Centric Relation: A Survey Study to Determine Whether a Consensus Exists Between Oral and Maxillofacial Surgeons and Orthodontists

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Purpose: The purpose of this study was to determine whether there is a consensus among oral and maxillofacial surgeons and orthodontists as to the definition of centric relation.

Materials and Methods: A survey constructed from 5 definitions of centric relation as provided from the “Glossary of Prosthodontic Terms” was sent to the chairpersons of every oral and maxillofacial surgery and orthodontic program in the United States. Only full-time faculty members from each program were asked to respond to the survey. The different responses were analyzed statistically by $\chi^2$ analysis and examined by use of 95% confidence intervals.

Results: We received 73 responses from the oral and maxillofacial surgeons and 64 from the orthodontists. There were 69 different programs represented in this survey. Orthodontists and surgeons had a significantly different response regarding the definition of centric relation ($\chi^2 = 28, df = 4, P < .0001$). There was no difference between the 2 groups on the need for mounting models in centric relation for use in orthognathic surgery ($\chi^2 = 1, P > .6$). Regarding the definition of centric occlusion, there was a significant difference between orthodontists and surgeons ($\chi^2 = 9.9, df = 1, P = .0070$). The fourth and fifth questions had to do with centric relation/centric occlusion slide and the direction of movement. There was a significant difference between the 2 groups regarding mandibular movement ($\chi^2 = 28, df = 2, P < .0001$). Surgeons were nearly unanimous in their opinion that the mandible would move anteriorly (88%), whereas there was more discordance among orthodontists. Within the orthodontic group, 50% indicated anterior movement and 47% indicated that either an anterior or posterior movement could occur. The surgeons were asked 1 additional question that the orthodontists were not. Forty-nine percent of the surgeons indicated that during a bilateral sagittal split osteotomy, the proximal segment should be seated vertically and posteriorly before rigid fixation.

Conclusions: The results of this study show that there is a statistical lack of consistency among practitioners regarding an absolute definition of centric relation as it relates to orthognathic surgery. The inconsistency exists between specialties and within practitioners in each specialty.

Orthognathic surgery requires accurate communication between surgeon and orthodontist as well as accurate presurgical laboratory preparation. Condylar position has been repeatedly shown to significantly affect postoperative skeletal stability as well as relapse of the occlusion. Failing to gain control of the proximal segment to achieve a preplanned change in centric relation (CR) position not only can result in decreased stability but can also have adverse affects on the temporomandibular joints. The common recom-
mendation in the literature is to capture bite registrations in CR in addition to mounting models in the same position. The importance of CR position is repeatedly found within the orthognathic literature; however, the definition of CR is controversial and undergoes frequent changes. Many clinicians believe that there is a complete lack of consensus regarding the definition of CR. This lack of consensus may encompass the entire field of dentistry as well as its specialties. At this time, no other study has evaluated whether a consensus definition exists among those practitioners most directly involved in orthognathic surgery and planning. The purpose of this study was to evaluate whether there is such a consensus among oral and maxillofacial surgeons and orthodontists as to the definition of CR.

**Materials and Methods**

An electronic survey was constructed to evaluate differences between oral and maxillofacial surgeons' and orthodontists' interpretation of condylar position and how it relates to orthognathic surgery. The definition of CR was limited to the 5 most commonly used definitions as provided by the Academy of Denture Prosthetics’ “Glossary of Prosthodontic Terms” (GPT). In addition, there were questions relating to centric occlusion (CO), presurgical model mounting, and proximal segment positioning during a bilateral sagittal split osteotomy (BSSO) (Table 1). The surveys were sent to the chairpersons of 115 oral and maxillofacial surgery programs and 95 orthodontic programs in the United States. Only full-time faculty members were asked to complete the survey. Differ-

**Table 1. QUESTIONS AND RESPONSES**

<table>
<thead>
<tr>
<th>CR is defined as which of the following?</th>
<th>No. (%)</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>When the condyles are in their most posterior-superior position within their fossa</td>
<td>Surgeons: 56 (78) Orthodontists: 22 (34)</td>
<td>67-86 24-47</td>
</tr>
<tr>
<td>When the condyles are in their most anterior-superior position within their fossa</td>
<td>Surgeons: 8 (11) Orthodontists: 16 (25)</td>
<td>6-20 16-37</td>
</tr>
<tr>
<td>When the condyles articulate with the thinnest avascular portion of their respective discs with the complex in the anterior-superior position against the slopes of the articular eminence</td>
<td>Surgeons: 2 (3) Orthodontists: 9 (14)</td>
<td>1-10 8-25</td>
</tr>
<tr>
<td>When the condyle is in its highest position on the posterior surface of the avascular eminence</td>
<td>Surgeons: 2 (3) Orthodontists: 2 (3)</td>
<td>1-10 1-11</td>
</tr>
<tr>
<td>When the condyle is in its most superior neutral position</td>
<td>Surgeons: 4 (6) Orthodontists: 15 (23)</td>
<td>2-13 15-35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CO is defined as which of the following?</th>
<th>No. (%)</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position at maximum intercuspation</td>
<td>Surgeons: 44 (61) Orthodontists: 53 (84)</td>
<td>50-72 73-91</td>
</tr>
<tr>
<td>Patient’s natural closing interdigititation</td>
<td>Surgeons: 28 (39) Orthodontists: 10 (16)</td>
<td>28-50 9-27</td>
</tr>
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</table>

When treatment planning in a patient for orthognathic surgery, the casts are mounted in which of the following?

- CR | Surgeons: 51 (72) Orthodontists: 47 (75) | 59-80 63-84 |
- No specific position | Surgeons: 1 (1) Orthodontists: 0 (0) | 0-7 0-6 |

If the patient has a CR/CO slide, when the patient moves from CR to CO, in which direction does the mandible move?

- Anterior | Surgeons: 63 (88) Orthodontists: 32 (50) | 78-93 38-62 |
- Posterior | Surgeons: 4 (6) Orthodontists: 2 (3) | 2-13 1-11 |
- Either | Surgeons: 5 (7) Orthodontists: 30 (47) | 3-15 35-59 |

If the patient has a CR/CO slide, when the patient moves from CR to CO, in which direction do the condyles move?

- Anterior | Surgeons: 62 (86) Orthodontists: 29 (45) | 76-92 34-57 |
- Posterior | Surgeons: 4 (6) Orthodontists: 4 (6) | 2-13 2-15 |
- Either | Surgeons: 6 (8) Orthodontists: 31 (48) | 4-17 37-60 |

During a BSSO, before rigid fixation, the proximal segments are seated in which of the following directions?

- Vertically | Surgeons: 19 (26) |
- Vertically and posteriorly | Surgeons: 35 (49) |
- Vertically and anteriorly | Surgeons: 0 (0) |
- Rotated superiorly and anteriorly | Surgeons: 2 (3) |
- Rotated superiorly and posteriorly | Surgeons: 16 (22) |
- No attempt is made to seat the proximal segment | Surgeons: 0 (0) |

ences between oral and maxillofacial surgeons’ and orthodontists’ responses to the questions were determined by $\chi^2$ analysis as well as 95% confidence intervals as shown in Table 1.

**Results**

We obtained 73 responses from the oral and maxillofacial surgeons and 64 from the orthodontists, representing 53% and 47% of the total responses, respectively.

Orthodontists and surgeons had a significantly different response regarding the definition of CR (question 1) ($\chi^2 = 28, df = 4, P < .0001$ with a 95% confidence interval). Significantly more surgeons chose the first answer (78%) than did orthodontists (34%). Orthodontists chose the second and last answer more often (25% and 23%, respectively) than surgeons (8% and 6%, respectively). When looked at with a 95% confidence interval, the findings related to differences among orthodontists were not deemed statistically significant. However, there does exist a statistically significant difference between surgeons and orthodontists as to the definition of CR.

Regarding the definition of CO (question 2), once again, there was a significant difference between orthodontists and surgeons ($\chi^2 = 9.9, df = 1, P = .0070$ with a 95% confidence interval). Whereas the majority of both groups chose the first answer, surgeons were more likely to choose the second answer than orthodontists. Thus there exists a significant difference in the definition of CO between surgeons and orthodontists and within both groups.

Regarding the third question, there was no difference between the 2 groups on the need for mounting models in CR ($\chi^2 = 1, P > .6$). Both groups primarily agreed with mounting in CR, although approximately 25% of each group believed that the models should be mounted in CO rather than CR.

The fourth and fifth questions had to do with a CR/CO slide and the direction of movement of the mandible and condyle, respectively. There was a significant difference between the 2 groups regarding mandibular movement ($\chi^2 = 28, df = 2, P < .0001$ with a 95% confidence interval). Surveys were nearly unanimous in their opinion that the mandible would move anteriorly (88%), whereas there was a nearly equal split among orthodontists, with 50% indicating anterior movement and 47% indicating that either anterior or posterior movement could occur. Condylar movement also showed the same differences ($\chi^2 = 28, df = 2, P < .0001$ with a 95% confidence interval). Surges indicated 86% of the time that anterior movement would occur, whereas orthodontists indicated this only 45% of the time. The more common answer for orthodontists was that movement could occur in either direction.

The surgeons were asked 1 additional question relating to proximal segment position that the orthodontists were not. Forty-nine percent of the surgeons indicated that during a BSSO, the proximal segment should be seated vertically and posteriorly before rigid fixation. The other 51% were divided with their answers. This is again supported by a 95% confidence interval among the surgeons.

**Discussion**

The definition of CR is controversial and frequently changing, as evidenced by the literature report conducted by Keshvad and Winstanley.1,3 CR is also one of the most controversial issues in the field of dentistry and has undergone multiple changes in definition over the past 50 years, and it is a concept that may never be resolved.4

In 2000 Jasinevicius et al5 reported a lack of consensus regarding the CR definition among both faculty and students at 7 dental schools. They concluded that the inconsistency in definitions and methods of recording CR has caused confusion in the literature, clinical practice, and dental education. What is concerning is that there appears to be a lack of consensus among clinicians, such as oral and maxillofacial surgeons and orthodontists, who routinely provide treatments that change occlusal and temporomandibular joint relations. Ellis6 showed that inaccuracy during model surgery can lead to statistically significant errors in maxillary repositioning. In 2006 Posnick et al7 noted that obtaining an accurate and reproducible bite registration in CR is essential if the surgeon is to avoid these same errors.

The importance of capturing the CR position has been, and continues to be, reinforced within our literature. Several authors have found that precise condylar positioning is required for long-term skeletal and occlusal stability to reduce dysfunction and improve joint function.8 These methods include manual/empiric, sonographic, navigation, and rigid retention.8,10 Others reported methods include intraoperative awakening9 and positioning splints.10

Every 6 years, the GPT is updated. Given the extensive and frequent changes, some authors use their own terminology, which has confused many practitioners.1 The most recent GPT from 2005 defines CR as a maxillomandibular relation in which the condyles articulate with the thinnest avascular portion of their respective discs with the complex in the anterior-superior position against the slopes of the articular eminences.11-14 It is interesting to note that in our study, only 2 surgeons (3%) and 9 orthodontists (14%) agreed with this definition. In 1987 CR went from
being a posterior position to one located in the ante-
rior-superior position. The majority of surgeons surveyed in our study chose a posterior-supe-
rior position as their definition of CR. When asked in what direction to seat the proximal segments during a BSSO, surgeons were more likely to answer vertically and posteriorly. When asked in what direction the mandible and condyles move in a patient from CR to CO with an associated slide, the majority of sur-
geons and orthodontists chose anteriorly, thus sup-
porting their opinion that CR is a posterior position. The majority of orthodontists also believed CR is a posterior position. However, the orthodontists were more likely to define CR as an anterior-superior posi-
tion when compared with the surgeons.

The results of this study show consistency among surgeons as to the definition of CR, although their definition was more likely to disagree with that proposed by the GPT from 2005. The majority of orth-
odontists agreed with the surgeons; however, there was less consistency within their group. In fact, the majority of orthodontic responses were not coincident with the majority of responses provided by the surgeons.

Even within the definition as given by the GPT, there exist confusing and conflicting statements. Al-
though the first definition listed in the GPT from 2005 is the one given previously, other current definitions are referred to that make reference to a retruded posterior position. It is clearly this abundant and confusing terminology within our profession that has contributed to such a wide disparity and lack of con-
sensus. Many practitioners believe that the changes in definition and concept of CR have been determined arbitrarily for the most part and were not based on science.

Although surgeons and orthodontists do not agree with the main definition offered in the GPT from 2005, they do agree that casts for orthognathic model surgery should be mounted in CR. This sup-
ports previous literature that CR position is clinically important to orthognathic surgery. Accurate surgery requires a position of the mandible that is reproduc-
ible both preoperatively and intraoperatively.

In conclusion, we believe that inconsistency and a lack of consensus can lead to confusion and increased difficulty among practitioners. The results of this study clearly show a significant lack of a consensus definition between surgeons and orthodontists as to the definition of CR. Orthognathic surgery requires accuracy, precise planning and communication be-
tween clinicians to achieve optimal and reproducible results. A continued lack of consensus will lead to further confusion, concern, and inconsistency. This study agrees with other reports that a lack of consen-
sus does exist.

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