ORIGINAL ARTICLE

STABILITY OF ORTHODONTIC MINI-SCREWS AND DIFFERENT EXPERIENCE LEVELS OF RESIDENCY TRAINING OF STUDENTS

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ABSTRACT

Objectives: To determine the association between the stability of orthodontic mini-screws with different experience levels of residency training of students.

Materials and methods: A total of 240 mini-screws with a diameter of 1.3 mm, and a length of 7 mm were inserted by orthodontic residents in the first, second, third, and fourth years. Stability was assessed after one month of application of orthodontic load. Chi-square tests were used to analyze data. P value ≤.05 was considered significant.

Results: Out of 240 implants, 172 were found to be stable and 68 were unstable after one month among different resident levels. There was a significant association between the stability of mini-screws and different experience levels of postgraduate residents. For first-year residents, stability was 53.8%, for second-year residents 27.3%, for the third year 93.3%, and the fourth year 90.5%. The association between the placement site of mini-screws and different levels of postgraduate residents was also significant and the highest number of stable mini-screws were found in maxilla and posterior mandible placed by fourth-year residents, and the least stable for second-year residents.

Conclusion: The experience level of residents is a significant factor in the stability of mini-screws and site-specific stability is higher in the maxilla and posterior mandible for fourth-year residents.

Key Words: Anchorage, Insertion site, Maxilla, Mandible, Orthodontists, Stability, Temporary Anchorage Devices (TADs).

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INTRODUCTION

The success of orthodontic treatment greatly depends on the anchorage control achieved.[1] Traditionally, for anchorage control, orthodontists use teeth, extra-oral means, or inter arch elastics. However, these methods require patients' compliance and it is difficult to achieve absolute anchorage using these means.[2,3]

Nowadays, orthodontists greatly opt for mini-screws for stationary anchorage.[4] Their high level of acceptance is because they are less technique sensitive and independent of compliance.[5] They are a source of absolute anchorage for retraction, protraction, and intrusion.[6-8] Lim et al. reported that experienced operators showed higher stability in mini-screw placement because of their knowledge and clinical experience. They were able to decide on an adequate angle for the insertion of mini-screws and maintain that angle during placement to avoid root injury, screw fracture, or any other complications.[9] Studies by Dobranszki and Moon also found that the stability of mini-screws has a significant relation to the operator's experience.[4,5] Regarding the site of placement and stability, a study by Topouzelis et al reported that screws in the posterior mandible and palate showed lower success rates as compared to the buccal site.[3]

The objective of our study is to find out whether in our setup the stability of the mini-screws is affected by residency level and site of placement in either jaw, as this may help us to predict which residency level requires more guidance and supervision, which may reduce the failure rate.

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MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Orthodontics, Khyber College of Dentistry, Peshawar from September 2020 to September 2021. Approval from the ethical committee was obtained in August 2020 (Ref. No. 12 ADR/KCD). A Convenient sampling technique was used for patient inclusion.

Orthodontic residents of all four years participated in the study. Year 1 had 12 first-year residents; Year 2 had 11 second-year residents; Year 3 had 12 third-year resi-

dents; Year 4 had 12 fourth-year residents. The residents eeveryyear had a different number of patients who already had been allotted to them for orthodontic treatment. These patients indicated mini-screws i.e. maximum anchorage cases.

Patients who had the following records were included in the study; date of insertion of the mini screw; diameter and length of the mini screw. Patients with systemic bone disorders and those on long-term medications were excluded.

The total number of patients was 90 (35 males and 55 females with a mean age of 20.62 years ± 4.29). The purpose, procedure, and associated risks and benefits of the study were explained to them. They were assured that the confidentiality of their data and records will be maintained. Informed consent was obtained from all participants.

The data of mini-screws inserted in patients was obtained from residents. A total of 240 titanium mini-screws of diameter 1.3 mm and a length of 7mm were inserted by residents over the four years. Year 1 inserted 52 mini-screws; Year 2 inserted 44; Year 3 inserted 60; Year 4 inserted 84 mini-screws.

The stability of mini-screws was observed concerning the level of residents and the site of placement after one month. The mini-screws were considered stable when there was an absence of pain and mobility. The pain was assessed after 24 hours and then 7 days after insertion, using a 10 points visual analog scale (VAS). Mobility was clinically assessed using cotton forceps by applying light force laterally to the head of the mini screw and if there was any detectable mobility, the mini screw was considered mobile and unstable; the scoring done was either 'stable' (immobile) or 'unstable' (mobile).[10]

Data obtained was analyzed by IBM SPSS version 25.0. Means and standard deviation for age, and frequency with percentages for the other categorical variables were calculated. Chi-square tests were done to check the association of experience level of residents and site of placement with the stability of mini-screws. A p-value of ≤ 0.05 was considered significant.

RESULTS

Of the total 47 orthodontic residents, 17 were males and 30 were females. The mean age of the residents included in the study was 25 years ± 1.28.

The overall percentage of stable mini-screws after a period of one month was 71% and that of unstable mini-screws was 28%.

Of the total stable mini-screws, the highest percentage was found in Year 3 (93.3%) and the lowest percentage in Year 2 (27.3%). Results were statistically significant (p-value <.001) for the different Years (Table-1).

Based on the site of placement, the highest number of stable mini-screws was found in Year 4 in the anterior maxilla (100%) and posterior mandible (100%), followed by the posterior maxilla (93.8%).

These results were statistically significant with p <.001. The highest number of unstable mini-screws was found in Year 2 in the posterior maxilla (57.1%) and posterior mandible (100%), with p=.002. For the other two years, the results regarding site-specific stability were insignificant.

Table 1: Chi-square test for stability of mini-screws among the four Years after 1-month duration.

Residency Year	Stable after 1 month		Unstable after 1 month		P value
	N	%	n	%	
Year 1	28	53.8%	24	46.2%	.000
Year 2	12	27.3%	32	72.7%	
Year 3	56	93.3%	4	6.7%	
Year 4	76	90.5%	8	9.5%	

Table 2: Stability of mini screw in Year 1 according to the site of placement.

	Stable after 1 month		Unstable after 1 month		Chi square test	P value
	N	%	n	%		
Ant. Maxilla	-	-	-	-	0.05	.812
Post. Maxilla	24	54.5	20	45.5		
Ant. Mandible	-	-	-	-		
Post. Mandible	4	50	4	50		

Table 3: Stability of mini-screws in Year 2 according to the site of placement.

	Stable after 1 month		Unstable after 1 month		Chi square test	P value
	N	%	n	%		
Ant. Maxilla	-	-	-	-	9.42	.002
Post. Maxilla	12	42.9	16	57.1		
Ant. Mandible	-	-	-	-		
Post. Mandible	0	0	16	100		

n= number of screws

%= Percentage of screws for that site of placement

Post= posterior

Ant= anterior

Table 4: Stability of mini-screws in Year 3 according to the site of placement.

	Stable after 1 month		Unstable after 1 month		Chi square test	P value
	N	%	n	%		
Ant. Maxilla	4	100	0	0	2.14	.343
Post. Maxilla	36	90	4	10		
Ant. Mandible	16	100	0	0		
Post. Mandible	-	-	-	-		

n= number of screws

%= Percentage of screws for that site of placement

Post= posterior

Ant= anterior

Table 5: Stability of mini-screws in Year 4 according to the site of placement.

	Stable after 1 month		Unstable after 1 month		Chi square test	P value
	N	%	n	%		
Ant. Maxilla	8	100	0	0	40.48	.000
Post. Maxilla	30	93.8	4	6.2		
Ant. Mandible	0	0	4	100		
Post. Mandible	8	100	0	0		

n= number of screws

%= Percentage of screws for that site of placement

Post= posterior

Ant= anterior

DISCUSSION

In our study, the experience level of the residents and the site of placement were the two factors evaluated for the stability of mini-screws after 1 month of insertion.

When considering the experience of the operator, the highest number of stable mini-screws were found for final-year residents and the lowest for second-year residents.

The number of stable mini-screws inserted by first-year residents was also more than that of second-year residents. This may be due to the reason that first-year residents insert mini-screws in their presence and under the guidance of their teachers, whereas, second-year residents prefer to perform mini-screw insertions independently. Then, with increasing experience in performing independent mini screw insertions, the stability increases over the years, from the second year to the final year.

Similar to our study, in a study by Choa et al on root contact during drilling for micro implant placement, it was concluded that operator experience was an important factor.[11] The operator might experience a high number of micro implant failures due to root contact in the initial period but this risk is markedly lowered in subsequent years as they gain experience in the field.

In another study by Lim et al., it was concluded that the experience of the operator is an important factor in the stability of mini-screws.[9] The authors reported that the mini-screws inserted by more experienced operators had 3.6 times higher initial stability as compared to those inserted by less experienced operators.

On the contrary, Moon et al in their study concluded that success rate is not affected by operator experi-

ence.[5] In our study, the site-specific stability was higher in the maxilla and posterior mandible ($p<.001$) for final-year residents. Jing et al reported that the site of placement is a significant factor in the success rate of mini-screws, and the stability of the mini-screws inserted in the maxilla is more than that of the mandible.[12] On the contrary, a study by Song Yi Lin et al showed that there is no significant association between the success rate of mini-screws and their site of insertion. [13] Our study did not address a few confounding factors, such as the age and gender of the patients, different lengths and diameters of screws, and the directions of force applied on the mini-screws, which may influence the failure rate.[4] Only the site of placement and operator experience were evaluated using a single type of mini screw. Further studies regarding the effects of these possible confounding factors should be carried out.

CONCLUSION

With increasing experience in performing independent mini screw insertions, the stability of mini-screws increases over the years, from the second year to the final year. Site-specific stability is higher in the maxilla and the posterior mandible for final-year residents.

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under

Gul P:	Conception, literature search and overall supervision
Ali S:	Writing up
Shah AM:	Data collection
Ali F:	Statistical analysis
Saleem H:	Bibliography
Asghar T:	Data collection

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.