**ORIGINAL ARTICLE**

# Assesment of Root Apices Closureof Permanent Incisors and First Molars in Digital Orthopantomographs: A Pilot Study From Pakistan

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## ABSTRACT

**Objective:**The purpose of the current study is to assess the degree of closure of the root apices of primary molars and permanent incisors in young children.
**Study Design:**Retrospective study
**Place and Duration:** This study was carried out at Department of Oral Biology, Sardar Begum Dental College, Peshawar from January, 2022 to July 2022.
**Methods:** There were 130 patients of both genders with ages 4-16 years were presented. After obtaining informed written consent, the enrolled cases' detailed demographics, including age, sex, body mass, and locale, were computed. Digital orthopantomographs of all the patients were taken. Chi square test was used to assess differences among closure of root apices of permanent incisors and first molars among all cases. SPSS 22.0 was used to analyze all data.
**Results:**Among 130 included cases, 80 (61.5%) were females and the rest were males 50 (38.5%).Mean age of the cases were 12.6±4.72 years. 85 (65.4%) cases had body mass index <18 kg/m$^2$ and 45 (34.6%) patients had BMI >18kg/m$^2$. There were 76 (58.5%) cases had urban and 54 (41.5%) patients had rural residency. Permanent incisors were 82 (63.1%) and first molars were 48 (36.9%). At age between 5-9 years frequency of closed root apices of mandibular central incisors was 50 (60.9%) and closed maxillary first molars were 22 (51.2%). At age 10-15 years number of closed root apices of central incisors were 65 (79.3%) and closed root apices of first molars were 30 (62.5%) with p value <0.003.
**Conclusion:**In this study, we came to the conclusion that the majority of root apices of permanent incisors and first molars in children in the studied sample close early compared to earlier reports, which is consistent with the pattern of emergence of permanent teeth previously reported in children.
**Keywords:**Root Apices, First Molars, Permanent Incisors, Children

## INTRODUCTION

The process of a tooth forming, erupting, and emerging up to a functional position in the oral cavity begins in a cellular state of development, followed by the production of hard tissues of the crown. Root production begins when the crowns of the permanent incisors and first molars are completed, but this process is dormant until the eruption process begins.[1] Erupting teeth move from their developing position within the jawbone (intraosseous) to their final, functioning placement within the mouth cavity (extraosseous). When teeth first begin to erupt through the gums and into the mouth, only then does root production begin in earnest.[1]

Root canal preparation is the most crucial aspect in determining the effectiveness of an endodontic therapy. Inadequate debridement of root canal space, leaving pulp tissue remnants, bacteria, or their byproducts in the canal space, is a leading cause of root canal failure [1, 2]. The post-treatment illness is caused by the leftovers acting as infectious foci. [3] A clinician's understanding of root and canal shape, and any variations thereto, is crucial for producing successful treatment outcomes. Root canal variances can be attributed to a wide range of causes, including racial and gender differences, as well as the examination technique employed. The first permanent teeth to emerge in the mouth are the mandibular molars, and early caries in these teeth is the most prevalent reason for needing endodontic therapy. [4,5] The shape of root canals varies between ethnic groups. Diverse morphologic differences in the root canal shape of the mandibular first molar have been observed across several demographic samples. [6]

The apex of a tooth is the most distal (from the occlusal or incisal side) point of the root [7]. When a mature, calcified permanent tooth is examined from the side, it may appear to have a closed root apex, but a closer inspection will reveal one or more foramina that connect the tooth pulp to the outside world. Two to three years after a permanent tooth erupts into the mouth, its root has matured to the point of apex closure [8].

Dentists who work with youngsters may want to keep an eye on the roots to ensure the apex of the tooth has closed properly. Treatment planning in orthodontics, paediatric dentistry, endodontics, and forensic dentistry relies on knowing the root apex of permanent teeth is still in the developmental stages of tooth formation [9]. Orthodontists rely on information about root apex closure to pinpoint when to begin treatment. Treatment times are reduced and stability is improved for teeth with closed root apices [10]. In dental traumatology, for instance, passive repositioning is recommended for a moderately intruded tooth with an open apex, whereas active repositioning, via surgery or orthodontics, is recommended for a tooth with a closed apex [9,10]. This is because in paediatric dentistry, treatment options are determined by the degree of root apex closure. Data on root apex closure may also be used to evaluate the health and development of children, which has relevance for paediatric dentistry and paediatrics more generally.Dentists and paediatricians caring for children want to know if their patients have normal or abnormal development of their teeth and bones. Knowledge of root apex closure is utilised in paediatric endocrinology and forensic dentistry to estimate a child's age or positively identify them by comparing dental and chronological ages [8-11]. Decisions on endodontic treatment are aided by knowledge of root apex closure; when the apex of a permanent tooth is closed, root canal therapy is recommended, whereas when it is open, apexification or apexogenesis may be necessary [7].

Root apices closure, tooth development, and occlusion are all influenced by environmental factors in addition to being under genetic control [12]. There is a disparity between boys' and girls' rates of development among populations. Sexual dimorphism is most pronounced during the early stages of root development and

disappears by the time the plant has a fully formed crown. It has been noted that the development of permanent mandibular incisors occurs before that of their maxillary counterparts [13], although the development of permanent mandibular and maxillary first molars occurs at around the same ages.

Genetics, sex, race, vitamin D imbalance, and other systemic illnesses have all been cited as potential contributors to the aforementioned inter- and intra-populational differences in the timing of root apex closure in permanent teeth. The timing of the closure of the root apices in permanent teeth has been observed to differ by sex, with girls reaching this developmental milestone a year before boys [14]. Root apices closure of permanent incisors and first molars is reported to be the same on the right and left sides of the same arches [15].

Results acquired with one demographic group cannot be generalized to phenotypic development as a whole due to differences in both genetic and environmental variables. It is crucial, then, to examine the root apices closure of the permanent teeth in several groups of patients that collectively represent various populations. Thus, the purpose of this study was to examine the degree of closure of the root apices of permanent incisors and first molars in children aged 4-16 years.

## MATERIAL AND METHODS

This retrospective study comprised of 130 children, conducted at Department of Oral Biology, Sardar Begum Dental College, Peshawar from January, 2022 to July 2022. After obtaining informed written consent from his/her or from their parents, the enrolled cases' detailed demographics, including age, sex, body mass, and locale, were computed. Patients with pathological illness or developmental abnormalities of the maxillary and/or mandibular arches. Additionally, OPGs with significant tooth deformities, such that the root structures were obscured, or OPGs with congenital bilateral tooth loss were not included.

By deducting the date of radiograph exposure from the date of birth, we were able to determine each person's chronological age. The months were rounded up to the nearest two decimal years. One researcher (TM) handled all of the data collection. The examiner was schooled in the ways of electronic OPGs by a seasoned dental radiologist, who taught him how to spot the difference between a root apex that was open and one that was closed. Root apexes were evaluated visually to ascertain their health. The researcher and radiologist utilized 20 separate OPGs until they were happy with the consistency (kappa=0.98) between them. Double-checking every 15th OPG allowed us to calculate the Kappa statistics that characterize the examiners' agreement with one another (kappa value 0.88).

All of the digital OPGs that met the inclusion criteria were taken straight from the hospital's computerized database and saved on CDs. The PC now has K-pacs loaded so that OPGs may be quickly accessed and viewed. All permanent incisors and first molars in the maxillary and mandibular arches were checked for root apices closure and their results were noted in the record form. Root development status was evaluated only for teeth that appeared above the alveolar boundary on the OPG as having entered the oral cavity. Closure of the root apex was defined and evaluated as follows: a score of 0 indicated that the apex was still open and a score of 1 indicated that the apex seemed to have closed. Missing tooth = 7, not erupted = 8, and not relevant for different reasons = 9 were also defined and documented. The closure of the root apices of the permanent incisors and first molars was compared using the Chi-square test. All data was analyzed with SPSS 22.0.

## RESULTS

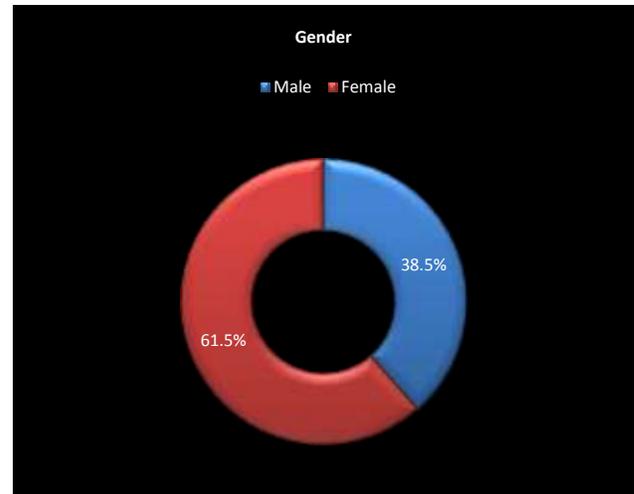Among 130 included cases, 80 (61.5%) were females and the rest were males 50 (38.5%) (Figure 1).



Figure-1: Cases wise distribution in Gender

Mean age of the cases were 12.6±4.72 years. 85 (65.4%) cases had body mass index <18 kg/m$^2$ and 45 (34.6%) patients had BMI >18kg/m$^2$. There were 76 (58.5%) cases had urban and 54 (41.5%) patients had rural residency.In 130 cases, frequency of permanent incisors was 82 (63.1%) and first molars were 48 (36.9%)(Table1).

Table-1: Included patients with detailed demographics

| Variables | Frequency | Percentage |
|---|---|---|
| Mean age (years) | 12.6±4.72 | |
| Mean BMI (kg/m$^2$) | 17.11±14.34 | |
| Residency | | |
| Rural | 54 | 41.5 |
| Urban | 76 | 58.5 |
| Tooth type | | |
| Permanent Incisors | 82 | 63.1 |
| First Molars | 48 | 36.9 |

At age between 5-9 years frequency of closed root apices of mandibular central incisors was 50 (60.9%) and closed maxillary first molars were 22 (51.2%) in which majority of the cases were males (table 2).

Table-2: Closure of root apices at age group 5-9 years

| Closure of Root Apices | Male | Female |
|---|---|---|
| Permanent Incisors (82) | | |
| Yes | 30 (36.6%) | 20 (24.4%) |
| No | 7 (8.5%) | 25 (30.5%) |
| Maxillary First Molars (48) | | |
| Yes | 12 (25%) | 10 (20.8%) |
| No | 5 (10.4%) | 21 (43.8%) |

At age 10-15 years number of closed root apices of central incisors were 65 (79.3%) and closed root apices of first molars were 30 (62.5%) with p value <0.003 (table 3).

Table-3: Closure of root apices at age group 10-15 years

| Closure of Root Apices | Frequency | Percentage |
|---|---|---|
| Permanent Incisors | | |
| Yes | 65 | 79.3 |
| No | 17 | 30.7 |
| Maxillary First Molars | | |
| Yes | 30 | 62.5 |
| No | 18 | 37.5 |

We found that root apices of permanent incisors and first molars in children in the studied sample close early. (Figure 2)
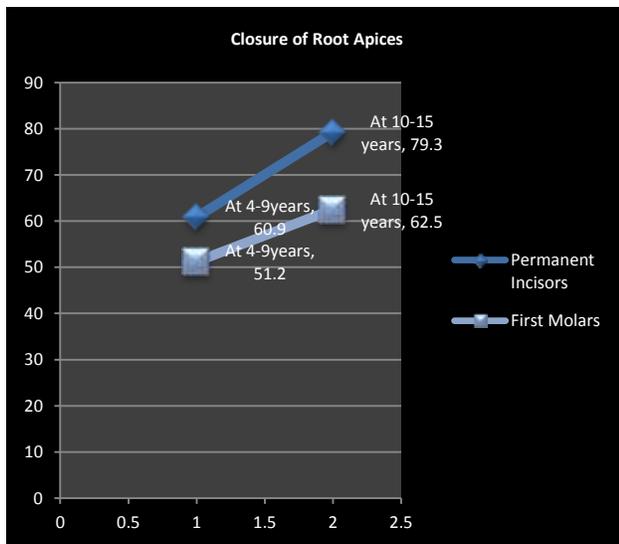
Figure-2: Comparison of root apices closure at different age groups

## DISCUSSION

In current 130 children with ages 4-16 years were presented. Majority of the cases were females. Among 130 cases, frequency of permanent incisor was 82 and 48 were first molars. Findings of our research was comparable to the studies conducted in past.[16,17] Among children, phase 2 of permanent teeth begin to erupt into the oral cavity at these ages, as documented by Mugonzibwa et al. [18], and crowding also begins to be visible at these ages, which demands seeking orthodontic advice at a young age. Our results run counter to those of a Saudi Arabian study by AL Emran [19], who claimed to have excluded children younger than 8.5 years old from their analysis due to a lack of appropriate data (low numbers of OPGs due to the low frequency with which panoramic radiographs were used as part of dental investigation in this age group).

It was shown that among children aged 4-9 years, a sizable percentage of mandibular central incisors (60.9% to be exact) had closed root apices, whereas among those aged 10-15 years, 62.5% of first molar root apices were closed, and 79.3% of mandibular central incisor root apices were closed. Root apices close around two to three years after teeth appear, according to a study by Ngassapa et al. [20]. This means that the age at which the root apices of the permanent first molars and the mandibular central incisors are reported to have closed by Mugonzibwa et al. [21] is consistent with the timing of their entry into the oral cavity. We found no evidence that root apices closed in Canadian children four years following tooth eruption, in contrast to the findings of Demirjian and Levesque [22]. When considering orthodontic, trauma, or endodontic treatment for children, early apical closure should serve as a warning signal to doctors, especially in regions where access to diagnostic services like x-ray is not always assured.

Although Nolla [23] revealed minor development changes between right and left teeth of the same type, the considerable variances of root apices closure between the left and right sides of the maxillary first molars seen may have been attributable to chance. No apical discrepancies were found between the two sides of any other maxillary or mandibular teeth. El Hafez's [24] research that found no significant difference between the left and right maxillary and mandibular arches is supported by these observations. Closure of the root apices of the mandibular central incisors occurred much before that of the maxillary central incisors, partly because the mandibular central incisors emerge first. As El Hafez of Egypt noted, similar results were seen there.[24]

Crowns of Roots Contrary to several articles culled from the literature that indicated men maturing sooner than women, there

were no sex differences in the timing of closure of the permanent incisors and first molars in both arches [25]. Given the lack of a comparator data set, the current results also serve as the population's baseline. When comparing results with those of other research, you may notice discrepancies. These might be the result of chance, differences in study design, criteria, data presentation, and analytic method.

Since this was a retrospective research, the age at which the tooth root apex closed cannot be determined with absolute certainty. Due to the fact that paternal race was the only racial category that could be determined based on the data; people of mixed racial backgrounds were not properly classified. In addition, OPGs were used, which limited the study's ability to gather contextual information from participants like their trauma histories. Potential research limitations may have resulted from the fact that apex closure is delayed in cases of trauma.

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