

Patterns of Extractions and Restorations in Mixed Dentition: A Retrospective Descriptive Study

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ABSTRACT

Background: The mixed dentition period is a critical stage of dental development and is associated with dental caries, pulpal disease, and premature loss or persistence of primary teeth. This study aimed to describe patterns of restorative treatment and tooth extraction among patients in the mixed dentition stage.

Methods: This retrospective descriptive study analyzed 85 medical records of patients in the mixed dentition stage treated at Dental Care, Kramat Jati, Jakarta, from January 2025 to March 2026. Data on age, sex, clinical diagnosis, restorative treatment, and tooth extraction were analyzed descriptively using frequencies and percentages.

Results: Of the 85 patients, 45 (52.9%) were girls and 40 (47.1%) were boys. The largest age group was 6–7 years (51; 60.0%). Restorative treatment was performed in 50 cases (58.8%), while 35 cases (41.2%) underwent extraction. Temporary filling was the most common restorative procedure (28 cases), followed by GIC filling (15 cases). The most frequent diagnoses were persistence of primary teeth (31; 36.5%), irreversible pulpitis (23; 27.1%), and dentine caries (19; 22.4%). Restorative treatment was more common in children aged 6–9 years, whereas extraction was more frequent among those aged 10–11 years. Persistence of primary teeth was the main indication for extraction.

Conclusions: Restorative treatment was more frequently performed than tooth extraction during the mixed dentition period. Dentine caries and pulpal conditions were the main indications for restorative treatment, while persistence of primary teeth was the predominant indication for extraction.

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INTRODUCTION

Primary teeth, also known as deciduous teeth, are the first set of teeth in children and are eventually replaced by permanent teeth¹. Primary teeth play important roles in mastication, speech development, facial aesthetics, and maintaining a pleasing smile. They also guide the eruption of permanent teeth and preserve arch space, thereby preventing crowding and malocclusion²⁻⁴. Oral health problems in primary teeth include dental caries and tooth loss⁵⁻⁷. Dental caries is a significant health problem for children^{8,9} because children with dental caries experience more learning difficulties and are more likely to be absent from school^{10,11}. Data from the Indonesian Health Survey (SKI) show that 57% of children aged 3 years and older experience dental problems¹². Globally, the World Health Organization (WHO) reports that 60%–90% of school-aged children are affected by dental caries¹³. This is consistent with previous studies showing that dental caries remains a prevalent oral health problem in many parts of the world¹⁴⁻²¹. Dental caries is a common and progressive disease associated with cariogenic bacteria, particularly *Streptococcus mutans*. These bacteria convert sugars from food into acids, slowly destroying and weakening tooth structure²². Other researchers describe dental caries as a complex, multifactorial, non-communicable disease mediated by biofilms, influenced by dietary factors, and characterized by progressive mineral loss of the dental hard tissues²³. However, when detected and treated early, dental caries can be managed effectively through restorative treatment²⁴.

Physiological root resorption enables primary teeth to exfoliate naturally and be replaced by permanent teeth. This process provides the space and eruption pathway required for permanent successors to emerge²⁵. Disruptions to this physiological process might lead to the retention (persistence) of primary teeth, which can hinder the normal emergence of permanent teeth and contribute to malocclusion²⁵. Dental trauma to primary teeth has the potential to interfere with the normal development and emergence of permanent replacement teeth²⁶. Furthermore, severe dental caries and pulpal infection in primary teeth can result in premature tooth loss, increasing the risk of eruption disturbances and malalignment of the permanent dentition²⁷.

The risk of dental caries increases during the mixed dentition period because newly erupted permanent molars are not yet fully mature and are more difficult to clean²⁸. The mixed dentition phase, which occurs between 6 and 12 years of age, represents a critical period that significantly influences craniofacial growth and the establishment of occlusal relationships²⁹. The first permanent molars erupt around the age of six, emerging behind the primary teeth without replacing them. These teeth are highly susceptible to caries during childhood and early adolescence.. When these teeth are severely affected by caries, clinicians must determine whether they should be preserved through restorative treatment or extracted, taking into account pulpal status, prognosis, and the potential for replacement by the second permanent molars³⁰⁻³².

Understanding the patterns of restorative treatment and tooth extraction during the mixed dentition period is important for identifying common clinical conditions requiring intervention and for supporting evidence-based treatment planning. Therefore, this retrospective descriptive study aimed to describe the patterns of restorative treatment and tooth extraction among patients in the mixed dentition stage using clinical record data. The findings are expected to provide valuable information for improving preventive strategies, promoting early intervention, and supporting appropriate pediatric dental care.

RESEARCH METHOD

This study was a retrospective descriptive study. Ethical approval was obtained from the Ethics Committee of Sultan Agung Islamic University, Semarang (Approval Number: 952/B.1-KEPK/SA-FKG/VII/2026). Data were collected from patient medical records at Dental Care, Kramat Jati, Jakarta, between January 2025 and Maret 2026. The sampling technique employed was purposive sampling. A total of 85 medical records that met the eligibility criteria were included in the study.

The study population consisted of pediatric patients in the mixed dentition stage who received dental treatment during the study period. The inclusion criteria were medical records of patients aged 6–12 years with mixed dentition and complete documentation of dental examinations and treatment procedures. The exclusion criteria were medical records with incomplete data, unclear treatment records, or missing information regarding the type of dental treatment performed.

The variables collected included patient age, sex, dentition status, type of tooth treated, restorative treatment performed, and tooth extraction procedures. Restorative treatments and extractions were categorized and analyzed descriptively according to their frequency and distribution. Data were analyzed using descriptive statistics and presented as frequencies and percentages to describe the patterns of restorative treatment and tooth extraction among patients in the mixed dentition stage.

RESULTS

Age (Year)	Table 1. Respondent Characteristics			
	Gender		Frequency (n)	Percentage (%)
	Girl	Boy		
6-7	26	25	51	60%
8-9	13	10	23	27.1%
10-11	6	5	11	12.9%
Total	45	40	85	100%

Table 1 presents the characteristics of the study participants. A total of 85 children in the mixed dentition stage were included, comprising 45 girls (52.9%) and 40 boys (47.1%). The participants ranged in age from 6 to 11 years. The largest age group was 6–7 years, comprising 51 participants (60.0%), followed by the 8–9-year age group with 23 participants (27.1%) and the 10–11-year age group with 11 participants (12.9%).

Table 2. Distribution of Clinical Diagnosis			
Clinical Diagnoses	Category	Frequency (n)	Percentage (%)
Caries	Dentine Caries	19	22.4
	Profunda Caries	1	1.2
Pulp	Reversible Pulpitis	3	3.5
	Irreversible Pulpitis	23	27.1
	Pulp Necrosis	6	7.1
	Gangrene radix	1	1.2
Normality of tooth change	Physiological resorption	1	1.2
	Persistence	31	36.5
Total		85	100

Table 2 presents the distribution of clinical diagnoses. The diagnoses were categorized into caries, pulpal conditions, and abnormalities related to tooth exfoliation. Persistence was the most frequently recorded

diagnosis (n = 31; 36.5%), followed by irreversible pulpitis (n = 23; 27.1%) and dentine caries (n = 19; 22.4%). Other diagnoses included pulp necrosis (n = 6; 7.1%), reversible pulpitis (n = 3; 3.5%), profunda caries (n = 1; 1.2%), radicular gangrene (n = 1; 1.2%), and physiological root resorption (n = 1; 1.2%).

Table 3. Action Types Based on Caries Severity Level

Category	Restoration						Extraction	Total
	Pulpectomy and GIC filling	Pulpectomy	Temporary Filling	GIC filling	Composite filling	RCT		
Dentine Caries	0	0	2	14	3	0	0	19
profunda Caries	0	0	0	0	1	0	0	1
Total	0	0	2	14	4	0	0	20

Table 3 presents treatment procedures according to caries severity. Dentine caries was the most frequently recorded caries diagnosis (n = 19). GIC filling was the most frequently performed treatment for dentine caries (n = 14), followed by composite filling (n = 3) and temporary filling (n = 2). One case of profunda caries was treated with a composite filling. No extraction was recorded among the cases diagnosed with caries.

Table 4. Action Types Based on Pulpal Diagnoses

Category	Restoration						Extraction	Total
	Pulpectomy and GIC filling	Pulpectomy	Temporary Filling	GIC filling	Composite Filling	RCT		
Reversible Pulpitis	0	0	2	1	0	0	0	3
Irreversible pulpitis	0	0	22	0	0	0	1	23
Pulp Necrosis	3	0	2	0	0	0	1	6
Radicular gangrene	0	0	0	0	0	0	1	1
Total	3	0	26	1	0	0	3	33

Table 4 shows the distribution of treatment procedures according to pulpal diagnosis. Irreversible pulpitis was the most common pulpal diagnosis (n = 23), with most cases managed using temporary fillings (n = 22) and one case requiring extraction. Cases of pulp necrosis were managed with temporary fillings (n = 2), pulpectomy with GIC filling (n = 3), and extraction (n = 1). Reversible pulpitis was managed using temporary fillings (n = 2) and GIC filling (n = 1). One case of radicular gangrene was managed by extraction.

Table 5. Action Types Based on Normality of Tooth Change

Category	Extraction	Total
Physiological root resorption	1	1
Persistence	31	31
Total	32	32

Table 5 shows that persistence was the most common indication for tooth extraction (n = 31), whereas only one extraction was associated with physiological root resorption.

Table 6. Distribution of Dental Actions

Action Types	Frequency (n)	Percentage (%)
Restoration:		58,8%
a. Pulpectomy and GIC filling	a. 3	
b. Pulpectomy	b. 0	

c. Temporary filling	c. 28	
d. GIC filling	d. 15	
e. Composite filling	e. 4	
f. Root Canal Treatment (RCT)	f. 0	
	50	
Total		
Extraction	35	41,2%
Total	85	100%

Table 6 shows that restorative treatment was more frequently performed than tooth extraction. Among restorative procedures, temporary filling was the most frequently performed treatment (n = 28), followed by GIC filling (n = 15), composite filling (n = 4), and pulpectomy with GIC filling (n = 3). Overall, 50 cases (58.8%) received restorative treatment, whereas 35 cases (41.2%) underwent tooth extraction.

Table 7. Comparison of Restoration and Extraction Based on Diagnosis

Diagnosis	Extraction	Restoration	Total
Persistence	31	0	31
Irreversible pulpitis	1	22	23
Dentine caries	0	19	19
Pulpal necrosis	1	5	6
Reversible pulpitis	0	3	3
Profunda caries	0	1	1
Physiological root resorption	1	0	1
Radicular gangrene	1	0	1
Total	35 (41,2%)	50 (58,8%)	85 (100%)

Table 7 presents the distribution of restorative treatment and tooth extraction according to diagnosis. Persistence was exclusively managed by tooth extraction (n = 31). Dentine caries and profunda caries were managed exclusively with restorative treatment. Most cases of irreversible pulpitis and pulp necrosis were also managed restoratively, although some cases required extraction. Overall, restorative treatment was performed more frequently (n = 50; 58.8%) than tooth extraction (n = 35; 41.2%).

Table 8. Distribution of Extraction and Restorative Treatment According to Age

	Age (Year)	Extraction (n)	Restoration (n)	Total n (%)
Mixed	6–7	15	34	49 (57.6%)
dentition	8–9	10	12	22 (25.9%)
period	10–11	10	4	14 (16.5%)
Total		35	50	85 (100%)

Table 8, presents the distribution of extraction and restorative treatment according to age. The highest number of dental procedures was recorded among children aged 6–7 years, with 49 procedures (57.6%), comprising 15 extractions and 34 restorative treatments. In the 8–9-year age group, 22 procedures (25.9%) were recorded, comprising 10 extractions and 12 restorative treatments. Among children aged 10–11 years, 14 procedures (16.5%) were recorded, comprising 10 extractions and 4 restorative treatments. Restorative treatment was more frequently performed than extraction among children aged 6–7 and 8–9 years, whereas extraction was more frequent than restorative treatment among children aged 10–11 years.

DISCUSSION

The present study identified three main categories of clinical diagnoses among children in the mixed dentition stage: dental caries, pulpal conditions, and abnormalities related to tooth exfoliation. Dental caries included dentine caries and profunda caries, while pulpal conditions included reversible pulpitis, irreversible pulpitis, pulp necrosis, and radicular gangrene. Abnormalities related to tooth exfoliation included physiological root resorption and persistence. Among these categories, pulpal conditions were the most frequently recorded diagnoses (38.8%), followed by abnormalities related to tooth exfoliation (37.6%) and dental caries (23.5%). No cases of superficial caries were recorded. Overall, restorative treatment was performed more frequently than tooth extraction, although extraction was more common than restorative treatment among children aged 10–11 years. Restorative treatment was most frequently associated with pulpal conditions, whereas extraction was predominantly associated with persistence of primary teeth.

Dental caries is a chronic disease affecting the hard tissues of the teeth and may progress to pulpal involvement and periapical complications if left untreated³⁴. In the present study, dentine caries was the most frequently recorded caries diagnosis ($n = 19$; 22.4%), whereas no cases of superficial caries were identified. This finding may suggest that children with early-stage caries were less likely to seek dental care, potentially because early carious lesions are often asymptomatic. As a result, children may present for treatment when the disease has progressed to dentine caries, profunda caries, or pulpal involvement. Research conducted by Anil & Anand³⁵ similarly reported that early childhood caries may remain untreated because initial lesions are frequently asymptomatic, with children often presenting to dental services only after developing symptoms such as pain during chewing, spontaneous pain, or persistent discomfort. Restorative treatment is an important approach to managing dental caries while preserving tooth structure and function. Common restorative materials include dental amalgam, resin composite, and glass ionomer cement (GIC)³⁶. In this study, GIC filling was the most frequently performed treatment for dentine caries, accounting for 14 of 19 cases. The frequent use of GIC may be associated with its clinical advantages in pediatric dentistry, including chemical adhesion to tooth structure, fluoride release, and relatively simple clinical application. These properties make GIC a suitable restorative material for the management of carious lesions in children.

Pulpitis is an inflammatory condition of the dental pulp that may result from dental caries, trauma, operative procedures, thermal irritation, and chemical irritation, with bacterial infection being an important etiological factor^{37–39}. As dental caries progresses, microorganisms and their products can penetrate through dentinal tubules and eventually affect the dental pulp. If the inflammatory process is not appropriately managed, pulpitis may progress from a reversible to an irreversible condition and may eventually result in pulp necrosis and periapical disease⁴⁰.

Maintaining pulp health is important in children because preservation of the pulp contributes to the maintenance of tooth vitality and supports the normal development of immature teeth⁴¹. Early detection and appropriate treatment of pulpal disease are therefore important components of pediatric dental care. In the present study, pulpal conditions accounted for 33 of 85 cases (38.8%). Irreversible pulpitis was the most frequently recorded pulpal diagnosis ($n = 23$; 27.1%), followed by pulp necrosis ($n = 6$; 7.1%), reversible pulpitis ($n = 3$; 3.5%), and radicular gangrene ($n = 1$; 1.2%). The relatively high frequency of irreversible pulpitis may indicate that a considerable proportion of children presented for treatment after the disease had progressed to

an advanced pulpal stage. However, the reasons for delayed presentation could not be directly determined from the retrospective medical records.

Treatment patterns varied according to the pulpal diagnosis. Most cases of irreversible pulpitis were managed with temporary fillings ($n = 22$), while one case was treated by extraction. Cases of pulp necrosis were managed using pulpectomy with GIC filling ($n = 3$), temporary filling ($n = 2$), and extraction ($n = 1$). Reversible pulpitis was managed with temporary filling ($n = 2$) and GIC filling ($n = 1$), whereas the single case of radicular gangrene was treated by extraction. These findings indicate that treatment decisions varied according to the clinical condition and prognosis of the affected tooth. When a tooth remains suitable for preservation, conservative or restorative treatment may be preferred, whereas extraction may be considered when the tooth has a poor prognosis or cannot be predictably maintained.

Overall, restorative treatment was more frequently performed than tooth extraction. Of the 85 treatment cases, 50 (58.8%) received restorative treatment, whereas 35 (41.2%) underwent tooth extraction. Temporary filling was the most frequently performed restorative procedure ($n = 28$), followed by GIC filling ($n = 15$), composite filling ($n = 4$), and pulpectomy with GIC filling ($n = 3$). The predominance of restorative treatment suggests that preservation of affected teeth was frequently possible and considered in the management of children in the mixed dentition stage. Maintaining primary teeth when clinically appropriate is important because they contribute to mastication, speech, arch-space maintenance, and guidance of permanent tooth eruption.

The distribution of treatment according to age demonstrated a different pattern in the older age group. Restorative treatment was more frequent than extraction among children aged 6–7 years and 8–9 years. In contrast, among children aged 10–11 years, extraction was more frequent than restorative treatment, with 10 extractions and 4 restorative procedures. This pattern may be related to the progression of the transition from primary to permanent dentition during the later mixed dentition period. At this stage, primary teeth may become persistent or may have a poor prognosis because of advanced disease, making extraction more likely. Nevertheless, because this study was retrospective and descriptive, the factors responsible for the age-related differences cannot be established definitively.

Regarding abnormalities related to tooth exfoliation, persistence was the most frequently recorded diagnosis ($n = 31$; 36.5%), whereas physiological root resorption was recorded in only one case ($n = 1$; 1.2%). All cases of persistence were managed by tooth extraction. Persistence of primary teeth, also referred to as retained primary teeth, occurs when a primary tooth remains in the oral cavity beyond its expected time of exfoliation^{42,43}. This condition may occur during the mixed dentition period, when primary teeth are progressively replaced by their permanent successors⁴⁴. The persistence of primary teeth may be associated with several factors, including delayed physiological root resorption, abnormal position or development of the permanent successor, and other local or systemic factors⁴⁵. Previous studies have reported that persistence may occur during the early mixed dentition period and may be relatively common around the age of seven years^{45,46}. Differences in the prevalence and distribution of persistence among studies may be related to variations in age groups, sample characteristics, dentition status, and diagnostic criteria.

Persistent primary teeth that are not appropriately managed may interfere with the eruption and positioning of permanent teeth. Reported consequences include abnormal tooth position, crossbite, malocclusion, traumatic occlusal relationships, abrasion, and gingival recession⁴⁷. Therefore, early identification and appropriate management of persistent primary teeth are important during the mixed dentition period. In the

present study, the high frequency of extraction associated with persistence emphasizes the importance of monitoring the eruption sequence and exfoliation of primary teeth in children.

Parental awareness and supervision may also contribute to the maintenance of children's oral health and the early identification of abnormalities in tooth eruption and exfoliation. Inadequate oral hygiene practices and insufficient monitoring of dental development may contribute to delayed recognition of dental problems and increase the risk of caries and other oral health complications^{48,49}. Knowledge of the normal timing of tooth eruption and exfoliation may help parents recognize abnormalities at an early stage^{50–51}. However, parental knowledge, oral hygiene practices, and reasons for delayed dental attendance were not directly assessed in the present study. Therefore, these factors should be considered as possible explanations rather than direct conclusions from the findings.

Preventive dental care remains essential to reduce the progression of dental caries and the subsequent need for restorative or extraction treatment. Preventive strategies include appropriate toothbrushing, dietary counseling, regular dental examinations, topical fluoride application, and school-based oral health programs. School-based fluoride mouth-rinse programs have also been reported as an effective strategy for reducing dental caries among schoolchildren⁵². Early preventive intervention may help control caries progression, preserve primary teeth when clinically appropriate, and reduce the need for extraction.

Overall, this retrospective study demonstrates that restorative treatment was more frequently performed than tooth extraction among children in the mixed dentition stage. Pulpal conditions represented the most frequently recorded clinical diagnosis, while persistence was the most common diagnosis associated with extraction. Restorative treatment predominated among children aged 6–7 and 8–9 years, whereas extraction was more frequent among those aged 10–11 years. These findings highlight the importance of early diagnosis, timely restorative treatment, monitoring of tooth eruption and exfoliation, and preventive dental care during the mixed dentition period. Such measures may help preserve primary teeth when appropriate and reduce the progression of oral disease and the need for tooth extraction.

CONCLUSION

Restorative treatment was more frequently performed than tooth extraction among children in the mixed dentition stage, accounting for 58.8% and 41.2% of cases, respectively. Pulpal conditions, particularly irreversible pulpitis, were the main indications for restorative treatment, while persistence of primary teeth was the predominant indication for extraction. These findings may support appropriate treatment planning and early preventive dental care during the mixed dentition period.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest related to this study.

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