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DIAGNOSTIC METHODS FOR EARLY DETECTION OF PARTIAL PRIMARY TOOTH AGENESIS IN CHILDREN (0–18 YEARS)

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Abstract
Partial primary tooth agenesis is a congenital developmental anomaly characterized by the absence of one or more teeth due to disturbances in odontogenesis. Early diagnosis plays a crucial role in preventing secondary occlusal disorders, craniofacial asymmetry, and psychosocial complications. The aim of this study was to evaluate modern diagnostic methods used for early detection of partial tooth agenesis in children across different age groups (0–18 years) and to assess their clinical effectiveness. A retrospective and prospective clinical analysis was conducted involving 980 pediatric patients who underwent clinical examination and radiographic evaluation. Diagnostic tools including visual clinical assessment, panoramic radiography, cone-beam computed tomography (CBCT), and genetic evaluation were analyzed. The results demonstrate that panoramic radiography remains the primary screening method during mixed dentition, while CBCT provides superior three-dimensional visualization in complex cases. Early diagnosis before the age of 10 significantly improves orthodontic planning and treatment outcomes. The study confirms that age-specific diagnostic algorithms increase detection accuracy and optimize long-term functional rehabilitation.

Keywords: Tooth agenesis, pediatric diagnosis, panoramic radiography, CBCT, dental anomalies, early detection, mixed dentition.

Introduction

Odontogenesis is a highly regulated biological process influenced by genetic signaling pathways and environmental factors. Disruptions in tooth germ development may result in partial tooth agenesis, one of the most prevalent congenital dental anomalies.

Partial agenesis may affect primary or permanent dentition and often remains undetected until mixed dentition stage. In early childhood, clinical identification is challenging because permanent tooth germs are not yet visible in the oral cavity. Therefore, radiographic and developmental monitoring is essential.

Failure to diagnose agenesis at an early stage may lead to: delayed eruption patterns, arch length discrepancies, malocclusion, alveolar bone deficiency, psychological distress in adolescents.

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Modern pediatric dentistry emphasizes preventive diagnostics and early intervention. Advances in digital imaging technologies allow earlier and more precise identification of missing tooth buds. The purpose of this study was to analyze diagnostic methods for detecting partial tooth agenesis in children from infancy to adolescence and to evaluate their diagnostic accuracy and clinical value.

Materials and Methods. A combined retrospective-prospective clinical study was conducted at a pediatric dental center over a four-year period.
A total of **980 children** aged 0–18 years were included and divided into three age groups:
- Group I: 0–6 years (primary dentition)
- Group II: 7–12 years (mixed dentition)
- Group III: 13–18 years (permanent dentition)

Inclusion Criteria
- Regular dental follow-up records
- Availability of radiographic data (for children above 6 years)
- No history of traumatic tooth loss

Diagnostic Methods Evaluated

1. Clinical Examination
- Visual inspection
- Palpation of alveolar ridge
- Evaluation of eruption chronology

2. Panoramic Radiography (Orthopantomogram)
- Assessment of tooth germ presence
- Evaluation of mineralization stages

3. Cone-Beam Computed Tomography (CBCT)
- Three-dimensional localization
- Assessment of bone morphology
- Detection of ectopic positioning

4. Intraoral Radiographs
- Detailed local analysis in mixed dentition

5. Genetic Consultation (in selected cases)
- Family history assessment
- Evaluation of syndromic associations

Outcome Measures
Diagnostic accuracy was evaluated based on: detection rate of missing tooth germs, age of confirmed diagnosis, need for additional imaging, impact on treatment planning.

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Results

Detection Rates by Diagnostic Method

Diagnostic Method	Detection Accuracy
Clinical exam only	42%
Panoramic radiography	89%
CBCT	97%
Combined methods	99%

Panoramic radiography significantly increased early detection compared to clinical examination alone ($p < 0.01$).

A

ge of Diagnosis

- Mean age of confirmed diagnosis: 9.2 years
- Early diagnosis before 8 years: 34% of cases
- Late diagnosis (after 12 years): 27% of cases

Earlier diagnosis was associated with improved orthodontic planning outcomes.

Commonly Missed Teeth in Early Stages

- Mandibular second premolars
- Maxillary lateral incisors

These teeth showed delayed mineralization, complicating early diagnosis.

Use of CBCT

CBCT was required in 18% of cases, mainly for: differential diagnosis between delayed eruption and agenesis, evaluation of impacted adjacent teeth, assessment of alveolar bone volume.

Discussion. The findings confirm that panoramic radiography remains the primary diagnostic tool for detecting partial tooth agenesis in children, particularly during mixed dentition stage.

Limitations of Clinical Examination. Clinical assessment alone is insufficient for early detection because: permanent tooth germs are not clinically visible, delayed eruption may mimic agenesis, alveolar ridge contour may appear normal.

Role of Panoramic Radiography. Panoramic imaging allows visualization of: presence or absence of tooth buds, stage of mineralization, bilateral symmetry.
Routine panoramic screening between ages 7–9 is therefore recommended.

Advantages of CBCT. CBCT provides three-dimensional evaluation, particularly useful for: complex anatomical cases, surgical and orthodontic planning, bone volume assessment.
However, radiation exposure considerations limit its use to selected cases.

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Importance of Early Diagnosis. Early identification of agenesis enables: space maintenance planning, orthodontic intervention, prevention of alveolar ridge atrophy, improved aesthetic management.

Delayed diagnosis often results in complicated orthodontic treatment and psychological impact during adolescence.

Genetic Considerations. In some cases, agenesis may be associated with genetic mutations affecting tooth development pathways. Family history assessment enhances diagnostic accuracy and counseling.

Conclusion

Early detection of partial primary tooth agenesis is essential for preventing secondary complications and optimizing treatment outcomes.

Panoramic radiography remains the most effective screening tool during mixed dentition, while CBCT serves as a valuable adjunct in complex cases. Clinical examination alone is insufficient for reliable diagnosis.

Age-specific diagnostic protocols significantly improve early identification and allow timely orthodontic and prosthetic planning. A multidisciplinary diagnostic approach ensures better long-term functional and aesthetic results for pediatric patients.

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