A cross-sectional study of temporomandibular joint coronal plane disk position: imaging reliability and clinical utility

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Objectives. The aim of this study was to assess the reliability, frequency, and clinical significance of temporomandibular joint (TMJ) medial and lateral disk positions, observed in the coronal−oblique plane, to determine their importance in clinical diagnosis and for routine imaging.

Study Design. This cross-sectional study involved secondary data analysis (clinical and imaging) of 401 participants of the TMJ Impact Study. We used the χ^2 statistic to evaluate the associations between coronal disk positions with (1) anterior disk displacements with reduction and without reduction; and (2) familiar TMJ pain resulting from excursive movements and palpation, range of motion, and joint sounds.

Results. Anterior disk displacements of any type occurred in 67.5% of joints; in contrast, medial and lateral disk positions occurred in 16% and 24% of joints, respectively. Radiologist reliability was as follows: sagittal posterior band position: right κ = 0.68, left κ = 0.60, average 84% agreement; and medial or lateral disk position: right κ = 0.36, left κ = 0.32, average 70% agreement. Medial and lateral disk positions were associated with sagittal displacements ($P < .001$). However, there were no associations between medial and lateral disk positions and familiar pain, range of motion, and joint sounds.

Conclusions. Coronal disk position does not contribute to clinical symptomatology or findings and currently lacks sufficient evidence to support its inclusion into standard TMJ imaging protocols or into a clinical diagnostic category. (Oral Surg Oral Med Oral Pathol Oral Radiol 2020;130:161−168)

The Diagnostic Criteria for Temporomandibular Disorders (DC/TMD)[1] classifies temporomandibular joint (TMJ) disk displacements (DD) as disk displacement with reduction (DDwR), DDwR with intermittent locking, and disk displacement without reduction (DDwoR), either with or without limitation. Each of these diagnoses is restricted to only anterior displacement of the disk and only as visualized in the sagittal plane by using magnetic resonance imaging (MRI) as a reference standard. This exclusive focus by the DC/TMD to TMJ disk displacement in the sagittal plane is consistent with anterior DD as the most prevalent among the possible directions of disk displacement, with some type of anterior disk displacement occurring in 70% to 80% of individuals with symptomatic temporomandibular joint disorders (TMDs),[2-5] in contrast to 34% to 35% in asymptomatic individuals.[6,7] The dominant prevalence of disk displacement in the sagittal plane has been critical in shaping the field. For example, prevalence studies generally use standard criteria that classify anterior displacements. However, other types of displacements warrant further attention. Specifically, medial or lateral displacement and posterior displacement also occur, but these are not addressed in the DC/TMD because of sparse information. In addition, disk positions also occur in anteromedial and anterolateral directions and are termed *rotational disk displacements*[2,8]; these are of particular interest because portions of the disk are often still in the normal position. These borderline positions tend to be grossly classified as either "normal" or "displaced," depending on the author(s) and the study purpose, but often without any clear criteria or rationale. Evidence regarding medial/lateral, posterior, and rotational displacements and their clinical relevance is currently lacking.

Statement of Clinical Relevance

Lateral or medial coronal position of the temporomandibular joint disk occurs at low prevalence and is not associated with joint-specific clinical symptomatology. Coronal disk position should not be included in primary clinical decision making or in diagnosis until better information emerges.

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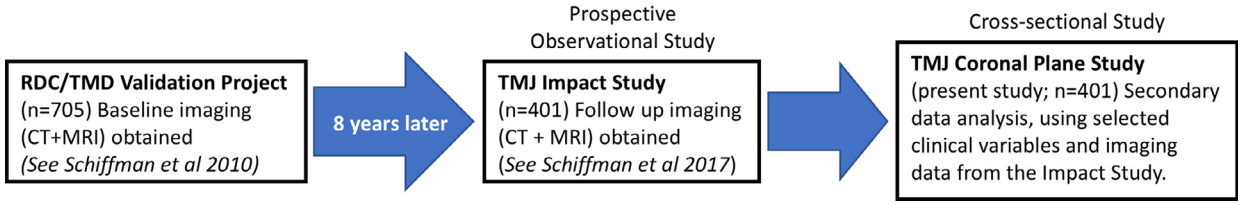

Fig. 1. Flow of participants from the first enrolment to the present study.

Anterior disk displacement is associated with a variety of clinical manifestations. The most ubiquitous are joint sounds ("clicks" and "pops"') during any of the mandibular movements (opening, closing, lateral, or protrusive), and although sounds may occur, in principle, with displacement in any direction, they are most commonly considered in relation to anterior disk displacement. Pain in the joint (diagnosed as arthralgia per DC/TMD) associated with joint movement or with joint palpation is often observed during clinical examination but is not linked, according to diagnostic criteria, to disk status. Limitations in the range of mandibular movements, readily observed in patients with masticatory myofascial pain, are also presumed to reflect interference in joint movement resulting from disk displacements.[9] However, clinical manifestations of medial and lateral positions in the coronal−oblique plane are not well known and have not been studied in depth. Moreover, observed associations between disk displacement and clinical manifestations involving pain do not imply causal relationships, given the overwhelming effects that pain processing can have on multiple aspects of a disorder.[10-12]

The present study was undertaken to assess the relative frequency of the medial or lateral position, as evidenced by coronal−oblique MRI scans, compared with sagittal displacement, and to evaluate clinical significance. To this end, it was important to determine the radiologist's reliability with regard to the assessment of coronal disk diagnosis. Together, these findings on coronal−oblique DD reliability, frequency, and any associated symptoms should have utility for clinical decision making regarding the need for coronal imaging as part of the standard TMJ imaging protocol and for making the differential diagnosis.

MATERIALS AND METHODS

Sample

This cross-sectional study represents secondary data analysis from the parent study (TMJ Impact Study), which was a prospective follow-up observational study of the cohort originally enrolled 8 years previously in the RDC/TMD Validation Project[13] across 3 study sites: University at Buffalo, University of Minnesota, and University of Washington (Figure 1). The aim of the TMJ Impact Study was to assess longitudinal TMJ stability and relate that to variables measured at enrolment.[14] Of the 620 potentially eligible subjects from the 705 participants of Validation study, 401 were recruited over a 2-year period, based on availability, for the TMJ Impact Study. There were no other inclusion criteria; and the only exclusion criterion was contraindication for imaging. The resultant sample included individuals with normal TMJs, TMJ disk displacements with or without reduction, various stages of degenerative joint disease, and specific clinical endpoints of pain, as measured by the Characteristic Pain Intensity and Disability Scale,[15] and global jaw functional limitation, as measured by the Jaw Functional Limitation Scale.[16] For the TMJ Impact Study, participants with normal TMJs served as the reference group for assessing soft tissue and hard tissue changes over time. The present study sought to evaluate whether coronal disk status provided additional information regarding the association between clinical characteristics and TMJ status. Consequently, all 401 individuals, including participants with no disk displacement in either the sagittal or the coronal plane who served as a reference group, were considered appropriate for assessing this question. Informed consent was obtained from all participants per local institutional review board approvals.

Measures and procedures

Methods from the TMJ Impact Study specific to the present analyses are described. Comprehensive clinical assessments were obtained by using the DC/TMD clinical examination protocol[17] and TMJ MRI[18] (described further below). Clinical examination parameters of interest included range of motion (pain-free, maximal unassisted and maximal assisted opening; lateral and protrusive excursions), TMJ noises, and familiar pain from provocation (range of motion, palpation). All clinical variables had been previously assessed for reliability in the same examiners during the RDC/TMD Validation Project and then again 8 years later. The reliability of clinical diagnoses was acceptable, as determined during the TMJ Impact Study. Further information is available elsewhere.[19] The examiners were calibrated and assessed for reliability initially and thereafter annually for 2 more years; Kappa (κ) for

diagnostic classification was computed, with a value of at least 0.8 obtained each year.

Bilateral TMJ MRI was performed by using standardized imaging protocols. At each study site, a 3 T computed tomography (CT) machine with specialized TMJ surface coils was used for TMJ disk assessment. Both T1- and T2-weighted images were assessed by the radiologists; however, only T1-weighted images are reported here as allowed by the scope of this article. The radiologists were calibrated through consensus review of previously collected representative images; their reliability in TMJ attribute interpretation was assessed initially and thereafter annually. Calibration of the radiologists addressed consistency among them in the identification of thresholds for determining the presence or absence of a feature, as operationalized in the published imaging criteria,[18] which is part of the DC/TMD protocol. Sagittal plane disk position was determined in the closed-mouth and open-mouth sagittal views utilizing the posterior band and intermediate band positions. Across the 5 to 7 sagittal slices, the slice with the worst disk attribute was chosen for classifying the disk. For example, if the most lateral slice indicated that the posterior band was anterior but all other slices were either normal or equivocal for displacement, the posterior band was classified as anterior. Axially corrected coronal plane disk position was determined in the closed-mouth view only to maintain a consistent transverse axis. Across the coronal slices, the slice with the most extreme position relative to equal coverage of both the medial and lateral poles of the condyle was selected for assigning disk position.

Sagittal plane imaging diagnosis based on DC/TMD included the following: no displacement (normal), indeterminate, disk displacement with reduction (DDwR), and disk displacement without reduction (DDwoR). The designation "indeterminate diagnosis" was used when the disk structure did not meet all of the criteria for classification as normal but also did not fulfil the criteria for disk displacement. Coronal disk position was classified as centered, medial, or lateral. For both sagittal and coronal plane interpretations, a classification of "disk not visible" was assigned when neither signal intensity nor outline made it possible to visualize the disk in the respective plane.

Protocol for consensus interpretation

Each imaging study was initially read independently by each of the 2 radiologists: the host study site radiologist and one selected in a pseudo-random manner that balanced assignments. The imaging studies were read with each subject's identity and clinical findings blinded. If the 2 independent interpretations of a participant's images were concordant for disk diagnosis, then no further interpretation was required. If the interpretations for disk diagnosis were not concordant, then the 2 radiologists reinterpreted the images separately and then communicated with each other via email or telephone to reach a consensus regarding the disk diagnosis. Each time a radiologist viewed the joint, the interpretation was entered into and stored on a web-based system along with the system time-stamp. Consequently, the web-based system contained each iteration of interpretation, including the first, which was completely independent of the other radiologist's interpretation, and then all subsequent interpretations that reflected the consensus process with the other assigned radiologist. The last-entered interpretation was the final consensus opinion and which informed the final disk diagnosis in the sagittal plane. There was no set time interval between successive interpretations by each radiologist as consensus was achieved. The disk position in the coronal plane, however, was not included in the radiologists' consensus process because the coronal position did not need to be considered for reaching a consensus regarding sagittal disk displacements, which was the primary aim of the parent study (TMJ Impact Study) and because of the radiologists' burden associated with the number of studies to interpret and agree on. Consequently, the first interpretation of the joint for coronal disk status was used for data analysis.

Data reduction and analysis

Marital status was dichotomized as "married" vs "all others," and income was dichotomized as $40,000 or less vs greater than $40,000. Vertical range of jaw movement was dichotomized by using 40 mm as the threshold. Descriptive analyses of demographic, clinical, and imaging variables were computed.

Radiologist reliability for interpretation of TMJ attributes was computed as follows: The first interpretations, for each of sagittal plane and coronal plane, by the 2 radiologists were used for assessing radiologist reliability because these interpretations were independent. Reliability was computed by using the κ statistic.[20,21] Initially, each of the 3 pairs of 3 radiologists was compared for reliability; κ for each of the 3 groups was comparable, and consequently an omnibus model in which the radiologists were considered interchangeable was computed to simplify the presentation of results. That is, a full κ model was computed for 2 radiologists who interpreted a given joint and were considered "first" and "second" per imaging parameter. The omnibus model yielded estimates concordant with the pair-wise models. κ values were interpreted as follows[22]: less than 0.40 = poor reliability; 0.40 to 0.75 = fair to good reliability; and greater than 0.75 = excellent reliability.

Associations between the medial or lateral disk position and each of the anterior disk displacements, pain, joint sounds, and range of movement were assessed by using Pearson's χ^2 test. Analyses were performed for the right and left sides initially to assess for sources of possible systematic bias; no such bias was identified, and the right and left joints were collapsed into a sample of 802 joints for subsequent testing of associations to simplify the results and improve reliability overall. All analyses were conducted by using the Stata software (Stata Corp., LLC, College Station, TX). Statistical significance was determined with $\alpha = 0.05$.

RESULTS

The mean age of the participants was 45.8 years (standard deviation [SD] 12.9), and 83% were females. Most (93%) of the participants had greater than 12 years of education, and 43% were college graduates. Annual income of greater than $40,000 was reported by 74% of the participants. Current marital status as "married" was reported by 54%. An arthralgia diagnosis was present in 143 right TMJs and 134 left TMJs; myalgia was present in 199 of the participants.

With regard to the reliability of sagittal plane disk attributes, the κ statistics were similar across the 3 groups of radiologists, whereas for coronal plane attributes, the κ statistics were less similar across radiologist groups. The difference in these 2 types of findings resulted from the much higher frequency of sagittal attributes, which were more evenly distributed across the 3 radiologist groups, whereas coronal displacements occurred at a lower frequency and were unevenly distributed across the 3 groups of radiologists, leading to greater penalty for disagreements in the κ computation. Otherwise, there were no notable differences in right joint vs left joint κ statistics. The reliability (κ) for the 4 sagittal disk attributes ranged from 0.46 to 0.86, whereas agreement ranged 72% to 94% (Table I). In contrast, the reliability for interpreting coronal disk position was poor, with $\kappa = 0.32$ (left TMJ) or 0.36 (right TMJ), whereas agreement was 70% or 69%, respectively.

The frequency of sagittal disk displacements in the study sample was 68%, of which 38% joints had DDwR and 30% had DDwoR (Table II). In the coronal plane, medial displacements were identified in 125 (16%) joints, and lateral displacements were identified in 189 (24%) joints. The disk was not visible because of poor image quality in 5 joints in the sagittal plane and in 7 joints in the coronal plane.

Associations between sagittal displacements and coronal position (right joint: N = 396; $\chi^2 = 21.8$; $P < .001$; and left joint: N = 394; $\chi^2 = 45.2$; $P < .001$) were identified. Combining joints, an omnibus association was significant (n = 790; $\chi^2 = 61.5$; $P < .001$) (Table III). Step-down χ^2 analyses were performed to determine the coronal disk position (medial vs lateral) that was more likely to be associated with a sagittal displacement by diagnosis; the coronal plane disk position "centered" was used as the reference group. The medial position occurred more often with anterior DDwoR ($\chi^2 = 20.0$; $P < .001$) compared with DDwR ($\chi^2 = 4.8$; $P = .03$), whereas the lateral position occurred equally in

Table I. Radiologist reliability for interpretation of individual soft tissue attributes of the temporomandibular joint (TMJ) disk in both sagittal and coronal planes. Kappa and percent agreement are based on 2 radiologists, considered as "first" and "second" for each attribute. (See text for details regarding preliminary reliability analysis)

Disk Attribute	Right joint		Left joint	
	Kappa	Agreement	Kappa	Agreement
Sagittal plane				
Posterior band position (closed mandible)	0.68	86%	0.60	82%
Intermediate band position (closed mandible)	0.71	89%	0.66	86%
Intermediate band position (open mandible)	0.82	92%	0.86	94%
Disk shape (closed mandible)	0.46	72%	0.47	74%
Coronal plane				
Medial or lateral disk position (closed mandible)	0.36	69%	0.32	70%

Table II. Prevalence of disk status: sagittal disk diagnosis and coronal disk position*

Disk status	Right joint (N = 401)		Left joint (N = 401)	
	Frequency	Percent	Frequency	Percent
Sagittal plane disk diagnosis				
Normal	104	26	109	27
Indeterminate	18	4	21	5
DDwR	156	39	146	36
DDwoR	121	30	122	30
Disk not visible	2	0	3	1
Coronal plane disk position				
Medial	71	18	54	13
Centered	235	59	241	60
Lateral	90	22	99	25
Disk not visible	5	1	7	2
Total	**401**	**100**	**401**	**100**

DDwR, disk displacement with reduction; *DDwoR*, disk displacement without reduction.
*Percent values are rounded to nearest integer and may not add to 100% within disc status section.

Table III. Test of association between sagittal disk diagnosis and coronal disk position, collapsing right and left joints*

Coronal disk position	Anterior Disk Displacement [n, (col %)]			Total
	None	DDwR	DDwoR	
Medial	29 (12%)	43 (14%)	53 (22%)	125 (16%)
Centered	196 (79%)	164 (55%)	116 (48%)	476 (60%)
Lateral	24 (10%)	92 (31%)	73 (30%)	189 (24%)
Total	249 (100%)	299 (100%)	242 (100%)	790 (100%)

DDwR, disk displacement with reduction; *DDwoR*, disk displacement without reduction.
*Overall Pearson's $\chi^2 = 61.5$; $P < .001$.Of 802 TMJs, the total n = 790 reflects missing values from "disk not visible" in 5 joints in the sagittal plane and 7 joints in the coronal plane.

Table IV. Association between coronal disc position and same-joint familiar TMJ pain, stratified by sagittal disk position diagnosis*

Coronal disk position	Familiar pain on palpation: N (%)			
	Absent	Present	Total	P
Sagittal disk position diagnosis: *Normal*				
Medial	21(12%)	8 (12%)	29 (17%)	.78
Centered	144 (79%)	52 (76%)	196 (74%)	
Lateral	16 (9%)	8 (12%)	24 (9%)	
Total	181 (100%)	68 (100%)	249 (100%)	
Anterior disk displacement with reduction				
Medial	30 (15%)	13 (13%)	43 (14%)	.73
Centered	105 (53%)	59 (58%)	164 (55%)	
Lateral	62 (32%)	30 (29%)	92 (31%)	
Total	197 (100%)	102 (100%)	299 (100%)	
Anterior disk displacement without reduction				
Medial	32 (21%)	21 (23%)	53 (22%)	.55
Centered	69 (46%)	47 (51%)	116 (48%)	
Lateral	49 (33%)	24 (26%)	73 (30%)	
Total	150 (100%)	92 (100%)	242 (100%)	

*Right and left joints have been collapsed; associations for each joint separately were not markedly different. Percent values are within column. Stated *P* values (*P*) are based on Pearson χ^2 statistic. The total n = 790 reflects missing values from "disk not visible" in 5 joints in the sagittal plane and 7 joints ian the coronal plane.

both anterior DDwoR ($\chi^2 = 43.2$; $P < .001$) and DDwR ($\chi^2 = 40.2$; $P < .001$).

No associations were observed between coronal position (medial or lateral) and the clinical variables pain, joint sounds, or any range of motion, stratified by anterior disk diagnosis. Associations between coronal disk position and pain (Table IV) are shown as an example.

DISCUSSION

The aim of the present study was to assess frequency of medial or lateral coronal disk position and whether coronal disk position warrants incorporation into TMJ internal derangement diagnoses, as currently based on sagittal plane visualization. In addition, the present study assessed the potential contribution of coronal disk position to clinical symptomatology. These findings would help determine whether evaluating the TMJ in the coronal−oblique plane as part of standard TMJ imaging protocol is justified. In this sample used for this evaluation, 83% comprised females, consistent with other TMJ imaging studies.[2,23,24] The proportion of sagittal disk displacements in this convenience sample was 68% of the total joints, with 38% showing DDwR and 30% showing DDwoR. Of the coronal disk displacements, 16% were medial and 24% lateral. Studies vary with regard to the prevalence of different types of coronal displacements, with no consistent findings indicating whether medial or lateral displacements are more common.[25,26]

In this study, sagittal plane disk attributes exhibited good radiologist reliability, whereas the single coronal plane disk attribute (i.e., position) exhibited poor radiologist reliability. The disk in the coronal plane has few landmarks, increasing the difficulty in determining when the disk is coronally displaced. Compared with the radiologist reliability for sagittal plane disk position, the lower radiologist reliability for coronal disk position may have also been influenced by the relatively lower frequency of medially or laterally positioned disks in the study sample. Although the percent agreement was substantially higher and more in line with that observed for the sagittal plane disk attributes, compared with the κ statistic, percent agreement may overestimate the true agreement because it does not control for examiner bias in predicting outcomes.[20,21] Even with use of percent agreement, however, sagittal plane attributes were mostly above 85%, whereas coronal plane disk position was no greater than 70%, highlighting the technical and interpretative challenges in assessing coronal disk position with sufficient reliability.

The disk position in the coronal plane was visualized as a single structure extending from the medial pole to the lateral pole of the condyle, and in most joints, it was interpreted from a single image slice because of the relatively lower image quality of the disk in the coronal plane vs the image quality in the sagittal plane. Consequently, interpretation of a potential coronal displacement is highly dependent on very good imaging technique and image quality, and it is further

influenced by anatomic variations, such as condylar shape (as a determinant of the landmarks for a displacement) and disk shape. In addition, a better criterion for demarcating when a disk is not in the normal position is needed for reliable classification. Given such methodologic limitations, it is quite possible that some coronal disk positions were wrongly interpreted in the present study. Because the radiologists were diplomates of American Board of Oral and Maxillofacial Radiology or of the American Board of Radiology and Neuroradiology, with 12 to 23 years of experience in interpreting TMJ images, we consider the problems in reliability of interpreting coronal disk position to primarily reflect the limitations in imaging quality and the lack of specific criteria. Moreover, the radiologists were calibrated 3 times throughout the study period, and the observed calibration consensus was equivalent for both coronal and sagittal plane attributes. This is consistent with other studies demonstrating the effectiveness of training and calibration trials in improving interexaminer agreement in reading MRI scans with respect to improved visualization of medial and lateral TMJ disk positions.[27,28] Although sagittal plane disk position has been well operationalized for radiographic diagnosis,[18] the medial or lateral disk position, as visualized in the coronal−oblique plane, lacks both defined criteria for determining disk position as well as any standardized method of classification.

It has been speculated that medial displacements are anatomically more likely to occur as a result of the insertion of the superior head of the lateral pterygoid muscle into the anterior part of the disk, which may pull the disk medially during function,[29] and the angulation of the condyle.[30] When associated with sagittal DDwoR (see Table III), coronal displacement is also more likely to be of a rotational nature or be anteromedial, rather than a true unidirectional, displacement. Anterolateral displacement is an equally plausible scenario in this study, considering the higher association of lateral displacements with DDwR or DDwoR, possibly as a result of the laxity of the oblique fibers of the temporomandibular ligaments, which, in normal circumstances, become taut and limit the lateral movement of the condyle on joint rotation.[31]

Given that medial and lateral positions are poorly understood, it is tempting to clinically speculate about the potential importance of any abnormal aspect of disk position when a patient has either pain or impaired function associated with the particular joint. Consequently, clinical morbidity or otherwise unexplained symptoms are often attributed to a presumed complex disk position, such as a rotated disk. For example, a DD in the lateral or medial direction, with coronal position in the respective location, presumably could lead to pain or limitation in lateral and protrusive movements. In this study, only 26.5% of normal joints (i.e., without sagittal or coronal displacements) had "familiar pain" upon palpation of the TMJs (see Table IV). No associations between medial/lateral coronal disk positions and joint pain or familiar pain upon joint palpation were observed. TMJ pain may not be a direct consequence of disk displacements.

Limitation in jaw opening is common in TMD and, according to the DC/TMD classification, maximum assisted opening (including vertical overlap) of less than 40 mm, coupled with self-reported limitation in jaw opening severe enough to interfere with the ability to eat, is clinically diagnostic of DDwoR with limited opening, to be confirmed by imaging.[1] In contrast, there is no diagnostic disorder or known impairment associated with abnormal coronal disk position. Although limitation in TMJ mobility could be a part of biomechanical constraint from the TMJ, measurements of active mandibular movements have been unable to discriminate patients with TMDs from asymptomatic patients,[9] and our data also failed to find any associations between medial and lateral coronal disk positions and measured jaw mobility. Although more refined measurement of jaw movement, such as with any of the jaw tracking devices, might permit an association to be identified, its clinical significance would remain debatable.

Sagittal disk displacements are not reliably associated with joint noises; for example, a positive history of noise and clinical presence of clicking noise has sensitivity of 34% and specificity of 92% for MRI-confirmed displacement.[1] Similarly, joint sounds, detected by the same examiners, upon vertical or excursive movement, were not associated with coronal disk position. The present findings add further evidence to support the notion that TMJ disk position is less important than function, such as the ability to chew or to open the mandible without limitation, in determining clinical significance.

One of the limitations of this study is the lack of strong criteria as well as lack of consensus regarding diagnosis of images of the coronal plane (in contrast to consensus regarding images of the sagittal plane); associations may be underestimated because of the poor radiologist reliability with regard to the coronal disk position. Despite the sample being specifically selected for DD, the proportion of coronal displacements was, nevertheless, low, reducing statistical power; however, the low proportion is itself potentially very informative regarding the putative clinical importance of coronal plane disk position. In other words, even if radiologist reliability is poor because the worst interpretation was taken, if there were a real phenomenon linking coronal position to symptoms, at least a suggestive pattern in the data should have emerged. Although the limitations

of this study point to obvious areas that could be improved in future studies, the very weak associations observed and reported here point to a lower likelihood of finding clinical importance even with improved methods. And the presumed low prevalence of the lateral or medial coronal position of the disk further points to the challenges in collecting substantially improved data.

To the best of our knowledge, this study is the first to assess an association between coronal disk position and clinical characteristics. Coronal disk position, as observed in this study, does not contribute to clinical symptomatology, including TMJ pain, joint sounds, and mobility, a finding that must be qualified at this time by the low interrater reliability with regard to coronal disk position. Yet, given the high frequency of DD and pain symptomatology in this sample, the far lower frequency of coronal disk displacement and the tentative absence of clinical meaningfulness suggest that it is premature to endorse the inclusion of coronal disk position into the standard TMJ imaging protocol or into a clinical diagnostic category. Standardized radiologic protocols must first be improved with regard to both technical methods for improved image quality and interpretation of coronal images to better identify anatomic variations and disk morphology in that plane.

CONCLUSIONS

The present study should be regarded as an initial investigation into the potential importance of coronal plane disk displacements; any purported significance of coronal plane imaging is, at present, premature until better imaging quality with more reliable interpretations can be obtained. In addition, such advances in coronal position imaging and interpretation are needed for application to individual cases when complex forms of mechanical locking are present and are not adequately explained by the disk position in the sagittal plane.

DISCLAIMER

The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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