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Original Article

Association of Impacted Third Molars with Facial Growth Patterns among Adult Indian Patients - A Retrospective Study

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Abstract

Introduction: The third molar (3M) varies more than other molars in terms of shape, size, timing of eruption, and tendency toward impaction. Hence, studies need to be carried out to clarify the association of the various patterns of facial growth with mandibular 3M impaction.

Purpose: The purpose of this study is to relate the level of impaction of mandibular 3Ms and their inclinations to various patterns of facial growth among Indian patients.

Materials and Methods: A total of 207 lateral cephalograms and optic pathway gliomas (OPGs) of patients were obtained from NISSAN Radiological and Diagnostic Centre. The OPGs were analyzed by a single examiner as per: (1) Angulations (using Quek's analysis - beta angle, 2003). (2) Depth of 3Ms. The lateral cephalograms were assessed by a single examiner using: (1) Down's analysis. (2) Beta angle. (3)Jarabak's ratio. (4) Bjork's analysis.

The subjects were further classified into skeletal Class I, II, and III as well as into horizontal, vertical, and normal growth patterns. The final study data were subjected to a Pearson correlation test to check the association between the 3M impactions and various angles. The values found significant were coded into ordinate data and Kendall's Tau-B Test was done.

Results: Statistically, significant correlation was found between depth of impacted mandibular 3Ms and facial angle, Y-axis, cant of occlusion, angle of convexity, and gonial angle.

Conclusion: Greater incidence of 3Ms was found to be at position B and C in Class II patients as compared to Class I and III patients. Furthermore, patients showing vertical growth pattern were found to have increased percentage of mandibular 3M impactions.

Key words: Beta angle, Bjork's analysis, Down's analysis, Facial growth pattern, Jarabak's ratio, Lateral cephalogram, Third molar impactions, Third molar

INTRODUCTION

The term "impacted" originates from a Latin word "impactus" (wedged). The WHO defined an impacted tooth like the one that is unable to fully erupt in its normal functional occlusion/location by its expected age of eruption, because it is blocked by overlying soft tissue or bone or another tooth.

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The third molar (3M) varies more than other molars in terms of shape, size, timing of eruption, and tendency toward impaction.[1] There are many causes of 3M impactions such as inadequate spacing, reduced mandibular growth, inadequate mandibular length, and varied facial growth.

Björk found that failure of wisdom tooth in the lower arch to erupt completely was usually associated with lack of space in the alveolar arch between the second molar and the ascending ramus.[2,3] A short mandibular length is thought to be another etiologic factor in M3 impaction.

However, Kaplan did not find any significant difference in the mandibular length between subjects with erupted and impacted 3Ms.[4]

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Broadbent believed that when a 3M became impacted, it was due to an inability of the mandible to achieve its full growth potential.[5,6] Richardson has found that there was reduced amount of mandibular growth in 3M impactions cases.[7] Forsberg found that failure of eruption and degree of arch crowding were proportional.[2] Bjork showed that 3M impaction was not only associated with a reduced amount of growth but also with a downward as opposed to forward growth direction.[8] However, Legović *et al.* showed no significant difference between the position of mandibular M3 and the type of facial growth.

Due to these controversies, further studies need to be carried out to clarify the association of the various patterns of facial growth with mandibular 3M impaction.

Thus, the purpose of this study is to relate the level of impaction of mandibular 3Ms and their inclinations to various patterns of facial growth among Indian patients.

MATERIALS AND METHODS

Sample Selection

NISSAN Radiological and Diagnostic Center, Pune, was contacted, and 207 lateral cephalograms and optic pathway gliomas (OPGs) of patients were obtained after seeking permission from Dr. Akshay Shah.

Note: Only those patients were included in the study that had both OPGs and lateral cephalograms taken at the same time.

Exclusion Criteria

The following criteria were excluded from the study:

- Unclear OPGs and lateral cephalograms.
- OPGs of patients undergoing or who have previously undergone orthodontic treatment.
- OPGs showing lesions or fractures or artifacts.
- OPGs of patients showing multiple missing teeth especially posteriors.
- Presence of mandibular M3s with less than two-thirds of root formation.
- History of medical problems with a potential effect on facial growth.

Requisite Permissions and Duration of Study

This study was conducted between May 2018 and September 2018 after receiving approval from the Institutional Ethics Committee (Reference No.: YMTDC/1125/2018).

Sample Collection and Analysis

- Panoramic radiographs were taken for each patient with the upper and lower incisors in an edge-to-edge relationship using the XTROPAN 2000 unit at 65 kVp, 10 mA, and 17.6 s.

The OPGs were analyzed by a single examiner as follows:

- Angulations (using Quek's analysis - beta angle, 2003).

The angle formed between the intersection of the long axis of second and 3M was measured in degrees and categorized as follows as shown in Figure 1:

- Depth of 3Ms.

As per the relationship between the occlusal surface of the impacted 3M with that of the adjoining second molar, the depth of the 3M is classified as as shown in Figure 2:

- Position A: Highest position of 3M is at or above the occlusal plane.
- Position B: Highest position of 3M is below the occlusal plane but above the cervical line of the adjacent 2nd molar.
- Position C: Highest position of 3M is below the cervical line of the adjacent 2nd molar.

Lateral cephalograms were taken for each patient in centric occlusion with the lips in repose and the Frankfort plane horizontal, according to the natural head position, using a XTROPAN 2000 X-ray unit at 65 kVp, 10 mA, and 14.2 s exposure.

A pilot study was conducted (using Down's analysis and Bjork's analysis) to compare between OneCeph app and manual method of cephalometrics tracing. The pilot study data were subjected to the *t*-test in which we found that there was statistically no significant difference between the two methods. Considering the ease of use of this app over manual tracing, OneCeph app was used to record the various angles on the lateral cephalogram.

The lateral cephalograms were then assessed by a single examiner using:

- Down's analysis (Angle of convexity, facial angle, AB plane angle, mandibular plane angle, Y-axis, and cant of occlusal plane),
- Beta angle,
- Jarabak's ratio and
- Bjork's analysis (Saddle angle, articular angle and gonial angle - upper and lower, and sum of angles) as shown in Figure 3.

The subjects were further classified into skeletal Class I, II, and III as well as into horizontal, vertical, and normal growth patterns as shown in Table 1.

(The values in Table 1 have been taken from standard Indian textbooks showing average values of the respective angles as seen in the average Indian population).

Table 1: Classification of sample into Class I, II & III, and vertical, horizontal & normal growth patterns as per various cephalometric analysis

Angles	Class I	Class II	Class III
Facial angle	82–95	<82	>95
Angle of convexity	−8.5–10	>10	<−8.5
AB plane angle	−9–0	<−9	>0
Y-axis	53–66	>66	<53
Cant of occlusion	1.5–14	>14	<1.5
Saddle angle	118–128	>128	<118
Articular angle	137–149	>149	<137
Beta angle	27–35	<27	>35
Angles	**Normal**	**Vertical**	**Horizontal**
Mandibular plane angle	17–28	>28	<17
Y-axis	53–66	>66	<53
Jarabak's ratio	62–65	<62	>65
Gonial angle	123–137	>137	<123
Upper	52–55	>55	<52
Lower	70–75	<70	>75
Sum of angles	396	>396	<396

Tables 2: Classification of mandibular 3Ms as per depth and type of impaction

Tooth number	Mandibular *n* (%)
Tooth status	
Present	390 (94.2)
Absent	24 (5.8)
Total	414 (100)
Depth	
A (1)	199 (48.1)
B (2)	154 (37.2)
C (3)	37 (8.9)
Total	390 (94.2)
Type of impaction	
Vertical	149 (36)
Mesioangular	211 (51)
Horizontal	21 (5.1)
Distoangular	8 (1.9)
Others	1 (0.2)
Total	390 (94.2)

The final study data were compiled in an Excel sheet, and Pearson correlation test was used to check the association between the 3M impactions and various angles enlisted above. The values thus found significant were further coded into ordinate data and Kendall's Tau-B Test was done.

RESULTS

After analyzing 207 OPGs, we found 390 mandibular molars suitable to include in our study [Table 2].

Out of the 390 mandibular 3Ms evaluated, 199 (48.1%) were found to be at Position A followed by 154 (37.2%) at Position B and 37 (8.9%) at Position C as shown in Figure 4.

Tables 3: Standard Deviations of values obtained on evaluation of lateral cephalogram analysis

Type of angles	Mean±SD	Minimum	Maximum
Angel of convexity	6.40±7.06	−14	24
Facial angle	84.37±5.250	72	99
AB plane angle	8.64±11.030	−7	96
Mandibular plane angle	25.09±6.744	7	41
Y axis	63.53±5.086	49	76
Cant of occlusion	12.07±10.585	−5	106
Jaraback's ratio	70.74±6.214	57	89
Saddle angle	121.22±6.001	104	141
Articular angle	143.87±7.048	126	167
Gonial angle	122.41±6.96	103	140
Upper	52.33±6.8	41	159
Lower	73.64±45.62	55	704
Beta angle	30.99±5.96	16	47
Sum of angles	387.49±6.882	369	405

SD: Standard deviation

Tables 4: Correlation of various cephalometric analysis with depth and type of mandibular 3M impaction using Pearsons Correlation Test

Angles	Depth		Angle code/type of impaction	
	r value	*P* value	*r* value	*P* value
Angel of convexity	0.099	0.025*	0.026	0.301
Facial angle	0.217	0.001*	0.027	0.299
AB plane angle	0.030	0.278	0.003	0.479
Mandibular plane angle	0.074	0.071	−0.040	0.214
Y-axis	0.138	0.003*	−0.047	0.180
Cant of occlusion	0.128	0.006*	0.034	0.250
Jaraback's ration	0.007	0.446	0.043	0.198
Saddle angle	−0.044	0.194	0.011	0.413
Articular angle	−0.069	0.087	−0.031	0.273
Gonial angle	0.086	0.045*	0.017	0.367
Upper	0.033	0.256	0.022	0.331
Lower	0.005	0.461	0.046	0.181
Beta angle	−0.064	0.103	0.002	0.482
Sum of angle	0.036	0.238	0.070	0.083

About 149 (36%) of the mandibular 3Ms were found to be vertically impacted, 211 (51%) showed mesioangular impactions, 21 (5.1%) were horizontally impacted, and 8 (1.9%) showed distoangular impactions as shown in Figure 5.

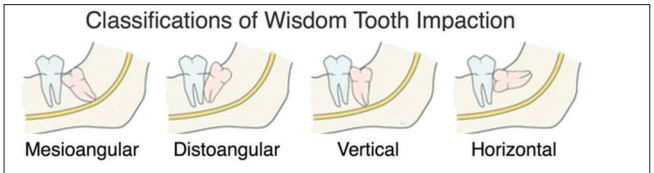
The lateral cephalograms of the same patients were evaluated and the results thus obtained are shown in Table 3.

After applying the Pearson correlation test, the results thus obtained are shown in Table 4.

As shown in Table 4, statistically significant correlation was found between depth of impacted mandibular 3Ms and facial angle ($P = 0.001$), Y-axis ($P = 0.003$), cant of occlusion ($P = 0.006$), angle of convexity ($P = 0.025$), and Gonial angle ($P = 0.045$).

Tables 5: Further results obtained on applying Kendall Tau-B test

Angles	Position A *n* (%)	Position B *n* (%)	Position C *n* (%)	Total *n* (%)	Approx T[b] value	*P* value
Facial angle						
Class I	148 (58.9)	89 (35.2)	16 (6.3)	253 (61.3)	7.065	0.001*
Class II	48 (37.2)	61 (47.3)	20 (15.5)	129 (31.2)		
Class III	3 (37.5)	4 (50)	1 (12.5)	8 (1.9)		
Cant of occlusion						
Class I	143 (55.4)	95 (36.8)	20 (7.8)	258 (62.5)	5.544	0.001*
Class II	49 (42.2)	52 (44.8)	15 (12.9)	116 (28.1)		
Class III	7 (43.8)	7 (43.8)	2 (12.5)	16 (3.9)		
Angle of convexity						
Class I	147 (54.2)	102 (37.6)	22 (8.1)	271 (65.6)	5.111	0.001*
Class II	47 (42.7)	48 (43.6)	15 (13.6)	110 (26.6)		
Class III	5 (55.6)	4 (44.4)	0	9 (2.2)		
Gonial angle						
Normal	104 (54.7)	73 (38.4)	13 (6.8)	190 (46)	4.810	0.001
Vertical	1 (33.3)	2 (66.7)	0	3 (0.7)		
Horizontal	94 47.7)	79 (40.1)	24 (12.2)	197 (47.7)		
Y-axis						
Normal	150 (55.4)	101 (37.3)	20 (7.4)	271 (65.6)	5.718	0.001*
Vertical	45 (39.8)	51 (45.1)	17 (15)	113 (27.4)		
Horizontal	4 (66.7)	2 (33.3)	0	6 (1.5)		



Type	Angulation
Vertical impaction	(−10° to 10°)
Mesioangular impaction	(11° to 79°)
Horizontal impaction	(80° to 100°)
Distoangular impaction	(−79° to−11°)
Others	(−111° to−80°)

Figure 1: Classifications of wisdom tooth impaction

No significant correlation was found between the angle of impaction and the various cephalometric angles.

The values thus found significant were further coded into ordinate data and Kendall's Tau-B Test was done and the results obtained are shown in Table 5.

Facial angle (formed by the intersection of nasion pogonion plane and Frankfort horizontal [FH] plane) gives us an indication of anterior-posterior positioning of the mandible. Thus, its value increases in skeletal Class III and decreases in skeletal Class II cases.

When we segregated our sample into Class I, II, and III based on the facial angle and compared it with the position of mandibular 3M, we found that:

- In Class I patients, 58.9% of 3Ms were found to be at Position A, 35.2% at Position B, and 6.3% at Position C.
- In Class II patients, 37.2% of 3Ms were found to be at Position A, 47.3% at Position B, and 15.5% at Position C.
- In Class III patients, 37.5% of 3Ms were found to be at Position A, 50% at Position B, and 12.5% at Position C.

Cant of occlusion (formed between the occlusal plane and FH plane) gives us a measure of the slope of the occlusal plane relative to the FH plane.

When we segregated our sample into Class I, II, and III based on Cant of occlusion and compared it with the position of mandibular 3M, we found that:

- In Class I patients, 55.4% of 3Ms were found to be at position A, 36.8% at position B, and 7.8% at position C.
- In Class II patients, 42.2% of 3Ms were found to be at Position A, 44.8% at Position B, and 12.9% at Position C.
- In Class III patients, 43.8% of 3Ms were found to be at Position A, 43.8% at Position B, and 12.5% at Position C.

The angle of convexity is formed by the intersection of a line from nasion to point A and point A to pogonion. A positive angle suggests a prominent maxillary denture base relative to the mandible. A decreased or negative angle suggests a prognathic profile.

When we segregated our sample into Class I, II, and III based on the angle of convexity and compared it with the position of mandibular 3M, we found that:

- In Class I patients, 54.2% of 3Ms were found to be at Position A, 37.6% at Position B, and 8.1% at Position C.

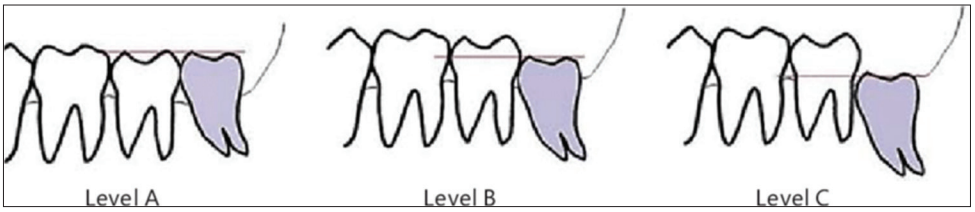


Figure 2: Classification of 3M impactions as per depth

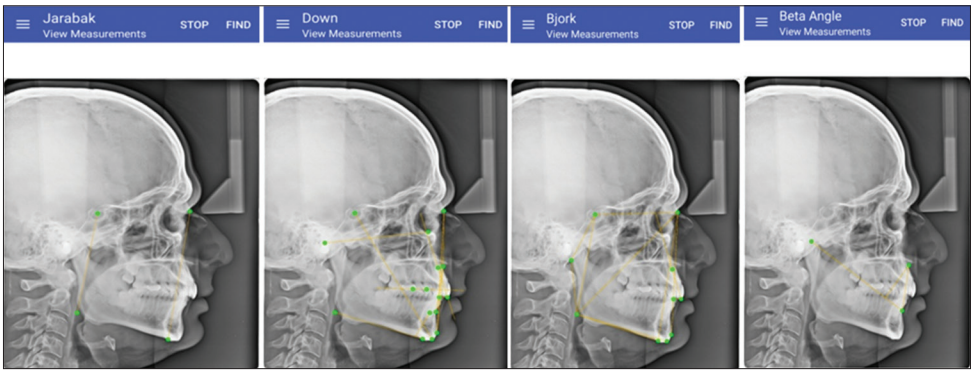


Figure 3: Analysis done on lateral cephalograms using OneCeph application

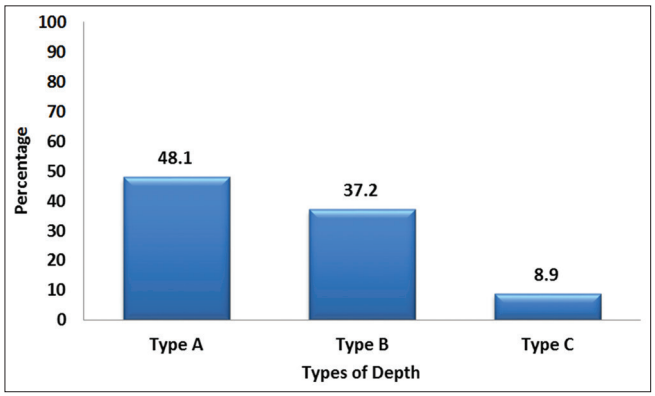


Figure 4: Percentage distribution of type of depth

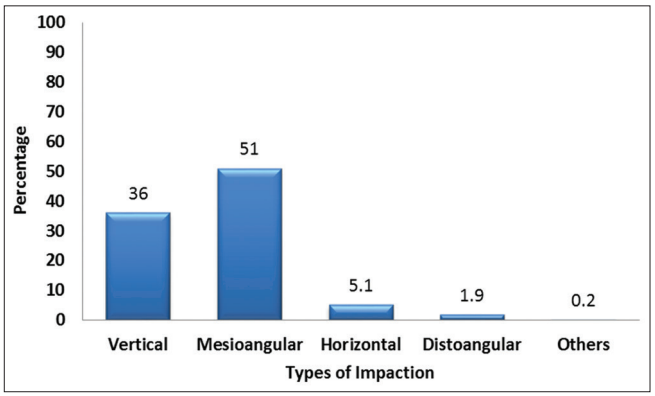


Figure 5: Percentage distribution of types of impaction

- In Class II patients, 42.7% of 3Ms were found to be at Position A, 43.6% at Position B, and 13.6% at Position C.
- In Class III patients, 55.6% of 3Ms were found to be at Position A, 44.4% at Position B, and 0% at Position C.

Y-axis (angle formed by joining sella-gnathion line with the FH plane.) indicates the growth pattern of the individual. Increased value indicated greater vertical growth of mandible whereas decreased angle indicates greater horizontal growth of the mandible.

When we segregated our sample into normal, vertical and horizontal growth pattern based on Y-axis and compared it with the position of mandibular 3M, we found that:

- In patients with a normal growth pattern, 55.4% of 3Ms were found to be at Position A, 37.3% at Position, and 7.4% at Position C.
- In patients with vertical growth pattern 39.8% of 3Ms were found to be at Position A, 45.1% at Position B, and 15% at Position C.
- In patients with horizontal growth pattern, 66.7 % of 3Ms were found to be at Position A, 33.3% at Position B, and 0% at Position C.

Gonial angle is formed by joining the lines between articulare and gonion and gonion and menton. Small angle indicates a horizontal growth pattern whereas a larger angle indicates vertical growth pattern.

When we segregated our sample into normal, vertical and horizontal growth pattern based on the gonial angle and compared it with the position of mandibular 3M, we found that:

- In patients with a normal growth pattern, 54.7% of 3Ms were found to be at Position A, 38.4% at Position B, and 6.8% at Position C.

- In patients with vertical growth pattern, 33.3% of 3Ms were found to be at Position A, 66.7% at Position B, and 130% at Position C.
- In patients with horizontal growth pattern, 47.7 % of 3Ms were found to be at Position A, 40.1% at Position B, and 12.2% at Position C.

Thus, a greater incidence of 3Ms was found to be at Position B and C (i.e., partially or completely impacted) in Class II patients as compared to Class I and III patients.

Furthermore, patients showing vertical growth pattern were found to have an increased percentage of mandibular 3M impactions (i.e., 3M at Position B and C).

DISCUSSION

Mandibular 3M impactions are multifactorial in its occurrence in which facial growth seems to play an essential role.

Our study shows the rate of mandibular 3M impactions to be 46.1% which was similar to the findings of [9] Pushappreet who found the rate of mandibular 3M impactions to be 54% with the right side more frequently involved. However, lesser rates of impaction were reported by[10] Andreason (18–32%) and[11] Dachi and Howell (17.5%) whereas a higher rates of 3M impactions were reported by[12] Sapkota *et al.* (63.77%) and[13] Vilela and Vitoi (60%).

Our study shows mesioangular impactions as the most prevalent (51%) which is similar to the findings of[14] Quek *et al.*,[15] Sandhu and Kaur,[16] Ventä *et al.*, and[17] Padhye *et al.*

Higher prevalence of mesioangular impaction might be related to the developmental position of its primordial germ, found high up in the mandibular ramus with its occlusal surface slanting mesially or sometimes, horizontally, and the developing crown then moves in response to postural change in the mandible induced by growth.[9,18] Cessation of jaw growth before complete uprighting of the crown will most likely trap the developing tooth in a mesioangular position.

Our study shows a greater incidence of impacted mandibular 3Ms in patients with Angle's Class 2 (Skeletal) malocclusion.

Similar results were reported by Richardson who found that skeletal Class II dental base relationship with a shorter, narrower, and more acute-angled mandible was found in association in impacted 3Ms, compared with erupted teeth.[6]

Yassaei *et al.* found that in Class I and II malocclusion, most teeth were erupted to Level B. In Class III malocclusion, the level of most teeth was at the level of the occlusal plane of M2.[19] This might be due to the fact that skeletal Class III patients have a prognathic mandible leading to more availability of space for an eruption of M3 as compared to skeletal Class I and II patients.

However, Abu Alhaija found an increased rate of mandibular 3M impactions in skeletal Class III patients.[20]

An explanation for this opposite result could be the way in which the malocclusion has been determined. Abu Alhaiji used only ANB Angle for classification of malocclusion which gives a relative position of the upper jaw in relation to the lower jaw but does not specify the relative position of the jaws to the rest of the facial skeleton. Thus, multiple angles should be recorded for more accuracy of results.

Our study also reported that patients showing vertical growth pattern have a greater incidence of mandibular 3Ms at Position B and C, i.e., partially or completely impacted as compared to patients with normal and horizontal growth patterns.

Breik and Grubor also found an increased rate of mandibular impactions in cases with facial axis 87>, i.e., dolichofacial (long face) profile.[3]

Sapkota *et al.* found the highest occurrence of 3M impactions in dolichocephalic type and least in brachycephalic type.[12]

However, no significant relationship was found between the angular position of 3Ms and the facial type in this study.[19] Yassaei *et al.* were also unable to find any such correlation between the angle of 3M and the malocclusion.

The minimum age of patients selected in this study was 20 years (Mean age: 25.76 years). The reason is that the growth of the jaws is usually completed by the age of 18 years. Thus, at the age of 20 years, it is possible to distinguish whether a 3M is in the normal eruptive process or will remain impacted in the jaw.

Limitations of this study include small sample size and sample type. Since growth is a multi-factorial phenomenon, a wide variety of factors can influence it and hence a larger sample size would give more accurate results. The sample consists of pre-orthodontic records of orthodontic patients. These patients are more likely to show malocclusion and crowding causing the greater occurrence of 3M impactions as compared to the general population.

CONCLUSION

Within the limitations of our study, our hypothesis that the rate of impaction in vertical growers is more than the patients with normal or horizontal growth patterns holds true. This is so because the space required for the eruption of lower 3Ms seems to be provided in patients having a horizontal or normal growth pattern compared to those having a vertical growth pattern.

Our study also concludes that the rate of mandibular 3M impaction is greater in patients showing skeletal Class II relation as compared to those showing skeletal Class I and Class III relations.

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