Retrospective Evaluation of the Success Rate and Factors Associated with the Stability of Alveolar Ridge Orthodontic Mini-screws

Sarah Abu Arqub BDS, M.Sc., M.Dent.Sc.[1], Sara Greene DDS [2], Renee Greene DDS, M.Sc. [2], Kolbe Laing [3], Chia-Ling Kuo Ph.D.[4], Lucas Da Cunha Godoy[4], Flavio Uribe DDS, M.Dent.Sc. [2]

[1]University of Florida, Department of Orthodontics, Gainesville, FL
[2]UConn Health, Division of Orthodontics, Department of Craniofacial Sciences, Farmington, CT
[3]University of Connecticut, School of Dental Medicine, Farmington, CT
[4]UConn Health, Connecticut Convergence Institute for Translation in Regenerative Engineering, Farmington, CT

INTRODUCTION

An uncommon location for orthodontic mini-screws is the alveolar ridge in an edentulous site. They were primarily indicated for pre-prosthetic molar uprighting because they may act as temporary teeth while providing stable anchorage and better force control. This retrospective study aimed to provide a comprehensive evaluation of the success rate of the alveolar ridge mini-screws and examine patients and treatment related factors that may have an impact on their treatment success.

METHODS & MATERIAL

Data from the record charts of the 295 patients treated with miniscrews at the Department of Orthodontics, University of Connecticut between January 2010 and February 2022 was used and screened against the inclusion criteria. The study was approved by the ethical committee (IRB# 22X-224-1). A total of 20 subjects [15 females and 5 males: mean age 39.70 + 15.59 years] who had 47 alveolar ridge miniscrews were included. A customized data collection form was used for the chart review. Data included patient-related factors (age, gender, malocclusion type I, II, or III, smoking status) and treatment-related factors (the use of other types of miniscrews, treatment duration, number of miniscrews used for each patient, site of miniscrew placement [upper or lower; right or left]). Results were analyzed with descriptive, comparative, and correlation statistics and $p<0.05$ was used as the level of statistical significance.

RESULTS

The overall failure rate of alveolar ridge miniscrews was 46.8% with a mean survival duration of 3.88 + 4.18 months.
Figure 1. Kaplan-Meier estimates of survival rates of alveolar ridge miniscrews: (A) purpose for distalization, (B) location in the second molar region, and (C) type of alveolar bony ridge [>6 Months following extraction].

CONCLUSION

- The failure rate for the alveolar ridge mini-screws was (46.8%), over an average survival period of 3.88 ± 4.18 months. While, the survival rate for those that did not fail was (53.2%) over an average period of 19.28 ± 21.13 months.
- Clinical and demographical variables had no effect on these mini-screws fully or partially achieving their desired treatment objectives.
- The biomechanical purpose for the alveolar mini-screw had a significant effect on its survival probability. Alveolar mini-screws used for distalization were significantly associated with reduced survival rates.
- Bone quality and quantity had a significant effect on survival probability. Alveolar ridge mini-screws placed in the 2nd molar regions and in an old extraction space (> 6 months post extraction) were significantly associated with increased failure rates.

TABLES & FIGURES

Table 1. Descriptive statistics for the collected variables – Implant level

Variable	Count (%) / Summary
Follow Up Period Mean ± SD (Med; Range)	19.28 ± 21.13 (12; 0.25 to 81)
Lower arch (L) vs Upper arch (U) ridge mini-implants	
L	39 (83.0%)
U	8 (17.0%)
Left side (LE) vs right side (R)	
LE	21 (44.7%)
R	26 (55.3%)
Replacement mini-ridge implants for failed ones	
N	37 (78.7%)
Y	10 (21.3%)
Percentage of Failure	
N	25 (53.2%)
Y	22 (46.8%)
Survival duration for those that failed (time to failure)	
Mean ± SD (Med; Range)	3.88 ± 4.18 (2.5; 0.25 to 16)
Evidence of splinting 2 mini-implants	
N	31 (66.0%)
Y	16 (34.0%)
Bracket or Tube breakage on the built composite	
N	37 (78.7%)
Y	10 (21.3%)
Location (1st Pm area)	
NONE	43 (91.5%)
Y	4 (8.5%)
Location (2nd Pm area)	
NONE	36 (76.6%)
Y	11 (23.4%)
Location (1st M area)	
NONE	19 (40.4%)
Y	28 (59.6%)
Location (2nd M area)	
NONE	22 (46.8%)
Y	25 (53.2%)
Anchorage type (direct vs indirect)	
Direct	44 (93.6%)
Direct and indirect	2 (4.3%)
Indirect	1 (2.1%)
Loading (Immediate vs delayed)	
Delayed	16 (34.0%)
Immediate	31 (66.0%)
Type of alveolar bone ridge	
1 (> 6 Months following extraction)	44 (93.6%)
2 (< 6 months following extraction)	3 (6.4%)
Diameter Category A: 1-1.4/ B: 1.5-1.9 /C: >2)	
B (1.5 -1.9 mm)	7 (14.9%)
C (>2 mm)	40 (85.1%)
Length mm	
Mean ± SD (Med; Range)	8.94 ± 0.79 (9; 7 to 11)
Brand	
Bioray	1 (2.1%)
Forestadent	1 (2.1%)
Imtec	3 (6.4%)
Lomas	42 (89.4%)

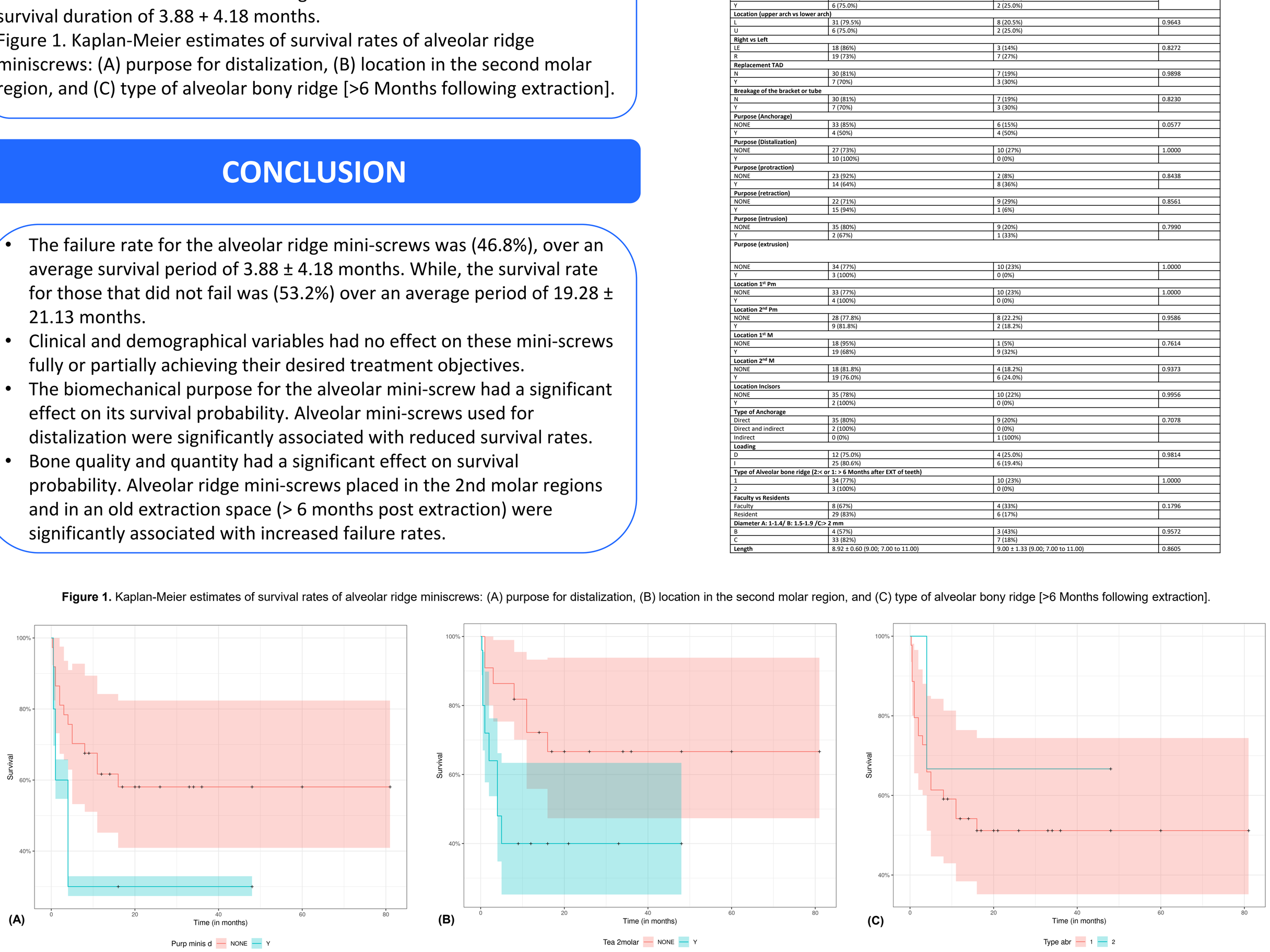
Table 2. Descriptive statistics for the collected variables – Patient level

Variable	Count (%) / Summary
Presence of other types of TADs	
No	13 (65.0%)
Yes	7 (35.0%)
Age	
Mean ± SD (Med; Range)	39.70 ± 15.59 (42; 14 to 67)
Sex	
F	15 (75.0%)
M	5 (25.0%)
Malocclusion	
I	7 (35.0%)
II	10 (50.0%)
III	3 (15.0%)
Smoking	
N	15 (75.0%)
Y	5 (25.0%)
Number of implants used in treatment	
Mean ± SD (Med; Range)	2.35 ± 1.60 (2; 1 to 7)
Purpose (Anchorage)	
NONE	15 (75.0%)
Yes	5 (25.0%)
Purpose (Distalization)	
NONE	18 (90.0%)
Yes	2 (10.0%)
Purpose (Protraction)	
NONE	10 (50.0%)
Yes	10 (50.0%)
Purpose (retraction)	
NONE	13 (65.0%)
Yes	7 (35.0%)
Purpose (Intrusion)	
NONE	18 (90.0%)
Yes	2 (10.0%)
Purpose (Extrusion)	
NONE	18 (90.0%)
Yes	2 (10.0%)
Location (Incisors' area)	
NONE	19 (95.0%)
Yes	1 (5.0%)
Success in achieving objective	
full	15 (75.0%)
Partial	5 (25.0%)
Placed by faculty or student	
Faculty	7 (35.0%)
Resident	13 (65.0%)

Table 3. Logistic mixed effects model to correlate partial and and full success of the ridge mini-implants with collected variables

Variable	FULL Success	PARTIAL Success	p-value
The use of other TADs			
N	29 (78.4%)	8 (21.6%)	0.9835
Y	8 (80.0%)	2 (20.0%)	
age	39.95 ± 13.60 (38.00; 14.00 to 67.00)	37.00 ± 14.41 (31.00; 18.00 to 58.00)	0.9580
Sex			
F	31 (82%)	7 (18%)	0.7901
M	6 (67%)	3 (33%)	
Malocclusion			
I	14 (82.4%)	3 (17.6%)	0.9956
II	18 (78.3%)	5 (21.7%)	
III	5 (71.4%)	2 (28.6%)	
Smoking status			
N	31 (79.5%)	8 (20.5%)	0.7902
Y	6 (75.0%)	2 (25.0%)	
Location (upper arch vs lower arch)			
L	31 (79.5%)	8 (20.5%)	0.9643
U	6 (75.0%)	2 (25.0%)	
Right vs Left			
LE	18 (86%)	3 (14%)	0.8272
R	19 (73%)	7 (27%)	
Replacement TAD			
N	30 (81%)	7 (19%)	0.9898
Y	7 (70%)	3 (30%)	
Breakage of the bracket or tube			
N	30 (81%)	7 (19%)	0.8230
Y	7 (70%)	3 (30%)	
Purpose (Anchorage)			
NONE	33 (85%)	6 (15%)	0.0577
Y	4 (50%)	4 (50%)	
Purpose (Distalization)			
NONE	27 (73%)	10 (27%)	1.0000
Y	10 (100%)	0 (0%)	
Purpose (protraction)			
NONE	23 (92%)	2 (8%)	0.8438
Y	14 (64%)	8 (36%)	
Purpose (retraction)			
NONE	22 (71%)	9 (29%)	0.8561
Y	15 (94%)	1 (6%)	
Purpose (intrusion)			
NONE	35 (80%)	9 (20%)	0.7990
Y	2 (67%)	1 (33%)	
Purpose (extrusion)			
NONE	34 (77%)	10 (23%)	1.0000
Y	3 (100%)	0 (0%)	
Location 1st Pm			
NONE	33 (77%)	10 (23%)	1.0000
Y	4 (100%)	0 (0%)	
Location 2nd Pm			
NONE	28 (77.8%)	8 (22.2%)	0.9586
Y	9 (81.8%)	2 (18.2%)	
Location 1st M			
NONE	18 (95%)	1 (5%)	0.7614
Y	19 (68%)	9 (32%)	
Location 2nd M			
NONE	18 (81.8%)	4 (18.2%)	0.9373
Y	19 (76.0%)	6 (24.0%)	
Location Incisors			
NONE	35 (78%)	10 (22%)	0.9956
Y	2 (100%)	0 (0%)	
Type of Anchorage			
Direct	35 (80%)	9 (20%)	0.7078
Direct and indirect	2 (100%)	0 (0%)	
Indirect	0 (0%)	1 (100%)	
Loading			
D	12 (75.0%)	4 (25.0%)	0.9814
I	25 (80.6%)	6 (19.4%)	
Type of Alveolar bone ridge (2:< or 1: > 6 Months after EXT of teeth)			
1	34 (77%)	10 (23%)	1.0000
2	3 (100%)	0 (0%)	
Faculty vs Residents			
Faculty	8 (67%)	4 (33%)	0.1796
Resident	29 (83%)	6 (17%)	
Diameter A: 1-1.4/ B: 1.5-1.9 /C:> 2 mm			
B	4 (57%)	3 (43%)	0.9572
C	33 (82%)	7 (18%)	
Length	8.92 ± 0.60 (9.00; 7.00 to 11.00)	9.00 ± 1.33 (9.00; 7.00 to 11.00)	0.8605

Figure 1. Kaplan-Meier estimates of survival rates of alveolar ridge miniscrews: (A) purpose for distalization, (B) location in the second molar region, and (C) type of alveolar bony ridge [>6 Months following extraction].



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