

ABSTRACT

Purpose: The aim of this retrospective study was to determine factors influencing successful second molar substitution following extraction of the first permanent molar in patients aged 5 to 15 years.

Methods: A chart review was conducted of patients treated at the UTHealth Houston School of Dentistry who underwent one or more permanent first molar extractions between 2005 and 2025. Radiographs were evaluated and scored using the Demirjian developmental stages to classify the second molar and second bicuspid and Patel toolkit to determine the angulation of the permanent second molar. Successful substitution was defined as presence of a visible contact without marginal ridge discrepancy at a minimum of nine-month post-extraction follow up. Generalized linear models assessed how success varied across explanatory variables.

Results: Eighty-three patient charts and 118 teeth were analyzed. Visible contact was observed in 49% of cases, absence of marginal discrepancy in 23%, and overall successful substitution in 22%. Tooth extracted ($P < .001$), age at extraction ($P = .002$), Demirjian stage of the permanent second molar ($P = .003$) and second bicuspid ($P = .018$), Patel angulation ($P < .001$), and presence or absence of third molar ($P = .004$) were significant predictors of success. Ethnicity, gender, overjet and overbite were not significant ($P > .05$).

Conclusion: Permanent second molar substitution following extraction of permanent first molar remains a viable treatment option for permanent first molars that are non- or questionably-restorable. Providers must consider patient-specific factors to ensure timing of extraction is ideal for clinical success.

BACKGROUND

- ❑ Second molar substitution is a treatment option for compromised or grossly decayed first permanent molars and involves the second permanent molar acting as a replacement for the extracted first permanent molar (Cobourne et al., 2014).
- ❑ When selected as a treatment option, it requires careful planning and collaboration between the pediatric dentist and orthodontist to optimize outcomes (Cobourne et al., 2014).
- ❑ Variables that may affect success of molar substitution:
 - ❑ Age at extraction
 - ❑ Demirjian stage of the second molar and second bicuspid
 - ❑ Mandibular second molar angulation
 - ❑ Absence/presence of third molar
 - ❑ Ethnicity and Gender
 - ❑ Overjet and Overbite before and after extraction

The goal of this project was to identify the clinical and radiographic factors that contribute to effective second molar substitution in pediatric patients.

METHODS

- ❑ This retrospective study was approved by the UTHealth Houston Institutional Review Board.
- ❑ Patients were identified in the Electronic Health Record that had an extraction of a first permanent molar between February 2005 – February 2025.
- ❑ Inclusion Criteria:
 - ❑ Age five to fifteen years
 - ❑ Extraction of one or more permanent first molars
 - ❑ Follow-up of a minimum of nine months
- ❑ Radiographic Analysis:
 - ❑ Patel et al. (2017) angulation of permanent second molar.
 - ❑ Demirjian Development stage of the permanent second molar and second bicuspid (Demirjian et al., 1973)
- ❑ Outcome Definition: Successful second molar substitution (at follow-up)
 - ❑ Presence of a visible contact
 - ❑ No marginal ridge discrepancy

RESULTS

- ❑ **Sample:** 83 patients and 118 extracted permanent first molars.
- ❑ Visible contact was observed in 42.6% of cases, absence of marginal discrepancy in 20%, and overall successful substitution in 19.1%.
- ❑ **Significant Predictors:** Tooth extracted ($P < .001$), age at extraction ($P = .002$), Demirjian stage of the permanent second molar ($P = .003$) and second bicuspid ($P = .018$), and presence or absence of third molar ($P = .004$)
- ❑ **Not Significant:** Ethnicity, gender, overjet and overbite, and angulation of second molar were not significant ($P > .05$). Patel angulation was only significant for visible contact ($P < .001$).

Predictor	Visible Contact (X=1)	Marginal Discrepancy (Y=0)	Overall Success (Z=1)
Gender	0.333	1	0.813
Ethnicity	0.392	0.245	0.29
Tooth Type	0.001	0.001	0.001
Age at Extraction	0.001	0.002	0.003
Overjet Before	0.546	0.841	0.787
Overjet After	0.405	0.212	0.18
Overjet Change	0.983	0.423	0.338
Overbite Before	0.136	0.683	0.579
Overbite After	0.971	0.534	0.772
Overbite Change	0.583	0.756	0.986
Demirjian Stage – Second Molar	0.001	0.003	0.004
Demirjian Stage – Second Bicuspid	0.001	0.018	0.013
Patel Angulation	0.001	0.216	0.216
Third Molar Presence	0.017	0.004	0.01

Table 1: Variables Associated with Success

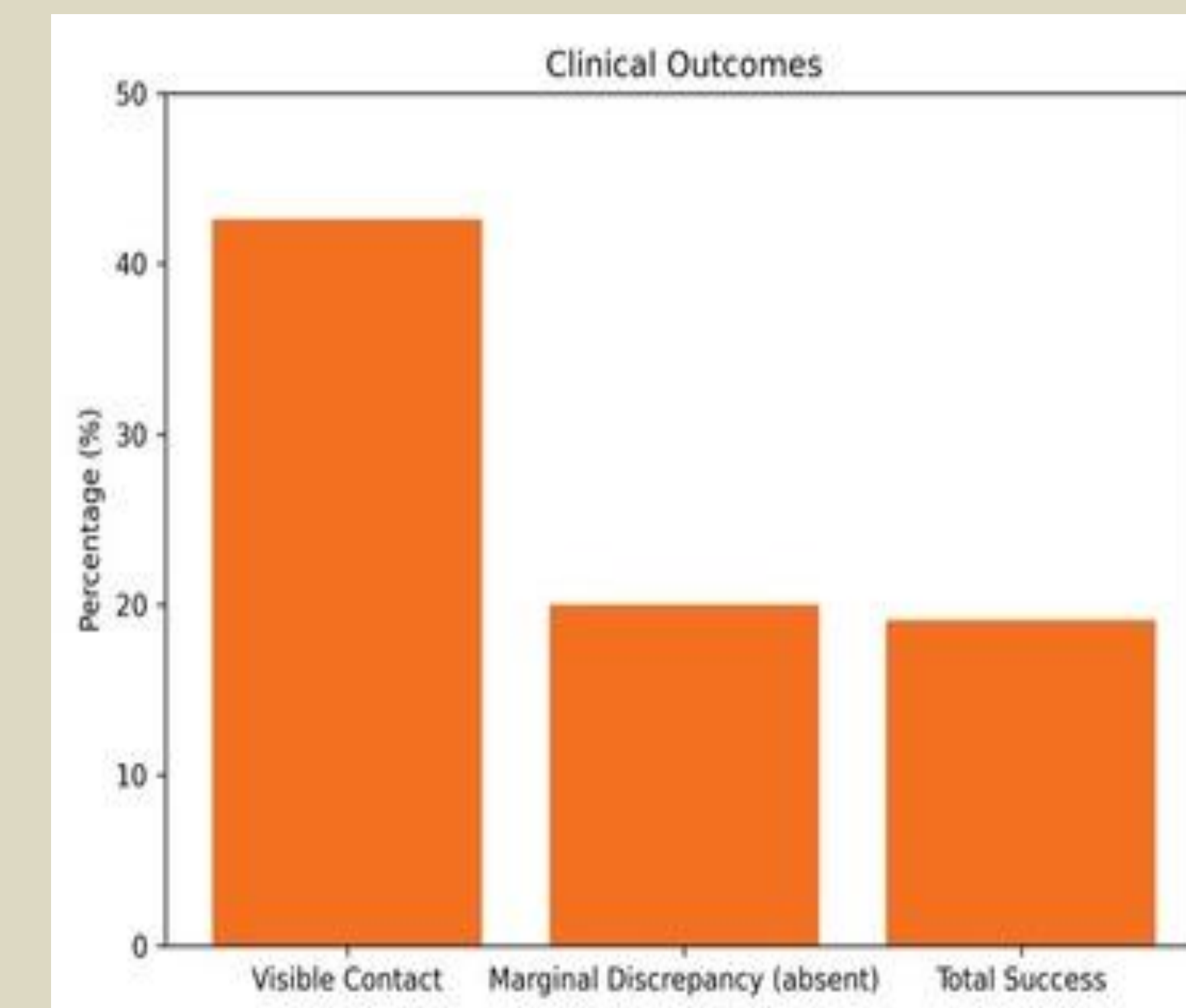


Figure 1: Clinical Outcomes

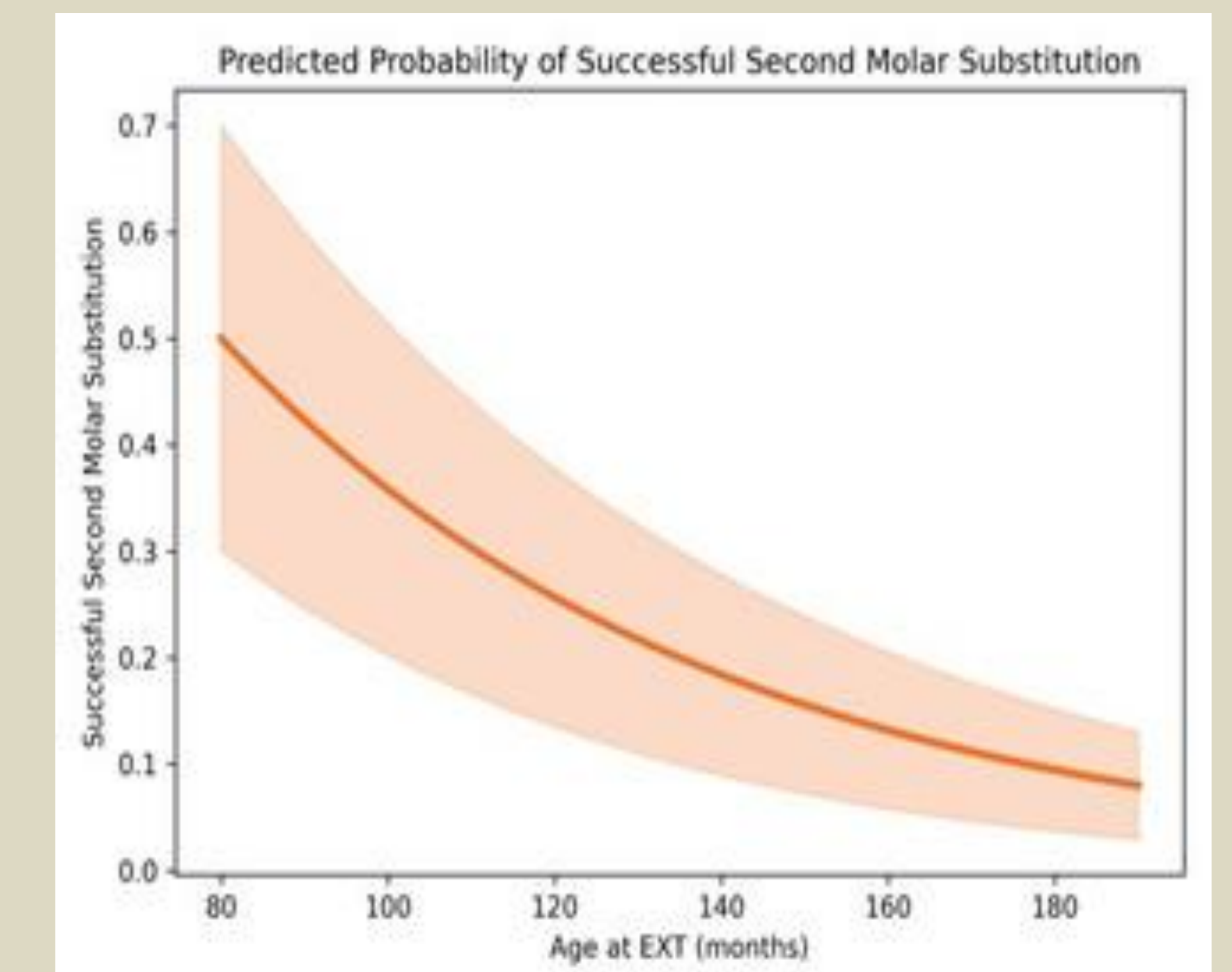


Figure 2: Predicted probability of successful second molar substitution by age at extraction

KEY FINDINGS and CLINICAL INDICATIONS

Key Findings:

- ❑ Younger age at extraction increased likelihood of successful substitution.
- ❑ Maxillary first molars demonstrated higher success rates compared to mandibular molars.
- ❑ Developmental stage of the second molar and second bicuspid were predictors of treatment success.
- ❑ Second molar angulation and third molar presence were statistically significant variables, but their clinical predictability was less consistent.

Clinical Indications:

- ❑ Second molar substitution is a viable treatment option for non- or questionably restorable first permanent molars.
- ❑ Consider patient-specific factors to ensure timing of extraction is ideal for clinical success.
- ❑ Interdisciplinary collaboration between pediatric dentists and orthodontist remains essential when planning second molar substitution.

Radiographic Analysis



References

