

Introduction

- The eruption timing and its position toward the back of the mouth make the first permanent molar (FPM) the **most caries-prone** teeth in the permanent dentition [1-3].
- Children in mixed dentition with extensive decay on the FPMs may require extraction.
- Early FPM extraction may result in unfavorable tooth *movements* or periodontal problems [4-6].
- There are no clear guidelines regarding the timing of FPM extraction** from the American Academy of Pediatric Dentistry or the American Association of Orthodontists.

Current Recommendations for spontaneous space closure by second permanent molar (SPM)





- The Royal College of Surgeons of England recommends the ideal time for extraction of is the **beginning of radiographic calcification of the SPM bifurcation**, which is typically **between 8 to 10 years of age** [7].
- Teo et al. (2013, 2016) Patel et al. (2017), suggest extraction of FPM **before development SPM furcation** area [8-10].

Objectives

- This study investigated the possibility of successful spontaneous space closure by SPM after extraction of the FPM due to caries, and to propose the optimal timing for FPM extraction.

Methods

- A 10-year retrospective review of patient records. Panoramic radiographs taken before and after extraction were used to analyze spontaneous space closure. A total of 2,579 charts of patients under the age of 12 years.

SPM Development Stages					
Crown		Calcification of second permanent molar crown	Furcation		Calcification of bifurcation
Early root		Less than 1/2 root length formation	Late root		More than 1/2 root formation

Assessment Grading Scale of Spontaneous Space Closure by SPM

I	Complete spontaneous space closure with minimum angulation
II	Incomplete spontaneous space closure occurred with mild angulation
III	Incomplete spontaneous closure occurred with moderate to severe angulation requires further intervention

Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none">Charts of patients under age of 12 at the time of extraction between 2010 and 2019Posted extraction codes (D7140 and D7210) for FPMEach extraction code was clinically independent and treated as a separate entity during the data analysis	<ul style="list-style-type: none">Incomplete pre and post extraction radiographsPast medical history directly affecting craniofacial development (i.e., cleft palate, etc)Hard tissue anomalies (i.e., pathology) on the radiographsCongenitally missing teeth (excluding third molars) or any abnormalities (i.e., ankylosis, impaction, developmental abnormalities)Patients were also excluded if orthodontic treatment was performed post-extraction

Methods (cont.)

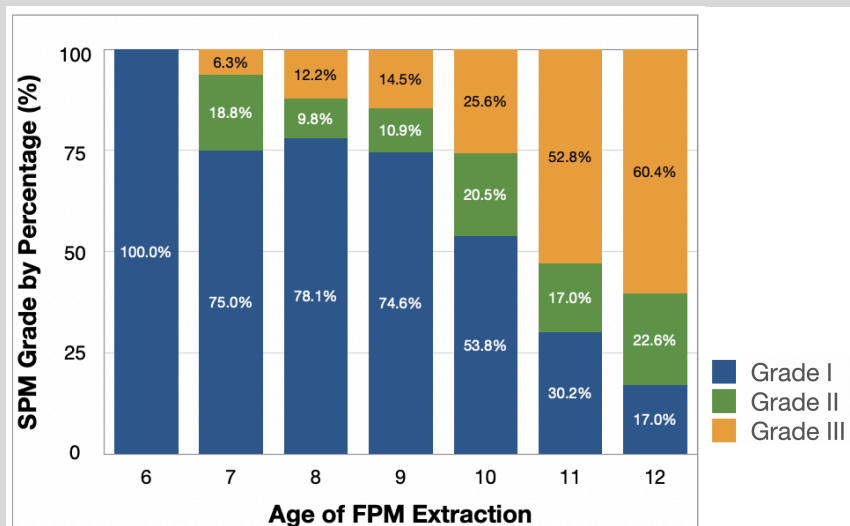
- Data Extraction:** Panoramic radiographs taken before and after extraction were used to analyze spontaneous space closure.

Results

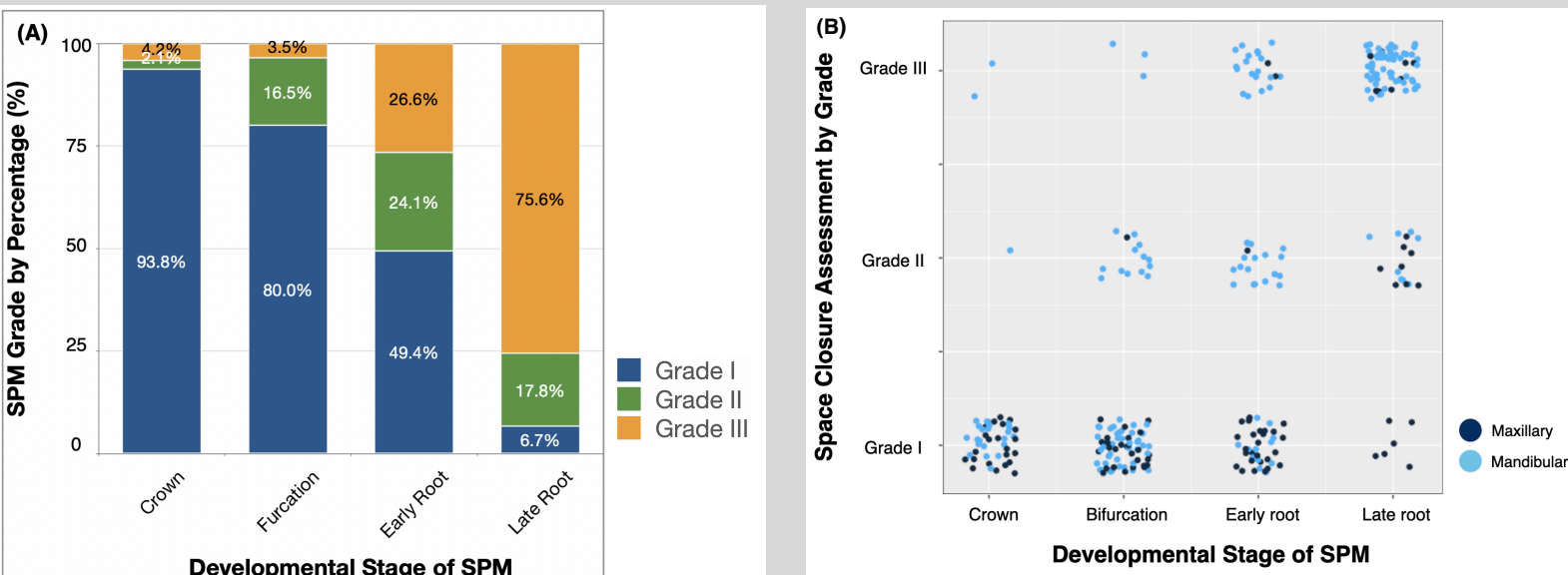
- Three hundred and two extraction sites met the inclusion criteria and were included in the final analysis.

Table 1. Patient Demographic and Clinical Characteristics			
Characteristic		N = 302	
Age	Anesthesia		
N	Local	154 (51%)	
Median (IQR)	Sedation	139 (46%)	
Mean (SD)	General	9 (3.0%)	
Molar	Orthodontic Referral		
Maxillary	No	135 (45%)	
Mandibular	Yes	167 (55%)	
Third molar			
Absent		18 (6.0%)	
Present		284 (94%)	

Success of SPM spontaneous space closure in relation to chronological age



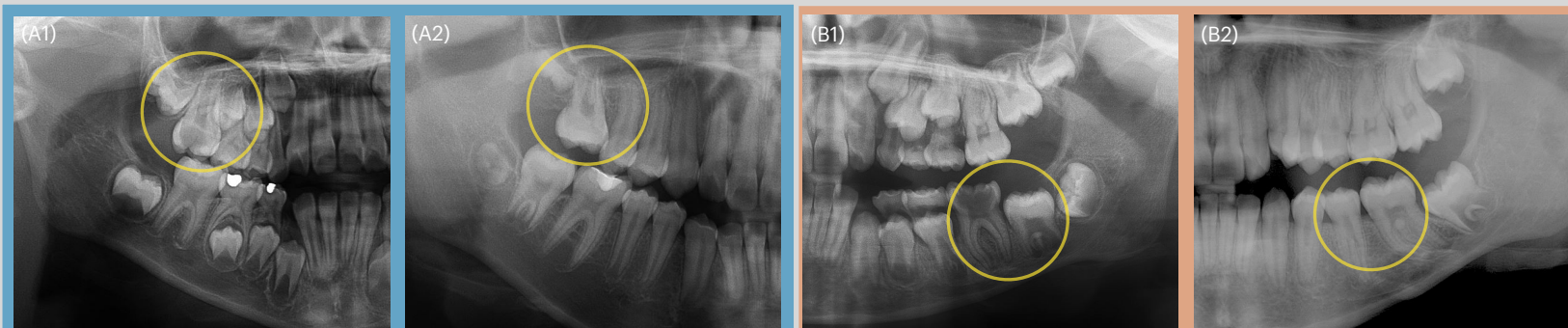
Success of SPM spontaneous space closure in relation to SPM developmental stage (A) and in relation to arch type (B)



- Success rate of spontaneous space closure after extraction of FPM was **significantly associated** with the **development stage** of the SPM ($p < 0.001$).
- Success rate associated with **arch type** was **statistically significant** ($p < 0.001$).
- The extractions of FPMs in the **maxillary arch may have favorable outcomes**, even at later stages of the SPM development.
 - Grade I success rate was 100% at the crown stage, 97% at bifurcation, 90% at early root, and 27.3% at late root stage.
- The mandibular arch may result in less favorable outcomes even at the crown stage and more so at later stages. Grade I success rate was 86% at the crown stage, 71% at bifurcation, 25% at early root, and 0% at late root stage.

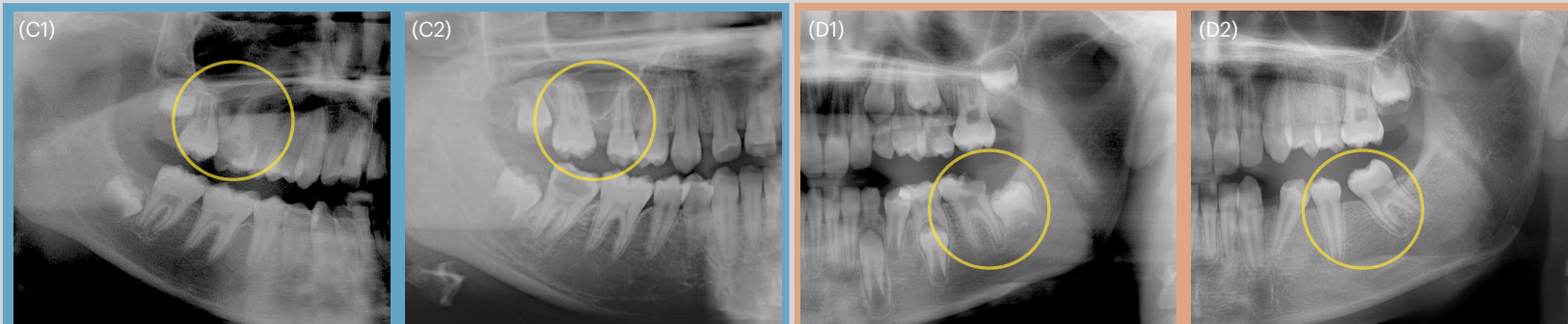
Results (cont.)

Panoramic radiographs before and after FPM extractions with **Grade I outcome** (1) FPM before extraction and (2) post extraction pano after eruption of SPM.



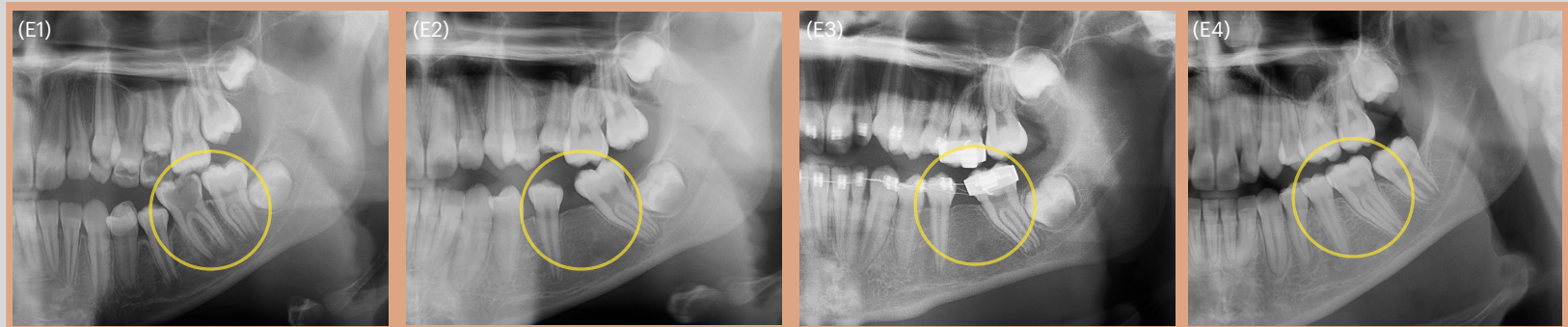
Grade I outcome demonstrated on maxillary and mandibular arch
(A) Tooth #3 extracted at the age of 7.3 years, post-op at age 12.8 years
(B) Tooth #19 extracted at the age of 9.7 years, post-op at age 13.1 years

Panoramic radiographs before and after FPM extractions with **Grade III outcome**



Grade III outcome demonstrated on maxillary and mandibular arch
(C) Tooth #3 extracted at the age of 12.2 years, post-op at 15.5 years
(D) Tooth #19 extracted at the age of 8.9 years, post-op at age 11.5 years

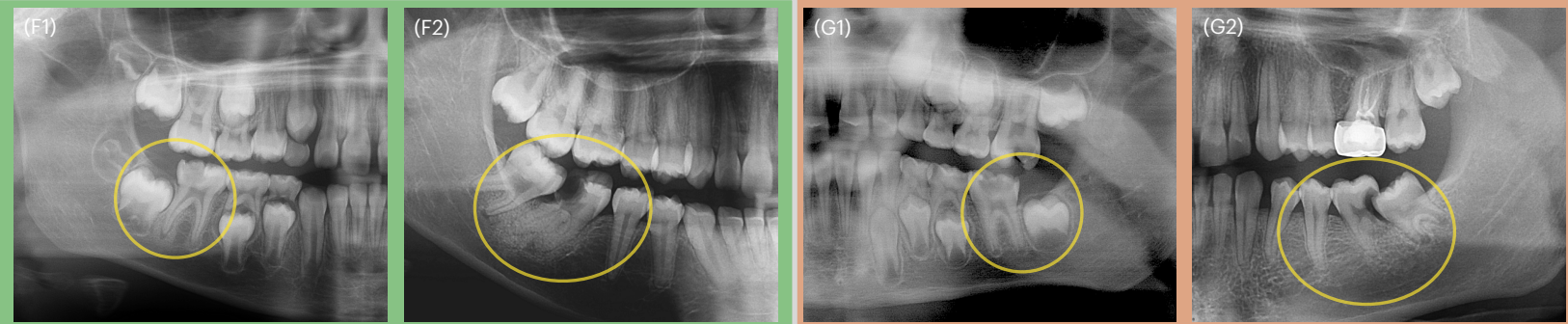
FPM extraction spontaneous space closure corrected with Orthodontic Treatment



Orthodontic treatment followed by extraction of FPM
(E1) Tooth #19 extracted at the age of 12.3 years, post-op
(E2) Post extraction pano at the age of 12.8 years
(E3) Pano during Orthodontic treatment at the age of 13.4 years
(E4) Post orthodontic treatment at the age of 18.7 years

Successful space closure by SPM but watch out!!

(1) FPM before extraction and (2) post extraction pano after eruption of SPM.



(F1) Tooth #30 extracted at the age of 8.3 years. (F2) Post extraction pano at age of 17.8 years shows complete spontaneous space closure by SPM. Now tooth #31 requires extraction due to caries.
(G1) Tooth #19 extracted at the age of 7.7 years. (G2) Complete spontaneous space closure achieved in post extraction pano at age of 13.7 years. Now due to #17 ectopic eruption now #18 requires extraction.

Discussion

- The developmental stage of SPM and chronological age, influences the success rate of spontaneous space closure.
- The probability of obtaining Grade I space closure was more than 75% at the age of 9, but the probability decreased to about half by the age of 10.
- Our data suggest that spontaneous space closure of the mandibular arch is less predictable.
- When the long-term prognosis of a carious FPM is poor, even if restoration is possible, extraction should be considered and presented as part of the comprehensive treatment plan.
- Well-timed extraction of the FPM can prevent or minimize unbalanced occlusion, or further interventions such as extensive orthodontic treatment.
- Child's social background, behavior, cooperation during restorative or orthodontic treatment, prevention and oral hygiene practices, and difficulties in accessing dental care should be considered.

Limitations

- Panoramic radiographs was the only method to investigate the spontaneous space closure.
- No other visual or clinical examinations (assessment of oral hygiene, periodontal health, and occlusal relationships).
- The developmental stage, distal drift, and shifting of the second permanent premolar were also not incorporated during the analysis.

Conclusions

- Early extraction of the FPM before age nine and the stage of SPM development before early root formation have strong potential to result successful spontaneous space closure. As chronological age increases, it is necessary to closely monitor tooth development.
- Extraction of FPMs in the maxillary arch yields higher success rates of spontaneous space closure than the mandibular arch.
- The maxillary arch may have potentially positive outcomes, regardless of a patient's chronological age or SPM developmental stage.
- In cases of FPM extraction, individual assessment is required, and it is recommended to closely monitor dental development and consider future orthodontic treatment if necessary.

References

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