

A Simple Method of Determining the Bite-Opening Effect of Posterior Extrusion

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Each millimeter of first molar extrusion is generally believed to cause 2mm of bite opening in the incisor region,¹ but this is only a rough estimation. The present article shows how to determine the exact amount of anterior bite opening caused by the extrusion of any posterior tooth for each individual patient.

Formula

Mouth opening is caused by a combination of rotation and translation of the mandible.² Because nearly 25mm of this opening is a result of condylar rotation,³ the movement caused by the extrusion of posterior teeth falls within the range of pure rotation. When the mandible rotates downward and backward within this limit, every part of the jaw rotates to the same degree, so that the angles from maxillary incisor to condyle to mandibular incisor (ICI') and from maxillary molar to condyle to mandibular molar (MCM') are equal (Fig. 1).

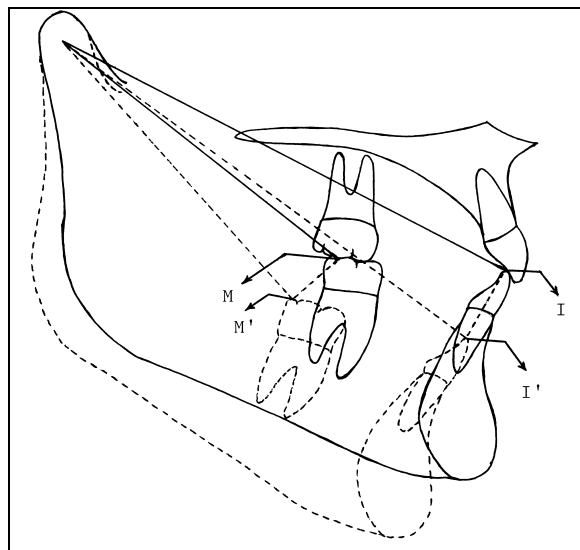


Fig. 1 Points ICI' and MCM' form isosceles triangles with equal angles (I = tip of incisal edge; C = center of rotation of condyle; M = most posterior occlusal contact of first molar). Care should be taken to identify points I, C, and M on the same side (left or right) of a lateral cephalogram.

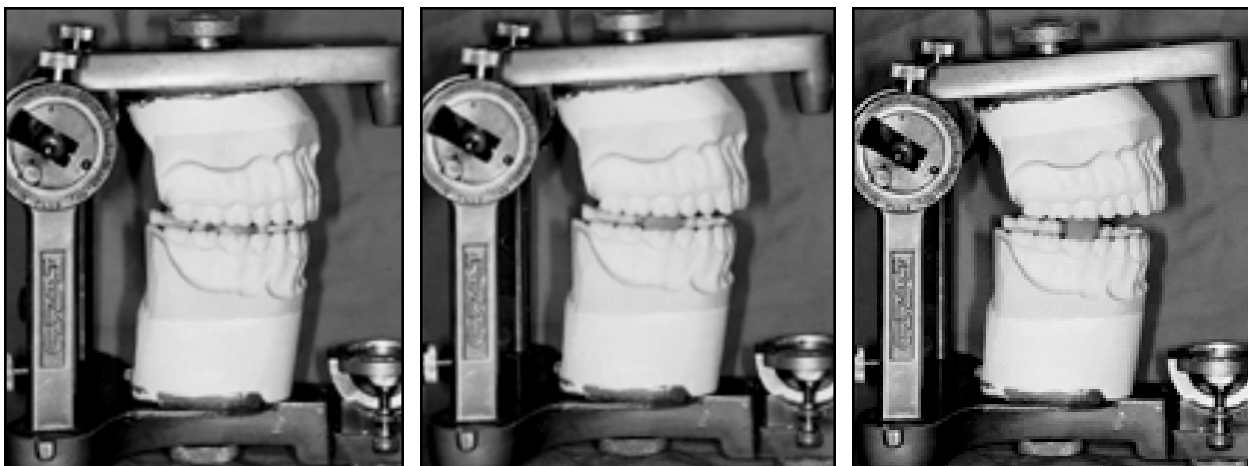
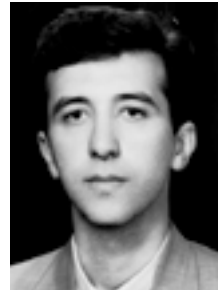


Fig. 2 Acrylic bite blocks with three different thicknesses at mandibular first molars. Ratio of anterior bite opening to bite block thickness is equal to CI/CM ratio.



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Since the triangles ICI' and MCM' are isosceles, their other two angles are also equal. This yields the formula:

$$\frac{CI}{CM} = \frac{II'}{MM'}$$

In other words:

$$\frac{\text{Condyle-incisor distance}}{\text{Condyle-molar distance}} = \frac{\text{Bite opening}}{\text{Molar extrusion}}$$

According to templates derived from growth studies,⁴⁻⁸ the CI/CM ratio for an average adult is 1.5. This means that 1mm of first molar extrusion would cause an average 1.5mm of bite opening. In other words, the commonly accepted 2mm of bite opening may be an overestimation (Fig. 2).

The above formula can be used to calculate the amount of bite opening caused by extrusion of any posterior tooth, simply by replacing the

condyle-molar distance with the distance from the condyle to that tooth. It is not critical whether point C is exactly on the hinge axis of the condyle, because moving point C a few millimeters upward and backward or downward and forward does not change the CI/CM ratio. However, ramus height, gonial angle, and the anteroposterior and vertical positions of mandibular teeth can affect the CI/CM ratio^{9,10} (Table 1).

Examples

Table 2 shows three applications of the formula under different conditions as listed in Table 1. The first patient is an average adult, with a CI/CM ratio of 1.43.

The second patient has a long ramus, an excessive gonial angle, an anteroinferiorly positioned mandibular first molar, and a posterosupe-

TABLE 1
CONDITIONS AFFECTING CI/CM RATIO

Condition	Usual Type of Case	Potential Effect on CI/CM
Short ramus	Long-face syndrome Trauma-induced mandibular deficiency	Increase
Long ramus	Short-face syndrome	Decrease
Small gonial angle	Short-face syndrome	Increase
Large gonial angle	Mandibular prognathism	Decrease
Forward-positioned mandibular molar	Serial extractions Missing mandibular second premolar	Decrease
Forward-positioned mandibular incisor	Dentoalveolar protrusion	Increase
Backward-positioned mandibular incisor	Serial extractions Dentoalveolar retrusion	Decrease
Supraerupted mandibular incisor Infraerupted mandibular molar	Mandibular deficiency	Decrease

TABLE 2
EXAMPLES OF CASES WITH DIFFERENT CI/CM RATIOS

Case No.	C-Go	Go-M*	Go-I*	M-GoGn	I-GoGn	C-GoGn	CI/CM
1	63mm	42mm	78mm	32mm	44mm	120°	1.43
2	73mm	45mm	74mm	30mm	47mm	135°	1.27
3	53mm	39mm	82mm	34mm	41mm	105°	1.74

*Perpendicular projection on GoGn.

riorly positioned mandibular central incisor. These factors reduce the CI/CM ratio to 1.27.

The third patient—virtually the opposite of the second—has a CI/CM ratio of 1.74. These ratios mean that 3mm of mandibular first molar extrusion would cause only 3.8mm of bite opening in the second patient, but 5.2mm of bite opening in the third.

Conclusion

The formula presented in this article emphasizes the importance of vertical control in orthodontic treatment. Since small amounts of molar extrusion can result in significant anterior bite opening, the ratio should be determined for every individual patient.

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