: one with MRI and the other with clinical findings as the gold standard.

Results. The sensitivity was 0.94 (specificity = 0.45) for the assumption that MRI is the gold standard and 0.86 (specificity = 0.49) for the assumption that the clinical examination is the gold standard. For reliability, the results for κ ranged from 0.06 to 0.327.

Conclusion. It can be concluded that PRs are not a reliable method of accurately judging the shape of the mandibular condyle. (Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;102:220-4)

Temporomandibular disorder (TMD) is an umbrella term, embracing conditions that involve the temporomandibular joint (TMJ) and/or masticatory muscles and associated structures.

[a]Assistant Professor, Department of Prosthodontics, University of Heidelberg.
[b]Assistant Professor, Department of Prosthodontics, University of Heidelberg.
[c]Assistant Professor, Department of Prosthodontics, University of Heidelberg.
[d]Assistant Professor, Department of Prosthodontics, University of Heidelberg.
[e]Assistant Professor, Department of Restorative Dentistry, University of Heidelberg.
[f]Head, Department of Prosthodontics, University of Heidelberg.
[g]Professor, Department of Neurology, Division of Neuroradiology, University of Heidelberg.

The primary assessment of TMD is based on a clinical examination of the masticatory system.[1] However, several studies have demonstrated that clinical diagnoses are unreliable with respect to the status of the TMJ.[2,3] Consequently, several imaging modalities are used to verify the clinical findings.[4,5] Magnetic resonance imaging (MRI) has been proposed to be the gold standard for the imaging of the TMJ, as it provides good quality images and gives excellent definition of soft and hard tissue structures when a suitable surface coil is used.[6,7] Tasaki and Westesson[8] showed in their cadaver joint study that MRI displayed a validity of 93% in the assessment of osseous changes. They concluded that MR imaging appears to be an accurate method for the assessment of soft and hard tissue of the TMJ. Crowley et al.[9] also found that MRI provided good images of the bony outline. These results were supported by animal experiments carried out by Watson et al.[10] Nakasato et al.[11] considered MRI to be the modality of choice in screening arthrosis of the TMJ. However, besides reliability and validity, costs have an essential impact on the selection of additional examination procedures.[12] In

Table I. Characterization of the study sample

	Pain duration in months	Number of pain locations in other parts of the body (eg, back pain)	Pain medication?
Patients suffering from arthrogenic problems	26.14 ± 24.74	0: 28.6% 1: 19.0% 2: 28.1% more than 2: 14.3%	Yes: 38.1% No: 61.9%
Patients without arthrogenic problems	0	Not available	0

consequence of this cost factor, panoramic radiography (PR) has been proposed for the assessment of (at least) erosions of the condyle in the TMJ.[13] In contrast, other authors found that panoramic imaging did not lead to changes in the clinical diagnosis in any patient.[14] In this controversial area, the reasons for this discrepancy are still unclear: Does panoramic imaging lack reliability or validity, or both?

If a clinical measurement technique is reliable, this means that any investigator or clinician should be able to apply this technique to asymptomatic or symptomatic individuals and obtain approximately the same value, repeatedly. If a clinical measurement technique is valid, this is an indicator that the resulting diagnosis is correct.

The purpose of this study was to evaluate both the reliability and the validity of the assessment of the shape of the condyle in panoramic images of the TMJ.

METHODS
Subjects

The study sample consisted of 40 subjects: 21 subjects (5 males and 16 females, 18 years to 73 years, mean age 39.12, SD 16.7) who had complained exclusively of arthrogenic problems exclusively and 19 subjects (8 male and 9 female, 18 years to 76 years, mean age 40.00, SD 15.95) who did not complain about arthrogenic problems. All subjects came to the Department of Prosthodontics seeking treatment for arthrogenic problems or dental problems. Consequently, this was not a consecutive sample from a community-based population but a sample from a clinic. The PRs were taken in the range of the initial medical examination. All patients signed an informed consent form. The characterization of the patients is given in Table I.

Clinical examination

The clinical examination was performed strictly according to the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) by a calibrated examiner.[15] The calibration was performed according to the guidelines of the RDC/TMD consortium. The reliability assessment of the calibration resulted in acceptable agreement in almost all parts of the examination.

The RDC/TMD examination procedure includes the assessment of the presence or absence of joint sounds and pain, the palpation of intraoral and extraoral masticatory muscles using defined pressure, and the measurement of the range of mandibular motion. This protocol provides cut-off limits for TMD diagnoses. The detailed RDC/TMD protocol is described elsewhere.[15]

Imaging

PRs were completed for all subjects using an Orthophos Plus/CD (Sirona, Bensheim, Germany). Additionally, all patients were examined in opened and closed mouth positions by means of MRI (1.5-Tesla tomograph, Symphony; Siemens, Munich, Germany, with TMJ surface coils; Siemens). The parameters for the sagittal-oblique slices were the following: proton-weighted fast low-angle shot, time of echo: 10.2 ms, time of repetition: 208 ms, field of view: 120×120, matrix: 256×256, slice thickness: 3 mm, and time of acquisition: 5.3 minutes. The sagittal-oblique images were used as a localizer for coronal-oblique imaging, as described by Hollender et al.[16]: proton-weighted fast low-angle shot, time of echo: 10.2 ms, time of repetition: 208 ms, field of view: 120×120, matrix: 256×256, slice thickness: 3 mm, and time of acquisition: 3.5 minutes. When the opened mouth images were taken, a Burnett BiDirectional TMJ Device (Medrad Inc, Pittsburgh, PA) was used to stabilize the maximal opened-mouth position and to minimize motion artefacts.

Evaluation of the images

Two calibrated raters (1 dentist and 1 head/neck radiologist), blinded to the clinical diagnosis, evaluated the MRIs and divided the joints into "deformation of the condyle" and "no deformation of the condyle" (dichotomous variable). The results of the calibration of the 2 raters (which took place before the start of the present study) with respect to the assessment of TMJ pathology was evaluated. The PRs (standard panoramic radiographs, not a special TMJ program) were assessed by 3 raters blinded to both the clinical findings and the MRI diagnosis. These raters (general dentists) classified the presence or absence of deformations of the condyle (deformed/not deformed/impossible to rate). The