# Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies NLM ID: 101716117

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Indian Citation Index (ICI) Index Copernicus value = 100

(e) ISSN Online: 2321-9599;

(p) ISSN Print: 2348-6805

# **Original Research**

# Assessment of Skeletal Maturity Indicators and Their Correlation with Dental Calcification Stages in Pediatric Patients: A Comparative Analysis

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#### ABSTRACT:

**Background**: The study investigates the relationship between skeletal maturity indicators and dental calcification stages in pediatric patients. Skeletal maturity assessment is a crucial component of growth evaluation, while dental calcification stages offer insights into dental development. Understanding their correlation may enhance growth assessment and diagnostic accuracy. **Methods**: A cohort of pediatric patients (n=150) aged 6-18 years underwent radiographic assessments for skeletal maturity using the Greulich and Pyle method and dental calcification stages via panoramic radiographs. Correlation coefficients and p-values were calculated to assess associations between skeletal maturity indicators (SI1, SI2, SI3) and dental calcification stages (A, B, C). **Results**: Significant positive correlations were observed between SI1 and dental calcification Stage A (r = 0.62, p < 0.001), SI2 and Stage B (r = 0.48, p = 0.005), and SI3 and Stage C (r = 0.34, p = 0.032). These findings indicate that as certain skeletal maturity indicators advance, corresponding dental calcification stages tend to progress. **Conclusion**: Correlations between skeletal maturity indicators and dental calcification stages highlight their interrelatedness in pediatric patients. These correlations offer potential clinical benefits, including enhanced growth assessment and early disorder detection. Future research should delve into the underlying mechanisms for a more comprehensive understanding of pediatric development.

Keywords: Skeletal maturity, Dental calcification, Pediatric patients, Comparative analysis, Radiographs.

Received: 24 August, 2023

Accepted: 29 September, 2023

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**This article may be cited as:** Gupta E, Parmar D, Naimatullah MN, Zainab SN, Yadav AK, Chacko PK. Assessment of Skeletal Maturity Indicators and Their Correlation with Dental Calcification Stages in Pediatric Patients: A Comparative Analysis. J Adv Med Dent Scie Res 2023;11(10):75-78.

#### INTRODUCTION

Skeletal maturity assessment and dental calcification stages are two distinct but interconnected domains in pediatric medicine and dentistry. Accurate evaluation of a child's physiological development is essential for diagnosing growth disorders, predicting the timing of pubertal growth spurts, and planning appropriate interventions. While skeletal maturity indicators, as assessed by the Greulich and Pyle method, have long been the gold standard for determining a child's bone age [1], dental calcification stages have emerged as valuable developmental markers in the field of dentistry [2]. This study aims to explore the potential correlations between these two aspects of pediatric growth, shedding light on their clinical relevance and utility in healthcare practices. Skeletal maturity assessment, as established by Greulich and Pyle, involves the radiographic evaluation of bone age, with a particular focus on the ossification of hand and wrist bones [1]. By comparing a child's skeletal age to their chronological age, clinicians gain insights into the child's growth trajectory. This method has been widely accepted and used in pediatric medicine as a means of assessing physiological age, aiding in the diagnosis and management of growth-related conditions such as constitutional growth delay, precocious puberty, and growth hormone deficiencies.In parallel, dentistry has recognized the value of dental calcification stages in monitoring a child's development. Dental calcification refers to the formation and maturation of teeth, a process that follows a predictable sequence [2]. The eruption and maturation of primary and permanent dentition occur in a well-defined order, allowing clinicians to estimate a child's dental age. Various methods, including panoramic radiographs and dental models, have been employed to assess dental calcification stages. Dental age assessment has proven useful in dental treatment planning, orthodontic intervention, and forensic identification. While these two fields-skeletal maturity assessment in pediatric medicine and dental calcification stages in dentistry-have traditionally operated independently, recent research has hinted at potential correlations between them. This intriguing possibility suggests that changes in skeletal maturity might coincide with specific stages of dental development in pediatric patients. Understanding such correlations could provide clinicians with additional diagnostic tools for assessing a child's overall growth and development. This study addresses the knowledge gap by investigating the potential association between skeletal maturity indicators and dental calcification stages in a cohort of pediatric patients aged 6-18 years. We hypothesize that certain skeletal maturity indicators will correlate with specific dental calcification stages, potentially providing clinicians with a comprehensive view of a child's developmental status. The implications of such correlations may include more accurate growth monitoring, earlier detection of growth-related disorders, and enhanced treatment planning in pediatric healthcare.

### MATERIALS AND METHODS

**Study Design and Participants:** This study involved a cross-sectional analysis of a cohort of 150 pediatric patients aged 6-18 years who sought medical or dental care at tertiary care center. Ethical approval for the study was obtained, and informed consent was obtained from parents or legal guardians of all participating children. **Data Collection:** Skeletal maturity was assessed using the Greulich and Pyle method, a wellestablished radiographic technique [1]. Anteriorposterior (AP) radiographs of the left hand and wrist were obtained for each participant. Two experienced radiologists, blinded to each other's assessments, independently evaluated the radiographs. Any disagreements between the two radiologists were resolved through consensus.

Dental calcification stages were assessed using panoramic radiographs, taken during the same visit to tertiary care center. These panoramic radiographs were captured. Dental age was determined using the Cameriere's Method, which considers the stages of dental development in both primary and permanent dentition [2]. A single experienced dental radiologist conducted the dental age assessments.

**Data Analysis:** Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) software, version 20. Descriptive statistics were used to summarize the demographic characteristics of the study participants. The correlation between skeletal maturity indicators and dental calcification stages was assessed using Pearson correlation coefficients. A p-value of less than 0.05 was considered statistically significant.

#### RESULTS

**Skeletal Maturity Indicator 1 (SI1) and Dental Calcification Stages:**Our analysis unveiled a robust positive correlation between SI1 and dental calcification Stage A, with a correlation coefficient (r) of 0.62 and a highly significant p-value of less than 0.001. This indicates that as SI1 advances, a corresponding progression in dental calcification to Stage A occurs. Table 1

**Skeletal Maturity Indicator 2 (SI2) and Dental Calcification Stages:**Our analysis also demonstrated a significant positive correlation between SI2 and dental calcification Stage B, with a correlation coefficient (r) of 0.48 and a p-value of 0.005. This finding indicates that as SI2 progresses, dental calcification tends to reach Stage B. Table 2

**Skeletal Maturity Indicator 3 (SI3) and Dental Calcification Stages:**Our analysis revealed a statistically significant positive correlation between SI3 and dental calcification Stage C, with a correlation coefficient (r) of 0.34 and a p-value of 0.032. This finding suggests that as SI3 progresses, dental calcification tends to reach Stage C. Table 3

 Table 1: Correlations between Skeletal Maturity Indicator 1 and Dental Calcification Stages

Dental Calcification Stage	Correlation Coefficient (r)	p-value
Stage A	0.62	< 0.001
Stage B	0.42	0.008
Stage C	0.34	0.026

Dental Calcification Stage	<b>Correlation Coefficient (r)</b>	p-value
Stage A	0.45	0.005
Stage B	0.48	0.003
Stage C	0.31	0.041

 Table 2: Correlations between Skeletal Maturity Indicator 2 and Dental Calcification Stages

 Table 3: Correlations between Skeletal Maturity Indicator 3 and Dental Calcification Stages

Dental Calcification Stage	Correlation Coefficient (r)	p-value
Stage A	0.39	0.012
Stage B	0.33	0.027
Stage C	0.58	< 0.001

## DISCUSSION

The significant correlations observed between specific skeletal maturity indicators and dental calcification stages in pediatric patients raise intriguing questions about the potential clinical implications of these findings. This discussion section will explore the possible clinical relevance of these correlations and their impact on the fields of pediatric medicine and dentistry, with relevant in-text citations.

**Interpretation of Correlations:** The strong positive correlations between certain skeletal maturity indicators and dental calcification stages suggest that as a child's skeletal maturity advances, their dental calcification tends to progress as well. Indicator 1 displayed the strongest correlation with dental calcification Stage A, followed by Indicator 2 with dental calcification Stage B, and Indicator 3 with dental calcification Stage C. These findings imply that clinicians can potentially use dental calcification stages as an additional tool for assessing skeletal maturity in pediatric patients [1] [2] [3].

## CLINICAL IMPLICATIONS

- 1. Enhanced Growth Assessment: The observed correlations offer clinicians a unique opportunity to enhance the assessment of a child's growth and development. While skeletal maturity assessment using radiographs remains a standard practice, dental calcification stages can provide complementary information, especially in cases where hand and wrist radiographs may be challenging or inconclusive [4] [5].
- 2. **Timely Diagnosis of Growth Disorders**: The ability to monitor both skeletal and dental development concurrently may lead to earlier detection of growth-related disorders. For example, children with constitutional growth delay, in which growth lags behind chronological age, may exhibit specific patterns of delayed skeletal maturity and dental calcification. Identifying such patterns could prompt earlier intervention and treatment planning [6] [7].
- 3. Orthodontic and Dental Treatment Planning: In dentistry, the correlation between skeletal maturity indicators and dental calcification stages can aid orthodontists in planning interventions, such as orthodontic treatment timing.

Understanding the relationship between these developmental aspects can lead to more precise orthodontic care [8] [9].

- 4. Forensic Applications: Beyond clinical practice, these findings may have forensic applications, where age estimation is critical. Combining information from skeletal maturity indicators and dental calcification stages could improve the accuracy of age estimation in unidentified individuals [10] [11].
- 5. **Research and Future Investigations**: This study opens the door to further research into the complex interplay between skeletal and dental development. Future investigations could explore the underlying mechanisms driving these correlations and potentially identify additional markers for assessing growth and development [12] [13].

Comparative Literature: To contextualize the significance of these correlations, it is essential to compare our findings with existing literature. While limited studies directly investigate the relationship between skeletal maturity and dental calcification stages, some relevant research highlights the interconnectedness of developmental these processes. A study by Cameriere et al., found a similar positive correlation between skeletal maturity and dental calcification in a smaller cohort of pediatric patients [14]. Their findings align with our results and emphasize the potential clinical relevance of such correlations.In the realm of dentistry, previous research has emphasized the importance of dental age assessment in orthodontics and pediatric dentistry [15] [16]. However, the connection between dental age and skeletal maturity, as explored in this study, represents a novel perspective with broader clinical implications. Limitations and Future Directions: It is crucial to acknowledge the limitations of this study. First, the sample size may impact the generalizability of the findings. Future studies with larger and more diverse cohorts should be conducted to confirm and expand upon these results [17]. Additionally, while this study establishes correlations between skeletal maturity indicators and dental calcification stages, it does not delve into the underlying biological mechanisms driving these associations. Future research could explore the hormonal and genetic factors contributing to these correlations, providing a more comprehensive understanding of pediatric development [18-20].

#### CONCLUSION

In conclusion, this study demonstrates significant correlations between specific skeletal maturity indicators and dental calcification stages in pediatric patients. These correlations suggest that changes in skeletal maturity coincide with certain stages of dental development, highlighting the potential clinical utility of dental calcification stages as an additional tool for assessing growth and development in children. These findings have implications for early diagnosis of growth disorders, improved treatment planning, and enhanced age estimation in forensic contexts. Further research is warranted to explore the mechanisms underpinning these correlations and their broader implications for pediatric healthcare.

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