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RESEARCH AND EDUCATION

Defining centric relation

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ABSTRACT

Statement of problem. Multiple definitions of centric relation (CR) have evolved over time that may have created confusion or impeded understanding. A recent attempt to achieve a singular definition by surveying the members of the Academy of Prosthodontics (AP) did not achieve majority consensus.

Purpose. The purpose of this study was to identify those aspects or attributes within the existing definitions of CR in which there was agreement or disagreement among the members of the AP.

Material and methods. After pretesting and institutional review board approval, a second survey of the AP membership was performed using both email and postal mail survey methods of contact. The CR Attributes Survey separated and stratified the previous definitions of CR into 5 domains: spatial relationship, condylar position, articular disks, mandibular movement, and recording. Each domain attribute was evaluated by agree-uncertain-disagree assessments. Also recorded were demographics, perception of scientific evidence, and open comments.

Results. Of the total 146 fellows, 100 completed the survey for an overall response rate of 68.5%. The query completion rate ranged from 96% to 98%. The CR Attributes Survey revealed those components within each domain in which there was strong agreement, disagreement, or uncertainty. The survey assessment of those queries with a moderate to strong agreement were that CR is a "spatial relationship" that is (1) a clinically determined relationship of the mandible to the maxilla, (2) a repeatable position, (3) is independent of tooth contact, and (4) is a physiologic position. Relative to "disks," the condyles articulate with the thinnest avascular intermediate zone of their respective disks; however, there is a lack of sufficient evidence to determine the position of the disks and the condyles. Relative to "mandibular movement," CR is (1) a starting point for vertical, lateral, or protrusive movements, (2) is where the individual can make to and from lateral movements, and (3) is restricted to pure rotary movement about a transverse horizontal axis. Relative to "recording CR" (1) it can be determined in patients without pain or derangement of the temporomandibular joints (TMJs), (2) but may not be recordable in the presence of dysfunction of the masticatory system, or (3) due to the neuromuscular influence or proprioception from the dentition, (4) is a clinical useful repeatable reference position for mounting casts, or (5) for developing a functional treatment occlusion, (6) at an established vertical dimension, and (7) may vary slightly by recording method.

Conclusions. The CR Attributes Survey revealed a majority agreement or consensus for various CR attributes that should be considered for defining the term 'centric relation.' In contrast, those CR attributes with a plurality agreement, disagreement, or uncertainty outcomes should be considered for exclusion. The evaluated weakness of these latter attributes indicates the need for further research and reassessment. (J Prosthet Dent 2018;120:114-22)

The Academy of Prosthodontics (AP) was established in 1918 as the first dental organization to advance prosthodontic education and the specialty of prosthodontics.[1] One of its many contributions to prosthodontics has been the development of the Glossary of Prosthodontic Terms (GPT) that began in 1956. Over the years there have been 8 editions, with the ninth edition published in 2017.[2] In compiling the Glossary, terminology and

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Clinical Implications

Understanding the principles and concepts that define centric relation is of significant relevance in communicating with health care professionals and providing patient care. As such, achieving consensus on agreement or disagreement assists in validating the CR definition that is essential for education, patient treatment, and clinical research.

definitions are requested from many prosthodontic organizations that represent the communities of interest. The members of the AP Committee of the Glossary of Prosthodontic Terms subsequently deliberate upon the terminology and definitions with the objective of universal acceptance based on the best available supporting evidence and acknowledged literature references.

In prosthodontics, centric relation (CR) is of considerable importance, with significant educational and clinical relevance when restoring or modifying a patient's occlusion.[3,4] The term has been periodically revised in an effort to achieve an acceptable consensus-based definition that would satisfy clinicians, educators, and researchers alike. Previously, multiple versions of a centric relation definition were published that provided a historical frame of reference based upon contemporary research and opinion, but at the same time the multiplicity of definitions may have created confusion or impeded understanding.[5] Also noted is the apparent lack of consistency between and within oral and maxillofacial surgeons, orthodontists, and periodontists regarding an absolute definition of CR.[6,7]

In 2013, a survey was performed at the annual session of the AP that explored the historical aspects of the 9 possible definitions of CR.[8] It was observed that none of the definitions achieved a simple majority, suggesting a lack of consensus regarding the proposed definitions of CR. The variability in wording and the resulting definition selection may have been related to the individual's educational era. The purpose of this study was to identify and validate those attributes within the existing definitions of CR in which there was agreement or disagreement among the members of the AP.

MATERIAL AND METHODS

A survey design was developed to separate the various attributes of the CR definitions. The survey was pretested for content validity, and subsequently approved as exempt from institutional review board (IRB) review (IRB protocol #1516-74). This survey included the various published definitions of CR and attempted to discover what subset attributes of centric relation were agreeable or disagreeable. The definitions were separated and stratified into 5 domains: spatial relationship, condylar position, articular disks, mandibular movement, and recording. The survey respondents were first asked their opinion relative to the level of scientific evidence using a modified Likert scale of weak-moderate-strong and then each domain attribute was evaluated by agree-uncertain-disagree assessments. An open-ended comment section was included for observational statements.

In addition to the 5 domains, demographic information was requested regarding the decade in which the respondent graduated from dental school, in what state and country, and the decade the respondent completed a postgraduate prosthodontic program, as well as their primary activity and their American or international board certification status. The CR Attributes Survey was submitted to the 146 members of the AP by email using SurveyMonkey.com, followed by mailing of paper surveys to nonresponders.

The data were imported into statistical software (IBM SPSS Statistics v22; IBM Corp), which revealed no errors; cross-tabulations were run to determine associations among demographic variables and survey items. A chi-square or Fisher exact test was used to determine the statistical significance (α=.05). The results were statistically analyzed by statistical cross-tabulations and then displayed using bar and radar charts. The cross tabulations compared the demographic information against outcomes of the 5 domain categories and the queries within each subgroup. Radar or star plots are a useful way to display multivariate observations that may have an arbitrary number of variables.[9] The radar chart is a visual method for plotting data that consists of a sequence of equiangular spokes (radii), with each spoke representing one of the variables. The data length of a spoke is proportional to the magnitude of the variable for the data point relative to variables across all data points. The radar charts visually displayed whether the 3 variables for each domain subgroup question were equivocal or unequivocal or diametrically polarized. A triangular shape will result when plotting 3 variables. Those outcomes that were similar or dissimilar, such as where one variable appreciably exceeded the others, were correspondingly grouped.

RESULTS

A total of 100 of 146 AP fellows completed the CR Attributes Survey for an overall response rate of 68.5%. The query completion rate ranged from 96% to 98% (Table 1). The first query measured the demographics of the survey respondents. The number of prosthodontic respondents were dispersed between years 1970 through 1999, peaking between 1980 and 1989. The greatest frequency distribution of respondents completing dental school occurred in the 1970s. Advanced postgraduate education

Table 1. Centric relation attributes survey data

Query 2. Regarding centric relation, the scientific evidence relative to …	Weak	Moderate	Strong
A. the spatial relationship of the mandible to the maxilla is?	24	46	27
B. the position of the condyles is?	36	41	19
C. position or presence of the articular disks is?	31	33	33
D. mandibular movement is?	14	40	43
E. recording centric relation is?	30	47	20
Query 3. Centric relation is a "SPATIAL RELATIONSHIP" that is …	**Agree**	**Uncertain**	**Disagree**
A. a retruded relationship of the mandible to the maxilla	45	15	36
B. a clinically determined relationship of the mandible to the maxilla	87	6	2
C. a physiologic position	48	31	14
D. a repeatable position	73	19	5
E. independent of tooth contact	94	2	1
Query 4. Relative to "CONDYLAR POSITION" and centric relation, the condyles …	**Agree**	**Uncertain**	**Disagree**
A. articulate in the anterior-superior position	47	30	20
B. are against the posterior slopes of the articular eminences	26	31	38
C. are in the most posterior unstrained position of the glenoid fossae	29	24	44
D. are in the uppermost and rearmost position of the glenoid fossae	20	32	46
E. are placed into their anterior uppermost position	24	36	37
F. there is a lack of sufficient evidence to determine the position of the condyles	54	15	28
Query 5. Relative to "DISK" and centric relation	**Agree**	**Uncertain**	**Disagree**
A. the condyles articulate with the thinnest avascular intermediate zone of their respective disks	52	33	11
B. the condyles and disks are in the midmost, uppermost position in the mandibular fossae	22	48	26
C. the disk complex is in the anterior-superior position against the shapes of the articular eminences	44	39	13
D. there is a lack of sufficient evidence to determine the position of the disk	55	22	19
Query 6. Relative to "MANDIBULAR MOVEMENT," centric relation is …	**Agree**	**Uncertain**	**Disagree**
A. where the individual can make to and from lateral movements	59	18	19
B. where lateral movement can be made at any given degree of jaw separation	31	22	43
C. a starting point for vertical, lateral, or protrusive movements	81	5	10
D. restricted to pure rotary movement about a transverse horizontal axis	52	14	31
Query 7. Relative to "RECORDING" centric relation, it	**Agree**	**Uncertain**	**Disagree**
A. is at an established vertical dimension	51	11	34
B. can be determined in patients without pain or derangement of the TMJs	73	15	10
C. may not be recordable in the presence of dysfunction of the masticatory system	89	6	2
D. may not be recordable due to the neuromuscular influence or proprioception from the dentition	73	13	12
E. is a clinically useful repeatable reference position for mounting casts	88	5	4
F. is clinically useful for developing a functional treatment occlusion	81	12	5
G. may vary slightly by method, such as depending upon the patient's head position	85	4	9

in prosthodontics was reported by 96 respondents, with 84 completing their training within and 12 outside the US. The primary activity for the respondents were education (51%), private practice (39%), federal services (5%), hospital (3%), and research (2%). Board certification was noted at 74%, with 56% being diplomates of the American Board of Prosthodontics and 18% having an international board–certified equivalent.

The survey responses for queries 2 through 7 are listed in Table 1. The second query asked the respondents to rank the strength of evidence for the following 5 domains: (1) spatial relationship, (2) condyle position, (3) disk position and/or presence, (4) mandibular movement, and (5) recording centric relation. The strength of evidence was greatest for "mandibular movement," followed by "spatial relationship" and "disk position/presence." While weaker evidence was suggested for "condylar position" and "recording centric relation" (Fig. 1).

The third query asked respondents to rank the level of agreement relative to CR and spatial relationship attributes. Relative to spatial relationship, the greatest level of consensus was (1) "independent of tooth contact," followed by (2) "is clinically determined," (3) "repeatable position," and (4) "physiologic position." In contrast, a "retruded relationship" was found to be equivocally polarized, indicating a lack of consensus.

The fourth query asked respondents to rank the level of agreement relative to CR and condylar position

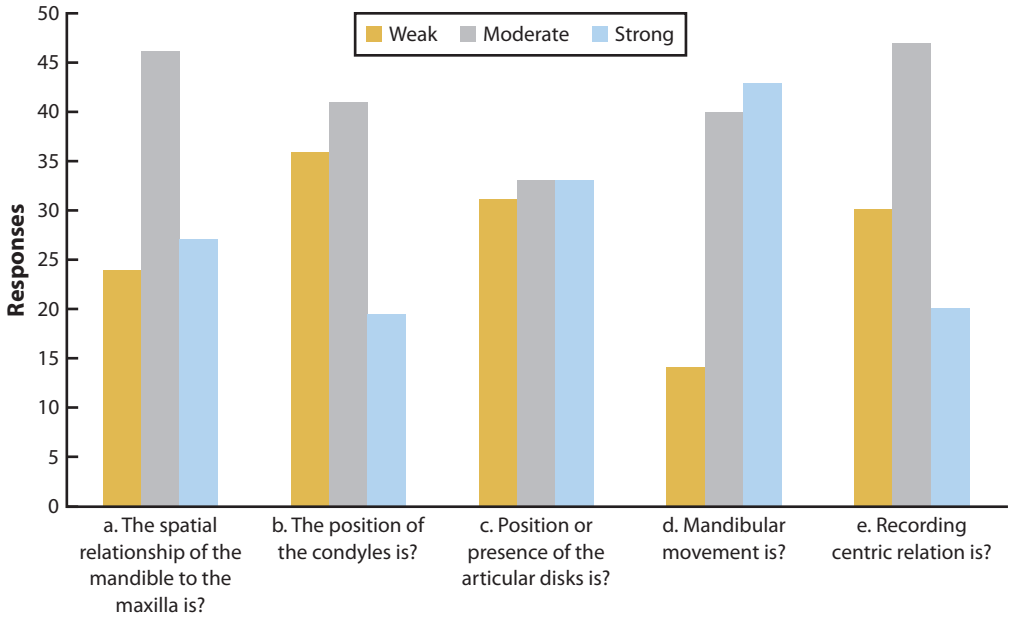

Figure 1. Assessment of scientific evidence. Values were applied as follows: weak=1, moderate=2, strong=3. Assessments were averaged, with those below 2.0 considered weaker than assessments greater than 2.0, which were stronger.

a. Moderate: "Moderate" variable predominates with strength supporting that of some scientific evidence regarding spatial relationship of mandible to maxilla (2.04).

b. Moderate to weak: "Moderate" variable predominates but with weakness suggesting that perceived scientific evidence for position of the condyles in centric relation reveals support, suggesting further research needed (1.83).

c. Moderate: While values are approximately equal, there were more moderate and strong than weak responses regarding relative presence of the disks (2.03).

d. Strong to moderate: "Strong" variable predominates, indicating perceived scientific evidence for mandibular movements (2.3).

e. Moderate to weak: "Moderate" variable predominates but with weakness, suggesting that perceived scientific evidence for recording centric relation is moderate to weak, suggesting further research needed (1.91).

attributes. Relative to condylar position, the greatest level of consensus was (1) "lacks scientific evidence," followed by (2) "anterior-superior position," which did not achieve simple majority consensus. An increased level of disagreement or lack of consensus was noted for 91) "uppermost and rearmost position," 92) "anterior uppermost position," (3) "most posterior unstrained position," and (4) "against posterior slopes."

The fifth query asked respondents to rank the level of agreement relative to CR and disk position attributes. Relative to disk position, the greatest level of consensus was (1) "lacks scientific evidence," followed by (2) "the condyles and disks articulate with the thinnest avascular intermediate zone of their respective disks." An uncertain consensus was noted for (1) "the disk complex is in the anterior-superior position against the shapes of the articular eminences," followed by "the condyles and disks are in the midmost, uppermost position in the mandibular fossae."

The sixth query asked respondents to rank the level of agreement relative to CR and mandibular movement attributes. Relative to mandibular movement, the greatest level of consensus was (1) "a starting point for vertical, lateral, or protrusive movements," followed by (2) "can make to and from lateral movements," and 93) "restricted to pure rotary movement about a transverse axis." A disagree to equivocal consensus was suggested for "lateral movements at any degree of jaw separation."

The seventh query asked respondents to rank the level of agreement relative to CR and recording. In general, all 7 recording CR attribute statements were found to be more acceptable than not acceptable. Relative to recording CR, the greatest level of consensus was (1) "may not be recorded in the presence of dysfunction of the masticatory system," (2) "is a clinically useful repeatable reference position for mounting casts," followed closely by (3) "may vary slightly by method" and (4) "is clinically useful for developing a functional treatment occlusion." A majority agreement was also noted for (5) "may not be recordable due to the neuromuscular influence or proprioception from the dentition," or (6) "can be determined in patients without pain or derangement of the TMJs." A simple majority was recorded for "is at an established vertical dimension."

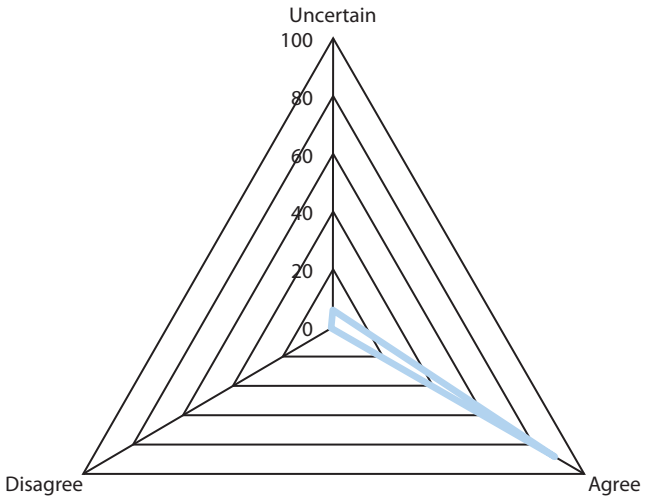

Figure 2. Supermajority agreement regarding centric relation attributes. Centric relation attributes in strong agreement, whereby "agree" variable overwhelmingly exceeded combined values of "disagree" or "uncertain," as represented by following radar chart (Query 3B, 3D, 3E, 6C, and 7B-G). Note: Radar charts used for this survey prepared so that 3 variables designed with "disagree" to left (8 o'clock), "agree" to right (4 o'clock), and "uncertain" in middle (12 o'clock) and directly above. Concentric black lines represent 0 to 100 response units for total number of possible responses in 20-unit increments. Blue triangle or arrowhead represents actual data charting for posed query.

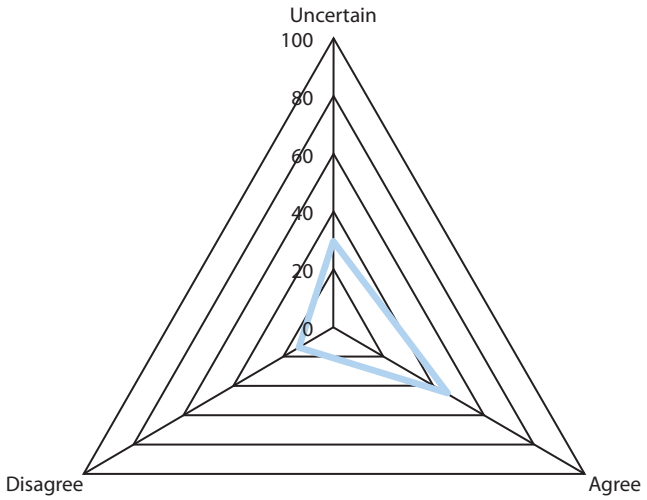

Figure 3. Simple majority agreement regarding centric relation attributes. Centric relation attributes in mild to moderate agreement, whereby "agree" value exceeded combined values of "disagree" or "uncertain" as represented by following radar chart (Query 3C, 4F, 5A, 5D, 6A, 6D, and 7A).

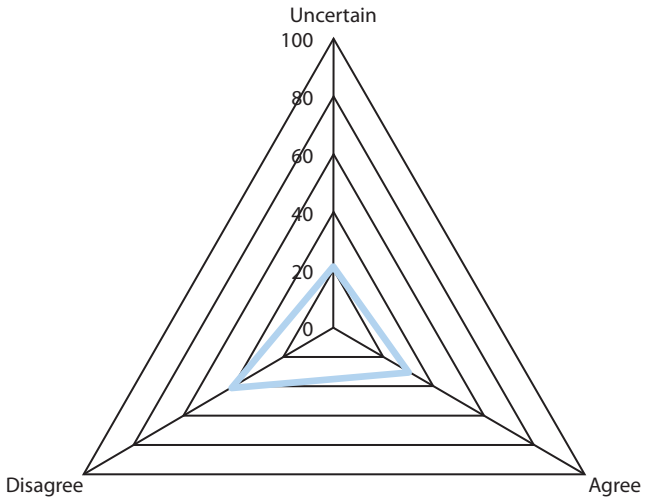

Figure 4. Plurality disagreement or agreement regarding centric relation attributes. Centric Relation Attributes in mild disagreement, whereby "disagree" variable values exceeded "agree" or "uncertain" values and vice versa for "agree" and were represented by following radar chart when in disagreement (Query 4A, 4B, 4C, 4D, and 6B).

The eighth query invited open-ended comments. Twenty-five of the respondents provided remarks: 11 affirmed the need and benefit for the CR survey process; 10 offered their understanding and opinion of how centric relation might be better defined; while, an additional 3 questioned its need, and 1 noted the difficulty with the established wording of centric relation. Chi square and Fisher exact tests between the demographic information and the outcomes of the queries within each subgroup of the 5 domain categories did not reveal any statistically significant correlations.

The assessment of scientific evidence and inclusion or exclusion of CR attributes were organized by radar charts. It was noted that some of the radar chart outcomes were similar while others were different. The attributes were subsequently grouped based upon whether there was "strong agreement," whereby the "agree" variable overwhelmingly exceeded the combined values of "disagree" or "uncertain" (Fig. 2); "mild to moderate agreement," whereby the "agree" value just exceeded the combined values of "disagree" or "uncertain" (Fig. 3); "mild disagreement," whereby the "disagree" variable values exceeded the "agree" or "uncertain" values (Fig. 4); "polarized", such as when one variable value is equivalent to another variable value (Fig. 5); and "uncertain," with the variable value exceeding the "agree" or "disagree" values (Fig. 6). These assessments are listed in Table 2.

Outcome assessment of those queries that indicated a strong agreement (supermajority) were 3B, 3D, 6C, and 7B-G, which included "CR is a clinically determined relationship of the mandible to the maxilla, is a repeatable position, is independent of tooth contact, is a starting point for vertical, lateral or protrusive movements, can be determined in patients without pain or derangement of the temporomandibular joints (TMJs), may not be recordable in the presence of dysfunction of the masticatory system, or due to the neuromuscular influence or proprioception from the dentition, is a

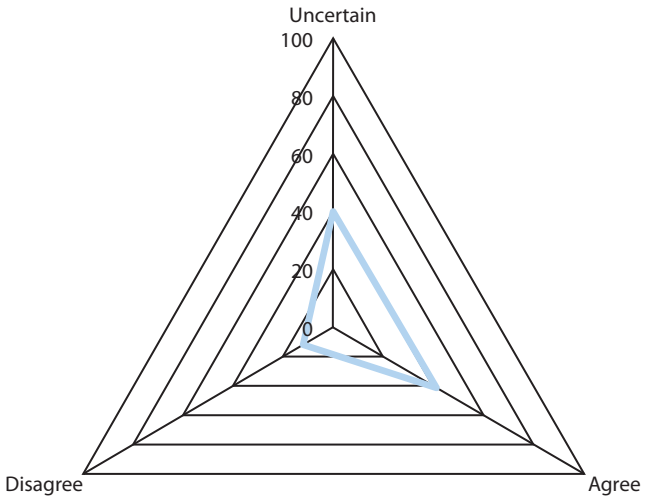

Figure 5. Polarized agreement regarding centric relation attributes. Centric relation attributes considered polarized in terms of agreement, such as 2 variable values being equal, represented by following radar chart (Query 3A, 4E, and 5C).

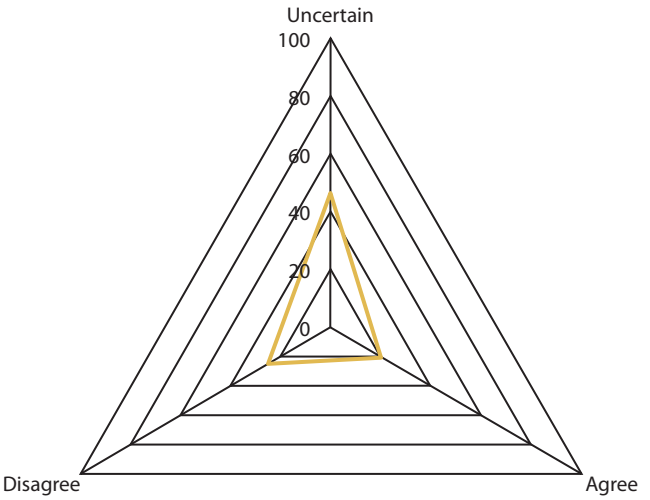

Figure 6. Plurality uncertain agreement regarding centric relation attributes. Centric relation attributes in uncertain agreement, whereby "uncertain" variable value exceeded "agree" or "disagree" values, as represented by following radar chart (Query 5B).

clinical useful repeatable reference position for mounting casts, for developing a functional treatment occlusion, but may vary slightly by recording method."

Outcome assessment of those queries that indicated moderate agreement (simple majority) were 3C, 4F, 5A, 5D, 6A, 6D, and 7A, which included "the condyles articulate with the thinnest avascular intermediate zone of their respective disks"; however, there was a "lack of sufficient evidence to determine the position of the condyles and disks" that challenges the previous attribute. Other moderate agreements were noted for "the individual can make to and from lateral movements, is restricted to pure rotary movement about a transverse horizontal axis at an established vertical dimension."

Outcome assessment of those queries that indicated weak agreement or disagreement (plurality) were 3A, 4A-E, 5B-C, and 6B, which included "CR is a retruded relationship of the mandible to the maxilla, where the condyles articulate in the anterior-superior position, and the disk complex is in the anterior-superior position against the shapes of the articular eminence." Those queries that indicated disagreement (plurality) were "the condyles are against the posterior slopes of the articular eminences, the condyles are in the most posterior unstrained position of the glenoid fossae, the condyles are in the uppermost a rearmost position of the glenoid fossae, and where lateral movement can be made at any given degree of jaw separation." Queries that were polarized or equivocal (plurality) were "CR is a retruded relationship of the mandible to the maxilla, and the disk complex is in the anterior-superior position against the shapes of the articular eminences." An uncertain plurality agreement was observed for 1 CR attribute, whereby the "uncertain" variable value exceeded the "agree" or "disagree" values, relative to "the condyles are placed into their anterior uppermost position."

The authors believe that a robust assessment where there is "moderately strong" to "strong" attribute agreement outcomes should be considered for inclusion when defining CR. Those attributes that are challenged by the perceived lack of evidence or did not achieve either a simple majority or supermajority agreement should be considered for exclusion when revising the definition of CR.

DISCUSSION

The response rate to the CR Attributes Survey was acceptable and was representative of educators and private practitioners with more than 30 years of specialist knowledge and clinical experience. Additionally, the authors believe that the survey respondents are representative of the prosthodontic community of interest based upon the preponderance of educationally qualified and the number of board-certified prosthodontists. Using radar charts with 3 variables (agree-uncertain-disagree) results in a triangular shape. In the authors' opinion, "uncertain" is a variable of equal value that is comparable with "agree" or "disagree." In assessing the resulting diagrams, if the shape has an acute apex angle (scalene or isosceles triangle, or an "arrowhead" shape), it would indicate a prominent response in favor of that variable. Therefore, on that basis, a particular attribute might be included if it points to "agree" or excluded if it points to "disagree" in the definition of centric relation, and so on. These observations become important when the value of 1 variable exceeds the combination of the other 2 variables, which represents a strong consensus and a simple

Table 2. Centric relation attribute agreement schedule

Query 3. Centric relation is a "SPATIAL RELATIONSHIP" that is …	**Plurality**	**Simple Majority**	**Supermajority**
A. a retruded relationship of the mandible to the maxilla	Agree		
B. a clinically determined relationship of the mandible to the maxilla			Agree
C. a physiologic position		Agree	
D. a repeatable position			Agree
E. independent of tooth contact			Agree
Query 4. Relative to "CONDYLAR POSITION" and centric relation, the condyles …	**Plurality**	**Simple Majority**	**Supermajority**
A. articulate in the anterior-superior position	Agree		
B. are against the posterior slopes of the articular eminences	Disagree		
C. are in the most posterior unstrained position of the glenoid fossae	Disagree		
D. are in the uppermost and rearmost position of the glenoid fossae	Disagree		
E. are placed into their anterior uppermost position	Equivocal		
F. there is a lack of sufficient evidence to determine the position of the condyles		Agree	
Query 5. Relative to "DISK" and centric relation	**Plurality**	**Simple Majority**	**Supermajority**
A. the condyles articulate with the thinnest avascular intermediate zone of their respective disks		Agree	
B. the condyles and disks are in the midmost, uppermost position in the mandibular fossae	Uncertain		
C. the disk complex is in the anterior-superior position against the shapes of the articular eminences	Agree		
D. there is a lack of sufficient evidence to determine the position of the disk		Agree	
Query 6. Relative to "MANDIBULAR MOVEMENT," centric relation is …	**Plurality**	**Simple Majority**	**Supermajority**
A. where the individual can make to and from lateral movements		Agree	
B. where lateral movement can be made at any given degree of jaw separation	Disagree		
C. a starting point for vertical, lateral, or protrusive movements			Agree
D. restricted to pure rotary movement about a transverse horizontal axis		Agree	
Query 7. Relative to "RECORDING" centric relation, it	**Plurality**	**Simple Majority**	**Supermajority**
A. is at an established vertical dimension		Agree	
B. can be determined in patients without pain or derangement of the TMJs			Agree
C. may not be recordable in the presence of dysfunction of the masticatory system			Agree
D. may not be recordable due to the neuromuscular influence or proprioception from the dentition			Agree
E. is a clinically useful repeatable reference position for mounting casts			Agree
F. is clinically useful for developing a functional treatment occlusion			Agree
G. may vary slightly by method, such as depending upon the patient's head position			Agree

Outcome assessments for questions 3 through 7. "Plurality" assessment for 3 variables defined as subset larger than other 2 variables individually, but not majority and less than 50%. "Majority" assessment defined as subset larger than other 2 variables when combined, or from 51% to 66% (less than a supermajority). "Supermajority" assessment defined as subset more than double other 2 variables combined, or greater than 67%. Attributes in supermajority group should be considered for inclusion into the definition of centric relation. Those query attributes that were in the majority group may be considered for inclusion into the definition of centric relation. Attributes in plurality group may be considered for exclusion from definition of centric relation.

to major majority agreement. In contradistinction, if no single variable achieves a simple majority then the resulting triangle appears similar to an equilateral shape. These plurality outcomes may range from weak to equivocal, which would suggest a diverse opinion or uncertainty and that further scientific research is needed for that centric relation attribute. Polarized responses that are "conflicted" have an ambiguity declaration suggesting exclusion of that attribute from the definition of CR due to the lack of specific direction. While radar charts may visually display trends or predilections, other tests are needed to determine statistical significance.

The Centric Relation and Scientific Evidence section of the query questioned the perceived strength of the "scientific evidence" relative to the topics presented in the prosthodontic literature. In contrast, with the subsequent domain queries a responder may agree or disagree or declare uncertainty based upon literature, belief, opinion, personal experience, conflicting evidence, dogma, educational training, or personal communications. The survey design included the ability to choose "agree," "disagree," or "uncertain." This latter option did not imply that the responder "did not know," but rather it allowed a "cognitive dissonance" whereby conflicting scientific literature or the lack of supporting information could preclude either an affirmative or a negative response. As such, the CR Attributes Survey design allowed an appraisal of whether the assessments were in agreement, lack of agreement, or an uncertain relationship.

The scientific literature is replete with analyses and assessments related to CR. They include anatomical considerations, recording methodology, professional interpretations and predilections, variability and repeatability, and comparisons of CR and maximal intercuspal

position (MIP). While efforts are directed to use the best available evidence to support any definition, it is subject to interpretation, personal biases, and perhaps the potential for "errors in judgment."[10] The CR Attributes Survey revealed that the greatest magnitude of agreement was for "recording centric relation and mandibular movements." In contrast, there appeared to be inadequate scientific evidence to support "condylar or disk position." These latter 2 observations were further confirmed in the attributes domain sections of the survey when respondents indicated that that there was a lack of evidence. Investigators have noted temporal and recording method variability of the centric relation position.[11-20] However, there are CR recording methods that verify consistent repeatability.[21-37] Although during clinical recordings it is difficult to know exactly where the disk and condyles are positioned. These observations are supported by the survey responses. Additional attempts to show differences between condylar positions between CR and MIP using magnetic resonance imaging have not been effective.[38] Several other investigators have reported minimal differences between CR and MIP.[39-43] The weakness in the scientific literature or disagreement in the attributes noted may direct a change in the current definition of CR by eliminating those aspects relative to condylar or disk position until such time that ample evidence provides greater clarity. Other researchers have suggested this observation.[44]

Defining of the term 'centric relation' remains essential for appropriate education, patient treatment, and clinical research. A previous survey queried reconstructing the occlusion using CR or MIP when restoring 1 quadrant in 1 arch, 1 quadrant in both arches, and 1 entire arch. The data revealed the preference to use CR to be 8%, 27%, and 83%, respectively.[6] These findings suggest that CR has a greater significance as the number of occlusal units that are being modified increases and/or when proprioception from the loss of teeth or their occlusal surfaces is modified by the clinician. Whereas, MIP has been suggested for other clinical situations.[45-50]

CONCLUSIONS

Based on the findings of the CR Attributes Survey, the following conclusions were drawn:

1. A majority agreement or consensus was found for various CR attributes that should be considered for defining the term 'centric relation.'
2. The survey assessment of those queries with a moderate to strong agreement were that CR is a "spatial relationship," which is a clinically determined relationship of the mandible to the maxilla, a repeatable position, independent of tooth contact, and is a physiologic position. Relative to "disks," the condyles articulate with the thinnest avascular intermediate zone of their respective disks; however, there is a lack of sufficient evidence to determine the position of the condyles and the disks. Relative to "mandibular movement," CR is a starting point for vertical, lateral, or protrusive movements, is where the individual can make to and from lateral movements, and is restricted to pure rotary movement about a transverse horizontal axis. Relative to "recording CR" it can be determined in patients without pain or derangement of the TMJs, but may not be recordable in the presence of dysfunction of the masticatory system or due to the neuromuscular influence or proprioception from the dentition. CR is at an established vertical dimension, is a clinical useful repeatable reference position for mounting casts and for developing a functional treatment occlusion. CR may vary slightly by recording method.
3. CR attributes with a plurality agreement, disagreement, or uncertainty outcomes should be considered for exclusion, including those with equally opposing or equivocal outcomes.
4. The evaluated weakness of these latter attributes indicates the need for further research and reassessment.

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