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ORIGINAL RESEARCH

Evaluation of incidence and location of fracture in round orthodontic archwires

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ABSTRACT:

Background: The orthodontic biomechanics is based on the principle of elastic energy storage and its conversion into mechanical energy during the tooth movement. The bending testing, but only on aesthetic covered arch wires collected from patients with minor crowding, without any extractions of premolars treated with fixed devices. Hence; the present study was undertaken for evaluating the incidence and location of fracture in round orthodontic arch wires. **Materials & methods:** A total of 125 orthodontic patients (239 arch wires) were included in the present study. Evaluation of all the patients was done during the regular treatment visits. Assessment of fracture of arch wires and their location was done. Complete demographic and clinical details of all the patients were obtained. Details about type of arch wires, type of brackets and time period of treatment before fracture was recorded separately. All the results were recorded in Microsoft excel sheet and were analysed by SPSS software. **Results:** Overall incidence of arch wire failure was 4.8 percent. Majority of arch wire failure occurred in 0.014" archwire. Out of 6 cases of arch wire failure, 4 was present maxilla while the remaining 2 were present in mandible. While evaluating the incidence of arch wire failure in maxillary arch and mandibular arch, non-significant results were obtained. **Conclusion:** Incidence of arch wire fracture during regular orthodontic visits is significantly low.

Key words: Fracture, Archwire, Location

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INTRODUCTION

The orthodontic biomechanics is based on the principle of elastic energy storage and its conversion into mechanical energy during the tooth movement. The optimal control of the tooth movement requires the application of a special force system, by using some accessory elements such as the archwires. Despite of the considerable number of existing commercial brands and their aggressive advertising, the most used dental arches remain the stainless steel (SS) archwires, nickel titanium (NiTi) and beta-titanium (β-Ti). In addition to these, the metal aesthetic coated archwires and the physiognomic non-metal coated archwires are more and more known.[1-3]
During the orthodontic treatment, the orthodontic archwires are subject to numerous factors and variables present into the oral cavity. The assessment of the surface morphology of these intra-orally used archwires was the purpose of numerous studies. However, there are only a few works in which the study the mechanical properties of the archwires used in vivo prevail. The bending testing, but only on aesthetic covered archwires collected from patients with minor crowding, without any extractions of premolars treated with fixed devices.[4-6] Hence; the present study was undertaken for evaluating the incidence and location of fracture in round orthodontic archwires.

MATERIALS & METHODS

The present study was conducted for evaluating the incidence and location of fracture in round orthodontic archwires. Ethical approval was obtained from institutional ethical committee and written consent was obtained from all the patients after explaining in detail the entire research protocol. A total of 125 orthodontic patients (239 archwires) were included in the present study. Evaluation of all the patients was done during the regular treatment visits. Assessment of fracture of archwires and their location was done. Complete demographic and clinical details of all the patients were obtained. Details about type of archwires, type of brackets and time period of treatment before fracture was recorded separately. All the results were recorded in Microsoft excel sheet and were analysed by SPSS software. Chi-square test and student t test were used for evaluation of level of significance. P- value of less than 0.05 was taken as significant.

RESULTS

In the present study, a total of 125 patients were analysed. A total of 239 archwires were evaluated. Overall incidence of archwire failure was 4.8 percent. Majority of arch wire failure occurred in 0.014" archwire. In the present study, out of 6 cases of archwire failure, 4 was present maxilla while the remaining 2 were present in mandible. While evaluating the incidence of archwire failure in maxillary arch and mandibular arch, non-significant results were obtained.

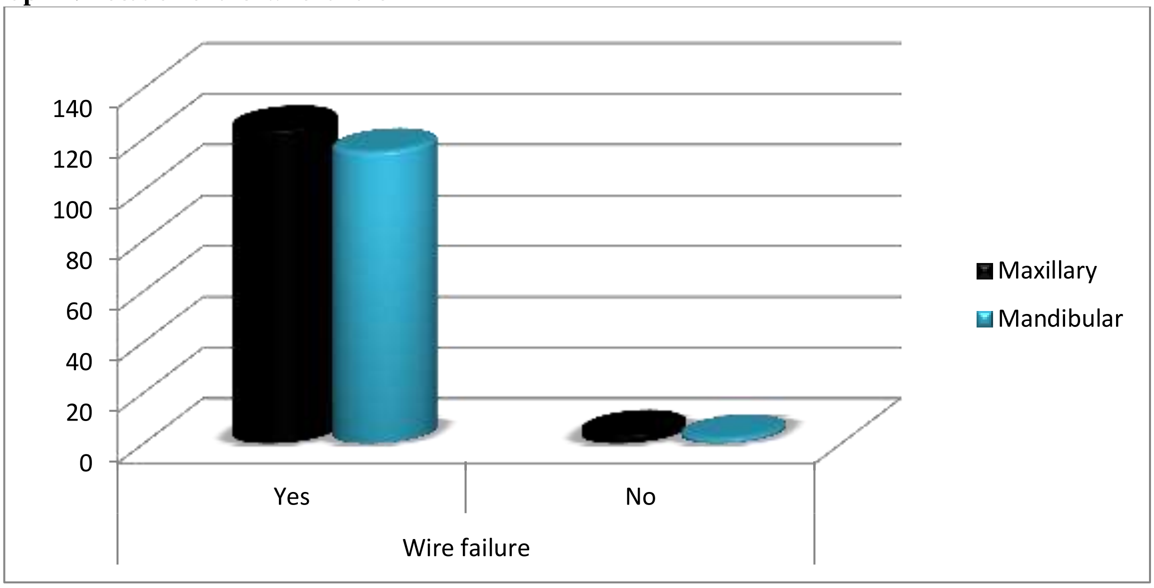
Table 1: Incidence of archwire failures

Archwire size	Number of NiTi failure	Number of SS failure
0.012"	1	0
0.014"	3	0
0.016"	1	0
0.018"	1	0
0.020"	0	0
Total	6	0
Incidence (%)	4.8	

Table 2: Location of archwire failure

Arch type	Wire failure		p- value
	Yes	No	
Maxillary	124	4	0.12
Mandibular	115	2	0.85

Graph 1: Location of archwire failure



DISCUSSION

In the past few decades, a number of wire alloys with a wide spectrum of mechanical properties have been introduced, adding versatility to orthodontic treatment. Selecting the appropriate archwire requires a thorough knowledge of the biomechanical properties of it. In the past, there have been attempts to improve the mechanical properties of orthodontic wires using different types of alloys and surface treatment of wires. These attempts were successful to some extent. Coating the orthodontic wires with nanoparticles is one such attempt that is still under research.[7-9] Hence; the present study was undertaken for evaluating the incidence and location of fracture in round orthodontic archwires.

In the present study, a total of 125 patients were analysed. A total of 239 archwires were evaluated. Overall incidence of archwire failure was 4.8 percent. Majority of arch wire failure occurred in 0.014" archwire. Guzman U et al determined the incidence and location of fracture in round nickel-titanium (NiTi) and round stainless steel orthodontic archwires. One thousand orthodontic patients (1434 archwires) were evaluated during regular treatment visits to assess archwire fracture and location. The patient's gender, age, type of archwire (round NiTi and round stainless steel), diameter of the archwire, arch type, location of fracture (anterior or posterior) and period of service before fracture were recorded. Twenty-five archwire failures were reported (1.7%) of the total sample size. All fractured archwires were NiTi, and 76% of the fractures were located in the posterior region. No statistical significance was found between archwire fracture and gender, arch type (maxillary/mandibular), archwire diameter or bracket type. The frequency of archwire fracture during regular orthodontic visits is very low. The most common archwire fracture site is the posterior region.[10]

In the present study, out of 6 cases of archwire failure, 4 was present maxilla while the remaining 2 were present in mandible. While evaluating the incidence of archwire failure in maxillary arch and mandibular arch, non-significant results were obtained. Alavi S et al compared the load-deflection and surface properties of coated superelastic archwires with conventional superelastic archwires in conventional and metal-insert ceramic brackets. 3 types of archwires including ultraesthetic polycoated, ultraesthetic epoxyresin coated and conventional (uncoated) superelastic nickel-titanium (NiTi) archwires were used in each of 2 types of brackets including conventional and metal-insert ceramic. To simulate oral environment, all specimens were incubated in artificial saliva using thermocycling model and then were tested in three-bracket bending test machine. Loading and unloading forces, plateau gap and end load deflection point (ELDP) were recorded. Epoxyresin archwires produced lower forces (19 to 310 gr) compared to polycoated (61 to 359 gr) and NiTi (61 to 415 gr) ($P<0.0001$). The maximum ELDP (0.43 mm) was observed in epoxyresin archwires ($P<0.001$). Coatings of some epoxyresin wires were torn and of polycoated wires peeled off. Conventional ceramic bracket produced higher loading forces with polycoated and NiTi archwires and lower unloading forces with all 3 types of archwires compared to metal-insert type ($P<0.05$). Epoxyresin-coated archwire had the lowest force and highest ELDP.[11] Damon stated that the specific use of CuNiTi 35ºC orthodontic wires associated with self-bonding brackets (Damon system) would significantly reduce the coefficient of attrition generated in conventional mechanics, which is the key to an efficient treatment. As a result, there would be significant reduction in the mean period of chair time, the number of visits paid to the orthodontist and in patient's degree of discomfort.[12]

CONCLUSION

From the above results, the authors concluded that incidence of archwire fracture during regular orthodontic visits is significantly low. However; further studies are recommended.

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