

“Dimensional Changes in the Dental Arches During Orthodontic Treatment with Prefabricated NiTi Arch Wires: A Prospective Cohort Study”

Population- Patients aged 12 to 35 undergoing orthodontic treatment at Seha facilities in Abu Dhabi

Intervention- Use of prefabricated NiTi arch wires

Comparator- Not applicable (since it's a prospective cohort study without a direct comparator)

Outcome- Changes in inter-canine and intermolar width

Time - From initial appointment to completion of the alignment stage of treatment

SUMMARY

Orthodontic treatment at time involves usage of arch wires to correct dental irregularity. This study investigates the dimensional change in dental arches during orthodontic treatment with prefabricated Nickel-Titanium (NiTi) arch wire in patients aged 12 to 35 with different malocclusions which is treated from 2023 to 2025 in Seha facilities (Abu Dhabi). With the information of these changes, the study aims to improve treatment outcomes and stability.

BACKGROUND

Orthodontic treatments are used to correct dental irregularities and achieve optimal occlusion (Cunningham et al., 2000). The prefabricated Nickel-Titanium (NiTi) arch wires are used in this treatment because of their shape memory and super-elastic property. This allowed them to apply consistent pressure over a long period of time. However, the dimensional change these wires cause in the mandibular arch need to be thoroughly explored as well as understood to optimize treatment.

The recent advancement in orthodontic technology shows the impact of different arch wires on dental arch dimension. There are studies which have shown that NiTi arch wires provide advantages like reduced treatment time, alignment efficiency, and

improved patient comfort compared to traditional arch wires (Srinivasan & Krishnan, 2023). For example, a study (Jain et al., 2021) compared the alignment efficacy and arch dimension changes with super elastic, heat-activated, and seven-stranded coaxial nickel-titanium arch wires during fixed orthodontic treatment found that all three types of NiTi arch wires were equally effective in reducing moderate crowding. The study indicated no significant differences in alignment efficiency or changes in arch dimensions among the different arch wires used.

However, dimensional stability of dental arches is maintained during orthodontic treatment with prefabricated NiTi arch wires. Sheibaninia et al. (2018) have found that there were no essential reductions in the stiffness of the NiTi wires with different cross-sections after 1-2 months of their clinical using. In the same way, the stiffness of the 0.014, 0.016, and 0.018" NiTi wires reduced insignificantly from the pretreated stage to after one and two months of use, which means that a large modification in the arch dimensions may not be caused during this period of treatment with the NiTi wires, because the stiffness of these wires is maintained during the initial months of use.

The literature remains inconclusive about the exact change in dental arch dimension brought by NiTi wires. This research aims to fill this gap with investigation of dimensional change in the dental arch of patients who are undergoing orthodontic treatment with prefabricated NiTi arch wires. This study will measure changes in inter-canine and intermolar width before as well as after the alignment stage of treatment.

Aim

The aim of this study is to examine the impact of prefabricated Nickel-Titanium (NiTi) arch wire on the dimensional change of mandibular arch during as well as post orthodontic treatment.

Objectives

- To determine the impact of prefabricated NiTi arch wire on inter-canine width in patients from 12 to 35 years of age.
- To evaluate the impact of prefabricated NiTi arch wires on inter-canine and intermolar width in the same patient cohort.

- To compare the arch form (ovoid, square or tapered) at the start of the treatment with post-alignment stage.

METHOD & MATERIAL

a. Study Design

This study is conducted as a longitudinal-study. The patients would be followed from their initial appointment for orthodontic treatment to the completion of the first stage (alignment stage).

b. Study Population

The study population will consist of patients **from** age 12 to 35 **who** visit orthodontic clinic in Seha facilities (Abu Dhabi) with **several** malocclusions **which** require orthodontic treatment from 2023 to 2025.

Inclusion Criteria

- Patients aged 12 to 35.
- Patients with various malocclusions requiring orthodontic treatment.

Exclusion Criteria

- Patients with hypodontia.
- Patients with cleft or syndromic cases.

c. Study Procedures

- Data Source & Data Collection Tool

Data will be collected using dental casts taken at two different time points

- a. before the start of orthodontic treatment
- b. after the completion of the alignment stage.

- The casts will be measured for inter-canine and intermolar width with the use of standardized measurement tools.

d. Measurements

- Inter-canine width (in millimetres) before and after the alignment stage.
- Intermolar width (in millimetres) before and after the alignment stage.

e. Variables

- Independent Variable: Use of prefabricated NiTi arch wires.
- Dependent Variables: Changes in inter-canine and intermolar width.
- Confounding Variables: Gender and initial arch form (ovoid, square or tapered).

f. Sample Size

With BlueSky Statistics software, the required sample size was calculated to be 72 patients. the assumed confidence level by the Wald method is 0.95 and a confidence interval width is 0.1. Accounting for a 10% dropout rate, the sample size will be 82 patients.

DATA ANALYSIS

Data will be analysed by comparing the cast measurements (inter-canine and intermolar width) before starting the treatment with measurements taken after the completion of alignment stage in the same patient. The statistical analysis will be performed to determine the the changes observed.

ETHICAL CONSIDERATIONS

The study will obtain ethical approval from the relevant ethics review committee. All patients will provide informed consent before participation in the study. The study will adhere to ethical standards related to research which involve human subjects.

TIMELINE

Task	Start Date	End Date	Duration
1. Study Preparation			
1.1. Obtain ethical approval	Jan 2023	Feb 2023	2 months
1.2. Develop data collection tools	Jan 2023	Feb 2023	2 months
1.3. Training for data collectors	Feb 2023	Feb 2023	1 month
2. Recruitment and Baseline Data Collection			
2.1. Recruit participants	Mar 2023	Aug 2023	6 months
2.2. Collect baseline data (initial dental casts)	Mar 2023	Aug 2023	6 months
3. Intervention Period (Alignment Stage)			
3.1. Orthodontic treatment using NiTi arch wires	Mar 2023	Mar 2024	1 year
4. Follow-Up Data Collection			
4.1. Collect post-alignment data (dental casts)	Mar 2024	Aug 2024	6 months
5. Data Analysis and Interpretation			
5.1. Analyze data	Sep 2024	Dec 2024	4 months
5.2. Interpret results	Sep 2024	Dec 2024	4 months
6. Reporting and Dissemination			
6.1. Prepare manuscripts	Jan 2025	Feb 2025	2 months
6.2. Submit for publication	Mar 2025	Apr 2025	2 months
6.3. Present findings at conferences	Apr 2025	Jun 2025	3 months

References

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