Midpalatal Suture Ossification and Skeletal Maturation: A Comparative Computerized Tomographic Scan and Roentgenographic Study

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Abstract

The main aim of this study was to evaluate and compare the ossification of the midpalatal suture using cross-sectional maxillary occlusal radiograph and computerized tomographic scan of the hard palate in the axial direction. The percentage of the ossification thus obtained was correlated with the skeletal maturation indicators like (CVMI categories and MP3 stages) in Group I subjects (8.0-16.0 years) and with chronological age in group II subjects (16.1-25.0 years). The radiograph of the middle phalanx of the third finger and lateral cephalogram in occlusion were taken for the Group I subjects. The total sample size of the study comprised of 21 subjects with transverse maxillary deficiency. The percentage of the ossification of the midpalatal suture was calculated using suture obliteration index described by Persson and Thilander.

The results of the study revealed that the total amount of ossification of the MPS in Group I subjects with computerized tomographic scan (22.56 ± 3.62%) was significantly less compared to cross-sectional maxillary occlusal radiograph (58.22 ± 3.79) at the end of skeletal maturation (p < 0.001). There was sudden spurt in the ossification of the MPS after CVMI category 4/MP3 H stage. In Group II subjects CT scan again showed significantly less amount of the ossification (40.78 ± 19.73) compared to maxillary occlusal radiograph (60.32 ± 14.41) in the total length of the MPS (p < 0.05). Thus CT scan of the hard palate showed less than 50% of the midpalatal suture ossification at the age of 25 years approximately. This was due to advantages of the computed tomographic technology, i.e. no superimposition of the overlying and adjacent structure, exact localization and accurate assessment of the MPS ossification over the conventional radiography.

Keywords: Midpalatal suture ossification, computerized tomographic scan, occlusal radiograph, skeletal maturation.

INTRODUCTION

Timms et al1 in a study of rapid maxillary expansion, used computed tomography for the first time and concluded that the method warranted further investigation. In orthodontics, many research studies have promoted the use of the computed tomography for the diagnostic procedure like localization of impacted teeth,2-5 amount of root resorption6, study of cleft palate, site planning for orthodontic implants, diagnosis of deformities of face and jaws,7 bone regeneration,8 evaluation of ossification of different craniofacial sutures,9-11 assessment of the maxillary movements induced by rapid maxillary expansion,1 the position of the condyle in the glenoid fossa of the temporomandibular joint,12 3D modeling, finite element analysis,13 quantitation of the transverse dimension of the maxilla14, etc.

However, very few studies utilized computerized tomography as a diagnostic tool for evaluation of ossification and closure of various sutures in craniofacial complex.8-11 The midpalatal suture is one of them, helping the orthodontist in bringing about the rapid maxillary expansion in the indicated cases.

None of the studies in the literature discussed the use of computerized tomographic scan for assessing the ossification of the midpalatal suture.

There are conflicting views about the closure of midpalatal suture. The chronological age does not seem to be a reliable indicator for a real morphological status of the midpalatal suture closure. According to earlier studies, sutures of the cranial vault start to obliterate during the third decade of life. According to Persson and Thilander15 earliest obliteration can be seen in the posterior palate of a 15-year-old girl and there may be no obliteration at all in a 27-year-old female. Earliest obliteration in male was found in a 21 years and no obliteration at all in a 32-year-old male. According to Sperber,10 obliteration may start in adolescence, but complete fusion is rarely found before 30 years of age. Hence, an attempt has been made in this study to evaluate and to compare the ossification of midpalatal suture in a growing and nongrowing subject by using cross-sectional...
maxillary occlusal radiograph and the computerized tomographic scan of the maxilla.

Also, the ossification status of the midpalatal suture has been correlated with skeletal maturity indicators like cervical vertebrae maturation stages and ossification stages of the middle phalanx of third finger (CVMI and MP3 stages).

MATERIALS AND METHODS

The total sample used in this study comprised of 21 subjects, which were divided into two groups depending on their chronological age.

• Group I: As growing group (age ranges from 8.1 to 16.1 years).
• Group II: As post—adolescent and young adults group (age ranges from 16.1 to 25 years). The group II was further subdivided into two groups:
  – Subgroup 1: 16.1 years to 20.0 years of age.
  – Subgroup 2: 20.1 years to 25.0 years of age.

The subjects were selected by using following criterias, first clinically, all subjects had moderate to severe transverse maxillary constriction in the form of narrow V-shaped maxillary arch with deep palatal vault and/or posterior crossbite. There is also no history of previous orthodontic treatment taken.

Diagnostic parameters uses are cross-sectional maxillary occlusal radiograph, computerized tomographic scan of maxilla an axial section through the hard palate (Fig. 1), radiograph of middle phalanx of third finger using dental X-ray film to assess maturation of middle phalanx of third finger and lateral Cephalogram in Occlusion (Natural Head Position) to assess cervical vertebrae maturation.

Landmarks to be Identified on Cross-section Maxillary Occlusal Radiograph and Computerized Tomographic Scan

• The midpalatal suture appears as a dark radiolucent line between the central incisors roots, extending to the posterior aspect of the palate. Absence of distinct radiolucency between the radiopaque cortical linings is considered as “Ossification of the midpalatal suture”.
  • Incisive foramen
  • Point A: Most anterior point of premaxilla
  • Point B: Most posterior point on posterior wall of incisive foramen
  • Point P: It is the point of intersection between midpalatal suture line and a line tangent to the posterior surface of permanent maxillary second molar (Fig. 2).

The landmarks to be identified on CT scan are same as that of cross-sectional maxillary occlusal radiograph except point P. It is derived according to the method suggested by Revelo and Fishman.17 Point P: It is the point of intersection of midpalatal suture and a line tangent to the posterior wall of the greater palatine foramen. As greater palatine foramen is clearly visible in the computerized tomographic scan section through hard palate, the distal margin of the greater palatine foramen was taken as a landmark for obtaining point P.

LATERAL CEPHALOGRAM (IN NATURAL HEAD POSITION)

The lateral cephalograms were taken with patients in natural head position.18 The skeletal maturity is assessed by using cervical vertebrae maturation index 20,21 (Fig. 3).

CROSS-SECTIONAL MAXILLARY OCCLUSAL RADIOGRAPH

A cross-sectional maxillary occlusal radiograph was taken for each subject using intraoral occlusal film. The occlusal radiographs were traced on an acetate tracing paper.

Suture Obliteration Index

An obliteration index was used as a quantitative description of the advance of the suture closure with age. Suture obliteration index15 was calculated as follows (separately for different parts).
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Suture obliteration index = \frac{\text{Length of midpalatal suture ossified} \times 100}{\text{Total length} \times \text{Total length of the suture}}

The same formula was being used for calculation of percentage of ossification of the midpalatal suture using computerized tomographic scan.

**RADIOGRAPH OF MIDDLE PHALANX OF THIRD FINGER (MP3 STAGES)**

The radiographs of middle phalanx of third finger were taken using dental X-ray unit with dental X-ray film by the method \(^{19}\) MP3 stages \(^ {22} \) were assessed (Fig. 3).

**COMPUTERIZED TOMOGRAPHIC SCAN AN AXIAL SECTION THROUGH THE HARD PALATE**

The scans were taken using Model-GE Sytec 2000i (3rd generation) computerized tomographic unit. Lateral digital scannogram of the skull was obtained. Inner reference line was selected in such a way that it should coincide with the radiopacity of the hard palate on the lateral digital scannogram. Axial section through hard palate was taken. The 5 mm thickness sections were taken using 120 kVp, 80 TO 120 mA, 1 mm collimation and 3.6 seconds of scan time.

The sections were printed thrice on CT film

1. One with no measurement markings
2. Second with normal length of the anterior and posterior part of the midpalatal suture. It showed the following measurements.
   1. A line tangent to the distal margin of the greater palatine foramen.
   2. A line extending from the anterior most point on the premaxilla to the distal margin of the incisive foramen.
   3. A line extending from the distal margin of the incisive foramen to a point of intersection with line tangent to the distal margin of the greater palatine foramen.

Third with the reading of the ossified part by taking with the help of following landmarks (Fig. 1).

**RESULTS**

Table 1 shows values of the comparison of mean percentage of midpalatal suture ossification according to skeletal maturation, when evaluated by both methods in the anterior part of the suture. Values with computerized tomographic scan showed significantly less amount of ossification in the anterior part (except in the CVMI category 2 and MP3 FG stage) of the midpalatal suture with the advancement in the skeletal maturation. Table 2 shows comparison between mean percentage of midpalatal suture ossification in the posterior part of the suture. When compared with maxillary occlusal radiograph, computerized tomographic scans showed significantly less (by 50\%) amount of ossification in the posterior part of the suture (p < 0.05). The difference in comparison of mean percentage of midpalatal suture ossification in the total length of the midpalatal suture by two methods was highly significant. Table 3 shows the comparison of mean percentage midpalatal suture ossification in the anterior part of the midpalatal suture when evaluated by maxillary occlusal radiograph and computerized tomographic scan. There was no significant difference in the amount of ossification in the anterior part when evaluated by both the techniques in both the subgroups, i.e. 1 and 2.

Table 4 shows comparison of the mean percentage sutural ossification in the posterior part of the midpalatal suture after applying the “unpaired t” test. The difference in the mean percentage ossification of the midpalatal suture was highly significant (p < 0.01) between the two techniques in both the subgroups.

Table 5 shows the comparison of the mean percentage sutural ossification in the total length of the midpalatal suture when evaluated by both maxillary occlusal radiograph and computerized tomographic scan. The difference between the two techniques for evaluating the midpalatal suture ossification was significant (p < 0.05).
Table 1: Table showing comparison of mean percentage of the midpalatal suture ossification (anterior part a-b) between cross-sectional maxillary occlusal radiograph and computerized tomographic scan an axial section through the hard palate (group I)

<table>
<thead>
<tr>
<th>CVMI category</th>
<th>MP3 stage</th>
<th>Mean percentage of the midpalatal suture ossification (Anterior part)</th>
<th>SE</th>
<th>t-value</th>
<th>p-value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cross-sectional maxillary occlusal radiograph</td>
<td>CT scan an axial section through the hard palate</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
</tr>
<tr>
<td>1 [N = 2]</td>
<td>F [N = 2]</td>
<td>0</td>
<td>0</td>
<td>3.83</td>
<td>2.52</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>2 [N = 3]</td>
<td>FG [N = 3]</td>
<td>5.67 ± 2.13</td>
<td>15.33 ± 6.32</td>
<td>3.23</td>
<td>1.31</td>
<td>p &gt; 0.05</td>
</tr>
<tr>
<td>3 [N = 3]</td>
<td>G [N = 3]</td>
<td>28.6 ± 4.71</td>
<td>24.38 ± 3.02</td>
<td>8.59</td>
<td>2.81</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>4 [N = 2]</td>
<td>H [N = 2]</td>
<td>35.11 ± 11.2</td>
<td>10.93 ± 4.73</td>
<td>8.59</td>
<td>2.81</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>5 [N = 1]</td>
<td>HI [N = 1]</td>
<td>60.41 ±</td>
<td>44.87 ± 9.62</td>
<td>12.02</td>
<td>1.29</td>
<td>p &gt; 0.05</td>
</tr>
</tbody>
</table>

N: Number of the subjects in each group, SE: Standard error

Table 2: Table showing comparison of mean percentage of the midpalatal suture ossification [Posterior part (b-p)] between cross-sectional maxillary occlusal radiograph and computerized tomographic scan an axial section through the hard palate (group I)

<table>
<thead>
<tr>
<th>CVMI category</th>
<th>MP3</th>
<th>Mean percentage of the midpalatal suture ossification (posterior part)</th>
<th>SE</th>
<th>t-value</th>
<th>p-value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cross-sectional maxillary occlusal radiograph</td>
<td>Computed tomographic scan an axial section through the hard palate</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
</tr>
<tr>
<td>1 [N = 2]</td>
<td>F [N = 2]</td>
<td>42.55 ± 11.6</td>
<td>20.96 ± 11.2</td>
<td>11.4</td>
<td>1.89</td>
<td>P &lt; 0.05</td>
</tr>
<tr>
<td>2 [N = 3]</td>
<td>FG [N = 3]</td>
<td>48.57 ± 9.86</td>
<td>17.28 ± 7.81</td>
<td>7.26</td>
<td>4.30</td>
<td>P &lt; 0.01</td>
</tr>
<tr>
<td>3 [N = 3]</td>
<td>G [N = 3]</td>
<td>32.73 ± 12.32</td>
<td>13.5 ± 9.89</td>
<td>9.13</td>
<td>2.10</td>
<td>P &lt; 0.05</td>
</tr>
<tr>
<td>4 [N = 2]</td>
<td>H [N = 2]</td>
<td>35.97 ± 8.61</td>
<td>20.5 ± 6.97</td>
<td>7.83</td>
<td>1.97</td>
<td>P &lt; 0.05</td>
</tr>
<tr>
<td>5 [N = 1]</td>
<td>HI [N = 1]</td>
<td>54.83 ± 12.87</td>
<td>17.49 ± 11.34</td>
<td>17.15</td>
<td>2.17</td>
<td>P &lt; 0.05</td>
</tr>
</tbody>
</table>

N: Number of the subjects in each group, SE: Standard error

Table 3: Table showing comparison of mean percentage of the midpalatal suture ossification [anterior part (a-b)] between cross-sectional maxillary occlusal radiograph and computerized tomographic scan an axial section through the hard palate (Group II subgroup 1 and 2)

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Mean percentage of the midpalatal suture ossification [anterior part (a-b)]</th>
<th>SE</th>
<th>t-value</th>
<th>p-value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cross-sectional maxillary occlusal radiograph</td>
<td>CT scan axial an section through the hard palate</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
</tr>
<tr>
<td>16.1-20.0 (n = 5)</td>
<td>32.92 ± 18.31</td>
<td>37.99 ± 23.94</td>
<td>13.47</td>
<td>0.38</td>
<td>P &gt; 0.05</td>
</tr>
<tr>
<td>20.1-25.0 (n = 5)</td>
<td>35.78 ± 22.47</td>
<td>33.46 ± 35.52</td>
<td>18.79</td>
<td>0.086</td>
<td>P &gt; 0.05</td>
</tr>
</tbody>
</table>

N: Number of the subjects in each group, SE: Standard error
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DISCUSSION

Maxillary occlusal radiograph is the most commonly used method for evaluation of midpalatal suture ossification. But, it has its own inherent technological limitations. Timms was the first person who advocated the use of computed tomography in a study of rapid maxillary expansion.

In the present study, two different skeletal maturity indicators were used to correlate them with the midpalatal suture ossification in subjects having transverse maxillary deficiency. The age group in the study was selected according to recommendations of the Hellsing and Revelo and Fishman. According to Hellsing cervical vertebrae reach to their full adult dimensions by the age of 15 years. Revelo and Fishman in their study on midpalatal suture ossification found that by the end of skeletal maturation only 50% of the midpalatal suture was ossified. Therefore, two groups were selected. Group I with chronological age between 8.1 to 16.0 years and Group II with chronological age between 16.1 to 25.0 years. Since the ossification status of the midpalatal suture is going to affect the outcome of result with rapid maxillary expansion, subjects with transverse maxillary deficiency were selected in the study.

There was gradual increase in the amount of ossification in the anterior part of the suture. This was in agreement with the finding of Revelo and Fishman and DN Kapoor et al. The progress in the ossification in the anterior part of the suture was irregular with advancement in the skeletal maturity as reported by Revelo and Fishman. Ossification also increases in the posterior part of the suture (agreement with DN Kapoor et al) but not in a linear pattern (disagreement with DN Kapoor et al). Very large increase in percentage ossification was seen after the CVMI category 4/MP3 H stage. This was in agreement with the Revelo and Fishman, DN Kapoor et al. The overall increase in the pattern of ossification was in a nonlinear fashion. This may be due to varying severity of transverse maxillary deficiency in the subjects with different stages of skeletal maturation.

There was spurt of ossification in the anterior and posterior part of the midpalatal suture in the late maturation stage, i.e. CVMI category 4/MP3 H stage onwards. Similar finding was reported by Revelo and Fishman. This finding was in accordance with the Melsen who also reported that there is greater sutural activity during the period of pubertal growth spur. The percentage of the midpalatal suture ossification in all the stages of skeletal maturation was higher in this study as compared to the findings of Revelo and Fishman, DN Kapoor et al. This may be because of transverse maxillary deficiency in all the subjects included in the study.

<table>
<thead>
<tr>
<th>Table 4: Table showing comparison of mean percentage of the midpalatal suture ossification [posterior part (b-p)] between cross-sectional maxillary occlusal radiograph and computerized tomographic scan an axial section through the hard palate (Group II subgroup 1 and 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
</tr>
<tr>
<td>Cross-sectional maxillary occlusal radiograph</td>
</tr>
<tr>
<td>Mean ± SD</td>
</tr>
<tr>
<td>16.1-20.0 (n = 5)</td>
</tr>
<tr>
<td>20.1-25.0 (n = 5)</td>
</tr>
</tbody>
</table>

N: Number of the subjects in each group, SE: Standard error

<table>
<thead>
<tr>
<th>Table 5: Table showing comparison of mean percentage of the midpalatal suture ossification [total length of the suture (a-p)] between cross-sectional maxillary occlusal radiograph and computerized tomographic scan an axial section through the hard palate (Group II subgroup 1 and 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
</tr>
<tr>
<td>Cross-sectional maxillary CT scan axial an section</td>
</tr>
<tr>
<td>Mean ± SD</td>
</tr>
<tr>
<td>16.1-20.0 (n = 5)</td>
</tr>
<tr>
<td>20.1-25.0 (n = 5)</td>
</tr>
</tbody>
</table>

N: Number of the subjects in each group, SE: Standard error
On comparison of percentage ossification of the midpalatal suture with maxillary occlusal radiograph and computed tomography, it was found that the percentage of ossification obtained was irregular at the different stages of skeletal maturation. In the CVMI category 2, computerized tomographic scan showed more amount of percentage ossification in the anterior part (15.33%) compared to maxillary occlusal radiograph (5.67%). But, for the same category, maxillary occlusal radiograph showed more amount of the midpalatal suture ossification posteriorly (48.57%) compared to computerized tomographic scan readings (17.28%).

It was concluded that computerized tomographic scan showed very less amount of percentage ossification posteriorly in comparison with the maxillary occlusal radiograph. In the anterior part, values with maxillary occlusal radiograph and computed tomography showed variable results for the subjects with same skeletal maturation stages.

The results of this study in the subjects with age group from 16.1 to 20.0 years revealed that there was further increase in the amount of percentage ossification mainly in the posterior part of the midpalatal suture. It was with maxillary occlusal radiograph 69.11% in the posterior part and 32.92% in the anterior part of the midpalatal suture. Persson and Thilander15 gave the explanation for this in their histological study on human autopsy specimens. They studied the extent of ossification in oronasal section of the intermaxillary suture in subjects with age group 15 to 35 years. They found that degree of obliteration was more posteriorly than anteriorly. They have also quoted Davida26 who reported that midpalatal suture in human skull starts to close posteriorly without exception. It showed greater degree of obliteration posteriorly than anteriorly. Ossification occurred very late anterior to incisive foramen.

When the values obtained in this group with both the techniques was compared with the findings of the previous age group, maxillary occlusal radiograph and computed tomography showed increased percentage of ossification in the posterior part of the suture. That means, with further increase in the skeletal maturity, there is more amount of ossification in the posterior part of the midpalatal suture. This result was similar to the study of Persson and Thilander15 Revelo and Fishman17 and DN Kapoor et al.24 But the total amount of ossification in this group (Group II subgroup 1) was same as that of the growing subjects. When the results obtained from computerized tomographic scan were compared with growing individuals, there was slightly more amount of ossification in the anterior part of the midpalatal suture in the growing individuals. The increased amount of ossification in the anterior part is due to increase in the sutural activity during the period of pubertal growth spurt. A similar finding was reported by the Melsen B.25

When the midpalatal suture ossification was evaluated in young adults with age range from 20.1 to 25.0 years, there was slight increase in the percentage ossification in both anterior and posterior part of the midpalatal suture compared to the younger age groups. The percentage of ossification with maxillary occlusal radiograph was 35.07% in the anterior part and 76.40% in the posterior part of the midpalatal suture. Total percentage suture ossification was 56.49%. This was comparable to the total amount of ossification found at the end of skeletal maturation in growing subjects. Computed tomography in the same group showed that more amount of ossification anteriorly (46.40%) than posteriorly (38.83%). Total amount of ossification was about 40.78%. On comparison with the previous group (chronological age 16.1-20.0 years), there was further increase in the percentage ossification both in anterior and posterior region. Total amount of percentage ossification observed was also increased.

It was found that in the young adult, the computed tomography showed very slight difference in the percentage ossification in the anterior part of the suture and highly significant difference in the posterior part of the midpalatal suture compared to maxillary occlusal radiograph. The amount of ossification of the midpalatal suture in total length was again significantly less with computerized tomographic scan.

In the present study, it was observed that there was a tendency for increase in the amount of ossification with the advancement in the skeletal maturation and the chronological age. The overall amount of percentage ossification was greater in the study in the different parts of the midpalatal suture as compared to the earlier study of Revelo and Fishman,17 DN Kapoor et al.24 There was spurt in the percentage of ossification in the midpalatal suture after the CVMI category 4/MP3 H stage. The extent of ossification showed by computed tomography was significantly less in both the groups. This was more so in the posterior part of the midpalatal suture.

Similar study can be carried out in a large sample size in male and female subjects as it was reported by DN Kapoor et al24 that sexual dimorphism affect the ossification pattern in the midpalatal suture.

The exact amount of ossification and the site of ossification will help the orthodontists and the oral and maxillofacial surgeons to plan the exact the site for the midline cortical osteotomy. Computed tomographic scan of the hard palate in the axial view clearly shows the amount and site of the ossification. The information obtained can be used to limit the extent of midpalatal cortical osteotomy. Thus, it will be helpful in making the surgery more conservative and fruitful.

Three-dimensional imaging of the suture can be used to evaluate the effect of the rapid maxillary expansion in the craniofacial region.

Thus, it can be concluded that computed tomography has wide applications in future. It will become one of the essential and important diagnostic tool for the orthodontists. The perfect diagnosis with computed tomography will help in achieving excellent orthodontic treatment results.

**CONCLUSION**

The results of this study revealed that:

**In Growing Subjects**

1. The subjects with transverse maxillary deficiency showed 58.22% of midpalatal suture ossification at the completion of the skeletal maturation stage [CVMI category 5/MP3 H I stage] using cross-sectional maxillary occlusal radiograph.
2. The computerized tomographic scan showed significantly less amount of ossification (22.50%) in the total length of the midpalatal suture at the completion of skeletal maturation stage (CVMI category 5/MP3 H1 stage).

**In the Postadolescent and Young Adults**

1. The ossification of the anterior part of the midpalatal suture was slightly more with the use of computerized tomographic scan compared to cross-sectional maxillary occlusal radiograph. At the same time computerized tomographic scan showed significantly less amount of ossification in the posterior part of the midpalatal suture (38.83%) as compared to the maxillary occlusal radiograph (76.40%).

2. The total amount of ossification at the age of 25 years was 40.78% by using computerized tomographic scan and 60.32% by using cross-sectional maxillary occlusal radiograph.

Thus, when the midpalatal suture ossification was evaluated using cross-sectional maxillary occlusal radiograph, the total amount of ossification at the completion of skeletal maturation and at the age of 25 years remains within range of 60% approximately. But, computerized tomographic scan showed gradual increase in the amount of ossification, i.e. 22.56% at the completion of skeletal maturation and 40.78% at the age of 25 years.

Based on the findings of this study, it can be concluded that the ideal time for proceeding to the rapid maxillary expansion would be cervical vertebrae maturation index category 1 or MP3 F stage. It is best to carry-out rapid maxillary expansion before CVMI 4 or MP3 H stage.

In this study, computerized tomographic scan showed less than 50% of ossification in young adults with transverse maxillary deficiency. This much remaining patency of the midpalatal suture along with advances in orthodontic appliance system, in future, will help the orthodontists to successfully treat the young adults with transverse maxillary deficiency in a more conservative manner.

**REFERENCES**