

# Frequency and Pattern of Skeletal Anchorage Usage by Iranian Orthodontists: A Cross-sectional Study

Soodeh Tahmasbi <sup>1</sup>, Seyyed Arian Taghavi Larijani <sup>2</sup>, Mahshid Namdari <sup>3</sup>,  
Mohammad Behnaz <sup>1</sup>, Samin Ghaffari <sup>1</sup>

<sup>1</sup> Department of Orthodontics, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

<sup>2</sup> School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

<sup>3</sup> Department of Biostatistics, Faculty of Paramedical Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

## ✉ Corresponding author:

Samin Ghaffari, Department of Orthodontics, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran

saminghaffari@gmail.com

## Article History

Received: 11 May 2024

Accepted: 25 Oct 2024

## Abstract

**Background and Aim:** Considering the importance of skeletal anchorage in orthodontic treatment, this study aimed to assess the frequency and pattern of skeletal anchorage usage by Iranian orthodontists.

**Materials and Methods:** In this cross-sectional study, 301 Iranian orthodontists filled out a questionnaire consisting of 10 questions, 5 about miniscrews and 5 about miniplate usage. It also asked for the demographic information of the participants. The relationship between the participants' demographic information and their responses to the questions was also analyzed. Statistical analysis was conducted by the Chi-square test, one-way ANOVA, t-test, and Mann-Whitney test ( $\alpha=0.05$ ).

**Results:** There were 46.7% males and 53.3% females with a mean age of 38.9 years and a mean work experience of 8.95 years. Of all, 89.7% of the participants used miniscrews and 16.3% of them used miniscrews and miniplates. Generally, participants not using skeletal anchorage were significantly older ( $P=0.002$ ) and had a significantly longer work experience ( $P=0.000$ ). Also, there was no significant association between gender and skeletal anchorage usage ( $P=0.204$ ). From the perspective of the orthodontists, the main indication of anchorage devices was to provide optimal anchorage.

**Conclusion:** The results showed that a high percentage of Iranian orthodontists used different types of skeletal anchorage devices. They preferred to use miniscrews more frequently than miniplates, mostly due to difficulties associated with their surgical insertion. Also, it was observed that older orthodontists used skeletal anchorage less frequently than younger orthodontists.

**Keywords:** Orthodontic Anchorage Procedures; Orthodontists; Surveys and Questionnaires

**Cite this article as:** Tahmasbi S, Taghavi Larijani SA, Namdari M, Behnaz M, Ghaffari S. Frequency and Pattern of Skeletal Anchorage Usage by Iranian Orthodontists: A Cross-sectional Study. *J Res Dent Maxillofac Sci.* 2025; 10(1):15-24.

## Introduction

The term anchorage was first used by Edward Angle, which is defined as resistance to

inadvertent tooth movements. The most successful orthodontic treatment is the treatment that minimizes anchorage loss [1].

Temporary skeletal anchorage devices (TADs) have been used for orthodontic treatment since the 1990s, and have enhanced many complex tooth movements [2, 3]. These devices, made of stainless steel or titanium [2], have been used in different forms such as miniscrews and miniplates [4]. TADs can be utilized for treatment of different malocclusions, such as correction of openbite through molar intrusion, correction of reverse overjet and class III malocclusion through en masse distalization of lower arch, correction of increased overjet and class II malocclusion via en masse distalization of upper arch, space closure, and rapid palatal expansion, among others. These treatments would be difficult or impossible to perform with orthodontic treatment alone and without orthognathic surgery or skeletal anchorage [1, 3, 5-7].

Skeletal anchorage provides many advantages such as decreased need for patient cooperation, no adverse effect on esthetics, easy insertion and removal, lower cost than other surgical procedures, good acceptance by patients, and high success rate up to 90% [4, 8, 9]; these have led to higher acceptance by orthodontists. Along with significant benefits, some complications can occur during treatment with these devices, such as screw fracture or loosening, infection, and damaging the adjacent structures due to screw-root proximity, which would finally result in failure of skeletal anchorage [10, 11]. Also, these devices can only be inserted after bone maturation, approximately around 11 years of age [12].

The choice of skeletal anchorage system varies among orthodontists, and some studies have evaluated the frequency of usage of TADs in different countries [13-15]. Considering the fact that application of TADs requires specialized training and skills, knowledge about the preferences of orthodontists with regard to TADs can indirectly indicate the educational quality of academic centers. Thus, the aim of this

study was to determine the frequency and pattern of skeletal anchorage usage among Iranian orthodontists.

## Materials and Methods

This study was approved by the ethics committee of the university (IR.SBMU.DRC.REC.1400.055).

This cross-sectional study was conducted from 2022 to 2023 through an online survey. The questionnaire used for data collection was derived from a study by Bock and Ruf [13]. The target population was Iranian orthodontists, and those who did not fill out the questionnaire were excluded from the study. Orthodontists were found through searching the social media and Google search engine and were included in the study after confirming their identity on the Iranian Medical Council website (irimc.org).

The sample size was calculated to be 236 orthodontists. The following formula was used to determine the sample size considering the frequency of skeletal anchorage usage to be 61.9% according to the study by Bock and Ruf [13],  $z=1.96$ ,  $p=0.62$  and  $d=0.1p$ . To increase the power of the study, the sample size was increased to 301.

$$n = \frac{z^2 p (1 - p)}{d^2}$$

The questionnaire was designed using a web application (Google Forms) for an online survey. The link of the online survey was sent to the orthodontists through email or messengers. All participants were ensured that their questionnaire information would remain confidential.

The questionnaire initially asked for the demographic information of the participants, including their first name and last name (optional), age, gender, graduation year, the attending university for their orthodontic residency program, city and address of their workplace, and their academic degree, and university faculty membership. The main questions were asked according to Table 1.

**Table 1.** Questionnaire used for evaluation of the frequency and pattern of skeletal anchorage usage by Iranian orthodontists

Number	Questions about miniscrews
	Answer the following question about the usage of miniscrews:
1	<ul style="list-style-type: none"> <li><input type="radio"/> a. I use miniscrews for treatment of my patients</li> <li><input type="radio"/> b. I have never used a miniscrew, but I plan to use it in future.</li> <li><input type="radio"/> c. I have previously used miniscrews, but I do not use them anymore.</li> <li><input type="radio"/> d. I have never used miniscrews, and I do not want to use them in the future.</li> </ul>
	If your answer to question 1 was "a", please answer questions 2 to 4. If your answer to question 1 was "b", please continue answering from question 6. If your answer was "c" or "d", please only answer question 5.
	How often do you use miniscrews?
2	<ul style="list-style-type: none"> <li><input type="radio"/> a. Frequently (for more than 2 patients per week)</li> <li><input type="radio"/> b. Moderately (for more than 2 patients per month)</li> <li><input type="radio"/> c. Occasionally (for more than 2 patients every 3 months)</li> <li><input type="radio"/> d. Rarely (for 2 patients every 3 months or less)</li> </ul>
	How was your experience with miniscrew usage? (More than one answer can be chosen)
3	<ul style="list-style-type: none"> <li><input type="radio"/> a. In most cases, a favorable result was obtained from the treatment.</li> <li><input type="radio"/> b. Their daily use in clinical work was easy with minimal problems.</li> <li><input type="radio"/> c. Application of them decreases the treatment time.</li> </ul>
	Please mention 3 major clinical indications of miniscrew usage.
4	<ul style="list-style-type: none"> <li>a.</li> <li>b.</li> <li>c.</li> </ul>
	Which of the following is the reason for your reluctance to use miniscrews? (More than one answer can be chosen)
5.	<ul style="list-style-type: none"> <li><input type="radio"/> a. From my point of view, there is no indication for miniscrew usage.</li> <li><input type="radio"/> b. It seems illogical that using miniscrews would be more beneficial than other treatment methods</li> <li><input type="radio"/> c. I am uncertain about their success/failure rate.</li> <li><input type="radio"/> d. I consider surgical insertion of miniscrews as a time-consuming and complicated procedure.</li> <li><input type="radio"/> e. I consider surgical insertion of miniscrews as a costly procedure.</li> <li><input type="radio"/> f. I am concerned about its complications.</li> <li><input type="radio"/> g. There is no trustworthy surgeon for this procedure near my office.</li> </ul>
	Questions about miniplates
	Answer the following question about the usage of miniplates:
6.	<ul style="list-style-type: none"> <li><input type="radio"/> a. I use miniplates for treatment of my patients.</li> <li><input type="radio"/> b. I have never used miniplates, but I plan to use them in the future.</li> <li><input type="radio"/> c. I have previously used miniplates, but I do not use them anymore.</li> <li><input type="radio"/> d. I have never used miniplates, and I do not want to use them in the future.</li> </ul>
	If your answer to question 6 was "a", please answer questions 7 to 9. If your answer to question 6 was "b", please do not answer the following questions. If your answer was "c" or "d", please only answer question 10.
	How often do you use miniplates?
7.	<ul style="list-style-type: none"> <li><input type="radio"/> a. Frequently (for more than 2 patients per week)</li> <li><input type="radio"/> b. Moderately (for more than 2 patients per month)</li> <li><input type="radio"/> c. Occasionally (for more than 2 patients every 3 months)</li> <li><input type="radio"/> d. Rarely (for 2 patients every 3 months or less)</li> </ul>
	How was your experience about miniplate usage? (More than one answer can be chosen)
8	<ul style="list-style-type: none"> <li><input type="radio"/> a. In most cases, a favorable result was obtained from the treatment.</li> <li><input type="radio"/> b. Their daily use in clinical work was easy with minimal problems.</li> <li><input type="radio"/> c. Application of them decreases the treatment time.</li> </ul>
	Please mention 3 major clinical indications of miniplate usage.
9	<ul style="list-style-type: none"> <li>a.</li> <li>b.</li> <li>c.</li> </ul>
	Which of the following is the reason for your reluctance to use miniplates? (More than one answer can be chosen)
10	<ul style="list-style-type: none"> <li><input type="radio"/> a. From my point of view, there is no indication for miniplate usage.</li> <li><input type="radio"/> b. It seems illogical that using miniplates would be more beneficial than other treatment methods</li> <li><input type="radio"/> c. I am uncertain about their success/failure rate.</li> <li><input type="radio"/> d. I consider surgical insertion of miniplates as a time-consuming and complicated procedure.</li> <li><input type="radio"/> e. I consider surgical insertion of miniplates as a costly procedure.</li> <li><input type="radio"/> f. I am concerned about their complications.</li> <li><input type="radio"/> g. There is no trustworthy surgeon for this procedure near my office.</li> </ul>

The questionnaire included 10 questions, 5 about miniscrews and 5 about miniplate usage. Of the five questions in each group, the first question was about the use of mini-screws or mini-implants, and the answers to the next four questions were related to the answer to the first question.

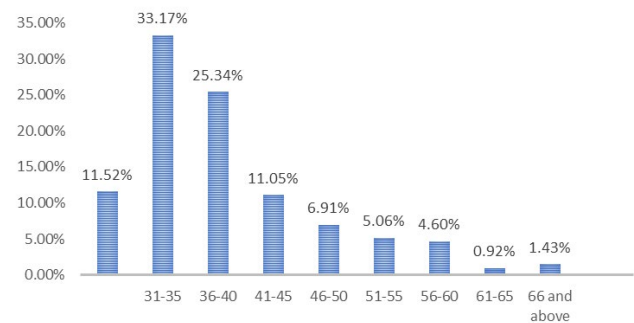
Finally, the participants' responses were collected and reported as percentages for each question for data analysis. Statistical analysis was carried out using SPSS version 21.0 (SPSS Inc., IL, USA) with the Chi-square test, one-way ANOVA, t-test and Mann-Whitney test. Significance level was set at 0.05.

### Results

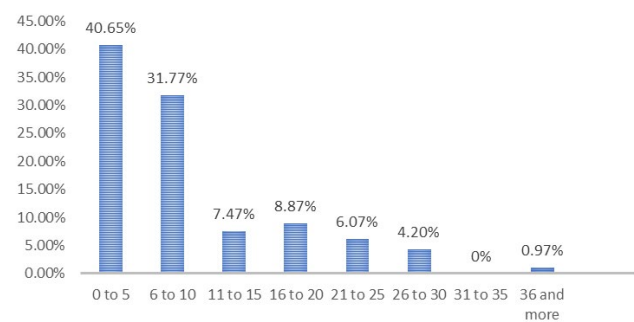
The questionnaire was sent to 437 orthodontists, and 301 orthodontists (68.9%) participated in this survey and completely responded to the questions. In this study, 46.7% of the participants were males, and 53.3% were females. Also, 42.5% of the participants were faculty members. In terms of workplace, 83.1% of the participants had their own private practice, 43.4% were working in private clinics, and 33.3% were working in public clinics; some were working in more than one center. The mean age of the participants was 38.9 years (Figure 1), and the mean work experience was 8.95 years (Figure 2). The majority of the participants had been graduated from Tehran University of Medical Sciences (15.88%), followed by Mashhad (12.61%) and Shahid Beheshti University of Medical Sciences (10.28%); the least was from Gilan and Yazd Universities. Most of the orthodontists were practicing in Tehran (35.04%) followed by Mashhad (8.41%) and a few in smaller cities such as Arak, Ilam, Bushehr, and Semnan.

The frequency percentage of the participants' answers to the multiple-choice questions is listed in Table 2. From the perspective of the participants, the three most common indications of miniscrew insertion were providing

maximum anchorage (63.20%), intrusion of posterior teeth (55.7%), and intrusion of anterior teeth (42.2%). Also, the three most common indications of miniplate insertion were as follows: intrusion of posterior teeth (65.60%), en masse distalization (41.40%), and providing maximum anchorage (29.3%).



**Figure 1.** Distribution of participants based on their age group



**Figure 2.** Distribution of participants based on their work experience (years)

In order to evaluate the relationship between demographic information of the participants and their answers to the questions 1, 2, 6, and 7, one-way ANOVA was carried out for the mean age and mean work experience, and the Chi-square test was used for gender and faculty membership (Table 3). As shown, there were significant associations among 6 pairs of variables; thus, pairwise comparisons were performed by the Tukey's test. According to this analysis, those who chose the fourth answer in questions 1 and 2 and also answered the question 4 were significantly older (senior orthodontists) and had a higher work experience as an orthodontist.

Also, for more precise statistical analysis, two types of grouping were performed for the

participants. In the first grouping, the participants were divided into 4 subgroups as follows:

1. Participants who only used miniscrews (73.4%)
2. Participants who used miniscrews and miniplates (16.3%)
3. Participants who did not use either of the two (10.3%)
4. Participants who only used miniplates (0%)

Since none of the participants were included in subgroup 4, this subgroup was omitted from the analysis.

Table 4 presents the distribution of gender, work experience, faculty membership, and age of the participants in the subgroups. According to the Chi-square test, there was no significant relationship between the subgroups and gender (P=0.446) or faculty membership (P=0.212). According to one-way ANOVA, there was no significant association between work experience and subgroup (P=0.092). However, age and subgroup had a significant association (P=0.000). Based on the results of the Tukey’s test, participants in the third subgroup were significantly older than the other subgroups (P<0.05).

With respect to the workplace, no information was available about the choice of TAD in each work place for orthodontists who were working in more than one place. Therefore, only the frequency percentage was reported for

this variable (Table 4), and no further statistical analysis was performed. Also, the Mann-Whitney test confirmed that there was no significant association between the frequency of miniscrew usage and subgroups of the first grouping (P=0.532, Table 5).

Regarding the orthodontists’ experience in miniscrew usage, the Chi-Square test showed no significant association between their experience and using miniscrews as their first choice (P=0.772), second choice (P=0.443) or third choice (P=0.286). Therefore, there was no significant association between the work experience of orthodontists and their miniscrew usage (Table 6).

In the second grouping, the participants were divided into two subgroups:

1. Participants who had used at least one type of skeletal anchorage (89.70%)
2. Participants who had not used either of the two types (10.30%)

The distribution of gender, faculty membership, work experience, age, work place, and the relationship between each variable and subgroup in the two subgroups are presented in Table 7. A significant relationship was only found between work experience and age with subgroups of the second grouping, such that the participants who had not used any type of skeletal anchorage had a higher work experience and were older (P<0.05).

**Table 2.** Participants’ answers to the multiple-choice questions

Answers	a	b	c	d			
<b>Questions</b>							
<b>1</b>	89.70%	3.7%	5.30%	1.30%			
<b>2</b>	6.60%	32%	32%	29.40%			
<b>3</b>	84.80%	52%	41%	-			
<b>6</b>	16.30%	45%	11.70%	27%			
<b>7</b>	0%	2%	28.60%	69.40%			
<b>8</b>	74.30%	20.00%	34.30%	-			
	a	b	c	d	e	f	g
<b>5</b>	0%	40%	13.3%	20%	60%	6.7%	6.7%
<b>10</b>	1.2%	16.5%	11.8%	51.8%	55.3%	18.8%	23.5%

**Table 3.** P-values for the relationship of gender, age, work experience, and faculty membership with answers to questions 1, 2 (related to miniscrews), 6, and 7 (related to the miniplates)

Question number	Question 1	Question 2	Question 6	Question 7
<b>Demographic data</b>				
<b>Gender</b>	0.096	0.727	0.075	0.560
<b>Age</b>	0.000*	0.000*	0.005*	0.810
<b>Work experience</b>	0.000*	0.000*	0.038*	0.534
<b>Faculty membership</b>	0.887	0.619	0.281	0.458

\*: Statistically significant

**Table 4.** Distribution of gender, work experience, faculty membership, age group, and workplace among the subgroups of the first grouping

		Subgroup 1	Subgroup 2	Subgroup 3
<b>Gender</b>	Male	44.93%	44.44%	59.09%
	Female	55.07%	55.56%	40.91%
<b>Work experience (years)</b>	0-5	40.50%	36.11%	50%
	6-10	32.28%	44.44%	9.09%
	11-15	9.49%	2.77%	9.09%
	16-20	8.86%	8.33%	4.54%
	21-25	5.69%	5.58%	9.09%
	26-30	2.55%	2.77%	13.65%
	31-35	0%	0%	0%
	36 and higher	0.63%	0%	4.54%
<b>Faculty membership</b>	Faculty membership	40.50%	55.55%	36.36%
	No faculty membership	59.50%	44.45%	63.64%
<b>Age group (years)</b>	26-30	12.65%	11.11%	4.45%
	31-35	32.91%	41.66%	22.72%
	36-40	27.21%	22.24%	18.18%
	41-45	10.12%	11.11%	18.18%
	46-50	6.32%	8.33%	9.09%
	51-55	5.69%	5.55%	0%
	56-60	3.84%	0%	13.84%
61-65	0.63%	0%	4.45%	
<b>Workplace</b>	66 and higher	0.63%	0%	9.09%
	Private practice	81.01%	86.11%	90.9%
	Private clinic	41.77%	50%	50%
	Public clinic	29.74%	47.22%	36.36%

Subgroup 1: using miniscrews, subgroup 2: using miniscrews and miniplates, subgroup 3: using none of them

**Table 5.** Frequency distribution of skeletal anchorage usage by the subgroups of the first grouping

	Subgroup 1	Subgroup 2
<b>Frequently</b>	6.32%	8.33%
<b>Moderately</b>	28.48%	44.44%
<b>Occasionally</b>	34.81%	22.23%
<b>Rarely</b>	30.39%	25%

Subgroup 1: using miniscrews, Subgroup 2: using miniscrews and miniplates

**Table 6.** Frequency distribution of experience of the participants with miniscrew usage in the subgroups of the first grouping

	Subgroup 1	Subgroup 2
<b>Favorable results in most cases</b>	84.17%	86.11%
<b>Their usage was easy with minimal problems</b>	51.26%	58.33%
<b>Their usage decreases the treatment time</b>	43.03%	33.33%

Subgroup 1: using miniscrews, Subgroup 2: using miniscrews and miniplates

**Table 7.** Frequency distribution of gender, faculty membership, work experience, age, and work place in the subgroups of the second grouping, and the relationship between each variable and the subgroups (P-values)

Variables		Subgroup 1	Subgroup 2	Type of data analysis	P-value
<b>Gender</b>	Female	44.84%	59.09%	Chi-Square	0.204
	Male	55.16%	40.91%		
<b>Faculty membership</b>	Faculty membership	43.29%	36.36%	Chi-Square	0.533
	No faculty membership	56.71%	63.64%		
<b>Work experience (years)</b>	0-5 years	39.69%	50%	T-test	0.000*
	6-10 years	34.53%	9.09%		
	11-15 years	8.24%	9.09%		
	16-20 years	8.76%	4.54%		
	21-25 years	5.67%	9.09%		
	26-30 years	2.60%	13.65%		
	31-35 years	0%	0%		
	36 and higher years	0.51%	4.54%		
	26-30	12.37%	4.45%		
	31-35	34.06%	22.72%		
<b>Age (years)</b>	36-40	26.28%	18.18%	T-test	0.002*
	41-45	10.3%	18.18%		
	46-50	6.7%	9.09%		
	51-55	5.67%	0%		
	56-60	3.6%	13.84%		
	61-65	0.51%	4.45%		
	66 and higher	0.51%	9.09%		
<b>Workplace</b>	Private practice	81.95%	90.9%	As mentioned previously, further data analysis was not possible.	
	Private clinic	43.29%	50%		
	Public clinic	32.98%	36.36%		

\*: statistically significant, Subgroup 1: using at least one type of skeletal anchorage, Subgroup 2: using no skeletal anchorage device

## Discussion

In this cross-sectional study, a survey was conducted about the frequency and pattern of skeletal anchorage usage among Iranian orthodontists through sending a questionnaire, responded by 301 orthodontists. The results revealed that 89.7% of the orthodontists used at least one type of skeletal anchorage device (miniscrew or miniplate); thus, it may be concluded that skeletal anchorage devices have high popularity among Iranian orthodontists.

In a similar study by Markic et al. [16] in Switzerland, they asked the orthodontists to design a treatment plan for a patient with class II division 2 malocclusion with deep bite and crowding of upper anterior teeth. The study showed that 75.1% of the orthodontists chose a treatment plan aided with skeletal anchorage

devices. Thus, skeletal anchorage devices are popular among the Swiss orthodontists similar to Iranians. In another study, Golshah et al. [17] evaluated the frequency of usage of miniscrews among Iranian orthodontists. They showed that 62.3% of 70 participants had previously used miniscrews, and the majority of them were satisfied with the results. Although the frequency of miniplate usage was not evaluated in their study, but the percentage of participants disfavoring skeletal anchorage devices was similar to that in the present study. Another similar survey in India by Meeran et al. [18] showed relatively low (43.7%) frequency of miniscrew usage, compared to the Iranian orthodontists. However, similar to the present study, they mostly utilized it to provide maximum anchorage during treatment. Another

study conducted in Germany by Bock and Ruf [13] evaluated the prevalence of palatal skeletal anchorage usage by clinicians, not necessarily orthodontists, performing orthodontic treatment, through sending a questionnaire to 2,459 participants. In their study, 47.9% responded to the questionnaire and it was concluded that only 38.1% of the participants were not interested in using any type of skeletal anchorage device. Therefore, it appears that skeletal anchorage devices are popular among German orthodontists similar to Iranians; although according to the present study, it appears that the popularity of skeletal anchorage devices is higher among Iranian orthodontists in comparison with Swiss and German orthodontists. Also, the response rate in the present study was 68.9% which was noticeably higher compared to the study by Markic et al. (24.4%) [16] and Bock and Ruf (47.9%) [13].

Another study by Barthelemi and Beauval [19] showed that 66% of French orthodontists preferred using miniscrews, mostly for mesialization/ distalization and intrusion/ extrusion. Also, similar results were reported for South African orthodontists, suggesting that more training in this regard should be considered for the postgraduate curriculum [20]. A similar frequency of miniscrew usage was seen among Canadian orthodontists, and they were mostly satisfied with the treatment results. However, the response rate (23.2%) and the number of participants (82 orthodontists) were very low [21]. It appears that Iranian orthodontists use skeletal anchorage devices more frequently, and prefer it to provide maximum anchorage. Also, in spite of the afore-mentioned studies, the present study evaluated the usage of both types of skeletal anchorage devices.

In the present study, the mean age and work experience were 38.9 and 8.95 years,

respectively; thus, the participants were younger and had less work experience in comparison with the study by Bock and Ruf [13]. Moreover, 53.3% of the participants in the present study were females, similar to the study by Bock and Ruf (53.8%); thus, equal number of males and females participated in the study. It is noteworthy that females preferred skeletal anchorage more than males; however, the difference was not significant.

In the present study, orthodontists, who did not use any type of skeletal anchorage devices, were older than the other groups, similar to the study by Bock and Ruf [13]; thus, it can be generalized that younger orthodontists are more familiar with the use of skeletal anchorage devices. On the other hand, orthodontists who were faculty members and present in the academic environment, preferred using both types of skeletal anchorage devices more than the other ones. However, statistical analysis showed that this association could be accidental.

A high rate of participants reported that they had experienced satisfactory results with miniscrews or miniplates, which can be related to their high success rate; although they doubted that use of miniscrew would decrease the treatment time. Also, in the present study, 52.3% of the participants stated that the use of miniscrews is easy and has minimal problems; however this rate was 20% for miniplates. Moreover, none of the participants preferred miniplates over miniscrews; in other words, none of the orthodontists were using only miniplates. A similar study by Cornelis et al. [22] confirmed that orthodontists believed that miniplate usage is very to moderately easy with a satisfaction rate of 3.8 out of 4, and with mild mobility or soft tissue irritation over one year. Also, they reported that they would prefer to use miniplates for their future patients.

The popularity of miniscrews among the participants of the present study was 89.7%;



however, this rate was 16.3% for miniplates. Therefore, it may be concluded that although miniplates have a very high success rate (92.5%) and are well-tolerated by most patients [22], but due to their difficulties such as the need for a flap surgery and causing more pain and discomfort for patients, they are less preferred. Based on the results of the present study, and from the point of view of Iranian orthodontists, the most important drawback of miniplates is the difficulties associated with their surgical insertion.

According to the present results, 45% of the participants had not used miniplates so far, but they tend to utilize them in the future for their patients. Therefore, it may be interpreted that there is a lack of adequate education in dental schools about the applications of miniplates, and the educational curriculum should better address this topic. Also, training courses must be held for graduates in this respect. Additionally, as mentioned earlier, older orthodontists with greater work experience were less likely to use skeletal anchorage devices than others; this finding emphasizes the importance of holding continuing education courses on this topic to increase the prevalence of application of TADs by older clinicians.

From the perspective of the participants of the present study, the greatest indication of miniscrew usage was to provide proper anchorage, followed by intrusion of posterior and anterior teeth, and distalization or protraction of molar teeth. Similar results were obtained by Bock and Ruf [13].

This study had some limitations. Since an online questionnaire was used for data collection, it is likely that the participants did not pay sufficient attention to answer the questions; also, they might have not disclosed their demographic information correctly. Moreover, due to inaccessibility of the complete list of

Iranian orthodontists, it was not possible to randomly select them for this study.

Future studies at a national level are recommended to randomly select orthodontists from across the country and distribute the questionnaire among them in person to maximize accuracy. Also, the orthodontists should be questioned about the work place in which they prefer to use skeletal anchorage devices. Moreover, it is suggested to conduct a survey on orthodontists' satisfaction with the quality of education they received during their dental education regarding the application of skeletal anchorage devices since the results would help improve the quality and efficiency of the educational curriculum.

## Conclusion

The present results showed that a high percentage of Iranian orthodontists, who participated in the present study, used different types of skeletal anchorage devices in their daily practice. They preferred to use miniscrews more frequently than miniplates, mostly due to difficulties associated with surgical insertion of miniplates. Also, older orthodontists with greater years of work experience were less likely to use skeletal anchorage devices than others. Therefore, further attention must be paid to this topic in the educational curricula, and continuing education courses in this regard should be held for the graduates.

## Funding

No funding was received for this study.

## Data availability

Datasets related to this manuscript will be available upon request to the corresponding author.

## Conflict of interests

The authors declare that they have no known competing financial interests or personal

relationships that could have appeared to influence the work reported in this paper.

## Acknowledgement

This study was based on a thesis by Seyyed Arian Taghavi Larijani (second author) submitted to Shahid Beheshti University of Medical Sciences, School of Dentistry, which was approved by the ethics committee of the university (IR.SBMU.DRC.REC.1400.055).

## References

- Jones JP, Elnagar MH, Perez DE. Temporary Skeletal Anchorage Techniques. *Oral Maxillofac Surg Clin North Am.* 2020 Feb;32(1):27-37.
- Casaña-Ruiz MD, Bellot-Arcís C, Paredes-Gallardo V, García-Sanz V, Almerich-Silla JM, Montiel-Company JM. Risk factors for orthodontic mini-implants in skeletal anchorage biological stability: a systematic literature review and meta-analysis. *Sci Rep.* 2020 Apr 3;10(1):5848.
- Park KH, Choi JY, Kim KA, Kim SJ, Chung KR, Kim SH. Critical issues concerning biocreative strategy in contemporary temporary skeletal anchorage device orthodontics: A narrative review. *Orthod Craniofac Res.* 2021 Mar;24 Suppl 1:39-47.
- Lam R, Goonewardene MS, Allan BP, Sugawara J. Success rates of a skeletal anchorage system in orthodontics: A retrospective analysis. *Angle Orthod.* 2018 Jan;88(1):27-34.
- Kim KA, Yu JJ, Chen Y, Kim SJ, Kim SH, Nelson G. Surgery Versus Nonsurgery Option for Scissors Bite Treatment. *J Craniofac Surg.* 2015 Nov;26(8):e726-9.
- Suh HY, Lee SJ, Park HS. Use of mini-implants to avoid maxillary surgery for Class III mandibular prognathic patient: a long-term post-retention case. *Korean J Orthod.* 2014 Nov;44(6):342-9.
- Jung SK, Kim TW. Treatment of unilateral posterior crossbite with facial asymmetry in a female patient with transverse discrepancy. *Am J Orthod Dentofacial Orthop.* 2015 Jul;148(1):154-64.
- Mizrahi E. The Use of Miniscrews in Orthodontics: a Review of Selected Clinical Applications. *Prim Dent J.* 2016 Nov 1;5(4):20-7.
- Cadavid D, Duque L, Correa S, H Buschang P, Roldan S. Miniimplant stability in Orthodontics." *Bone Biology and Biomechanics". CES Odontología.* 2014;27(2):93-103.
- Papageorgiou SN, Zogakis IP, Papadopoulos MA. Failure rates and associated risk factors of orthodontic miniscrew implants: a meta-analysis. *Am J Orthod Dentofacial Orthop.* 2012 Nov;142(5):577-595.e7.
- Petrey JS, Saunders MM, Kluemper GT, Cunningham LL, Beeman CS. Temporary anchorage device insertion variables: effects on retention. *Angle Orthod.* 2010 Jul;80(4):446-53.
- Zago H, Navarro RL, Laranjeira V, Fernandes TM, Conti AC, Oltramari PV. 3-D Evaluation of temporary skeletal anchorage sites in the maxilla. *J Clin Exp Dent.* 2021 Nov 1;13(11):e1131-9.
- Bock NC, Ruf S. Skeletal anchorage for everybody? a questionnaire study on frequency of use and clinical indications in daily practice. *J Orofac Orthop.* 2015 Mar;76(2):113-24, 126-8. English, German.
- Monini Ada C, Gandini Júnior LG, dos Santos-Pinto A, Maia LG, Rodrigues WC. Procedures adopted by orthodontists for space closure and anchorage control. *Dental Press J Orthod.* 2013 Nov-Dec;18(6):86-92.
- Krieger E, Yildizhan Z, Wehrbein H. One palatal implant for skeletal anchorage--frequency and range of indications. *Head Face Med.* 2015 Apr 21;11:15.
- Markic G, Katsaros C, Pandis N, Eliades T. Temporary anchorage device usage: a survey among Swiss orthodontists. *Prog Orthod.* 2014 Apr 1;15(1):29.
- Golshah A, Rahnemoon MF, Bagheri Z, Karami N. Frequency of using miniscrew anchorage by the iranian orthodontists. *Open Access Maced J Med Sci.* 2021;9(D):98-102.
- Meeran NA, Venkatesh KG, Jaseema Parveen MF. Current trends in miniscrew utilization among Indian orthodontists. *J Orthod Sci.* 2012 Apr;1(2):46-50.
- Barthelemi S, Beauval H. Prevalence of the use of anchorage miniscrews among French orthodontists. *Int Orthod.* 2015 Dec;13(4):436-61.
- Mothobela TF, Sethusa MP, Khan M. The use of temporary skeletal anchorage devices amongst South African orthodontists. *SADJ.* 2016;71(10):513-7.
- Van Sant LA. Survey Of Canadian Orthodontists Regarding Orthodontic Miniscrew Usage. The University of Western Ontario (Canada); 2020.
- Cornelis MA, Scheffler NR, Nyssen-Behets C, De Clerck HJ, Tulloch JF. Patients' and orthodontists' perceptions of miniplates used for temporary skeletal anchorage: a prospective study. *Am J Orthod Dentofacial Orthop.* 2008 Jan;133(1):18-24.