Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2020;10:4:344-347.

# Comparative Evaluation of Bacterial Adhesion on Different Niti Orthodontic Arch-Wires

**Kumar Adarsh[1*] Mohammad Kashif Noorani[2] Rakesh Ranjan[3] Bhavana Sharma[4] Kunal Gaurav Seth[5] Sumit Verma[6]**

[1]MDS, Department of Orthodontics, Dr. B.R. Ambedkar Institute of Dental Sciences & Hospital. Patna, Bihar, India.
[2]Senior Lecturer, Department of Prosthodontics, Dr. B.R. Ambedkar Institute of Dental Sciences & Hospital. Patna, Bihar, India.
[3]Private Practitioner, Hajipur, Bihar, India.
[4]Senior Lecturer, Department of Periodontology, Hazaribagh College of Dental Sciences and Hospital, Hazaribagh, Jharkhand, India.
[5]Private Practitioner, Department of Periodontology, Muzaffarpur, Bihar, India.
[6]Senior Lecturer, Department of Oral and Maxillofacial Surgery, Dr. B.R. Ambedkar Institute of Dental Sciences & Hospital. Patna, Bihar, India.

## ABSTRACT

**Background**: One of the major criteria for successful orthodontic treatment is patient compliance in maintaining excellent oral hygiene. Bacterial adhesion to biomaterials and the ability of many microorganisms to form biofilm on foreign bodies are well-known steps in the pathogenesis of oral infections.

**Material and method**: Conventional 0.016 NiTi archwires and Teflon coated 0.016 NiTi archwires were placed in the mouth of each patient for 4 weeks after proper sterilization. On retrieval from the mouth the bacterial count was compared with the initial bacterial count before placement inside the mouth.

**Conclusion**: Comparatively more bacterial adhesion was found in Teflon coated 0.016 NiTi.

**Keywords:** NiTi archwire, bacterial growth.

## INTRODUCTION

One of the major criteria for successful orthodontic treatment is patient compliance in maintaining excellent oral hygiene. Bacterial adhesion to biomaterials and the ability of many microorganisms to form biofilm on foreign bodies are well-known steps in the pathogenesis of oral infections. Cariogenic mutant streptococci are currently classified into six species *Streptococci cricetus, Streptococci mutans, Streptococci sobrinus, Streptococci downei, Streptococcci ferns, Streptococci macaque*. Among these *Streptococcus mutans* and *streptococcus sobrinus* have been associated with smooth surface caries. The ability of this organism to cause dental caries is dependent on its adherence to the tooth surface, conversion of a wide variety of carbohydrates to organic acids through glycolysis, tolerance of low pH and its ability to synthesize water-insoluble glucans which is dependent on the expression of extracellular glucosyltransferases (GTFs)[1].

Understanding of the *S. mutans* level in patients before, during and after orthodontic therapy may help to determine caries risk level and may thus lead to appropriate preventive or antimicrobial therapy[2]. The in vitro adhesion of microbial flora is influenced by surface characteristics of biomaterials, particularly surface roughness and surface free energy (SFE)[3,4]. It has been suggested that rougher surfaces promote bacterial adhesion to the extent that exceeds the influence of SFE by increasing the adhesion areas and preventing dislodgement of bacterial colonies[5]. Also a material with high surface free energy attracts more

**Received:** Aug. 9, 2020**: Accepted**: Oct. 8, 2020
***Correspondence Dr. Adarsh Kumar.**
Department of Orthodontics, Dr. B.R. Ambedkar Institute of Dental Sciences & Hospital. Patna, Bihar, India.
**Email: kumarkumaradarsh@gmail.com**





pISSN 2278-0076
eISSN 2321-9270

bacteria to its surface than one with low surface free energy, in accordance with thermodynamic rules[4,6,7].

## MATERIALS AND METHOD

Fifty patients undergoing non-extraction orthodontic treatment were selected. Conventional 0.016 NiTi wire was placed for 4 weeks followed by placement of Teflon coated 0.016 NiTi archwires for 4 weeks. A 20-mm-long segment of each wire sample was sterilized in an autoclave. Each wire sample was placed into bacterial suspensions of *S. mutans* and incubated for 6 hours at 37°C. The adhered bacteria were then detached by scraping method with a cotton swab. The suspension was then serially diluted up to $10^{-1}$ to $10^{-3}$, and 100 µl of each dilution was spread on an agar plate. After incubation for 48hrs, bacterial colony on each plate was counted. The data was subjected to statistical analysis using SPSS (Statistical Package for Social Sciences) version 20.0 statistical analysis software. One way ANOVA was used to compare the mean bacterial adhesion. A Fisher LSD test was also used for multiple comparisons between the groups.

## RESULTS

The aim of the study was to compare bacterial adhesion on conventional and esthetic NiTi wires before and after their clinical use. Bacterial colony count of each sample (conventional NiTi, and Teflon coated 0.016 NiTi) was measured before and after placing into the mouth.

Table 1: Multiple comparisons of means of CFU by LSD test (wires as retrieved from the patient)

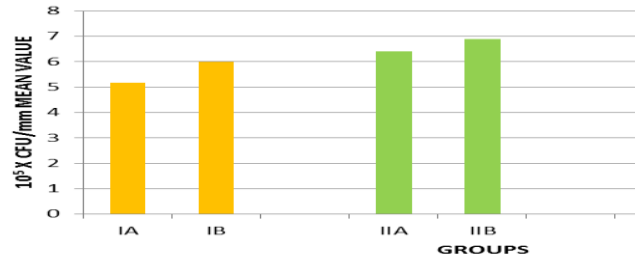
| As retrieved from the patient | | | | 95% Confidence Interval | |
|---|---|---|---|---|---|
| Group | mean difference | Std error | Significance | lower bound | upper bound |
| Conventional vs Teflon coated 0.016 NiTi | -0.94676 | 0.08374 | *p*< 0.001* | -1.1144 | -0.7791 |

**p* value < 0.001-Highly significant

Table 2: t-test comparing the intra group mean values

| | Paired Differences | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 95% confidence interval of the difference | | | | |
| | Mean Difference | Std Deviation | Std Error Mean | Lower | Upper | t | df | Significance ( p) |
| IA-IB | -0.813 | 0.466 | 0.104 | -1.031 | -0.594 | -7.791 | 19 | p < 0.001* |
| IIA-IIB | -0.540 | 0.250 | 0.056 | -0.658 | -0.423 | -9.664 | 19 | p < 0.001* |

**p* value < 0.001-Highly significant




A-As received from the manufacturer; B- Retrieved from a patient.

**Graph 1:** The bacterial adhesion on different wires before and after clinical use I) conventional NiTi (IA, IB); II) Teflon coated NiTi (IIA, IIB)

## DISCUSSION

The insertion of orthodontic wire tends to create new surfaces available for plaque formation, therefore to increase the level of microorganisms in oral cavity[1]. This knowledge regarding the growth and adhesion of cariogenic bacteria to orthodontic materials will offer a better way of preventing white spot lesions[5]. Currently, the most commonly used esthetic archwires are either Teflon coated or Epoxy coated. Teflon or polytetrafluoroethylene (PTFE) is a material characterized by a completely fluoridated chain. Elayyan et al. reported an increase in surface roughness of different wires after 4 weeks of use in

mouth. This could be explained by the abrasive influence of tooth brushing and the interaction between the archwire coating and bracket edges, with the presence of areas of remaining coating and areas of metallic exposure increasing surface roughness. With an increase in surface roughness, the biofilm adherence on the wires may alter[8]. So the aim of our study was to evaluate the adhesion of *Streptococcus mutans* on conventional and esthetic Nickel Titanium wires after clinical usage. So for this purpose, two types of NiTi wire were selected, i.e. conventional NiTi and Teflon coated NiTi. Although the oral cavity contains a large variety of microorganisms for our study, we used *Streptococcus mutans* because it is the most abundant bacteria found in the oral cavity. *Streptococcus mutans* and *streptococcus sobrinus* are the two most abundant bacteria found in the oral cavity. *Streptococcus mutans* (ATCC 25157) represents very small round pale white colour colonies which are very well differentiated on Brain Heart infusion agar and Blood agar. In glucose broth, long white coloured linear strands can be seen. Maetaniet et al. in their study stated that coating intraoral instruments with Teflon reduces the amount of plaque accumulation and eases plaque removal which proves that surface characteristics of the intra-oral instrument are an important factor in microbial plaque accumulation[9]. Kim et al. (2014) have reported esthetic coating on NiTi wire decreased *Streptococcus mutans* attachment probably by decreasing the surface free energy[4]. The initial affinity of bacteria to a solid surface is mostly due to electrostatic and hydrophobic interactions. It has been shown that the physicochemical properties of the bacteria, as well as those of the solid surface, contribute a mediator during the process of adherence to a hard surface. The composition, as well as the rate of saliva secretion, may also affect bacterial adherence. It is well known that the adherence of oral bacteria to the enamel tooth surface and orthodontic material has a harmful effect[9]. When we compared the retrieved wires with the as-received wires, there was an increase in the microbial adhesion for all groups.

This could be explained by the abrasive influence of tooth brushing, wearing from food, and the interactions between archwire coating and brackets edges, which cause peeling of some coating, with the presence of areas of remaining coating and areas of metallic exposure increasing surface roughness. Fournier et al. indicated that the adherence of *S. mutans* is weaker on metal than plastic and ceramic brackets. They even assumed that surface of all the brackets were same, which is not absolutely true, and this fact explains why their findings differ from their expectations[10].

In the present study, we have compared the bacterial adhesion on different NiTi wires before and after placement inside the mouth. A significant difference in bacterial adhesion was seen after retrieval from the mouth. A significant difference was seen between both the wires after retrieval, however more bacterial adhesion was seen in Teflon coated wire.

## CONCLUSION

For all types of wires, there was an increase in bacterial adhesion after clinical usage, and more adhesion was seen in Teflon coated wire.

## CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

## REFERENCES

1. Lee HJ, Park HS, Kim KH, Kwon TY, Hong SH. Effect of garlic on bacterial biofilm formation on orthodontic wire. Angle Orthod. 2011; 81:895–900.

2. Rosenbloom RG, Tinanoff N. Salivary S. mutans level in orthodontic treatment. Am J Orthod Dentofacial Orthop. 1991; 100:35-37.

3. Kwon TY, Hong SH, Kim YK, Kim KH. Antibacterial effects of 4-META/MMA-TBB resin containing chlorhexidine. J Biomed Mater Res B Appl Biomater. 2010; 92:561-67.

4. Kim IH, Park HS, KimYK, Kim KH, Kwon TY. Comparative short-term in vitro analysis of mutans streptococci adhesion on esthetic, nickel-titanium, and stainless-steel arch wires. Angle Orthod. 2014; 84:680-86.

5. Taha M, Fallal AE, Degla H. In vitro and In vivo biofilm adhesion to esthetic coated arch wires and its correlation with surface roughness. Angle Orthod. 2016; 86:285-91.

6. Bollen CM, Papaioanno W, Van Eldere J, Schepers E, Quiryem M, van Steenberghe D. The influence of abutment surface roughness on plaque accumulation and peri-implant mucositis. Clin Oral Implants. Res 1996; 7: 201-11.

7. Kang SH, Lee HJ, Hong SH, Kim KH, Kwon TY. Influence of surface characterstics on the adhesion of candida albicans to various denture lining materials. Acta Odontol Scand. 2013; 71: 241-48.

8. Elayyan F, Silikas N, Bearn D. Ex vivo surface and mechanical properties of coated orthodontic archwires. Eur J Orthod. 2008; 30:661–67.

9. Postlethwaite KM. Advances in fixed appliance design and use: Bracket and archwires. Dental update. 1992; 19:276-80.

10. Corbett JA, Brown LR, Keene HJ, Horton IM. Comparison of Streptococcus mutans concentrations in non-banded and banded orthodontic patients. J Dent Res. 1981; 60:1936-42.