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# Co-Relation between root resorption patterns of deciduous mandibular molars and position of erupting permanent successors: A radiographic evaluation

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**Abstract**
**Purpose:** The study was designed to investigate the relationship between root resorption patterns of deciduous mandibular molars and position of erupting permanent successors by a Radiographic Evaluation.
**Methods:** A total of 250 radiographs of primary mandibular molars (126 first molars and 124 second molars) of 5- to 12-year-old patients were evaluated. The root resorption pattern and the premolar location were observed.
**Results:** Half of the teeth were primary first molars. In the primary first and second molar a majority of 80.2% of the root resorption occurred in the distal root and 55.6% of the root resorption was symmetrical respectively. Distal location of the premolar was the most commonly observed followed by central location of the premolar in primary first and second primary molar respectively.
**Conclusion:** The position of premolar and presence of caries influences the root resorption pattern of the primary mandibular molars. The distal location of premolar was most commonly observed in primary 1st molar. Distal caries in a tooth when coupled with distally located premolar showed 99**%** distal root resorption

**Keywords:** Radiographic Evaluation, Root Resorption Patterns, Deciduous Mandibular Molars

## 1. Introduction
Eruption is the axial movement of a tooth from its non-functional position in the bone to functional occlusion. It is the developmental process responsible for moving a tooth from its crypt position through the alveolar process into the oral cavity to its final position of occlusion with its antagonist. It is a dynamic process that encompasses completion of root development, establishment of the periodontium and maintenance of afunctiona locclusion [1]. Although many theories have been proposed, the factors responsible for the eruption of a tooth are still under question. Factors like forces exerted by the vascular tissues around and beneath the root, growth and pull of the periodontal membrane, influences by various hormonal, presence permanent tooth dental follicle and resorption of the alveolar crest have all been related to the process of tooth eruption.
Root resorption is a physiological process in the life span of primary tooth. The roots develop after the crown is completed. However initial resorption begins between one and three years after apical closure of the apices of the primary teeth, and exfoliation follows by approximately three years. The cell responsible for dental tissue resorption is odontoclasts. To date we know a little about how the precursor of odontoclasts appear, what causes their differentiation, what gives them the signal to start resorbing the primary root at a specific area and time and why they get activated to resorb dental tissue prematurely in some pathologic conditions and not in others. Although protection of the root from resorption While the adjacent bone is constantly degrading is puzzling phenomenon, a even more intriguing is the question why the roots of the primary teeth eventually resorb while the roots of the permanent teeth do not [2].

Dental caries is also known to reportedly accelerate the pace of resorption of root of primary molars and thus facilitating eruption of the corresponding permanent tooth. Congenital absence of the permanent tooth bud may inhibit the resorption of the primary teeth. It was also found that eruption of teeth may occur earlier among girls**.** A number of pathological causes have been proposed to change the pace of root resorption which in turn can cause early or delay in eruption of permanent tooth. They include periodontal abscess in the primary tooth, internal resorption, chronic pulpitis, and pulp necrosis [3, 9].

Thus these factors may affect the resorption of primary molar root and may cause uneven root resorption, either causing the mesial or the distal root to be more resorbed. There is little information on the pattern of root resorption of primary teeth and the location of the successor permanent tooth throughout the eruption. Hence, the study was designed to investigate the relationship between root resorption patterns of deciduous mandibular molars and position of erupting permanent successors by a radiographic evaluation.

## 2. Material and materials

A cross-sectional study was conducted at department of pediatric dentistry, Sri Aurobindo College of dentistry, Indore. A total of 250 radiovisiographs (RVG) of primary mandibular molars (126 first molars and 124 second molars) of 5 to 12 year old children were reviewed. The patterns of root resorption, premolar location and caries were evaluated. Primary mandibular molar teeth were identified on radiovisiograph that were taken as part of the children's routine examinations. Radiographs were selected for the present study based on the following inclusion and exclusion criteria

### 2.1 Inclusion criteria

1. An image with minimal evidence of distortion on the surfaces of teeth;
2. An image consisting of the roots of the primary mandibular molars and successor premolar's crown.

### 2.2 Exclusion criteria

1. Teeth with pulp therapy and stainless steel crowns.
2. Teeth with periapical pathology.

### 2.3 The following parameters were investigated

1. The resorption of the mesial and distal roots (i.e., symmetrical or if either the mesial or the distal root were more resorbed); symmetry was defined if the line connecting the apices was parallel to a line connecting the CEJ at the mesial and distal surfaces; (fig 1)

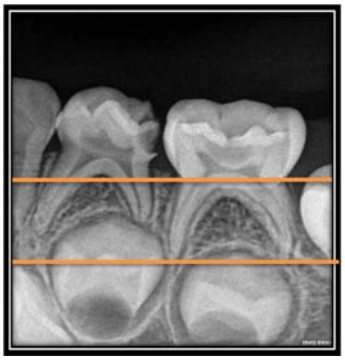

**Fig 1:** Symmetry of the resorption

2. The location of the successor premolar, evaluated in relation to the long axis of the primary molar; this long axis was defined by a line connecting the middle of the furcation and a line connecting the widest mesiodistal dimension of the crown of the primary molar; this line was extended apically; the successor premolars were defined as mesial (fig 2), center (fig 3), or distal to the long axis of primary molars (fig 4).

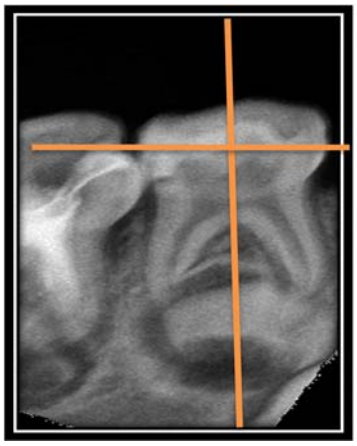

**Fig 2:** Premolar mesial

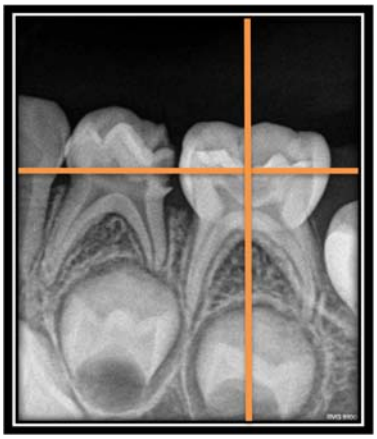

**Fig 3:** Premolar centred

**Fig 4:** Premolar distal

3. Presence of caries or a restoration on each of the tooth surfaces (i.e., mesial, occlusal, distal). (Fig 5)

**Fig 5:** distal caries

**2.4 Statistical analysis:** Statistical analyses included both descriptive and inferential methods. The data was analyzed by using statistical software SPSS version 17.0. Descriptive statistical analysis has been used to depict the main features and characteristic of the collected samples. Results on categorical measurements are presented in numbers (%). A non-parametric test, Pearson's Chi-Square test was used for qualitative data to observe the association of patterns of root resorption with various premolar locations and caries with primary first (D) and second molars (E). The probability value $p<0.05$ was considered as significant while $p<0.001$ was considered as highly significant.

**3. Results:** There were 250 RVG in total of 5 to 12-year old patients. The mean age and standard deviation (±SD) of the patients was 8.2±1.8 years old. There were no gender differences in the age of the participants or distribution of the evaluated teeth. For patients whose radiographs demonstrated both primary molars, one tooth was chosen arbitrarily. Out of 250 RVG'S; 50.4% of the teeth were D (126) and remaining 49.6% were E (124) that met the inclusion criteria.

In D about 78.6% of the premolars were located distal to the long axis of the tooth which in turn showed more of the distal root resorption in about 80.2%. While in E central location of the premolar was most common accounting to 49.2% corresponding to 55.6% of the symmetrical resorption. (Table 1)

**Table 1:** Distribution of premolar location and symmetry of root resorption in primary molars

| **Location Of Premolar** | | | | |
|---|---|---|---|---|
| **Premolar** | **Location** | | | **Total** |
| | **Distal to long axis** | **Centred** | **Mesial to long axis** | |
| D | 99 (78.6%) | 21 (16.7%) | 6 (4.8%) | 126 (100%) |
| E | 54 (43.5%) | 61 (49.2%) | 9 (7.3%) | 124 (100%) |
| **Symmetry Of Root Resorption** | | | | |
| **Premolar** | **Root resorption** | | | **Total** |
| | **Distal root more resorbed** | **Symmetrical resorption** | **Mesial to long axis** | |
| D | 101 (80.2%) | 21 (16.7%) | 4 (3.2%) | 126 (100%) |
| E | 40 (32.3%)* | 69 (55.6%) | 15 (12.1%) | 124 (100%) |

*The parenthesis () showed the corresponding percentage.

For the D the distal root was more resorbed when the premolar was located distal to the long axis of the tooth as 96 %. In E more symmetrical root resorption was found when the premolar was situated symmetrical to the long axis of the tooth. Thus the location of the premolar was strongly associated with symmetry of root resorption of the D that confirmed highly significant ($p<0.001$) on statistical ground (Table 2)

**Table 2:** Association of root resorption of primary molars and location of premolar

| **D** | | | | | **E** | | | |
|---|---|---|---|---|---|---|---|---|
| **Location of Premolar** | **Root resorption** | | | **Total** | **Root resorption** | | | **Total** |
| | **Distal root** | **Symmetrical** | **Mesial root** | | **Distal root** | **Symmetrical** | **Mesial root** | |
| Distal | 95 (96.0) | 3 (3.0) | 1 (1.0) | 99 (100) | 38 (70.4) | 10 (18.5) | 6 (11.1) | 54 (100) |
| Centered | 4 (19) | 17 (81.0) | 0 (0.0) | 21 (100) | 2 (3.3) | 58 (95.1) | 1 (1.6) | 61 (100) |
| Mesial | 2 (33.3) | 1 (16.7) | 3 (50.0) | 6 (100) | 0 (0.0) | 1 (11.1) | 8 (88.9) * | 9 (100) |
| Total | 101 (80.2) | 21 (16.7) | 4 (3.2) | 126 (100.0) | 40 (32.3) | 69 (55.6) | 15 (12.1) | 124 (100.0) |
| p-value | $\chi^2_4 = 121.19^{\#}$ *P*<0.001 (Highly Significant) | | | | $\chi^2_4 = 126.17^{\#}$ *P*<0.001 (Highly Significant) | | | |

# The association is highly significant at 4 degrees of freedom at the 0.001 levels of significance. *The parenthesis () showed the corresponding percentage.

In D and E more distal root resorption was found when the tooth had distal caries; 87.9 and 90.9 % respectively. These differences in qualitative measurements of caries and symmetry of root resorption of the E were highly significant ($p<0.001$) confirmed statistically. (Table 3)

**Table 3:** Association of root resorption of primary molars and location of caries

| Type of caries | D | | | | E | | | |
|---|---|---|---|---|---|---|---|---|
| | Root resorption | | | Total | Root resorption | | | Total |
| | Distal root | Symmetry | Mesial root | | Distal root | Symmetry | Mesial root | |
| Distal | 87 (87.9) | 10 (10.1) | 2 (2.0) | 99 (100) | 10 (90.9) | 0 (0.0) | 1 (9.1) | 11 (100) |
| Occlusal | 5 (35.7) | 8 (57.1) | 1 (7.1) | 14 (100) | 11 (31.4) | 18 (51.4) | 6 (17.1) | 35 (100) |
| Mesial | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 3 (27.3) | 5 (45.5) | 3 (27.3) * | 11 (100) |
| No caries | 9 (69.2) | 3 (23.1) | 1 (7.7) | 13 (100) | 16 (23.9) | 46 (68.7) | 5 (7.5) * | 67 (100) |
| Total | 101 (80.2) | 21 (16.7) | 4 (3.2) | 126 (100.0) | 40 (32.3) | 69 (55.6) | 15 (12.1) | 124 (100.0) |
| p-value | $\chi_4^2 = 22.97^{\#}$ *P*<0.001 (Highly Significant) | | | | $\chi_4^2 = 25.86^{\#}$ *P*<0.001 (Highly Significant) | | | |

# The association is highly significant at 4 degrees of freedom at the 0.001 levels of significance. *The parenthesis () showed the corresponding percentage.

When the caries was distal in D, the distal root resorption was observed approximately in all (98.8%) of the cases with distally located premolar. Hence the distal location of the premolar and the distal caries was strongly associated with symmetry of root resorption of the D with $p<0.001$ on statistical ground.

When the caries was distal in the E most of the cases (90.0%) demonstrated distal root resorption when the premolar was distal. Overall, these differences in location of the premolar when the caries was distal with symmetry of root resorption of the E were statistically insignificant ($p>0.05$). (Table 4)

**Table 4:** association of root resorption of primary molars and location of premolar in distal caries

| Distal Caries With Symmetry Of Root Resorption | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Location of Premolar | D | | | | E | | | |
| | Root resorption | | | Total | Root resorption | | | Total |
| | Distal root | Symmetrical | Mesial root | | Distal root | Symmetrical | Mesial root | |
| Distal | 81 (98.8) | 1 (1.2) | 0 (0.0) | 82 (100) | 9 (90.0) | - | 1 (10.0) | 10 (100) |
| Centered | 4 (33.3) | 8 (66.7) | 0 (0.0) | 12 (100) | 1 (100.0) | - | 0 (0.0) | 1 (100) |
| Mesial | 2 (40.0) | 1 (20.0) | 2 (40.0) | 5 (100) | - | - | - | - |
| Total | 87 (87.9) | 10 (10.1) | 2 (2.0) | 99 (100.0) | 10 (90.9) | - | 1 (9.1) * | 11 (100.0) |
| p-value | $\chi_4^2 = 88.98^{\#}$ *P*<0.001 (Highly Significant) | | | | $\chi_1^2 = 0.11^{\otimes}$ *p*>0.05 (Insignificant) | | | |

# The association is highly significant at 4 degrees of freedom at the 0.001 levels of significance. ⊗ The association is not significant at 1 degree of freedom at the 0.05 levels of significance. *The parenthesis () showed the corresponding percentage.

## 5. Discussion

The study finding's focussed onto the asymmetrical root resorption occurring in between the two roots of the primary molar. It has also been found in various studies that even the agenesis of the permanent tooth bud retards the pace of exfoliation of primary tooth. The root resorption of the primary teeth starts at the site which is in the closest approximation with the permanent tooth bud.[4] Even in cases of the anterior tooth the completed crown of the permanent successor is found lingual to the primary tooth apex with its eruption in labial and incisal direction causing the resorption of the lingual surfaces of the apical third of the primary tooth root. Likewise on molar teeth the position and size of the tooth follicle also plays a very important role leading to Unequal influences on to the tooth root causing asymmetrical resorption. This is also seen in primary upper molar where the palatal root is often spared from resorption due to its highly divergent nature [5].

This study's findings showed that the resorption patterns of the D and E are different from each other with the distal root more commonly resorbed. This study's findings are different from another similar study by Moorrees *et al.* [6]. Who found that the mesial roots resorbed earlier than the distal roots. The difference may be attributed to different study populations or different study methodologies. While Moorrees *et al*. used lateral or oblique radiographs, we used radiovisiography.

This study's findings go in parallelism with Benjamin Peretz *et al.* [3]. Who found that the premolar location between the primary roots is significantly associated with root resorption. Therefore, it can be hypothesized that the distal location of the premolar is intended for the future lateral expansion of the arch by using the "leeway" space [5].

There was a significant association between the premolar location and the root resorption pattern. Harokopakis Hajishengallis *et al.* reported that resorption of the primary root begin where the primary root is closest to the permanent tooth [2]. Another significant finding in the study was a coupling effect of distal caries and distal location of premolar causing a significant 99% of the distal root

resorption. As reported earlier dental caries in a primary molar reportedly accelerate resorption of the root and eruption of the corresponding permanent tooth [8]. We are aware that one limitation of the current study is that the sample of radiographs was relatively small and a larger number would be needed to draw firmer conclusions. Nevertheless, our findings shed some light on a topic of considerable interest that, unfortunately, has not been well researched.

## 6. Conclusion

Based on this study's results, the following conclusions can be made:

1. The location of the premolar influences the root resorption of the primary mandibular molars.
2. The distal location of premolar was most commonly observed in primary 1st molar.
3. The mesial location of the premolar was the least observed.
4. Presence of caries influences the root resorption pattern of primary molars.
5. Coupling effect
   Distal caries + distally located premolar = 99% distal root resorption. Mesial caries + mesially located premolar = 66.7 % mesial root resorption.
6. Mesial surface of 1st primary molar is the most caries resistant surface amongst the both primary mandibular molars.

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