(e) ISSN Online: 2321-9599

(p) ISSN Print: 2348-6805

ORIGINAL ARTICLE

Assessment of metal ion release from different bracket arch wire combinations

Srerama Janardhana Rao

Assistant Professor, Department of Dental surgery, Andhra Medical College, Visakhapatnam, Andhra Pradesh, India

ABSTRACT:

Background: A considerable part of an orthodontist's armamentarium consists of metal. The present study was conducted to assess metal ion release from different bracket arch wire combinations. **Materials & Methods:** The present invitro study comprised of 80 sets of new arch wire, band material, brackets and ligature wires simulating fixed orthodontic appliance. These sets were divided into four groups of twenty each. Group I was stainless steel rectangular arch wires. Group II was rectangular NiTi arch wires. Group III was rectangular copper NiTi arch wires. Group IV was rectangular elgiloy archwires. These appliances were immersed in 50 ml of artificial saliva solution and stored in polypropylene bottles in the incubator to simulate oral conditions. After 90 days the solution were tested for nickel, chromium, copper, cobalt and iron ions using atomic absorption spectrophotometer. **Results:** The mean iron level was 0.32, 0.46, 0.62, 0.54 and 0.05 in group I, II, III and IV respectively. The mean nickel level was 1.3, 1.9. 2.5, 2.2 and 0.87. The mean cobalt level was 0.005, 0.02, 0.013, 0.014 and 0.02. The mean chromium level was 0.0, 0.019, 0.04, 0.03 and 0.01. The mean copper level was 0.01, 0.02, 0.003, 0.005 and 0.01 in group I, II, III and IV respectively. The difference was significant ($P < 0.05$). **Conclusion:** The measurable amount of metals, released from orthodontic appliances in artificial saliva, was significantly below the average dietary intake and did not reach toxic concentrations.

Key words: Orthodontic appliances, Nickel, Cobalt

Corresponding author: Srerama Janardhana Rao, Assistant Professor, Department of Dental surgery, Andhra Medical College, Visakhapatnam
Andhra Pradesh, India

This article may be cited as: Rao SJ. Assessment of metal ion release from different bracket arch wire combinations. J Adv Med Dent Scie Res 2016;4(4):297-299.

INTRODUCTION

A considerable part of an orthodontist's armamentarium consists of metal. Noble metals and their alloys were esthetically pleasing and were corrosion resistant, but they lacked flexibility and tensile strength, these alloys were inappropriate for complex machining and joining when used as traction bars at that time.[1] Stainless steel has been the mainly used material in orthodontics since its introduction in 1932, with a wide range of applications in both fixed and removable appliances.[2]

Almost all fixed metallic orthodontic appliances comprise metals, such as nickel (Ni), chromium (Cr) and cobalt. Apart from withstanding physical, mechanical, and biological assaults, a fixed orthodontic set-up should also be biocompatible in the oral environment. Thus, it become an integral part of almost every routine orthodontic intervention.[3]Some arch wires with elastic properties (shape memory alloys) can contain more than 50% nickel. Release of nickel from metallic orthodontic appliances has been observed in several in vitro studies. Nickel release in vivo in the oral cavity has been more difficult to demonstrate, although corrosion has clearly been evident in the orthodontic appliances after treatment.[4]

During the last decade there has been an increased interest amongst health professionals about the side effects of biomaterials especially the metallic materials. This concern has been raised because of the well-established hazardous nature of the metal ions.[5]The present study was conducted to assess metal ion release from different bracket arch wire combinations.

MATERIALS & METHODS

The present invitro study comprised of 80 sets of new archwire, band material, brackets and ligature wires simulating fixed orthodontic appliance. These sets were divided into four groups of twenty each. Group I was stainless steel rectangular archwires. Group II was rectangular NiTiarchwires. Group III was rectangular copper NiTiarchwires. Group IV was rectangular elgiloyarchwires. These appliances were immersed in 50 ml of artificial saliva solution and stored in polypropylene bottles in the incubator to simulate oral conditions. After 90 days the solution were tested for nickel, chromium, copper, cobalt and iron ions using atomic absorption spectrophotometer.Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I: Distribution of samples

Groups	Material	Number
Group I	Stainless steel rectangular archwires	20
Group II	rectangular NiTiarchwires	20
Group III	rectangular copper NiTiarchwires	20
Group IV	rectangular elgiloyarchwires	20

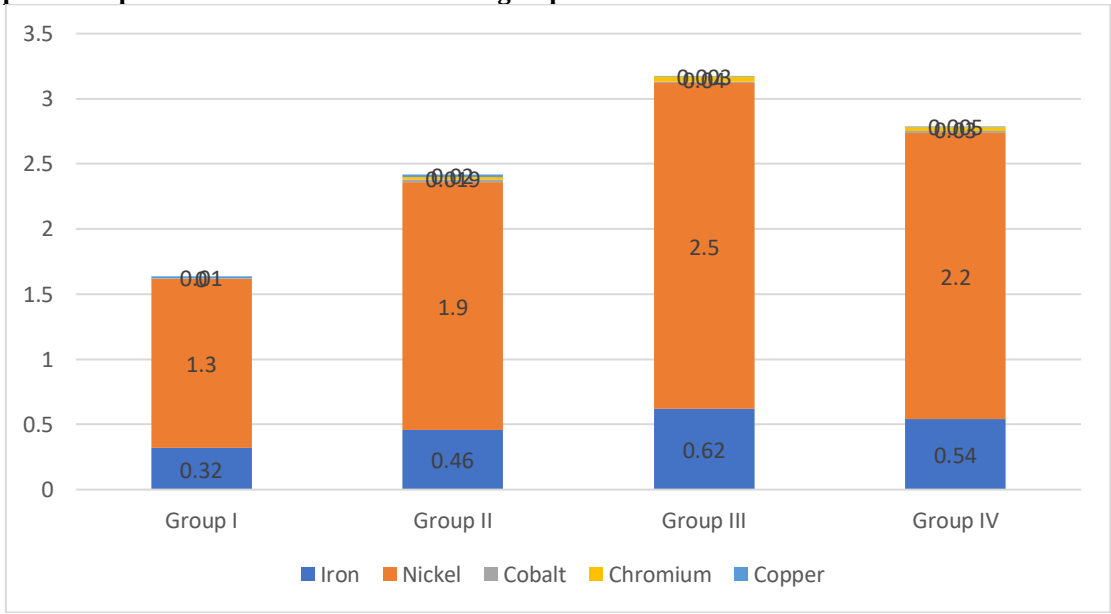
Table I shows distribution of samples in different groups.

Table II: Comparison of ions levels in different groups

Groups	Iron	Nickel	Cobalt	Chromium	Copper
Group I	0.32	1.3	0.005	0.0	0.01
Group II	0.46	1.9	0.02	0.019	0.02
Group III	0.62	2.5	0.013	0.04	0.003
Group IV	0.54	2.2	0.014	0.03	0.005
P value	0.05	0.87	0.02	0.01	0.01

The mean iron level was 0.32, 0.46, 0.62, 0.54 and 0.05 in group I, II, III and IV respectively. The mean nickel level was 1.3, 1.9. 2.5, 2.2 and 0.87. The mean cobalt level was 0.005, 0.02, 0.013, 0.014 and 0.02. The mean chromium level was 0.0, 0.019, 0.04, 0.03 and 0.01. The mean copper level was 0.01, 0.02, 0.003, 0.005 and 0.01 in group I, II, III and IV respectively.The difference was significant (P< 0.05).

Graph I: Comparison of ions levels in different groups



DISCUSSION

Orthodontic appliances are highly biocompatible, although some side effects associated with therelease of nickel ions have been documented.[6] Fixed orthodontic appliances including brackets and arches are commonly made of stainless steel and nickel–titanium (NiTi) alloys and, therefore, have corrosion potential in the oral environment.[7] The amount of nickel as the main constituent of contemporary orthodontic appliances may vary from 8% in stainless steel to more than 50% in NiTi alloys. Stainless-steel alloys include 17% to 22% of chromium.[8]Nickel (Ni) and chromium (Cr) containing alloys are present in great numbers in a wide variety of appliances, auxiliaries, and utilities used in orthodontics and thus become an integral part of almost every routine orthodontic intervention. The use of various combinations of metal alloys for prolonged durations in orthodontic patients warrants special consideration regarding their biocompatibility.[9]The present study was conducted to assess metal ion release from different bracket arch wire combinations.

We found that the mean iron level (mg/L) was 0.32, 0.46, 0.62, 0.54 and 0.05 in group I, II, III and IV respectively. The mean nickel level (mg/L) was 1.3, 1.9. 2.5, 2.2 and 0.87. The mean cobalt level (mg/L) was 0.005, 0.02, 0.013, 0.014 and 0.02. The mean chromium level was 0.0, 0.019, 0.04, 0.03 and 0.01. The mean copper level (mg/L) was 0.01, 0.02, 0.003, 0.005 and 0.01 in group I, II, III and IV respectively. Amini et al[10] conducted a study in which patients were divided into two groups and level of nickel was determined by atomic absorption spectrophotometry. Nickel concentration value (mg/L) in first group prior

to starting treatment was 0.097± 0.071. An increase in level of nickel was followed by decrease 4 and 8 weeks after applying the arch wire (0.208± 0.112) and (0.077±0.056 mg/L) respectively. Nickel levels in saliva of the second group were showed minimal variation and ranged from 0.061± 0.044mg/L to 0.083±0.054 throughout period of study. It may be concluded that there could be a release of nickel from the appliances used in first group but it doesn't reach toxic level in saliva.

Petoumenou et al[11] in their study comprised of 45 orthodontic patients. The selected sample was divided into 3 groups. The first group consisted of 15 patients with fixed appliances in their upper & lower arches. The second group consisted of 15 patients with a fixed appliance placed only in the upper arch. The control group consisted of 15 patients who were not undergoing orthodontic treatment. Nickel and chromium release was quantified with the use of an atomic absorption spectrophotometr. The analysis of variance was used to determine if differences existed between the nickel and chromium release according to time interval. Four samples of stimulated saliva were collected from each patient before insertion of fixed appliance, 1 week, 1month, and 2 months after insertion of the appliance. A considerable variation in the concentrations of both nickel and chromium was observed. Significant differences were found between the no-appliance samples and the samples obtained after insertion of the appliance. Nickel and chromium concentrations of saliva are significantly affected by fixed orthodontic appliances during the first 2 month of treatment.

Karnam et al[12] in their study sixty sets of new archwire, band material, brackets and ligature wires were prepared simulating fixed orthodontic appliance. These sets were divided into four groups of fifteen samples each. Results showed that high levels of nickel ions were released from all four groups, compared to all other ions, followed by release of iron ion levels. There is no significant difference in the levels of all metal ions released in the different groups.

The limitation the study is small sample size.

CONCLUSION

Authors found that the measurable amount of metals, released from orthodontic appliances in artificial saliva, was significantly below the average dietary intake and did not reach toxic concentrations.

REFERENCES

1. Martinez JR, Barker S. Ion transport and water movement. Arch Oral Biol1987;32:843-47.
2. Maijer R, Smith DC. Corrosion of orthodontic bracket bases. Am J Orthod Dentofacial Orthop1982;81:43-48.
3. Maijer R, Smith DC. Biodegradation of orthodontic bracket system. Am J Orthod Dentofacial Orthop1986;90:195-98
4. Rahilly G, Price N. Nickel Allergy and Orthodontics. J Orthod. 2003; 30:171-174.
5. Staffolani N, Damiani F, Lilli C, Guerra M, Staffolani NJ, Belcastro S, et al. Ion release from orthodontic appliances. J Dent. 1999; 27(6):449–54.
6. Talic NF, Alnahwi HH, Al-Faraj AS. Nickel and chromium levels in the saliva of a Saudi sample treated with fixed orthodontic appliances. Saudi Dent J. 2013; 25(4):129–33.
7. Lindsten R, Kurol J. Orthodontic appliances in relation to nickel hypersensitivity: A review. J OrofacOrthop 1997; 58:100–8.
8. Gürsoy S, Acar AG, Seşen C. Comparison of metal release from new and recycled bracket-archwire combination. Angle Orthod. 2005. Jan;75(1):92–4.
9. Starkjaer L, Menné T. Nickel allergy and orthodontic treatment. Eur J Orthod. 1990;12:284–10.Agaoglu G, Arun T, Izgi B, Yarat A. Nickel and chromium levels in the saliva and serum of patients with fixed orthodontic appliances. Angle Orthod 2001;71(5):375-9.
10. Matos de Souza R, Macedo de Menezes L. Nickel, chromium and iron levels in the saliva of patients with simulated fixed orthodontic appliances. Angle Orthod 2008;78(2):345-50.
11. Park SB, Lee BT. Metal release from brackets and archwires. Korean Journal of Orthodontics 1989;19;75-84.
12. Kim, et al. A study on metal release of TiN ion plated stainless steel orthodontic appliances. Korean Journal of Orthodontics 1995;25;43-54.
13. Rhu, et al. A study on the release of nickel and chromium from simulated orthodontic appliances. Iksan, Chollabuk-do; Korea; Wonkwang University 1998.
14. Lee SH, Chang Y. Effects of sterilization on the mechanical properties and surface topography of NiTi alloy wires. Am J Orthod Dentofacial Orthop2001;120:654-63.
15. Amini F, Jafari A, Amini P, Sepasi S. Metal ion release from fixed orthodontic appliances-an in vivo study. Eur J Orthod. 2012; 34(1):126-30.
16. Petoumenou E, Arndt M, Keilig L, Reimann S, Hoederath H, Eliades T, et al. Nickel concentration in the saliva of patients with nickel-titanium orthodontic appliances. Am J Orthod Dentofacial Orthop 2009;135(1):59-65.
17. Karnam SK, Reddy AN, Manjith CM. Comparison of metal ion release from different bracket archwire combinations: an in vitro study. J Contemp Dent Pract. 2012 May 1;13(3):376-81.