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## Research Article

### ASSESSMENT OF POSTERIOR TEETH ANGULATION IN PATIENTS WITH ANTERIOR OPEN BITE AND NORMAL OCCLUSION

**Krushna Pathak\*, Falguni Mehta, Renuka Patel, Amit Bhattacharya,  
Harshik Parekh and Rahul Trivedi**

Department of Orthodontics and Dentofacial Orthopaedics, Ahmedabad, Gujarat, India

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#### ABSTRACT

The aim of this study was to compare the posterior tooth angulations in patients with open-bite malocclusion and normal occlusion. Lateral cephalograms of 30 untreated open-bitesubjects were compared with the lateral cephalograms of 30 subjects with normal occlusion in the permanent dentition. The groups were matched for age and sex distribution and compared with t tests. The maxillary and mandibular premolars were more mesially angulated in relation to the bisected occlusal plane, and the first and second molars were significantly more distally angulated in the open-bite group in relation to the palatal and mandibular planes. The maxillary and mandibular premolars were more mesially angulated in relation to the bisected occlusal plane and therefore do not compensate for the divergence of the palatal and mandibular planes as the molars do.

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#### INTRODUCTION

Open bite malocclusion holds a challenging fascination in Orthodontics as it is not only difficult to treat but relapse tendencies are also strong. Numerous theories are proposed for cause of open bite mal occlusion including inherited facial form, unfavourable growth pattern, habits, nasopharyngeal airway obstruction, tongue posture and tongue function. Young Kim observed change in angulation in posterior teeth in subjects with open bite malocclusion as compared with normals. Increased mesial inclination of posterior teeth was significant finding in his study. According to him, last molars in the mouth are the only teeth that may occlude and this mesial inclination of molars block closure of the bite. Therefore efforts should be directed to upright the inclined molars thereby closing the bite.<sup>1</sup>

Extensive studies can be observed describing etiological factors for open bite. However fewer studies are observed which measures angulation of posterior teeth in open bite malocclusion. So the present study is carried out to compare angulation of posterior teeth in subjects with open bite compared to normal subjects.

#### MATERIAL AND METHOD

The present study "Assessment of posterior teeth angulation in anterior open bite and normal occlusion" was carried out at the Department of Orthodontics and Dentofacial Orthopedics, Government Dental College & Hospital, Ahmedabad. The pre-treatment lateral cephalometric radiographs of 30 subjects with anterior open bite and 30 subjects with normal occlusion with the age range of 18 to 25 years who reported to the Department of Orthodontics, Government Dental College and Hospital, Ahmedabad were taken as sample for this study. Ethical clearance was obtained by institutional ethical committee.

Lateral cephalometric radiographs of 60 selected subjects were obtained and divided into two groups based on the amount of overbite.

**Group 1:** 30 untreated subjects with overbite ranging from 0.5mm-4mm with class I malocclusion (normal) and having pleasant facial profile.

**Group 2:** 30 untreated subjects with anterior open bite of 0.5 mm or more with class I skeletal maxillo mandibular base relationship irrespective of any other irregularities.

The lateral cephalograms were traced manually using 0.5 mm 3H micro tip pencil on matte acetate tracing paper.

\*Corresponding author: **Krushna Pathak**

Department of Orthodontics and Dentofacial Orthopaedics, Ahmedabad, Gujarat, India

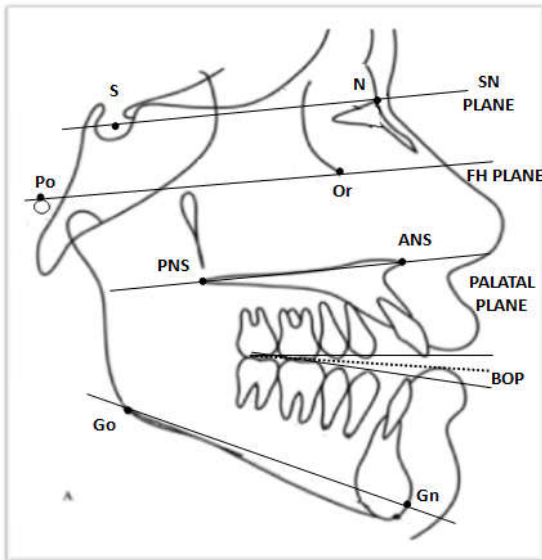


Figure 2 Cephalometric Planes used in the study are [Figure 2]

**Bisecting occlusal plane (BOP):** The BOP was obtained by bisection of the maxillary occlusal plane (from the disto-buccal cusp of the maxillary second molar to the incisal edge of the most extruded maxillary central incisor) and the mandibular occlusal plane (from the disto-buccal cusp of the mandibular second molar to the incisal edge of the most extruded mandibular central incisor).

- **Go-Gn plane**
- **Palatal plane (ANS-PNS)**
- **SN plane (Sella to Nasion)**
- **Frankfort horizontal (FH plane) (porion to orbitale)**

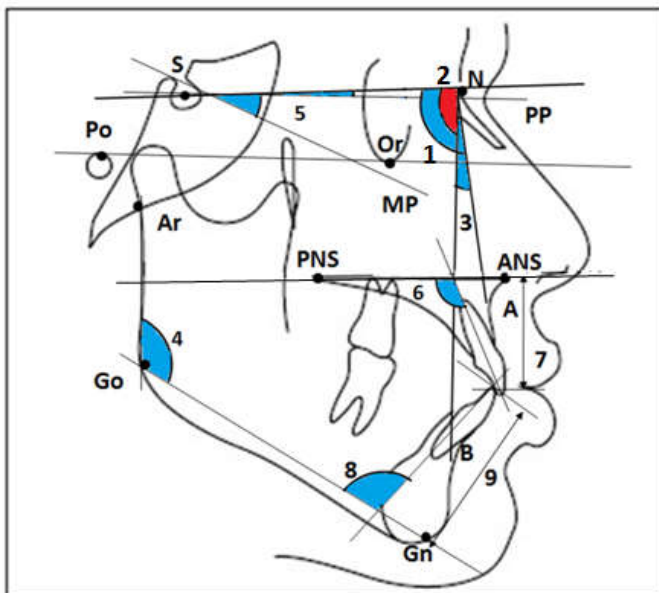


Figure 3 Cephalometric variables used in the study are: [Figure 3,4]

1. **SNA**(°)-Angle between Sella, Nasion and point A.
2. **SNB**(°)-Angle between Sella, Nasion and point B.
3. **ANB**(°)-Angle between point A, Nasion and point B.
4. **Gonial angle** (°)- Angle between Articulare, Gonion, Gnathion.

5. **SN.GoGn** (°) - Angle between SN plane and mandibular plane (Go-Gn).
6. **1.PP**(°)-Angle between long axis of maxillary incisor and palatal plane.
7. **1.PP(mm)** -Perpendicular distance between edge of maxillary incisor and palatal plane.
8. **1.MP**(°)-Angle between long axis of lower incisor to Mandibular plane.
9. **1.MP(mm)**-Perpendicular distance between edge of lower incisor to mandibular plane

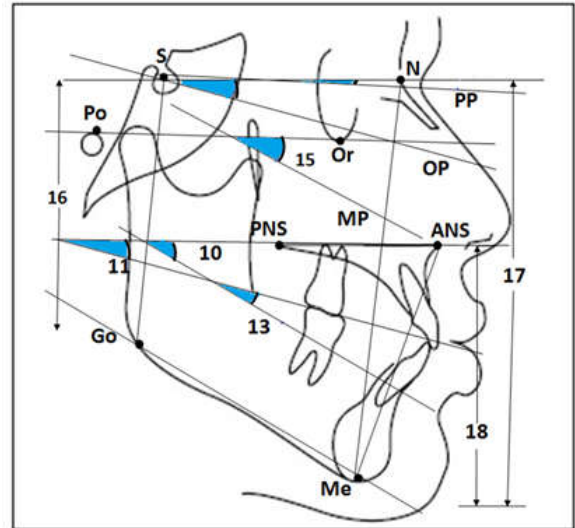


Figure 4

1. **PP.MP**(°)-Angle between palatal plane and mandibular plane
2. **OCC.PP**(°)-Angle between occlusal plane and palatal plane
3. **OCC.SN** (°) -Angle between occlusal plane to SN plane
4. **OCC.MP**(°)-Angle between occlusal plane to MP (mandibular plane; Go-Gn)
5. **SN-PP** (°)-Angle between SN plane and palatal plane
6. **FMA**(°)-Frankfort horizontal plane angle: It is the angle formed between FH plane and mandibular plane
7. **S-Go**-Posterior facial height: distance from sella to gonion
8. **N-Me**-Anterior facial height: distance from nasion to menton
9. **ANS-Me**-Lower anterior facial height: distance from ANS to Menton
10. **Overbite**-Distance between the maxillary and mandibular incisor borders perpendicular to the functional occlusal plane. [Figure 5]

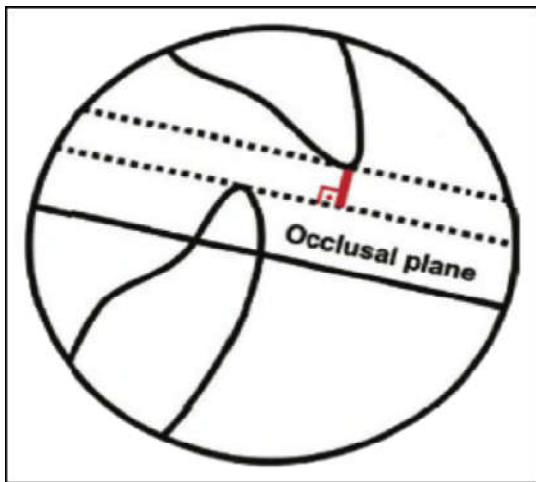


Figure 5

Posterior teeth angulations are measured in the maxillary and mandibular arches between the long axes of premolars' (apex-cusp tip) and the molars' long axes (furcation-center of the crown) to the bisecting occlusal plane (BOP), palatal plane and mandibular plane respectively. The inter premolar and inter-molar angulations were measured.

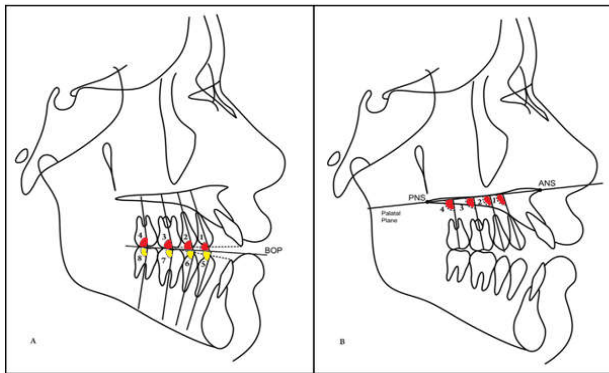


Figure 6

- **A**, Maxillary and mandibular posterior tooth angulation measurements in relation to the BOP:
- 1, Mx4.BOP; 2, Mx5.BOP; 3, Mx6.BOP; 4, Mx7.BOP; 5, Md4.BOP; 6, Md5.BOP; 7, Md6.BOP; 8, Md7.BOP.
- **B**, Maxillary posterior tooth angulation measurements in relation to the palatal plane (PP):
- 1, Mx4.PP; 2, Mx5.PP; 3, Mx6.PP; 4, Mx7.PP.

**Maxillary Mesiodistal Angulations (°) [Figure 6]**

1. **Mx4.BOP**- Angle between long axis of the maxillary first premolar to the BOP
2. **Mx5.BOP** -Angle between long axis of the maxillary second premolar to the BOP
3. **Mx6.BOP** -Angle between long axis of the maxillary first molar to the BOP
4. **Mx7.BOP** -Angle between long axis of the maxillary second molar to the BOP
5. **Mx4.PP** -Angle between long axis of the maxillary first premolar to the palatal plane(ANS-PNS)
6. **Mx5.PP** -Angle between long axis of the maxillary second premolar to the palatal plane
7. **Mx6.PP** -Angle between long axis of the maxillary first molar to the palatal plane

8. **Mx7.PP** -Angle between long axis of the maxillary second molar to the palatal plane

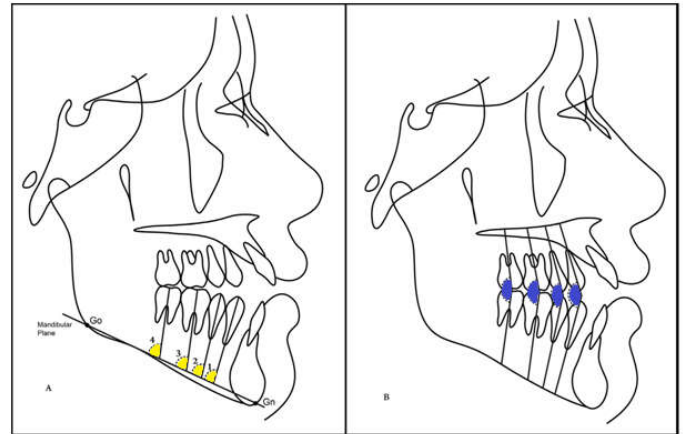


Figure 7

**A**, Mandibular posterior teeth angulation measurements in relation to the mandibular plane (MP):

- 1, Md4.MP; 2, Md5.MP; 3, Md6.MP; 4, Md7.MP.

**B**, Inter-molar and inter-premolar angulation measurements:

- 1, Mx4.Md4; 2, Mx5.Md5; 3, Mx6.Md6; 4, Mx7.Md7.

**Mandibular Mesiodistal Angulations (°) [Figure 6,7]**

**Md4.BOP** - Angle between long axis of the mandibular first premolar to the BOP

**Md5.BOP** - Angle between long axis of the mandibular second premolar to the BOP

**Md6.BOP** - Angle between long axis of the mandibular first molar to the BOP

**Md7.BOP** - Angle between long axis of the mandibular second molar to the BOP

**Md4.MP** - Angle between long axis of the mandibular first premolar to the mandibular plane (Go-Gn)

**Md5.MP** - Angle between long axis of the maxillary second premolar to the mandibular plane

**Md6.MP** -Angle between long axis of the mandibular first molar to the mandibular plane

**Md7.MP** -Angle between long axis of the mandibular second molar to the mandibular plane

**Interdental Angulations (°) Figure 7]**

**Mx4.Md4** -Angle between long axis of the maxillary and mandibular first premolar

**Mx5.Md5** - Angle between long axis of the maxillary and mandibular second premolars

**Mx6.Md6** -Angle between long axes of the maxillary and mandibular first molars

**Mx7.Md7**- Angle between long axes of the maxillary and mandibular second molars

Above mentioned various angular and linear parameters were measured twice to eliminate error. Data thus obtained was analysed using SPSS version 23. Tests performed were descriptive for scale data, Independent t test for intergroup comparison.

**RESULTS**

**Table 1** Inter group comparison of all variables (t test)

Parameter	N	Group 1		Group 2		Mean Difference	P value
		Mean	Std. Deviation	Mean	Std. Deviation		
SN-PP	30	9.17	1.663	7.60	1.476	1.567	<0.001**
SN-GoGn	30	28.67	1.953	38.43	3.202	-9.767	<0.001**
FMA	30	27.00	1.875	33.40	2.527	-6.400	<0.001**
Ar-GoGn	30	125.03	2.735	129.97	3.057	-4.933	<0.001**
Occ-Sn	30	15.10	1.647	19.63	2.977	-4.533	<0.001**
Occ-PP	30	9.00	2.464	14.67	3.397	-5.667	<0.001**
Occ-MP	30	13.67	2.339	18.50	2.850	-4.833	<0.001**
PP-MP	30	23.00	2.000	32.47	3.082	-9.467	<0.001**

NS- Not significant (p>0.05) \*Significant (p<0.05) ,\*\*-Highly significant (p<0.001)

**Table 1** shows various angular measurements between anterior cranial base to palatal plane and occlusal plane and palatal plane to mandibular plane and occlusal plane. Highly statistically significant differences exist between these planes, between open bite group as compared to normal, indicating more vertical growth pattern in open bite subjects.

**Table 2** shows anterior facial height(N-Me) as well as facial height of lower third (ANS-Me) has increased value in open bite group compared to normal group. Whereas posterior facial height is decreased for open bite group compared to normal.

Parameters	N	Group 1		Group 2		Mean difference	P value
		Mean	S.D	Mean	S.D		
ANS-Me	30	61.23	2.269	66.63	2.189	-5.400	<0.001**
S-Go	30	81.27	2.392	78.40	3.369	2.867	<0.001**
N-Me	30	125.20	4.139	130.93	3.991	-5.733	<0.001**

NS- Not significant (p>0.05) \*Significant (p<0.05) ,\*\*-Highly significant (p<0.001)

**Table 3** shows maxillary and mandibular anterior teeth are proclined and mildly extruded in open bite subjects compared to normal subjects.

Parameter	N	Group 1		Group 2		Mean Difference	P value
		Group 1	Std. Deviation	Group 2	Std. Deviation		
Mx1to PP	30	111.37	3.801	116.33	3.880	-4.967	<0.001**
Mx1to PP(mm)	30	30.96	2.846	31.43	2.314	-0.5	0.244NS
Md1to pp	30	99.53	3.730	104.67	3.661	-5.133	<0.001**
Md1toMP(mm)	30	42.5	4.015	43.63	4.342	-1.13	0.149NS

NS- Not significant (p>0.05) \*Significant (p<0.05) ,\*\*-Highly significant (p<0.001)

**Table 4** shows more mesially angulated maxillary first and second premolars in relation to BOP(Bisected Occlusal Plane) in open bite group compared to normal group. Whereas no significant difference exists between angulation of maxillary first molar between two groups. Maxillary second molar is distally angulated in open bite group compared to normal group.

Parameter	N	Group 1		Group 2		Mean Difference	P value
		Group 1	Std. Deviation	Group 2	Std. Deviation		
Mx4.BOP	30	82.57	2.300	77.70	2.003	4.867	<0.001**
Mx5.BOP	30	89.07	2.664	85.97	1.866	3.100	<0.001**
Mx6.BOP	30	90.33	2.695	91.07	1.964	-0.733	0.233 NS
Mx7.BOP	30	96.17	3.018	98.40	4.336	-2.233	0.024*

NS- Not significant (p>0.05) \*Significant (p<0.05) ,\*\*-Highly significant (p<0.001)

**Table 5** shows maxillary first and second molars are distally angulated in relation to palatal plane in open bite group compared to normal group

Parameter	N	Group 1		Group 2		Mean Difference	P value
		Mean	Std. Deviation	Mean	Std. Deviation		
Mx4.PP	30	93.50	2.713	92.47	3.989	1.033	0.246 NS
Mx5.PP	30	89.00	3.965	87.97	2.456	1.033	0.230 NS
Mx6.PP	30	84.97	2.965	80.90	2.644	4.067	<0.001**
Mx7.PP	30	76.97	2.810	71.47	4.006	5.500	<0.001**

NS- Not significant (p>0.05) \*Significant (p<0.05) ,\*\*-Highly significant (p<0.001)

**Table 6** shows more mesially angulated mandibular first and second premolars in relation to BOP(Bisected Occlusal Plane) in open bite group compared to normal group. Whereas no significant difference exists between angulation of mandibular first and molar between two groups.

Parameter	N	Group 1		Group 2		Mean Difference	P value
		Mean	Std. Deviation	Mean	Std. Deviation		
Md4.BOP	30	83.03	3.000	76.90	2.928	6.133	<0.001**
Md5.BOP	30	83.93	3.129	79.17	2.805	4.767	<0.001**
Md6.BOP	30	83.00	2.754	82.00	2.704	1.000	0.161 NS
Md7.BOP	30	78.07	2.947	78.33	3.717	-0.267	0.759 NS

NS- Not significant (p>0.05) \*Significant (p<0.05) ,\*\*-Highly significant (p<0.001)

**Table 7** shows mandibular first and second molars are distally angulated in relation to mandibular plane in the open bite group compared to normal group.

Parameter	N	Group 1		Group 2		Mean Difference	P value
		Mean	Std. Deviation	Mean	Std. Deviation		
Md4.MP	30	80.67	3.144	81.00	3.291	-0.333	0.960 NS
Md5.MP	30	80.07	2.924	80.17	3.007	-0.100	0.897 NS
Md6.MP	30	81.67	2.771	77.30	2.818	4.367	<0.001**
Md7.MP	30	87.00	2.533	81.97	2.566	5.033	<0.001**

NS- Not significant (p>0.05) \*Significant (p<0.05) ,\*\*-Highly significant (p<0.001)

**Table 8** shows decreased interdental angulation between maxillary and mandibular premolars indicating both first and second premolars are mesially inclined in open bite group as compared to normal group.

Parameter	N	Group 1		Group 2		Mean Difference	P value
		Mean	Std. Deviation	Mean	Std. Deviation		
Mx4.Md4	30	164.0	3.434	153.7	2.952	10.333	<0.001**
Mx5.Md5	30	170.7	3.497	163.3	3.261	7.367	<0.001**
Mx6.Md6	30	173.0	3.227	172.6	2.619	0.367	0.631 NS
Mx7.Md7	30	177.0	1.884	177.2	2.408	-0.200	0.721 NS

NS- Not significant (p>0.05) \*Significant (p<0.05) ,\*\*-Highly significant (p<0.001)

**DISCUSSION**

The phenomenon of anterior open bite is multifactorial and there are variety of the dento-skeletal configuration and the magnitude of dysplasia associated with it.<sup>10</sup> Open bite result from the interplay of many different etiological factors. These factors include growth of the maxilla and mandible, function of the lips and tongue and dento-alveolar development with the eruption of the teeth.<sup>14</sup> The diagnosis and treatment of anterior open bite continues to be one of the most difficult problems facing the practicing orthodontist.

Incomplete compensatory guidance during eruption is responsible for resultant malocclusion up to greater extent than due to dysplastic deformation of the dental arches. The factors potentially responsible for impairing the compensatory mechanism should be identified and prophylactic and interceptive measures should be planned in such a way that it considers the action of such forces on the development of the occlusion<sup>33</sup>.

Vertical discrepancy in anterior open bite cases has been given much importance whereas less importance is given to angulations of posterior teeth which can affect treatment outcome in these cases. So comparison of mesiodistal angulations of posterior teeth in subjects with anterior open bite and subjects with normal occlusion helps us to modify treatment mechanics.

Appropriate axial inclinations of the teeth have been generally assessed for incisors in different malocclusions. The inclination of posterior teeth has been not considered playing role in malocclusion and is not usually incorporated into the diagnosis of a malocclusion. In any malocclusion, the axial inclination of each component of the entire dentition is important. Especially in open bite cases, posterior teeth are mesially angulated<sup>1</sup>

In this study, when inclination of maxillary and mandibular molars were measured with palatal plane and mandibular plane respectively showed marked distal inclination in open bite group. This can be attributed to dentoalveolar compensation of maxillary and mandibular molars which take distally angulated eruption path to occlude when palatal and mandibular planes are more divergent, whereas maxillary and mandibular premolars do not show significant difference in their angulations to palatal plane and mandibular plane, but highly significant difference when compared to bisected occlusal plane. This difference shows that palatal plane and mandibular plane shows more divergence in open bite group.

Above findings are strengthened by various angular measurements between anterior cranial base to palatal plane and occlusal plane and palatal plane to mandibular plane and occlusal plane. Highly statistically significant differences exists between these planes, between open bite group as compared to normal, indicating more vertical growth pattern in open bite subjects.

Anterior teeth also show variation in their inclination while comparing normal with open bite subjects. Open bite group shows increased proclination of maxillary and mandibular teeth and as a compensatory mechanism, extruded maxillary and mandibular incisors.

To summarize, open bite group subjects have vertical growth pattern, proclined and extruded upper and lower anteriors, mesially inclined premolars and distally inclined molars. So treatment should be directed to upright posterior teeth to compensate for the divergence between palatal and mandibular plane.

## CONCLUSION

**The following Conclusion are Drawn Based on the Findings of this study**

- Open bite subjects have vertical growth pattern when compared to normal group of subjects.
- Open bite subjects have more proclined maxillary and mandibular incisors when compared to normal group of subjects.
- Open bite subjects have extruded maxillary and mandibular incisors as compared to normal group of subjects suggesting dentoalveolar compensation.
- Maxillary and mandibular premolars are more mesially angulated in relation to Bisected Occlusal Plane (BOP) in open bite group than normal group.
- Maxillary and mandibular first and second molars are more distally angulated in relation to palatal and mandibular plane respectively in open bite group than normal group. Orthodontic mechanics should be directed to compensate for this variation.

Treatment should be directed at treating proclined and extruded incisors along with up righting of premolars and molars as per individual case requirements.

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