

IMPACT OF SHAPE-MEMORY ARCHWIRES IN PATIENTS WITH ACTIVE INFLAMMATION TO REDUCE PLAQUE RETENTION AND IMPROVE COMFORT

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ABSTRACT

Shape-memory NiTi archwires may improve early orthodontic treatment by reducing plaque retention and enhancing patient comfort. Thus the goal was to assess the effect of shape-memory archwires on plaque retention and comfort in orthodontic patients with active inflammation in a total of 100 patients which were equally divided into 2 groups i.e. group 1 NITI archwire and stainless steel archwire. Plaque index, gingival index, and patient comfort were assessed at Baseline, 1 week, 4 weeks, and 8 weeks. We have found that, both the groups showed improvement over time, but the test group demonstrated a greater reduction in plaque index and gingival index compared with the control group. Patient comfort was also better in the shape-memory archwire group at all follow-up points. The intergroup differences were statistically significant, indicating superior clinical performance of shape-memory archwires. Thus, we have come to conclude that, shape-memory NiTi archwires were more effective than stainless steel archwires in reducing plaque retention, improving gingival health, and enhancing patient comfort.

Keywords : NiTi, Shape-Memory, Archwires, Plaque Retention, Inflammation

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INTRODUCTION

Orthodontic treatment commonly begins with initial archwires that must align crowded teeth efficiently while remaining comfortable and biologically acceptable for the patient.¹ Nickel-titanium (NiTi) shape-memory archwires have transformed early orthodontic mechanics because they combine superelasticity, low stiffness, high springback, and shape-memory behavior, allowing delivery of light continuous forces that are generally better tolerated clinically.² In addition to their mechanical advantages, the titanium oxide surface film on NiTi wires has been reported to have an antiadherent effect that may help limit plaque accumulation, which is especially relevant in patients with fixed appliances who already have a higher risk of plaque retention and gingival inflammation.³ Since oral hygiene often worsens after appliance placement and discomfort can reduce compliance, selecting an archwire that supports both efficient alignment and better periodontal tolerance is important. However, despite the wide use of NiTi wires, there is limited clinical evidence specifically evaluating their effect on plaque

retention, gingival inflammation, and patient comfort in patients with active inflammation, particularly in the Indian population. Therefore, this study was designed to assess the impact of shape-memory archwires on plaque retention and comfort in orthodontic patients from Rajasthan and Karnataka.

AIM

To evaluate the effectiveness of shape-memory archwires in reducing plaque retention and improving patient comfort in orthodontic patients with active inflammation.

MATERIAL AND METHOD

This prospective comparative clinical study which was conducted among 100 orthodontic patients from Rajasthan and Karnataka, India. The patients were divided into two equal groups, with one group receiving shape-memory NiTi archwires and the other receiving conventional stainless steel archwires as shown in figure 1, and both groups will be assessed for plaque accumulation, gingival inflammation, and comfort at baseline and follow-up visits (Baseline, 1 week, 4 weeks, and 8 weeks) using standard clinical indices and a visual analog scale.



FIGURE 1 : NITI and STAINLESS STEEL ARCHWIRES

INCLUSION CRITERIA

1. 15 to 35 years with permanent dentition
2. Clinically evident active inflammation
3. Willingness to participate
4. Both sex male and female

EXCLUSION CRITERIA

1. Systemic diseases affecting periodontal health
2. Tobacco use
3. Medications influencing gingiva
4. Recent periodontal treatment
5. Poor compliance
6. Factors interfering with plaque assessment

STATISTICAL ANALYSIS

The data was entered into Microsoft Excel and analyzed using SPSS software. Descriptive statistics such as mean, standard deviation, frequency, and percentage was calculated for all variables, and the normality of data will be checked before analysis. Intergroup comparison of plaque index, gingival index, and comfort scores between the two groups was performed using the independent t test or Mann–Whitney U test as appropriate, while intragroup changes over time was analyzed using paired t test or repeated measures analysis. A p value of less than 0.05 was considered statistically significant.

RESULT

VARIABLE	TEST GROUP	CONTROL GROUP
AGE	21.4±3.2	21.1±3.5
MALE	22 (44%)	21(42%)
FEMALE	28 (56%)	29(58%)
BASELINE PLAQUE INDEX	2.11±0.31	2.09±0.29
BASELINE GINGIVAL INDEX	1.98±0.26	1.95±0.24

TABLE 1 : BASELINE CHARACTERISTICS OF PATIENTS

Table 1 shows that both groups were comparable at baseline with no statistically significant difference in age, sex distribution, plaque index, or gingival index. Thus, the study groups were well matched before intervention.

FOLLOW-UP	TEST GROUP	CONTROL GROUP	P VALUE
BASELINE	2.11±0.31	2.09±0.29	0.72
1 WEEK	1.76±0.28	1.92±0.30	0.01
4 WEEK	1.42±0.25	1.68±0.27	0.001
8 WEEK	1.18±0.22	1.49±0.24	<0.001

TABLE 2: PLAQUE INDEX

Table 2 shows that, plaque scores decreased in both groups, but the reduction was greater in the test group receiving shape-memory archwires. Thus, the difference became more evident at later follow-up visits, suggesting better plaque control with shape-memory archwire as the p value was <0.001.

FOLLOW-UP	TEST GROUP	CONTROL GROUP	P VALUE
BASELINE	1.98±0.26	1.95±0.24	0.54
1 WEEK	1.62±0.23	1.78±0.25	0.004
4 WEEK	1.29±0.21	1.54±0.23	<0.001
8 WEEK	1.05±0.19	1.32±0.21	<0.001

TABLE 3 : GINGIVAL INDEX

Table 3 shows that, gingival inflammation improved in both groups, but the test group showed a greater reduction in gingival index. This indicates that shape-memory archwires may be more effective in reducing active gingival inflammation.

FOLLOW-UP	TEST GROUP	CONTROL GROUP	P VALUE
IMMEDIATE AFTER INSERTION	3.2 ±0.7	4.1±0.8	<0.001
24 HOURS	2.6±0.6	3.5±0.7	<0.001
1 WEEK	1.9±0.5	2.8±0.6	<0.001
4 WEEK	1.4±0.4	2.1±0.5	<0.001

TABLE 4 : PATIENT COMFORT SCORE

Table 4 shows that, test group reported lower discomfort scores at all time points, showing better comfort after placement of shape-memory archwires. This suggests that these archwires may be better tolerated by patients during the initial phase of treatment.

OUTCOME	TEST GROUP	CONTROL GROUP	P VALUE
MEAN REDUCTION IN PLAQUE INDEX	0.93	0.60	<0.001
MEAN REDUCTION IN GINGIVAL INDEX	0.93	0.63	<0.001
MEAN IMPROVEMENT IN COMFORT SCORE	1.8	1.2	<0.001

TABLE 5 : OVERALL OUTCOME COMPARISON

Table 5 shows that, test group showed greater improvement in plaque retention, gingival health, and patient comfort compared with the control group. These findings suggest that shape-memory archwires may be more beneficial than conventional archwires in patients with active inflammation.

DISCUSSION

In the present study, shape-memory archwires showed better clinical performance than conventional archwires in terms of plaque retention, gingival inflammation, and patient comfort. This finding is consistent with the known properties of nickel-titanium alloys, which provide light, continuous forces and greater flexibility during the initial phase of orthodontic treatment. Because these wires adapt better to irregular tooth alignment, they may cause less mechanical irritation and improve patient tolerance during early treatment.^{3,4}

The reduction in plaque and gingival scores observed in the test group may be explained by the smoother clinical behavior and lower rigidity of shape-memory archwires. Literature suggests that NiTi wires have an antiadherent effect and may help to minimize plaque

accumulation when compared with more rigid alternatives.⁴ In addition, better comfort in the test group is in line with prospective clinical evidence showing that heat-activated and superelastic NiTi wires are useful in the early alignment phase and are generally well accepted by patients.^{5,2}

Our findings also agree with studies reporting that superelastic and heat-activated NiTi archwires are effective in the initial stage of fixed orthodontic treatment because they maintain force over a wider range of activation. This property may reduce unnecessary force fluctuations and local tissue irritation, which can contribute to better oral comfort. Since patient discomfort and oral hygiene problems are common after appliance placement, the use of shape-memory archwires may be clinically advantageous in patients with active inflammation.⁶

At the same time, some studies focus mainly on alignment efficiency rather than periodontal outcomes, so direct comparison with plaque retention and gingival inflammation outcomes is limited.⁴⁻⁶ This means our study adds a value by addressing a less commonly studied but clinically important area i.e. the relationship between archwire choice, plaque retention, and comfort in inflamed patients. Therefore, our results can be discussed as supportive of using shape-memory archwires as an initial wire option in patients who need both effective alignment and improved soft tissue tolerance.

CONCLUSION

The present study concluded that shape-memory NiTi archwires were more effective than stainless steel archwires in reducing plaque retention, improving gingival condition, and enhancing patient comfort in orthodontic patients with active inflammation. Their superelastic and heat-activated properties likely contributed to the better clinical outcomes by providing light continuous forces and improved adaptability during the initial phase of treatment. Therefore, shape-memory archwires may be considered a better initial archwire option in patients who require both effective tooth alignment and better periodontal tolerance.

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