Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies **NLM ID:** 101716117

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Indian Citation Index (ICI) Index Copernicus value = 100

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

Clinical evaluation of rate of decrowding and perception of pain between coated and conventional wire during leveling and aligning stage – An in vivo study

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ABSTRACT:
Nickel-titanium (niti) archwires are routinely used for initial leveling and alignment of teeth in orthodontic treatment. This study aimed to clinically compare the level of pain and tooth alignment in orthodontic treatment with teflon coated niti versus conventional niti archwires. In this study, 70 orthodontic patients (12–25 years) with an irregularity index>2 mm in the anterior site of the lower dental arch who required non-extraction orthodontic treatment of the lower arch were randomized into two groups (n=35) for treatment with teflon coated niti and conventional niti archwires. Each archwire was used for 4 weeks. After 3 months, the irregularity index was measured, and the level of pain was scored using the modifed Mcgill Pain Questionnaire (MPQ) and Visual Analog Scale (VAS) according to the time of onset and duration of pain. Data were analyzed by independent t test. The data are tabulated in microsoft excel and analysed with SPSS V.24 software. The variables are presented with mean and standard deviation. Independent t test is used for the statistical analysis. The p value ≤0.05 is considered statistically significant. Teflon coated NiTi wire exhibited excessive rate of decrowding in comparison to conventional NiTi wire. However, pain perception was lower in patient incorporated with teflon coated wire in comparison to patient incorporated with conventional NiTi wire.

Keywords: Conventional NiTi wire, Decrowding, Pain, Teflon coated wire.

Received: 22 March, 2024 Accepted: 25 April, 2024

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This article may be cited as: Karim MS, Mongia JP, Mahobia Y, Sthapak R, Gupta S, Jai VA. Clinical evaluation of rate of decrowding and perception of pain between coated and conventional wire during leveling and aligning stage – An in vivo study. J Adv Med Dent Scie Res 2024;12(5):61-72.

INTRODUCTION

The most important application of fixed orthodontic treatment is the correction of misaligned teeth. Because nearly in all malocclusions, some of the teeth, particularly in the anterior segment, have irregularity[1]. Orthodontic treatment is performed for the correction of dental irregularities. Archwires generate the force required for orthodontic tooth movement. Selection of an appropriate archwire in fixed orthodontic treatment for load application to the teeth can contribute to treatment success. Initial archwires are used at the onset of fixed orthodontic treatment and are mainly used for the correction of crowding and slight tooth rotation. Light continuous force is ideal for orthodontic treatment since it would result in controlled and predictable tooth movement with minimal damage to the teeth and their supporting structures. Clinically, efficient force should cause maximum tooth movement with minimum root resorption and pain[2].

The first stage of orthodontic treatment entails levelling and aligning. During this stage, archwires with desirable stiffness are required to correct vertical and horizontal discrepancies. The forces in play during levelling and aligning are deactivation forces, and hence clinicians should know deactivation forces to level and align the malpositioned teeth. The ideal archwires for this vital stage generate a continuous and light force over a long period. When a clinician engages a wire into the bracket slots of an appliance, energy is stored which represents activation forces. While the archwire tries to return to its original position, work is done on the dentition, as evidenced by the tooth movement which constitutes the deactivation forces. Hence, the force in play to level and align the teeth is not the activation force but the deactivation force or unloading force of the appliance. The selection of an appropriate wire size, and alloy type, in turn, would provide the benefit of optimum and predictable treatment results[3].

The force generated by an archwire highly depends on the physical properties of the material used for the fabrication of the archwire. Due to the wide range of mechanical properties of different alloys, archwires with the same size and shape but different stiffness can be fabricated[2]. Ideally, an archwire should be biocompatible, must have low stiffness to release light force upon activation, have high strength, and resistance to permanent deformation, should preserve its elasticity for a long period, and must be easy to use and low-cost[2].

In fixed orthodontic treatment, the wires are employed for applying force to the teeth. Selection of the appropriate wire is a prerequisite for success in various phases of treatment[4].

At present, different orthodontic archwires are used for the initial phase of orthodontic treatment.

Nickel– titanium (NiTi) archwires are most commonly used for the initial levelling and alignment of the teeth due to the optimal elasticity, low stiffness, high flexibility, and high spring back of the NiTi alloy[6–8]. NiTi alloy is available in two crystalline phases of martensite and austenite (A-NiTi), with different physical and mechanical properties. The formation of each phase depends on the magnitude of the applied stress and temperature change. Phase transformation alters the properties of the wire without changing the type of material. The presence of both phases in an archwire results in the super-elasticity of the alloy. This unique property is favourable for the initial levelling and alignment of the teeth. The temperature at which phase transformation occurs is known as the transition temperature. The A-NiTi wire, mainly composed of the austenite (high-temperature) phase, has higher elasticity than stainless steel. Bending the NiTi wire by at least 2mm helps in the formation of the martensite phase. This process is referred to as the stress-induced martensitic transformation. To achieve maximum clinical efficacy, the transition temperature should be adjusted close to or right below the oral temperature[2]. Conventional wisdom states that an orthodontist must apply added force to overcome friction, the result of which can be increased anchorage loading and subsequent anchorage loss. This concept has motivated our speciality to seek techniques to reduce friction and, consequently, reduce the potential for increased anchorage loss. Ceramic brackets produce nearly twice as much friction compared to the SS brackets. To overcome the increased friction of ceramic brackets, some manufacturers have incorporated a SS slot into the ceramic bracket. No significant difference was found between the SS brackets and the ceramic bracket with a SS slot.

Farranato et al studied friction and found that Teflon-coated wires had the least frictional losses among all the experimental groups[9]. Although different components were tested, De Franco et al found that Teflon-coated ligatures could reduce bracket-archwire friction[10]. Considering that Teflon could impart a tooth-coloured shade to the archwire and reduce friction as evidenced by Husmann et al, Teflon-coated wires are viable for use in orthodontics[11].

All coatings can reduce frictional losses compared with an uncoated reference wire by the same manufacturer. Measured frictional losses ranged from 48.3–6.1%, with the Teflon® coatings reducing the frictional losses to less than 10% in some cases[11]

Teflon-coated archwires produced lower frictional levels than their corresponding uncoated archwires. Coating archwires with Teflon may be a possible way to reduce resistance to sliding(RS). The best frictional results were found with a combination of Teflon-coated archwires and Quick brackets[28].

Pain is one of the most important reasons patients are discouraged from seeking orthodontic treatment[9]. Although the reason for the pain encountered during orthodontic tooth movement is not fully understood, various concepts have been discussed. Periodontal pain is caused by a process of pressure, ischemia, inflammation, and oedema [10]. It was identified that an immediate and delayed pain response; the former being related to the initial compression of the periodontal ligament (PDL) immediately after placement of the archwire[11]. The latter response, which started a few hours later, was termed hyperalgesia of the PDL. Prostaglandins have been shown to cause hyperalgesia, which is an increased sensitivity to noxious agents such as histamine, bradykinin, serotonin, acetylcholine, and substance P. There are indications that perceptions of pain are due to changes in blood flow in the PDL and are correlated with the presence of substances such as prostaglandins and substance P [10-12]. The subjective perception of pain is difficult to measure. It was noted a wide range of individual responses when similar forces were applied to the teeth[10]. Several investigations have described patient responses to fixed orthodontic appliances. These reported that pain begins a few hours after application of an orthodontic force and lasts approximately 5 days[10-12].

The aims and objectives of the study were, to evaluate the rate of decrowding between the coated wire and conventional niti wire during the levelling and aligning stage and to evaluate pain perception during levelling and aligning stage for both coated and conventional niti wire.

MATERIALS AND METHOD

SOURCE OF DATA

Seventy patients with mean age 12-25 year were selected to begin orthodontic treatment according to inclusion criteria, suitable treatment planning for each case determined before treatment onset based on patient's initial records. Patients were selected randomly from Department Of Orthodontics And Dentofacial Orthopaedics of New Horizon Dental College And Research Institute, Sakri, Bilaspur, Chhattisgarh and divided into two groups.The primary outcome was alignment efficiency; this was calculated by taking the difference in Little's irregularity index. Measurements were taken of contact point displacements between canine and canine for mandibular models on pretreatment and after completion dental casts using digital calipers.The difference between the 2 measurements gave us the reductions in irregularity and alignment efficiency.

INCLUSION CRITERIA

1. Patients having a permanent dentition (with the exception of the second and third molars).
2. 12–25 years old patients with crowding in anterior segment of lower arch.
3. Irregularity Index > 2mm in lower arch.
4. No expansion phase or distalisation in the lower arch in the process of the study.
5. No missing or spacing in lower arch.

EXCLUSION CRITERIA

1. Active periodontal diseases
2. History of previous orthodontic treatment
3. Systemic disease influencing pain
4. Chronic NSAID therapy
5. Blocked teeth limiting brackets bonding on teeth or engagement of the wire

ARMAMENTERIUM

1. D-Tech Teflon Coated 0.016" NiTi Wire Round Lower
2. Conventional 0.016" NiTi Wire Round Lower
3. Ceramic Brackets 0.022"
4. Elastomeric Ligature
5. Gloves
6. Composite Kit 3M-TRANSBOND – XT
7. LED Light Curing Unit
8. Bracket Holding plier (GDC)
9. Digital Vernier Caliper for measurement
10. Alginate
11. Dental Stone

Bonding Kit

Ceramic Brackets with Teflon Coated NiTi Wire in Group A

Ceramic Brackets with Conventional NiTi Wire in Group B

Digital Vernier Caliper

METHOD OF THE STUDY

Seventy patients with mean age 12-25 year were selected to begin orthodontic treatment according to inclusion criteria, suitable treatment planning for each case determined before treatment onset based on patient's initial records. Patients were selected randomly from Department Of Orthodontics And Dentofacial Orthopaedics of New Horizon Dental College And Research Institute, Sakri, Bilaspur, Chhattisgarh and divided into two groups.

1. Group A: Teflon Coated 0.016" NiTi Wire Round Lower for initial leveling and aligning.
2. Group B: Conventional 0.016" NiTi Wire Round Lower for initial leveling and aligning.

MBT prescription Ceramic brackets 0.022" slot were used for study purpose. Bracket placement was done according to MBT prescription for each patient.

Leveling and aligning has been started with 0.016" NiTi wire. Group A patients had Teflon Coated NiTi wires and Group B patients had Conventional NiTi wires.

T0 records
Pretreatment measurements of crowding was recorded from pretreatment cast with the help of vernier caliper for each group patients using little irregularity index in lower arch. 0.016" Teflon Coated NiTi Wire was placed in lower arch in group A patients and 0.016" NiTi wire place in lower arch in group B patients.After the placement of wires, the modified McGill Pain Questionnaire with Visual Analogue Scale (VAS) had been given to all subjects and had been asked to fill it out until the next appointment (after 4 weeks). The Questionnaire consist of questions concerning the trigger of pain, description, location, duration, intensity, beginning, and medication. Data was calculated for rate of decrowding and perception of pain and compared statistically between both groups and the results was formulated.

Group A patient cast at T0

T1 records
After 1 month, the patients were recalled and asked to submit the modified McGill Pain Questionnaire.The wires were removed in both the group and alginate impression of mandibular arch made and poured with orthokal. After making study models the measurements were taken of contact point displacements between canine and canine for mandibular models on pretreatment and after completion dental casts using digital calipers.The difference between the 2 measurements gave us the reductions in irregularity and alignment efficiency. After taking records, 0.018" Teflon Coated NiTi Wire was placed in lower arch in group A patients and 0.018" NiTi wire place in lower arch in group B patient.

T2 records
After 1 month, the patients were recalled and the wires were removed in both the group and alginate impression of mandibular arch made and poured with orthokal. After making study models the measurements were taken of contact point displacements between canine and canine for mandibular models on pretreatment and postintervention dental casts using digital calipers.The difference between the 2 measurements gave us the reductions in irregularity and alignment efficiency. After taking records, 0.019 x 0.025" Teflon Coated NiTi Wire was placed in lower arch in group A patients and 0.019 x 0.025" NiTi wire place in lower arch in group B patients.

T3 records
After another 1 month, the patients were recalled and the wires were removed in both the group and alginate impression of mandibular arch made and poured with orthokal. After making study models the measurements were taken of contact point displacements between canine and canine for mandibular models on pretreatment and after treatment dental casts using digital calipers.The difference between the 2 measurements gave us the reductions in irregularity and alignment efficiency.

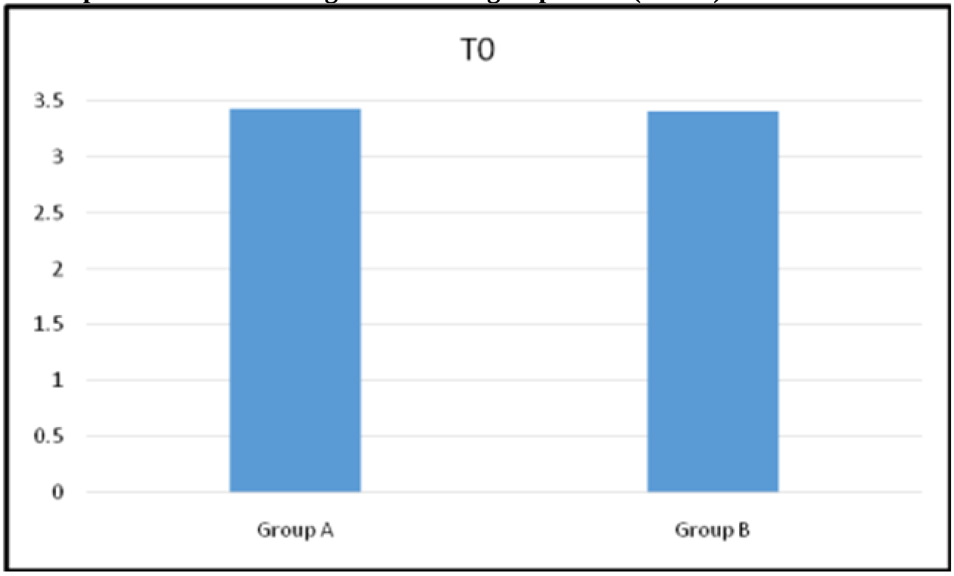
Group B patient cast at T3

RESULTS
The data are tabulated in Microsoft excel and analysed with SPSS V.24 software. The Variables are presented with mean and standard deviation. Independent t test is used for the statistical analysis. The p value ≤ 0.05 is considered statistically significant.
The crowding at T0 which was before placement of wires in group A which was allocated with Teflon coated NiTi wire was 3.43mm (SD = 0.62mm) and in group B which was allocated with conventional NiTi wire was 3.41mm (0.54mm)(Table no.1)(Graph no.1).

Table 1. Comparison of decrowding between the groups at T0(in mm)

Time	Group	N	Mean	SD	P value
T0	Group A	35	3.43	0.62	0.981
	Group B	35	3.41	0.54	

Graph No. 1. Comparison of decrowding between the groups at T0(in mm)

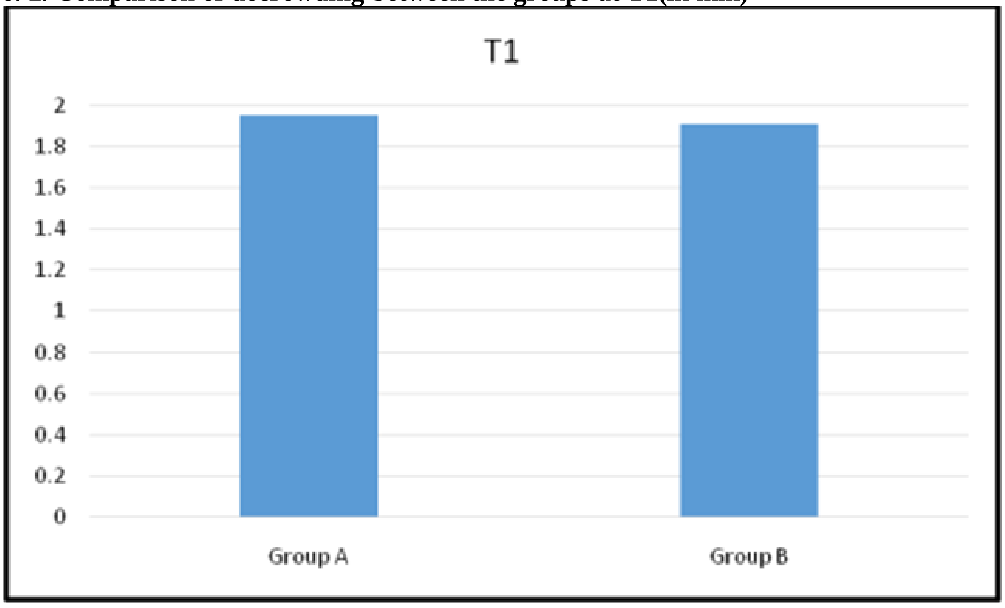


The crowding at T1 in group A with Teflon coated wire was 1.95mm (SD = 0.38mm) and in group B with conventional NiTi wire was 1.91mm (SD = 0.31mm)(Table no.2)(Graph no.2).

Table 2. Comparison of decrowding between the groups at T1(in mm)

Time	Group	N	Mean	SD	P value
T1	Group A	35	1.95	0.38	0.904
	Group B	35	1.91	0.35	

Graph No. 2. Comparison of decrowding between the groups at T1(in mm)

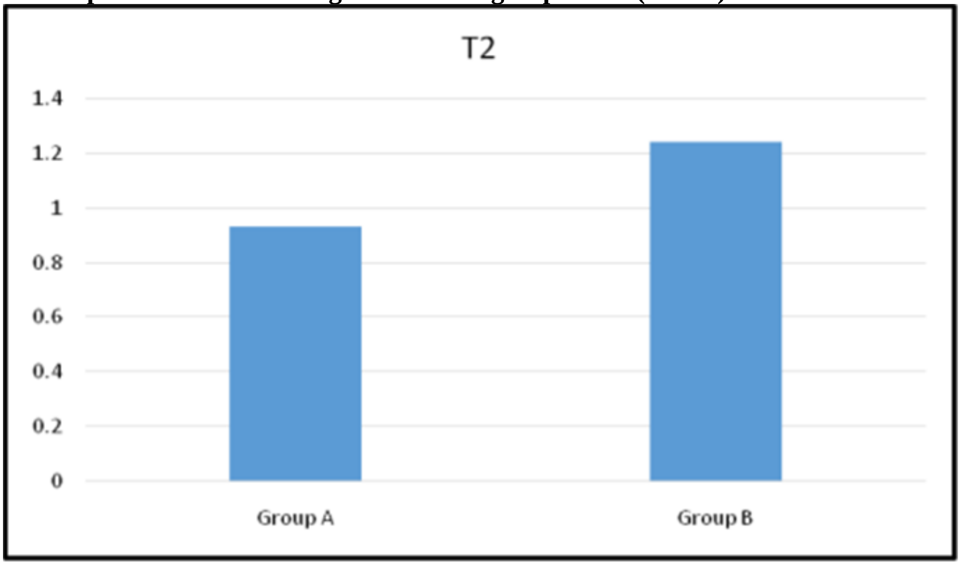


The crowding at T1 in group A with Teflon coated wire was 0.93mm (SD = 0.15mm) and in group B with conventional NiTi wire was 1.24mm (SD = 0.33mm)(Table no.3)(Graph no.3).

Table 3. Comparison of decrowding between the groups at T2(in mm)

Time	Group	N	Mean	SD	P value
T2	Group A	35	0.93	0.15	0.026
	Group B	35	1. 24	0.33	

Graph No. 3. Comparison of decrowding between the groups at T2(in mm)

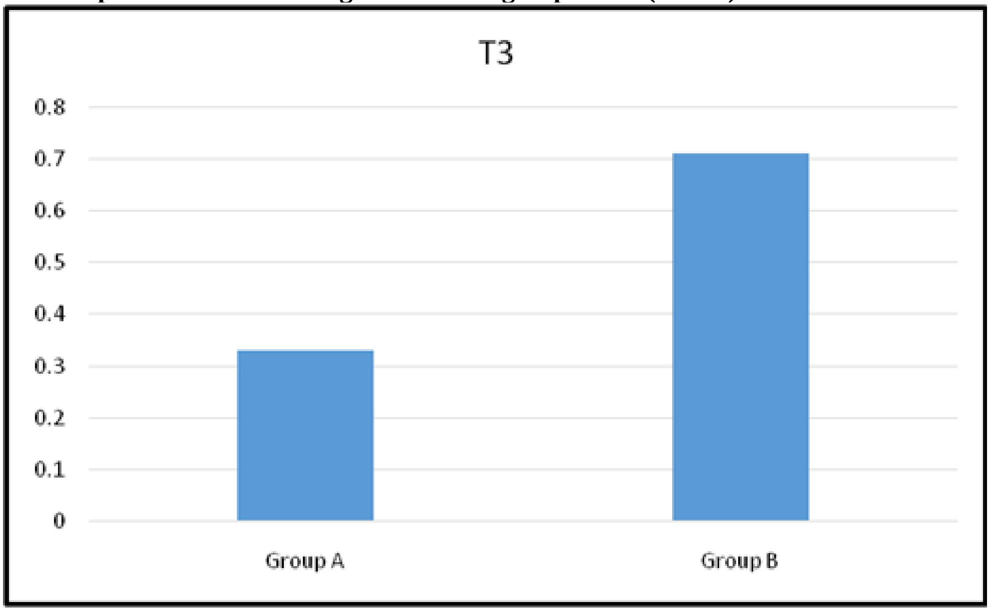


The crowding at T1 in group A with Teflon coated wire was 0.33mm (SD = 0.11mm) and in group B with Conventional NiTi wire was 0.71mm (SD = 0.19mm)(Table no.4)(Graph no.4).

Table 4. Comparison of decrowding between the groups at T3(in mm)

Time	Group	N	Mean	SD	P value
T3	Group A	35	0.33	0.11	0.001
	Group B	35	0.71	0.19	

Graph No. 4. Comparison of decrowding between the groups at T3(in mm)



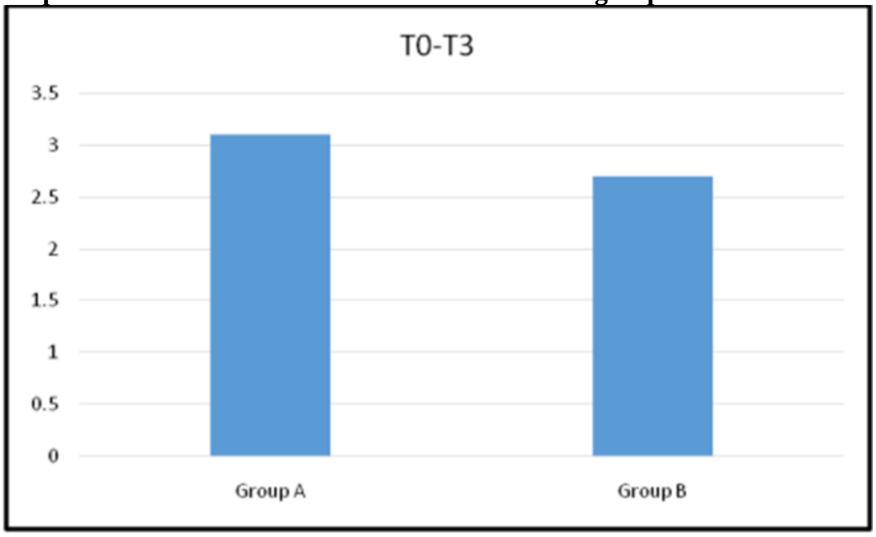
Rate of decrowding

Over the four month observation, the rate of decrowding was more in group A with Teflon coated NiTi wire. The overall decrowding from T0-T3 with Teflon coated NiTi wire is 3.1mm (SD=0.51mm) and 2.7mm (0.35mm) with Conventional NiTi wire (Table 5)(Graph no.5).

Table 5. Comparison of difference from T0 to T3 between the groups

Time	Group	N	Mean	SD	P value
T0-T3	Group A	35	3.1	0.51	0.008
	Group B	35	2.7	0.35	

Graph No. 5. Comparison of difference from T0 to T3 between the groups



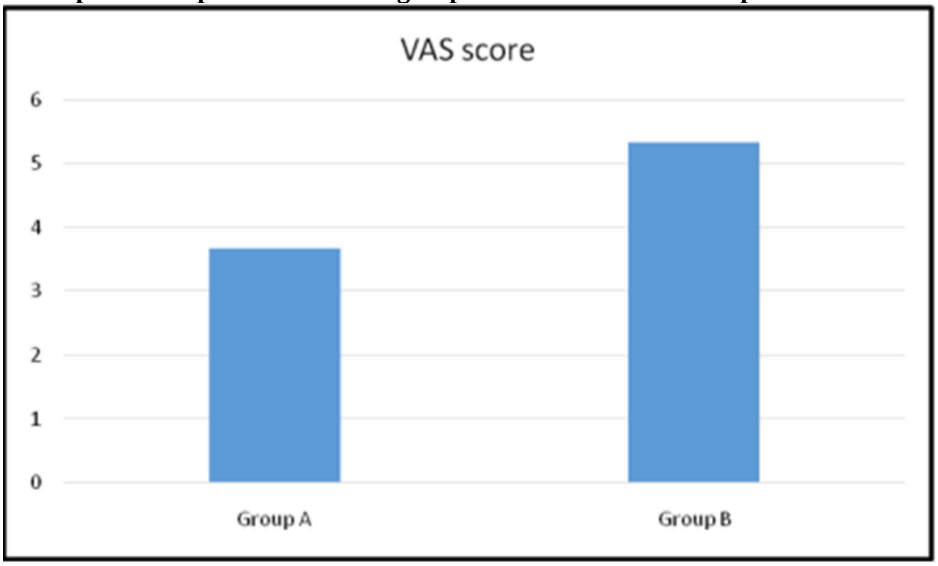
Perception of Pain

The level of pain perception in Group A with Teflon coated NiTi wire is 3.67(SD=0.59) and 5.33(SD=0.73) in Group B with conventional NiTi wire (Table no. 6)(Graph no.6).

Table 6. Comparison of pain between the groups after one week of wire placement

Pain	Group	N	Mean	SD	P value
VAS score	Group A	35	3.67	0.59	0.005
	Group B	35	5.33	0.73	

Graph No. 6. Comparison of pain between the groups after one week of wire placement



DISCUSSION

The growing demand for better aesthetics during orthodontic treatment has led to the development of appliances that combine both acceptable aesthetics for the patient and adequate technical performance for the clinician. Most fixed orthodontic appliance components are metallic and silver in colour. This problem was partially solved by the introduction of aesthetic transparent brackets made of ceramic or composite. However, archwires are still made of metals such as stainless steel, titanium-molybdenum alloy, and nickel titanium. Coating metallic archwires with plastic resin materials is an existing solution to this aesthetic problem. Coating improves aesthetics, but creates a modified surface, which can affect friction corrosive properties, and the mechanical dura bility of the wires [53].

Today, it has become common place for orthodontists to use nickel titanium archwires, at least in the initial stage of treatment for levelling and aligning. These wires are capable of large elastic deflections and they allow greater working ranges and therefore fewer archwire changes [54]. The demand for aesthetic appliances has resulted in manufacturers coating the Ni-Ti wires with Teflon [polytetrafluoroethene] to be used with ceramic or composite brackets. Atomized Teflon particles are used to coat the wires using clean compressed air as a transport medium. This is further heat treated in a chamber furnace [12].

There are different opinions in the literature concerning coated archwires. An evaluation of sliding properties and adherence of coating to the archwires revealed that the plastic coating decreased friction between archwires and bracket. The coated wires are also found to be routinely damaged from mastication and activation of enzymes, due to which this coating has been described as undurable. Other authors have also experienced difficulties, claiming that the colour tends to change with time and that the coating splits during use in the mouth, exposing the underlying metal.

The present study aimed to evaluate the rate of decrowding using Teflon coated NiTi wire and conventional NiTi wire during levelling and alignment stage over a four month period. In addition the perception of pain was also evaluated on using Teflon coated NiTi wire and conventional NiTi wire. Statistically significant difference were found in the rate of decrowding in both the groups. The total decrowding from T0-T3 aided with Teflon coated wire is 3.1mm while the group 2 aided with conventional NiTi wire is 2.7mm as mentioned in table 5.

In the study conducted by K Ranjan R.Bhat et al, two groups contained polycrystalline ceramic brackets with a metal slot in combination with stainless steel wire and Teflon-coated stainless steel wire show that the wire-bracket combinations with Teflon-coated stainless steel archwire had significantly less frictional resistance when compared to stainless steel wire. They concluded that, for all bracket-archwire combinations, Teflon-coated archwires resulted in lower friction than the corresponding uncoated archwires, and the results showed that Teflon coating has the potential to reduce resistance to the sliding of orthodontic archwires. In this present study, compared to niti wire, teflon-coated wire shown higher decrowding. One possibility is the teflon-coated wire's low frictional resistance [55].

Teflon-coated stainless steel wires show lesser surface roughness compared to stainless steel wires, observed in a study conducted by Mousavi et al. to evaluate the effect of esthetic coating on the surface roughness of orthodontic archwires [56]. However they have suggested that the processes such as teflon coating and ion implantation are the most common techniques used to improve the surface characteristics of wires [63]. Hence, these processes can decrease surface roughness and make their surface smoother which facilitates sliding movements between the wire and the bracket [64]. The finding strongly suggest that Teflon coating reduces the surface roughness which facilitates faster tooth movement.

On the other hand, study carried out with coated orthodontic archwires by Firas Elayyan et al reported that, on average 25 per cent of the coating was lost during use which led to significant reduction of the aesthetic qualities and the coating peeled off in many areas during in vivo use leaving surface defects. The irregular surfaces found microscopically may lead to plaque accumulation in surface defects and tooth movement may be affected due to entrapment of bracket edges inside these defects [33]. Few other authors, such as, Oliveira et al. [65] and Asiry et al. [66] supported the increased number of plaque on orthodontic archwires. But these studies had very low certainty, which is an inferior result compared to studies done by Costa Lima et al. [67] and Al-Sheakli et al. [68] who found that coating NiTi archwires with teflon reduces plaque adhesion. In this present study to counter this limitation, higher quality Teflon coated wire is used to overcome loss of coating and proper oral hygiene instructions were given to avoid plaque accumulation.

Loading curve illustrates the force applied to insert the wire in the bracket on the malaligned teeth; thus, the force is usually recorded at the last deflection of loading curve; whereas, the unloading curve represents the force delivered to teeth during treatment and usually is recorded in several deflection points. In a study conducted by Hosseinagha Aghili et al., HUBIT(Teflon) wires showed slightly lower force while the Ni-Ti presented higher force levels in both loading and unloading phases. This could be explained by the fact that the Teflon (HUBIT) layer adds a minimal thickness of 0.0008 to 0.001inch. Therefore, coating of these wires may result in a smaller Ni-Ti inner core compared to the conventional Ni-Ti arch wires. To its contrary, in this present study Teflon coated wires showed higher level of decrowding in comparison to conventional NiTi wires [57].

The ceramic bracket with metal reinforced slot had a lower frictional force value than did the traditional ceramic bracket, and it seems to be a promising alternative to solve the problem of friction reported by Clarice Nishio et al[58].

Nonetheless, in a study conducted by Guerrero et al. [59], stated that friction values for ceramic brackets with metal slots were similar to those of conventional ceramic brackets. This could be because of several factors. Studies have shown that friction in ceramic brackets with metal slots increases in the wet state [69]. By scanning microscopy, it was also observed that the metal inserts of the brackets do not have a constant width along the slot nor do they extend to the top of it [70]. Thus for the convenience we used conventional ceramic brackets in this present study.

Pain is one of the most important reasons why patients are discouraged from seeking orthodontic treatment [37]. Although the reason for the pain encountered during orthodontic tooth movement is not fully understood, various concepts have been discussed. According to Furstman and Bernick (1972), a combination of pressure, ischaemia, inflammation, and oedema may be the cause of periodontal pain [38].

Several studies have reported that ceramic brackets generate greater friction compared to stainless steel brackets [60,61]. In this present study as discussed earlier, ceramic brackets being same in both the groups, the initial NiTi arch wire in group B showed increased friction compared to Teflon coated wire in group A, might cause increased pain in Group B because of greater compression of the PDL and blood vessels.

A study conducted by Burstone [38], classified the pain response into an instant and late response after application of an orthodontic force. He explained the instant reaction because of compression and late reaction because of hyperalgesia of the PDL. The hyperalgesia is linked to the release of prostaglandins.

In a study conducted exclusively on orthodontic wires, Jones [62] concluded that majority of the patients felt pain 4h after arch wire engagement, which would rise at 24 h and then decrease. The results of this study are similar to our results where there was a peak in pain intensity after 1 day and then declined up to 5 days.

SUMMARY & CONCLUSION

The purpose of the study was to comparatively evaluate the rate of decrowding and perception of pain between Teflon coated NiTi wires and Coventional NiTi wires during leveling and aligning stage. NiTi wires are the initial wires which are primarily utilized for the leveling and alignment stages of the treatment. To reduce friction and improve aesthetics, coating has been added to archwire substance. Multiple investigations have been conducted to examine the rate of decrowding with coated wire and conventional niti.

In this present study, patients were selected with the due consent. Patients were divided into two groups, Group A and Group B. Each group had 35 number of patients. Ceramic brackets 0.022” were used for study purpose.

Bracket placement were done according to MBT prescription for each patient. Leveling and aligning had been started with 0.016” NiTi wire. Group A patients had teflon coated NiTi wires and Group B patients had conventional NiTi wires. Pretreatment measurements of crowding were recorded for each group patient using little irregularity index in lower arch. The amount of decrowding was calculated for 4 months with 1 month interval during leveling and aligning stage for lower arch in both the group using digital vernier calliper. At the end of bonding session, the modified McGill Pain Questionnaire with Visual Analogue Scale (VAS) had been given to all subjects and were asked to fill it out until the next appointment (after 4 weeks). The Questionnaire consisted of questions concerning the trigger of pain, description, location, duration, intensity, beginning, and medication. Data were calculated for rate of decrowding and perception of pain and compared statistically between both groups and the results were formulated.

According to this present study, teflon coated NiTi wire exhibited excessive rate of decrowding in comparison to conventional NiTi wire. However, pain perception was lower in patient incorporated with teflon coated wire in comparison to patient incorporated with conventional NiTi wire.

Limitation of this study is that, a ceramic bracket with a metal-reinforced slot can be utilized to improve results. This type of bracket exhibits lower frictional forces than a standard ceramic bracket and it seems to be a promising alternative to solve the problem of friction. Surface roughness of Teflon coated niti wire due to distortion of its coating can bind to the edges of the slot and increase friction and decrease in tooth movement. Teflon coating discoloration has been observed as a result of food and drink.

Ceramic brackets with metal-reinforced slots can be utilized to reduce frictional forces in order to get around this. Surface roughness resulting from coating distortion can be mitigated by routinely inspecting the wire during each visit, and replacing it as necessary. Many more aesthetic wires that do not discolor from food and drink can be utilized in place of teflon-coated wire.

The values obtained from this study proposes that more decrowding and less pain perception is observed in Teflon coated NiTi wires than Coventional NiTi wires during leveling and aligning stage.

REFERENCES

1. Proffit WR, Fields HW, Sarver DM, Ackerman JL. Contemporary orthodontics. Missouri, Mosby, St Louis 2013
2. Wang Y, Liu C, Jian F, McIntyre GT, Millett DT, Hickman J, et al. Initial arch wires used in orthodontic treatment with fxed appliances. Cochrane Database Syst Rev. 2018;7:CD007859.
3. Rajesh Kumar Reddy, Pavan K. Katari , Tarun T. Bypureddy, Venkata Naga Sri Harsha Anumolu , Yenugupalli Kartheek , Nemala. R. V. Sairam. Forces in initial archwires during leveling and aligning: An *in-vitro* study. J Int Soc Prev Community Dent. 2016 Sep-Oct; 6(5): 410–416.
4. Jian F, Lai W, Furness S, et al. Initial arch wires for tooth alignment during orthodontic treatment with fixed appliances. Cochrane Database Syst Rev 2013;30:CD007859.
5. Santoro M, Nicolay OF, Cangialosi TJ. Pseudoelasticity and thermoelasticity of nickeltitanium alloys: a clinically oriented review. Part I: temperature transitional ranges. Am J Orthod Dentofacial Orthop 2001;119:587–93.
6. Jian F, Lai W, Furness S, McIntyre GT, Millett DT, Hickman J, et al. Initial arch wires for tooth alignment during orthodontic treatment with fxed appliances. Cochrane Database Syst Rev. 2013;2013:CD007859.
7. Pandis N, Polychronopoulou A, Eliades T. Alleviation of mandibular anterior crowding with copper-nickel-

titanium vs nickel-titanium wires: a double-blind randomized control trial. Am J Orthod Dentofacial Orthop. 2009;136:152.e1-152.e7.
8. Sarul M, Kawala B, Antoszewska J. Comparison of elastic properties of nickel–titanium orthodontic Archwires Porównanie właściwośc isprężystych ortodontycznych drutów niklowo-tytanowych. Adv Clin Exp Med. 2013;22:253–60.
9. Farronato G P, Casiraghi G, Giannì A B, Salvato A 1988 The use of PTFE in orthodontics. Mondo Ortodontico 13: 83–89.
10. Farronato G, Maijer R, Carìa MP, Esposito L, Alberzoni D, Cacciatore G. The effect of Teflon coating on the resistance to sliding of orthodontic archwires. Eur J Orthod. 2012;34(4):410–7.
11. De Franco DJ, Spiller RE, von Fraunhofer JA. Frictional resistances using Tefloncoated ligatures with various bracket-archwire combinations. Angle Orthod. 1995;65(1):63–72.
12. Husmann P, Bourauel C, Wessinger M, Jäger A. The frictional behavior of coated guiding archwires. J Orofac Orthop. 2002;63(3):199–211.
13. Aslıhan M. Ertan Erdinç and Banu Dinçer. Perception of pain during orthodontic treatment with fixed appliances. European Journal of Orthodontics 26 (2004) 79–85.
14. Paul Scott et al. Perception of discomfort during initial orthodontic tooth alignment using a self-ligating or conventional bracket system: a randomized clinical trial. European Journal of Orthodontics 30 (2008) 227–232.
15. G.Farronato et al. The effect of Teflon coating on the resistance to sliding of orthodontic archwires. European Journal of Orthodontics, 2011 Apr, 34(4): 410-7.
16. Hamid Rakhshan , Vahid Rakhshan. Pain and discomfort perceived during the initial stage of active fixed orthodontic treatment. The Saudi Dental Journal (2015) 27, 81–87.
17. Reem Sh. Abdelrahman ; Kazem S. Al-Nimri ; Emad F. Al Maaitah. Pain experience during initial alignment with three types of nickel-titanium archwires: A prospective clinical trial.Angle Orthod. 2015;85:1021–1026.
18. Qamruddin et al. Pain perception and rate of canine retraction through self-ligating brackets and conventional elastomeric ligation system: a split mouth study. Pesqui Bras Odontopediatria Clin Integr. 2020 Feb; 20(5): 1-7.
19. Jawaid M, Qadeer TA, Fahim MF. Pain perception of orthodontic treatment – A cross-sectional study. Pak J Med Sci. 2020;36(2):160-165.
20. Mara Varma chandra pandian, uma maheswari, Devaki vijayalakshmi. Comparison Of Friction In Coated Stainless Steel Archwires Using Ceramic Brackets And Ceramic Self-Ligating Brackets – An Invitro Study. Annals of R.S.C.B., Vol. 24, Issue 1, 2020, pp. 873-891.
21. Azizi et al. Tooth alignment and pain experience with A-NiTi versus Cu-NiTi: a randomized clinical trial. BMC Oral Health, 2021 Sept; 21(431): 1-8.
22. Jnaneshwar PR et al. Evaluation and Comparison of load deflection rate of four arch wires used in the alignment phase of fixed orthodontic treatment – An In-Vitro Study. Int J Orthod Rehabil 2022; 13(3):01-09.
23. Azizi et al. Tooth alignment and pain experience with A-NiTi versus Cu-NiTi: a randomized clinical trial. BMC Oral Health, 2021 Sept; 21(431): 1-8.
24. Jnaneshwar PR et al. Evaluation and Comparison of load deflection rate of four arch wires used in the alignment phase of fixed orthodontic treatment – An In-Vitro Study. Int J Orthod Rehabil 2022; 13(3):01-09.
25. Reddy RK, Katari PK, Bypureddy TT, Anumolu VN, Kartheek Y, Sairam NR. Forces in initial archwires during leveling and aligning: An in-vitro study. J Int Soc Prevent Communit Dent 2016;6:410-6.
26. Pamela Husmann et al. The Frictional Behavior of Coated Guiding Archwires. J Orofac Orthop/Fortschr Kieferorthop 2002;63:199–211.
27. Pamela Husmann et al. The Frictional Behavior of Coated Guiding Archwires. J Orofac Orthop/Fortschr Kieferorthop 2002;63:199–211
28. Marković E. et al. The Correlation between Pain Perception among Patients with Six Diff erent Orthodontic Archwires and the Degree of Dental Crowding. Srp Arh Celok Lek. 2015 Mar-Apr;143(3-4):134-140.
29. Aman Ulhaq et al. Alignment efficiency and esthetic performance of 4 coated nickel-titanium archwires in orthodontic patients over 8 weeks: A multicenter randomized clinical trial. Am J Orthod Dentofacial Orthop 2017;152:744-52.
30. Keerthana P, Chitra P. Alleviation of lower anterior crowding with super-elastic and heat-activated niti wires: a prospective clinical trial. Turk J Orthod. 2021; 34(2): 127-135.
31. Nagalakshmi S, Sriram G, Balachandar K, Dhayanithi D. A comparative evaluation of mandibular incisor decrowding with coaxial and optiflex arch wires and their load-deflection rates. J Pharm Bioall Sci 2014;6:S118-21.
32. Wang Y, Liu C, Jian F, McIntyre GT, Millett DT, Hickman J, Lai W. Initial arch wires used in orthodontic treatment with fixed appliances. Cochrane Database of Systematic Reviews 2018, Issue 7.
33. M.N. Ahmad. Force-deflection behaviour of NiTi archwires in a polytetrafluoroethylene (Teflon) bracket system. Materialwiss. Werkstofftech. 2019, 50, 289–294.
34. Anca-Oana Dragomirescu et al. Reducing Friction in Orthodontic Brackets: A Matter of Material or Type of Ligation Selection? In-Vitro Comparative Study. Materials 2022, 15:1-12
35. Eleni Bazakidou. Evaluation of frictional resistance in esthetic brackets.Am J Orthod Dentofac Orthop 1997;112:138-44.
36. Firas Elayyan et al. Ex vivo surface and mechanical properties of coated orthodontic archwires. European Journal of Orthodontics 30 (2008) 661–667.
37. Choi S, Park DJ, Kim KA, Park KH, Park HK, Park YG. In vitro sliding-driven morphological changes in representative esthetic NiTi archwire surfaces. Microsc Res Tech. 2015;78(10):926–34.
38. Ryu SH, Lim BS, Kwak EJ, Lee GJ, Choi S, Park KH. Surface ultrastructure and mechanical properties of three different white-coated NiTi archwires. Scanning. 2015;37(6):414–21.
39. Oliver R G, Knapman Y M 1985 Attitudes to orthodontic treatment. British Journal of Orthodontics 12: 179–188.

40. Furstman L, Bernick S 1972 Clinical consideration of the periodontium. American Journal of Orthodontics 61: 138–155.
41. Burstone C 1964 Biomechanics of tooth movement. In: Kraus B S, Riedel R A (eds) Vistas in orthodontics. Lea & Febiger, Philadelphia, pp. 197–213.
42. Kvam E, Gjerdet N, Bondevik O 1987 Traumatic ulcers and pain during orthodontic treatment. Community Dentistry and Oral Epidemiology 15: 104–107.
43. White L W 1984 Pain and cooperation in orthodontic treatment. Journal of Clinical Orthodontics 18: 572–575.
44. Ngan P, Kess B, Wilson S 1989 Perception of discomfort by patients undergoing orthodontic treatment. American Journal of Orthodontics and Dentofacial Orthopedics 96: 47–53.
45. Jones M, Richmond S 1985 Initial tooth movement: force application and pain—a relationship? American Journal of Orthodontics 88: 111–116.
46. Feinmann C, Ong M, Harvey W, Harris M 1987 Psychological factors influencing post-operative pain and analgesic consumption. British Journal of Oral and Maxillo-Facial Surgery 25: 285–292.
47. Jones M, Chan C 1992 The pain and discomfort experienced during orthodontic treatment: a randomised controlled clinical trial of two initial aligning arch wires. American Journal of Orthodontics and Dentofacial Orthopedics 102: 373–381.
48. Jones ML, Chan C. Pain in the early stages of orthodontic treatment. J Clin Orthod. 1992;26:311–313.
49. Scheurer PA, Firestone AR, Burgin WB. Perception of pain as a result of orthodontic treatment with fixed appliances. Eur J Orthod. 1996; 18:349-57.
50. Bergius M, Berggren U, Kiliaridis S. Experience of pain during an orthodontic procedure. Eur J Oral Sci. 2002; 110:92-8.
51. Barta A, Nagy G, Csiki Z, Marton S, Madlena M. Changes in gingival blood flow during orthodontic treatment. Cent Eur J Med. 2010; 5(6):758-65.
52. Tecco S, D'Attilio M, Tete S, Festa F. Prevalence and type of pain during conventional and self-ligating orthodontic treatment. Eur J Orthod. 2009; 31:380-4.
53. Giannopoulou C, Dudic A, Kiliaridis S. Pain discomfort and crevicular fluid changes induced by orthodontic elastic separators in children. J Pain. 2006; 7:367-76.
54. Da Silva Campos MJ, Fraga MR, Raposo NRB, Ferreira AP, Vitral RWF. Assessment of pain experience in adults and children after bracket bonding and initial archwire insertion. Dental Press J Orthod. 2013; 18(5):32-7.
55. Vittorio Cacciafesta et al. Evaluation of friction of conventional and metal-insert ceramic brackets in various bracket-archwire combinations.
56. Anil Abdul Kaphoor and Shobha Sundareswaran. Aesthetic nickel titanium wires—how much do they deliver? *European Journal of Orthodontics*, Volume 34, Issue 5, October 2012, Pages 603–609.
57. Andreasen G F, Morrow R E 1978 Laboratory and clinical analyses of nitinol wire. American Journal of Orthodontics 73: 142–151.
58. Bhat K R, Ahmed N, Joseph R, et al. (April 15, 2022) Comparative Evaluation of Frictional Resistance Between Different Types of Ceramic Brackets and Stainless Steel Brackets With Teflon-Coated Stainless Steel and Stainless Steel Archwires: An In-Vitro Study. Cureus 14(4): e24161.
59. Mousavi SM, Shamohammadi M, Rastegaar Z, Skini M, Rakhshan V: Effect of esthetic coating on surface roughness of orthodontic archwires. Int Orthod. 2017, 15:312-21.
60. Abbas, et al. The Effect of Wire Dimension, Type and Thickness of Coating Layer on Friction of Coated Stainless-Steel Arch Wires. Int J Med Res Health Sci 2018, 7(3): 115-121.
61. Nishio C, Motta AFJ, Elias CN, Mucha JN. In vitro evaluation of frictional forces between archwires and ceramic brackets. Am J Orthod Dentofacial Orthop. 2004 Jan;125(1):56-64. Guerrero et al. Evaluation of frictional forces between ceramic brackets and archwires of different alloys compared with metal brackets. Braz Oral Res. 2010 Jan-Mar;24(1):40-5.
62. Guerrero et al. Evaluation of frictional forces between ceramic brackets and archwires of different alloys compared with metal brackets. Braz Oral Res. 2010 Jan-Mar;24(1):40-5.
63. Soltis JE, Nakfoor PR, Bowman DC. Changes in ability of patients to differentiate intensity of forces applied to maxillary central incisors during orthodontic treatment. *J Dent Res.* 1971;50:590–6.
64. Omana HM, Moore RN, Bagby MD. Frictional properties of metal and ceramic brackets. *J Clin Orthod.* 1992;26:425–32.
65. Jones ML. An investigation into the initial discomfort caused by placement of an archwire. *Eur J Orthod.* 1984;6:48–54.
66. Murayama M, Namura Y, Tamura T, Iwai H, Shimizu N. Relationship between friction force and orthodontic force at the leveling stage using a coated wire. J Appl Oral Sci 2013;21:554–9.
67. D'Anto' V, Rongo R, Ametrano G, et al. Evaluation of surface roughness of orthodontic wires by means of atomic force microscopy. Angle Orthod 2012;82:922–8.
68. Oliveira, D.C.; Thomson, J.J.; Alhabeil, J.A.; Toma, J.M.; Plecha, S.C.; Pacheco, R.R.; Cuevas-Suárez, C.E.; Piva, E.; Lund, R.G. In vitro Streptococcus mutans adhesion and biofilm formation on different esthetic orthodontic archwires. Angle Ortho. 2021, 91, 786-793.
69. Asiry, M.A.; Alshahrani, I.; Almoammar, S.; Durgesh, B.H.; Al Kheraif, A.A.; Hashem, M.I. Influence of epoxy, polytetrafluoro- ethylene (PTFE) and rhodium surface coatings on surface roughness, nano-mechanical properties and biofilm adhesion of nickel titanium (Ni-Ti) archwires. *Mater. Res. Express* **2018**, *5*, 026511.
70. Costa Lima, K.C.; Benini Paschoal, M.A.; de Araújo Gurgel, J.; Salvatore Freitas, K.M.; Maio Pinzan-Vercelino, C.R. Comparative analysis of microorganism adhesion on coated, partially coated, and uncoated orthodontic archwires: A prospective clinical study. *Am. J. Orthod. Dentofac. Orthop.* **2019**, *156*, 611–616.
71. Al-Sheakli, I.I.; Al-Lami, A.A.R. Quantitative Assessment of Mutans Streptococci Adhesion to Coated and Uncoated Orthodontic Archwires: In Vitro Study. *J. Baghdad Coll. Dent.* **2014**, *26*, 156–162.
72. Thorstenson G, Kusy R. Influence of stainless steel inserts on the resistance to sliding of esthetic brackets with second-order angulation in the dry and wet states. Angle Orthod. 2003 Apr;73(3):167-75.

73. Kusy RP, Whitley KQ. Frictional resistances of metal-lined ceramic brackets versus conventional stainless steel brackets and development of 3-d friction maps. Angle Orthod. 2001 Oct;71(1):364-74.