Vol: 8 Issue: 1

EDJ

Archwire Preferences and Rationale Among Iraqi Orthodontists During the Alignment Stage of Fixed Orthodontics: An Online Survey-Based Study

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Abstract

Background: Archwire selection is critical for optimizing tooth movement and patient comfort in orthodontic treatment. However, data on archwire preferences in Iraq is limited.

Objectives: To examine archwire preferences and selection practices among Iraqi orthodontists during the alignment stage of fixed orthodontic treatment.

Methods: A cross-sectional survey was conducted among 83 Iraqi orthodontists using an online questionnaire. Questions assessed demographics, archwire preferences, factors influencing selection, and perceptions of treatment efficiency.

Results: Traditional super-elastic nickel-titanium was the most frequently used archwire (55.4%), followed by 35° C thermo-active copper Ni-Ti (39.8%). Main factors influencing selection were achieving fast tooth movement (27.4%) and ease of manipulation (23.1%). Ease of manipulation and market availability showed statistically significant associations with archwire selection ($p<0.05$). Most respondents (71.1%) reported an average alignment duration of 6 months. According to 50.6% of respondents, Super-elastic Ni-Ti were the most effective in reducing treatment duration. However, 35°C copper Ni-Ti was rated as most clinically efficient (53% of respondents).

Conclusion: Iraqi orthodontists prefer super-elastic NiTi archwires for alignment, influenced by biomechanical properties and practical factors. Perceptions of efficiency varied between wire types. Further research is needed to directly compare clinical outcomes with different archwires.

Keywords: Orthodontic Wires Orthodontics, Corrective Dental Materials, Nickel-Titanium Alloys, Copper Alloys, Surveys and Questionnaires

Article Information

Submission Date: 30/4/2025
Revision date: 30/5/2025
Acceptance date: 13/6/2025
Publishing date: Jun 2025

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DOI: doi.org/10.15218/edj.2025.10

INTRODUCTION

The process of orthodontic tooth movement in fixed orthodontic mechanotherapy relies on the application of light, and continuous force exerted by the archwire within the bracket slots. The magnitude of this force is determined by the type and properties of the archwire employed.[1]
In the context of rapid technological advancements, various types of archwires are continually being developed, with ongoing efforts to reduce pain and shorten treatment duration. Fixed orthodontic treatment comprises three primary stages, with the initial stage being alignment. This stage is critical for achieving optimal tooth positioning and significantly influences treatment efficacy and patient comfort.[2]
The success of the alignment stage is largely dependent on the selection of appropriate archwires, as different materials can markedly affect treatment outcomes and patient experiences.[3] The choice of archwires impacts not only the speed of alignment but also the level of pain experienced by patients during treatment.[4] Selecting the appropriate archwire is essential for optimizing tooth movement while minimizing discomfort and root resorption.
A comprehensive understanding of the various types of archwires and their effects on treatment is crucial for orthodontists. The selection of archwires necessitates careful consideration of their mechanical properties and clinical applications to ensure effective and comfortable treatment outcomes.[5]
The material of the archwire dictates its mechanical properties and subsequent performance; therefore, different materials are utilized for various stages of orthodontic treatment. The alignment stage requires a highly resilient and flexible material with sufficient shape memory. Orthodontic practitioners have access to a wide array of commercially available archwires. Super-elastic nickel-titanium (Ni-Ti) and thermoactive copper nickel-titanium (CuNiTi) are examples of such archwires.[6]
Orthodontic archwires are fundamental components in orthodontic treatment, serving as the primary force generators that facilitate tooth movement through their interaction with brackets and buccal tubes. The evolution of archwire materials has been significant, transitioning from gold in the early 20th century,[7] to stainless steel, and subsequently to advanced alloys like nickel-titanium, which introduced revolutionary properties such as shape memory and super elasticity.[3] These advancements have resulted in a diverse array of archwires, each possessing unique mechanical and aesthetic properties, thereby enabling orthodontists to tailor treatment to individual patient needs.[8]
Nickel-titanium wires are particularly favoured for their super-elastic properties, rendering them ideal for both the alignment and finishing phases of treatment. The metallurgical properties of these wires, including their micro-grain structure and the presence of intermetallic compounds, are crucial for their performance, with ongoing research aimed at enhancing these properties for more predictable outcomes.[9,10]
Furthermore, the demand for aesthetic treatment options has spurred the development of esthetic arch wires, which aim to combine visual appeal with clinical efficacy.[8]
The introduction of innovative materials such as organic polymer wires and bactericide arch wires further exemplifies the continuous advancements in this field, underscoring the importance of selecting the appropriate wire type and size to achieve optimal treatment results. [11]
This study aims to clarify the main factors guiding archwire selection among Iraqi orthodontists, a topic not yet explored regionally. By employing a comparative framework, this study aims to enhance evidence-based orthodontic practice by thoroughly examining local trends in archwire usage.
This research explores the preferences and clinical approaches of Iraqi orthodontists when choosing archwires in the alignment phase of fixed orthodontic therapy. The focus is on evaluating how these selections impact treatment effectiveness and patient comfort to enhance the existing knowledge of the significance of archwire selection in maximizing therapeutic results, thus facilitating more efficient and patient-focused orthodontic care.

SUBJECTS AND METHODS

STUDY DESIGN

This study was a quantitative and qualitative

cross-sectional survey to understand the archwire selection preferences among Iraqi orthodontists during the alignment stage of fixed orthodontic treatment. Online questionnaires made by Google Forms were used to gather clinicians' responses regarding clinical decision-making practices. The questionnaires were shared via social media platforms and online communication groups shared by Iraqi Orthodontic Society members and personally sent to orthodontic specialists and practitioners.

Participants were licensed orthodontists and orthodontic practitioners actively practicing in Iraq, including members of the Iraqi Orthodontic Society and the Kurdistan Region Orthodontic Association. The sample was purposively targeted for convenience. The inclusion criteria required participants to be registered orthodontic specialists or postgraduate orthodontic trainees currently involved in clinical practice.

Those not actively practicing or without orthodontic credentials were excluded. The final number of respondents was 83, resulting in a response rate of 55.3% from the 150 invited participants.

The cross-sectional online survey was conducted over the month of March 2025 (from March 15 to March 31).

Data were collected using a structured online questionnaire distributed via Google Forms. The survey link was disseminated through professional orthodontic social media groups.

The questionnaire included sections on demographics (e.g., degree type, age, weekly patient number); types of arch wires used during the alignment phase; the rationale behind their choices; and clinicians' observations considering variation in treatment duration and efficiency with different types of wires.

Five types of archwires were compared in the questionnaires, namely: traditional super-elastic nickel-titanium wires, 27°C Super-Elastic Copper NiTi, 35°C Thermo-Active Copper NiTi, 40° C Thermo-Active Copper NiTi, and multistrand stainless steel.

The questionnaire was developed based on a review of the literature[12,13] and pilot-tested on a small group of orthodontists (n=5) to ensure clarity and relevance before broader distribution. Adjustments were made based on feedback to improve validity and readability.

Ethical approval was granted by the scientific review board of the college. Informed consent was obtained electronically through a brief introductory statement at the beginning of the survey, where participants indicated agreement before proceeding. Personal information (e.g., names, email addresses, IP addresses) was not collected or stored to ensure complete anonymity of responses. Thus, participants' identities remained unknown to the researchers, maintaining full anonymity while upholding ethical standards of informed consent.

The collected data were analyzed using SPSS statistical software (Version 26, IBM, USA). Descriptive statistics, including frequencies and percentages, were calculated to summarize responses. Where applicable, cross-tabulations (chi-square tests) were performed to examine associations between demographic variables and archwire selection preferences to find statistical significance. P values <0.05 were considered statistically significant.

RESULTS

The first part of the survey results shows descriptive information about the participants. The majority of the sample (45%) had a master's degree in orthodontics followed by a PhD degree (25%); most (55%) of the respondents' age lay in the second group (30-40), as illustrated in Table 1.

The mean weekly number of orthodontic patients for the sample was 29.1± 25.7, while, the median was 22 (not affected by the extremity of the values); however, there was no statistically significant difference in the number of patients between different degrees in orthodontics (masters' and PhD), see Table 2.

DOI: doi.org/10.15218/edj.2025.10

Table 1. Demographic characteristics of the sample, including age and orthodontic degree.

		Age of respondents			Total
		N (%)	N (%)	N (%)	N (%)
		<30 years	30-40 years	>40 years	
Degree in orthodontics	Masters' degree	3 (7.8)	29 (76.3)	6(15.7)	38 (45.7)
	PhD degree	0(0)	3(14.2)	18(85.7)	21 (25.4)
	Professional Diploma	3(23)	10(76.9)	0(0)	13 (15.6)
	General practitioner	6(54.5)	4(36.3)	1(9)	11 (13.3)
Total		12(14.4)	46(55.4)	25(30.1)	83(100)

Table 2. The table below presents the average weekly number of patients treated, categorized by orthodontic qualification.

Degree in orthodontics	**N**	**Mean weekly patients**	**p-value**
Masters' degree	38	**28.23 ± 25.3**	**0.17(> 0.05)**
PhD degree	21	**38.2 ± 27.7**	

*Note: An independent sample t-test was used for the comparison of means.

directly addresses the research question. Based on the collected data, the traditional super-elastic nickel-titanium archwire was the most frequently utilized during the alignment and leveling stage, reported by 55% of respondents (Table 3).

Table 3. The most frequently used type of archwire (listed in descending fashion) for the alignment and levelling stage of orthodontic treatment by Iraqi practitioners.

Archwire type	**Frequency**	**Percentage**
Traditional super-elastic nickel-titanium wires	46	55.4 %
35°c thermo-active copper Ni-Ti	33	39.8 %
27°c super-elastic copper Ni-Ti	2	2.4 %
40°c thermo-active copper Ni-Ti	1	1.2 %
Multistrand stainless steel	1	1.2 %
Total	83	100 %

The second part of the results A statistically significant association was found between the type of archwire selected and the practitioner's orthodontic qualification ($p < 0.05$), as illustrated in Figure 1.

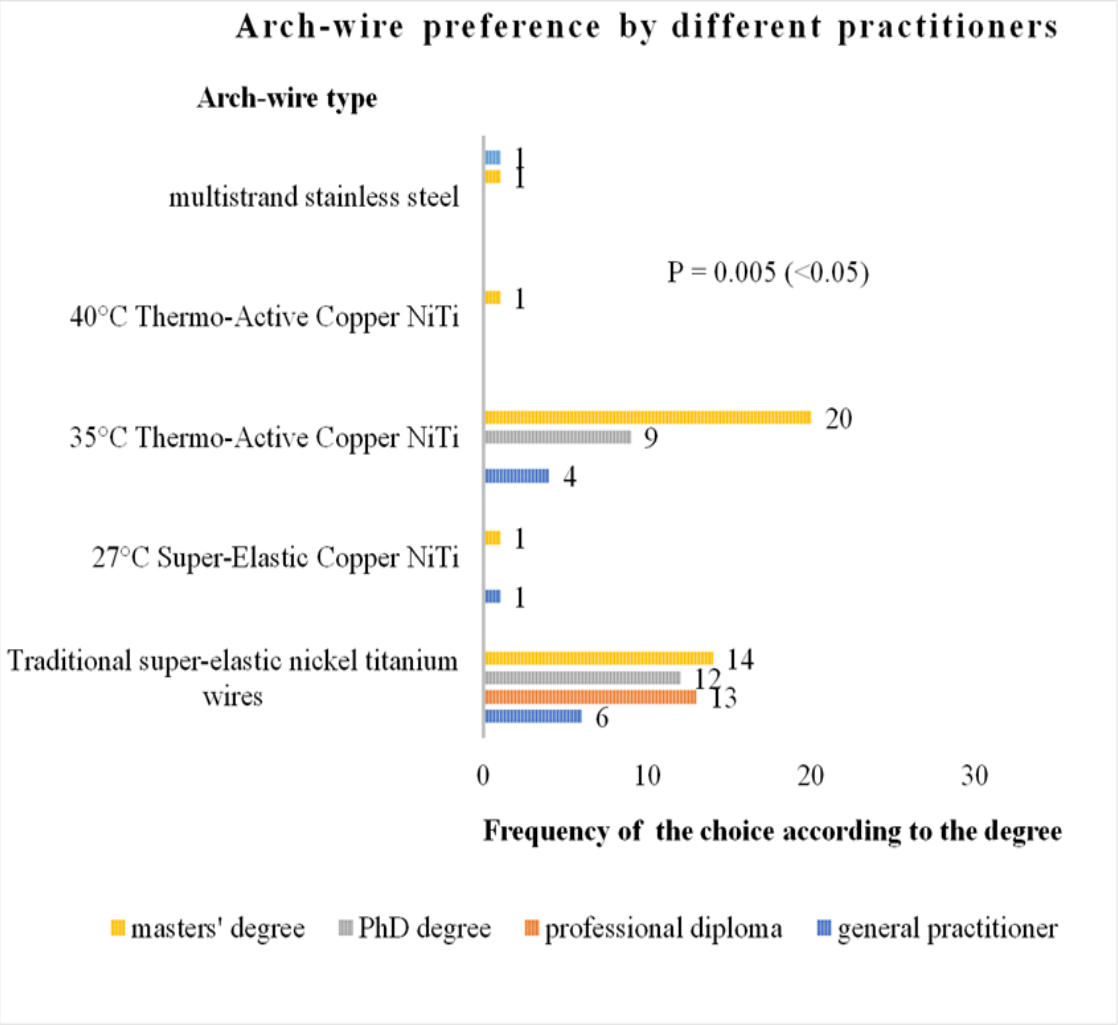

Figure 1. The chart above displays the frequency of archwire choices among respondents, categorized by their orthodontic qualification. Fisher's exact test was used to assess the statistical significance of the association.

The main factors that influenced the choice of archwire by the practitioners, according to the survey responses, were the achievement of fast tooth movement (27%) and easy manipulation of the wire (24%), according to the analytical results of the data, as illustrated in Table 4. The relevant factors of statistically significant association with the selected archwires (as indicated by a P value of <0.05), however, were easy manipulation of the wire and the availability of the wire in the market, respectively, as shown in Table 5. These results suggest that beyond clinical effectiveness, practical handling and accessibility significantly influence archwire selection.

Although some variables did not show statistically significant associations (e.g., less pain, faster movement, and cost-effectiveness; $p > 0.05$), they still highlight trends in practitioners' preferences, with copper Ni-Ti (35°C) being the most frequently associated with faster movement and easier handling.

DOI: doi.org/10.15218/edj.2025.10

Table 4. This table summarizes the main reasons selected by respondents in a multiple-response question regarding their preferred type of archwire, along with corresponding frequencies and percentages within the sample.

Reason for the choice	Frequency		Percent of cases
	N	Per cent	
Less pain by the patient	33	15.6 %	39.8 %
Faster tooth movement	58	27.4 %	69.9 %
Easier manipulation	49	23.1 %	59 %
Cost-effectiveness	31	14.6 %	37.3 %
Availability in the market	41	19.3 %	49.4 %
Total	212	100 %	255.4%

Table 5. This table presents the cross-tabulation between the selected archwire types and the rationale behind practitioners' choices. Associations with P-values < 0.05 were considered statistically significant.

Type of arch-wire chosen							
Reasons for the choice	Traditional super-elastic Ni-Ti wires		27°c super-elastic copper Ni-Ti	35°c thermo-active copper Ni-Ti	40°c thermo-active copper	Multistrand stainless steel	P value
Less pain by the patient	N	20	1	11	1	0	0.5 (>0.05)
	%	44.4%	50%	33.3%	100%	0%	
Faster tooth movement	N	30	0	26	1	1	0.1 (>0.05)
	%	66.7%	0%	78.8%	100%	100%	
Easier manipulation	N	19	1	29	0	0	<0.001
	%	42.2%	50%	87.9%	0%	0%	
Cost-effectiveness	N	22	0	9	0	0	0.1 (>0.05)
	%	48.9%	0%	27.3%	0%	0%	
Availability in the market	N	29	0	11	0	0	<0.05
	%	64.4%	0%	33.3%	0%	0%	

*Note: The statistical test used to determine the P values was Fisher's Exact Test.

*Percentages were based on a total per reason.

The average duration of the alignment and levelling stage, according to the answers of the participants, was 6 months (71%), as shown in Table 6. According to most of the participants (50%) perception, super-elastic Ni-Ti wires decreased the duration of the treatment more than the other types, while most participants (47%) thought that 27°C super-elastic copper Ni-Ti did not decrease the treatment duration, as described in detail in Table 7.

Table 6. The table presents the frequency distribution of alignment and leveling stage durations, as reported by respondent orthodontists based on predefined questionnaire categories.

The average duration of alignment and levelling stage			
Categories	**Frequency**	**Per cent**	**Cumulative Per-cent**
6 months	59	71.1	71.1
3-4 months	18	21.7	92.8
2-3 months	4	4.8	97.6
>6 months	2	2.4	100.0
Total	83	100.0	

Table 7. The table below presents the relationship between archwire type and its perceived impact on treatment duration, based on participants' responses.

Arch-wires that do not decrease duration						
		Super elas-tic Ni-Ti	27°C Super -Elastic Copper Ni-Ti	35°C Super -Elastic Copper Ni-Ti	40°C Super -Elastic Copper Ni-Ti	Total N (%)
Arch-wires that de-crease du-ration	40°C Super-Elastic Cop-per Ni-Ti	2	1	3	0	6 (7.2%)
	35°C Super-Elastic Cop-per Ni-Ti	11	15	0	7	33 (39.8%)
	27°C Super-Elastic Cop-per Ni-Ti	2	0	0	0	2 (2.4%)
	Super elastic Ni-Ti	1	23	2	16	42 (50.6%)
	Total N (%)	16 (19.3%)	39 (47%)	5 (6%)	23 (27.7%)	83 (100%)

According to the analytical results, the most efficient archwire type chosen by the sample was 35°C super-elastic copper Ni-Ti (53%), as shown in Figure 2.

DOI: doi.org/10.15218/edj.2025.10

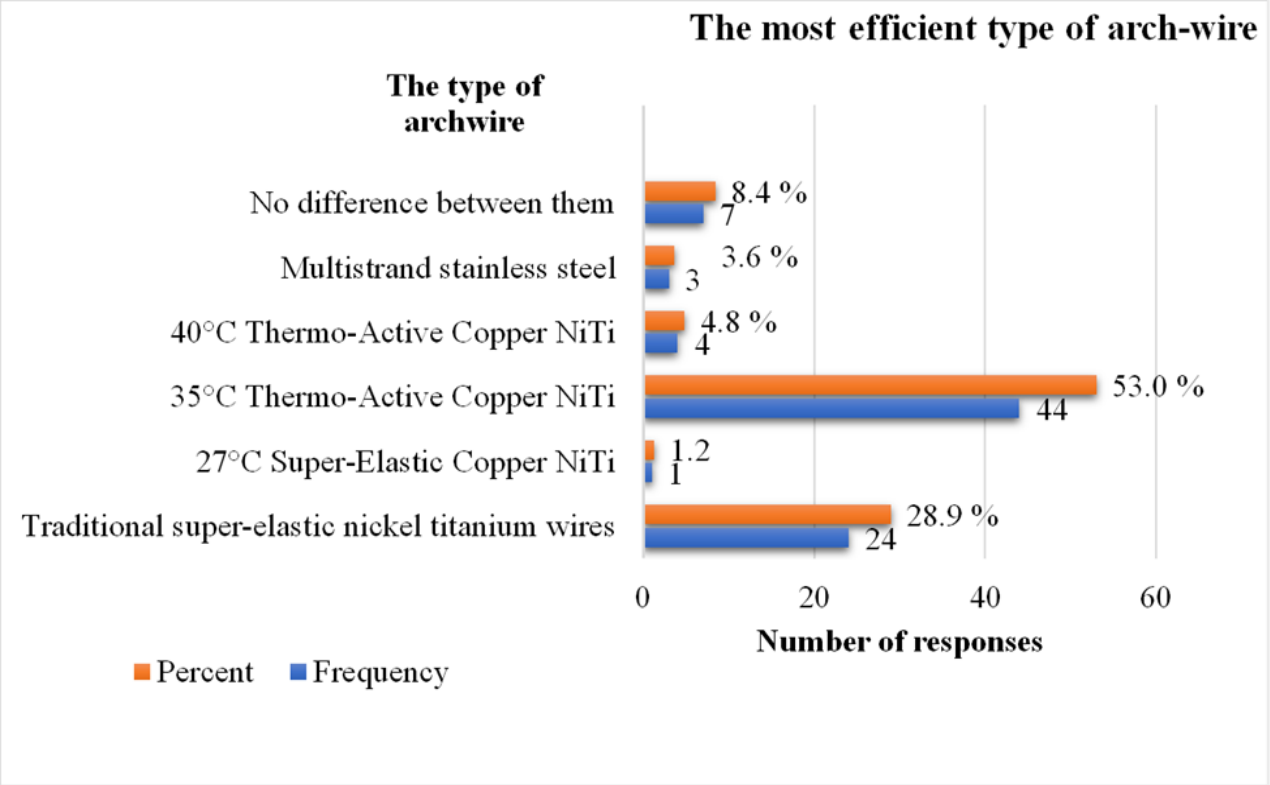

Figure 2. The bar chart displays clinicians' most frequently selected archwire type for clinical efficiency.

DISCUSSION

The results of this survey provide valuable insights into the archwire preferences and selection practices among Iraqi orthodontists during the alignment stage of fixed orthodontic treatment. Several key findings can be summarized from the data: The most used archwire for alignment was traditional super-elastic nickel-titanium (55.4% of respondents), followed by 35°C thermo-active copper Ni-Ti (39.8%). This aligns with the widespread use of nickel-titanium wires in the initial stages of treatment due to their favourable properties of flexibility and shape memory.[14] The preference for super-elastic Ni-Ti suggests most practitioners value its ability to deliver light continuous forces over a wide range of activation.[10,13]

The primary factors influencing archwire choice were achieving fast tooth movement (27.4%), and ease of wire manipulation (23.1%). A recently conducted study,[15] mentioned Ni-Ti wires as being superior in accelerating tooth movement due to their light, consistent force, making them optimal for the alignment phase, as shown by these survey results. Moreover, ease of manipulation is important, especially in severely crowded arches that allow better handling and require less chair time by the orthodontist. Therefore, super elastic Ni-Ti wires are an excellent choice for the alignment stage, as supported by the literature.[16] Interestingly, ease of manipulation and market availability showed statistically significant associations with archwire selection. These findings shed light on the status of the Iraqi market, indicating that desirable archwires are not readily available for purchase. This result highlights the importance of practical considerations like handling properties and accessibility in clinical decision-making, alongside biomechanical factors. On the other hand, Silvia-Izabella et al. in 2013 stated that biocompatibility of the archwire material was the most important factor considered by orthodontic practitioners when selecting their archwires.[2]

Regarding treatment duration, 71.1% of re-

spondents reported an average alignment phase of six months. Super-elastic NiTi was perceived by 50.6% of orthodontists as the most effective wire type in reducing treatment time. This suggests that minimizing treatment duration is a key concern for Iraqi orthodontic practitioners. However, one study found that surgical and biomechanical methods, rather than wire type, are more influential in accelerating treatment.[12] Interestingly, 53% of respondents rated 35°C copper Ni-Ti as the most clinically efficient, indicating a discrepancy between perceived speed and overall efficiency. This highlights a need for further investigation into how clinicians define and assess efficiency. Similarly, studies show limited consensus among practitioners on the ideal archwire type and properties.[2] A recent clinical trial by Ashok et al. (2024) and another earlier study found no significant difference in alignment efficiency between heat-activated and super-elastic Ni-Ti wires based on their mechanical performance, consistent with our findings.[17,18]

According to the results of this study, a statistically significant difference was found between the orthodontist's level of education and their choice of archwire when considering efficiency. This suggests that educational background and training may influence clinical preferences and decision-making. Further research could help identify the specific aspects of education or clinical experience that shape these choices. However, despite the differences in practitioners' perceptions regarding the most efficient wire type, a recent clinical trial found no significant difference in the aligning efficiency among various aligning archwires.[18]

These findings both align with and diverge from previous research in other regions. For instance, a survey of a sample of orthodontists found a preference for super-elastic NiTi in initial alignment, similar to these results.[19,20] However, that study reported greater use of multi-stranded stainless-steel wires, which were rarely chosen by Iraqi orthodontists in our sample.[19] This highlights potential regional variations in practice patterns.

The study's limitations include its reliance on self-reported data, which may be subject to recall bias. The sample size, while adequate for preliminary analysis, could be expanded in future research to increase generalizability. Additionally, the cross-sectional nature of the survey does not capture changes in preferences over time or in response to new product introduction

The findings suggest considering both biomechanical properties and practical factors in arch wire selection. Orthodontists should know their educational background can influence their choices and base decisions on recent evidence as well as on clinical experience. The perceived efficiency of 35°C copper Ni-Ti wires suggests an area for further clinical investigation, as suggested by other systematic reviews in this regard.[21]

The preference for the 35°C super-elastic copper Ni-Ti archwire as the most efficient option aligns with findings from international studies, which report that thermally activated Ni-Ti wires, particularly those activated at body temperature, demonstrate superior unloading force constancy and more biologically favorable tooth movement compared to conventional Ni-Ti wires.[22]

Future studies could employ prospective designs to directly compare treatment outcomes with different archwire types. Investigating the relationship between wire selection and specific case characteristics (e.g., crowding severity, arch form) could provide more nuanced guidance for clinical decision-making. Additionally, exploring patient-reported outcomes like comfort and satisfaction concerning different archwires would add valuable perspectives to inform treatment planning.

CONCLUSION

This survey reveals that the traditional super-elastic nickel-titanium (Ni-Ti) archwire is the most commonly used during the alignment and leveling stage by orthodontic practitioners in Iraq, with a usage rate of 55%. The choice of archwire shows a statistically significant association with the practitioner's level of qualification in orthodontics ($P < 0.05$), indicating that educational background influences clinical decisions. Additionally, clinicians' preferences are significantly linked to factors such as ease of manipulation and market availability ($P < 0.05$), suggesting that archwire selection is guided by

DOI: doi.org/10.15218/edj.2025.10

practical considerations rather than made arbitrarily. Among the options evaluated, the 35°C super-elastic copper Ni-Ti archwire is perceived as the most efficient for clinical use.

CLINICAL IMPLICATIONS

These findings underscore the importance of aligning product availability with practitioner needs and patient expectations. By recognizing that ease of manipulation and accessibility influence clinical decisions, suppliers and educational programs can better support clinicians with practical, evidence-based material choices. The perceived superiority of copper Ni-Ti wires also highlights a potential shift toward thermally activated wires, warranting their broader integration into clinical protocols where efficiency is prioritized.

FUTURE DIRECTIONS

Future studies should further investigate how orthodontists define and measure clinical efficiency and treatment speed in real-world settings. Longitudinal clinical trials comparing different wire types in terms of treatment outcomes, patient comfort, and biological response are essential.

CONFLICT OF INTEREST(S)

The Author declares no conflict of interest

FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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DOI: doi.org/10.15218/edj.2025.10

APPENDIX
QUESTIONNAIRE

Purpose, participation, confidentiality, and consent:

Purpose

This study aims to explore how and why orthodontic practitioners in Iraq choose specific aligning wires during treatment.

Participation Details

- Takes approximately 5–10 minutes
- Voluntary and completely anonymous
- You may stop at any time
- No personal or identifying information will be collected

Confidentiality

Your responses will remain strictly anonymous and confidential. Data will be used only for academic and research purposes.

Consent

By continuing, you confirm:

- You are a dental or orthodontic practitioner in Iraq
- You have read and understood this information
- You voluntarily agree to participate

Do you agree to participate in this study under the conditions described above?

What degree in orthodontics best describes you

Questions (all questions required by default)

1. What degree in orthodontics best describes you?
- Masters' degree
- Phd degree
- Professional diploma
- General practitioner

2. Average number of patients per week?
Short answer text

3. Age?
- <30
- 30-40
- >40

4. Most commonly used type of arch wire for alignment and levelling stage?
- Traditional super-elastic nickel titanium wires
- 27°C super-elastic copper niti
- 35°C thermo-active copper niti
- 40°C thermo-active copper niti
- Multistrand stainless steel

5. The average duration of alignment and levelling stage?
- 2-3 months
- 3-4 months
- 6 months
- >6 months

6. The reason behind your arch wire choice? (multiple-choice question)
- Less pain described by patient
- Faster tooth movement
- Easier manipulation
- Cost-effectiveness
- Availability in market

7. Is there significant difference among the above-mentioned types in terms of decreasing the duration of treatment stage?
- Super Elastic Niti yes no maybe
- 27°C Super-elastic Copper Niti yes no maybe
- 35°C Super-elastic Copper Niti yes no maybe
- 40°C Super-elastic Copper Niti yes no maybe

8. Do you find significant differences between the above-mentioned types regarding efficiency?
- Yes
- No

Section 2 of 2

If you answered positively to the last question, go to section 2.

9. Which type do you find most efficient?
- Traditional super-elastic nickel titanium wires
- 27°C super-elastic copper niti
- 35°C thermo-active copper niti
- 40°C thermo-active copper niti
- Multistrand stainless steel