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Short Review On Orthodontic Archwires

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Abstract

Abundance of material and ideas of the pioneer lead to refinement of procedure and development of newer archwires. Many different types of archwires have evolved with time. As esthetic archwires are introduced, metallic archwires will likely be replaced for most orthodontic mechanotherapy.

Introduction

Orthodontic wires plays a major role in the effectiveness of an orthodontic treatment. There are various types of orthodontic archwires, with newer technologies and advances in mechanotherapy leads to invention of newer orthodontic archwires.

Early contributers in the field of orthodontics used Wood, rubber, vulcanite, piano wire and silk thread for the correction of malocclusion, and the first orthodontic material documented is gold ligature wire.[1]

Several desirable characteristics of an ideal archwire are shown (Figure 1).

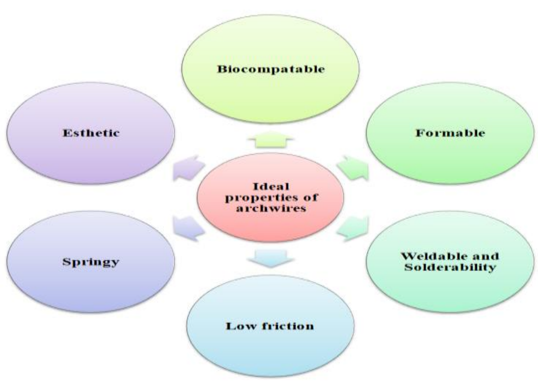

Figure 1 Desirable characteristics of an archwire.

Early Archwires

The birth of contemporary orthodontics was marked by Delabarre[2] in 1819 with introduction of wire crib.[1] Later Schange[3] . showed advantages of the gold wire crib.[1]

Angle in 1887 tried replacing noble metals with German silver, a brass called 'Neusilber' which were actually Copper, nickel, and zinc alloys that contained no silver.[1] It was composed of German silver, 65% Cu, 14% Ni, 21% Zn.[4]

Gold Archwires

They come under precious metal alloys. Before 1950, precious metal alloys were used routinely for orthodontic purpose primarily because nothing else would tolerate intraoral conditions. Nowaday's use of Gold is greatly reduced because it is expensive to use as an orthodontic appliances and recent advances in properties of wire material. [5]

Stainless Steel Archwires

Stainless steel entered dentistry in 1919, introduced at Krupp's Dental Polyclinic in Germany by the company's dentist Dr F Hauptmeyer.[1] Austenitic SS was introduced as an orthodontic wire in 1929, and because of its superior strength, higher modulus of elasticity, good resistance to corrosion, and moderate costs, SS promptly gained acceptance and preference over gold.[6] The austenitic 18-8 stainless steel type is most commonly used. It contains chromium and nickel content of approximately 18% and 8%, respectively. Stainless steel wires have good biocompatibility, good corrosion resistance, excellent formability, high yield strength, and high modulus of elasticity.[7]

Australian Archwires

Wilcock finally produced a Cold drawn heat treated wire that combined the balance between hardness and resiliency with unique property of Zero stress relaxation that Dr Begg was seeking.for his mechanotherapy.[8]

Multistranded Wires

Multistranded wires are made of a varying number of stainless steel wire strands coaxially placed or coiled around each other in different configurations. The important characteristics of these wires are development of low forces, low stiffness and a resilience.[9], and these wires are inexpensive than titanium alloys[10-11] They develop higher friction at bracket-wire interface compared to stainless steel and NiTi wires.

Cobalt Chromium Alloys (Elgiloy)

This alloy was first developed in the 1950s for the manufacture of watch springs was patented by the Elgin National Company. Cobalt chromium alloys are available commercially as Elgiloy™. Elgiloy, Soft (blue), ductile (yellow), semi resilient (green), and resilient (red) in increasing order of resilience. The formability of the material was modified by heat treatment. It consist of cobalt (40%), chromium (20%), silver (16%) and nickel (15%).[12]

Nickel Titanium Archwires[13-15]

It was original work of Buehler for the Naval Ordinance Laboratory in the early 1960s. Around 1970s with effort of Andreason and Unitek company martensitic alloy that does not exhibit any shape-memory effect (SME) Nitinol alloy was marked in orthodontics as Nitinol™. Different types of NiTi archwires are summarized in Table 2.

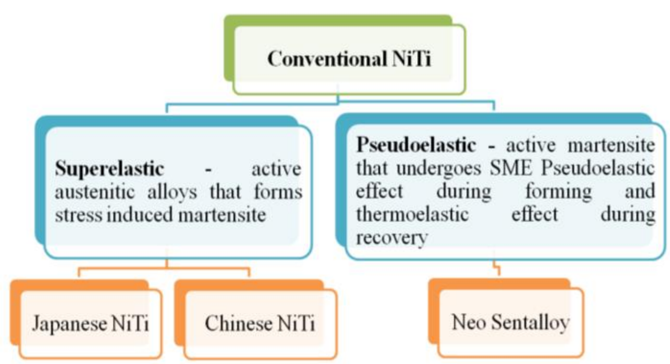

Figure 2 Types of NiTi archwires.

Beta and Alpha Titanium Wires

These wires were developed by AJ Wilcock Jr in 1988 and claimed to have extraordinary resilience whilst maintaining formability. Like the SS and NiTi orthodontic wires pure titanium has different crystallographic forms at high and low temperatures. At temperatures below 885ºC, the stable form is a-titanium, which has the hexagonal closed pack crystal structure, whereas at higher temperatures the stable form is β-titanium, which has the bcc structure. The elastic modulus and yield strength at room temperature for α-titanium is approximately 110 GPa and 40 MPa respectively.[4,16]

Esthetic Archwires

Plastic coatings on archwires occur too in 1970s. One such coating, poly(tetrafluoroethylene) or Teflon, has the lowest friction. [4,13]

Composite Wires

Manufacturing the composite wire in the photo pultrusion process, fibers are drawn into a chamber where they are uniformly spread, tensioned and coated with the monomer. [17]

Optiflex wires

It is non-metallic orthodontic wire designed by Dr. Talass in 1992[18]. This wire is made up of clear optical fibre having good mechanical properties, esthetic appearance and stain resistant property. The wire consists of three layers which are[19]:

1. Silicon dioxide core: This is part of wire which provides force for orthodontic tooth movement.

2. Silicon resin layer: It is middle layer protecting the core of wire from moisture and adds strength.

3. Stain resistant nylon layer: It is outermost layer of wire which protects wire from damage and also increases strength of wire

Teflon coated wires

Teflon coating on wire makes it tooth colored. The coating also protects wire from corrosion. Teflon coating increases esthetics of wire and decreases friction. The commonly used coating is Teflon which is applied in two coats by conventional air spray or by electronic technique. Thickness of coating is 0.002”. types of Teflon coated archwires are shown in Figure 3[4].

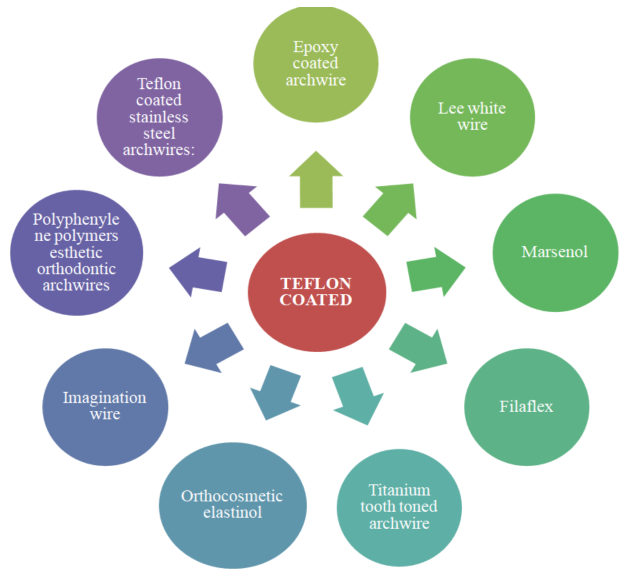

Figure 3: Types of teflon coated archwires.

Nitanium tooth tone plastic coated wires

These super elastic NiTi wires are stain and crack resistant with plastic and friction reducing tooth colored coatings. These are available in round 0.014’’, 0.018’’ and rectangular 0.016 × 0.022’’ and marketed by Ortho Organizers. These wires deliver 29 to 150 grams of force. The colors of these wires blend in with tooth color, ceramic, plastic and composite brackets. [4]

Epoxy coated wires

Epoxy resin is the frequently used material for coating because of its excellent adhesion, chemical resistance, electrical insulation, and dimensional stability. Material used for making coating on wire is synthetic fluorine containing resin or epoxy resin consisting mainly polytetrafluoroethylene. Epoxy coating is done by a depository process called as Electrostatic coating or E – coating in which a high voltage charge is applied to the archwire and atomized liquid epoxy particles are air sprayed over the wire surface. The thickness of coating around the wire is 0.002-inches .[20]

Bioforce wires

These wires have unique property of variable transition temperature, introduced by GAC. These wires are able to deliver differential forces according to need of individual dental arch segments. These deliver 80 grams of force for anteriors and 320 grams for molars. These arch wires have low-reflectivity rhodium coating which gives them white appearance. [21]

Combined Wires

The key to success in a multiattachment straight wire system is to have the ability to use light tipping movements in combination with rigid translation and to be able to vary the location of either, at any time the need arises during treatment. They used three specific combined wires for the technique; Dual Flex-l, Dual Flex-2, and Dual Flex-3 (Lancer orthodontics). The Dual Flex-1 consists of a front section made of 0.016" round Titanal and a posterior section made of 0.016" round steel. The Dual Flex-2 consists of a flexible front segment composed of an 0.016 × 0.022" rectangular titanal and a rigid posterior segment of round 0.018" steel. The Dual Flex-3, however, consists of a flexible front part of a 0.017 × 0.025" Titanal rectangular wire and a posterior part of 0.018 square steel wire[4]

Recent Advances in Archwires

Super-cable

In 1993, Hanson combined the mechanical advantages of multistranded cables with the material properties of superelastic wires to create a superelastic NiTi coaxial wire. This wire, called supercable, comprises seven individual strands that are woven together in a long, gentle spiral to maximize flexibility and minimize force delivery.[22]

Copper-NiTi

Copper NiTi is the most recent introduction to the family of NiTi alloy wires and the credit goes to Rohit Sachdeva and Suichi Miyazaki (1994). i\It display the SME at 27°C, 35°C, or 40°C.[7]

Timolium archwires

Timolium (titanium vanadium) is an advanced technology titanium wire with a smooth surface that greatly reduces friction. The surface of Timolium is much smoother than traditional TMA (beta titanium) wire. Higher resistance to breakage with its smooth surface, it is ideal for torquing and tipping ceramic brackets, with higher yield and compressive strength than TMA.[4]

Organic polymer wire (QCM)

Organic polymer retainer wire made from 1.6 mm diameter round polyethylene terephthalate.5 This material can be bent with a plier, but will return to its original shape if it is not heat–treated for a few seconds at temperature less than 230°C.[4]

Conclusion

The urge to make treatment still more comfortable, less time consuming, esthetically advanced with more ideal archwire properties have led us to the introduction of these material. As time passed scientifically based orthodontics evolved and we can see how new innovation in material science evolved.

Reference

1. Kusy RP. Orthodontic biomaterials: from the past to the present. The Angle Orthodontist. 2002 Dec 1;72(6):501-12.
2. Delabarre CF. Traite de La Second Dentition. Paris, France; 1819.

3. Schange´ JMA. Precis sur Le Redressement Des Dents. Part 2; 1841
4. Malik N, Dubey R, Kallury A, Chauksye A, Shrivastav T, Kapse BR. A review of orthodontic archwires. Journal of Orofacial Research. 2015:6-11.
5. Robert P, Kusy. A review of the contemporary archwires: their property and characteristics. Angle Orthod 1997;67(3):197-208.
6. Kapila S, Sachdeva R. Mechanical properties and clinical applications of orthodontic wires. Am J Orthod Dentofacial Orthop 1989;96:100e9.
7. Brantley WA. Orthodontic wires, in: Brantley WA, Eliades T, eds. Orthodontic materials: scientific and clinical aspects. Stuttgard: Thieme, 2001: 91-9.
8. Agarwal A, Agarwal DK, Bhattacharya P. Newer orthodontic wires: a resolution in orthodontics. Orthodontic Cyber J 2011. p. 1-17.
9. Wilkinson PD, Dysart PS, Hood JA, Herbison GP. Load-deflection characteristics of superelastic nickel-titanium orthodontic wires. Am J Orthod Dentofac Orthop 2002;121:483-95
10. Rucker BK, Kusy RP. Elastic flexural properties of multistranded stainless steel versus conventional nickel titanium archwires. Angle Orthod 2002a;72:302-9
11. Kusy RP, Stevens LE. Triple-stranded stainless steel wires. Evaluation of mechanical properties and comparison with titanium alloy alternatives. Angle Orthod 1987;57:18-32.
12. Castro SM, et al., Orthodontic wires and its corrosion - The specific case of stainless steel and beta titanium, Journal of Dental Sciences (2014)
13. Kusy RP. A review of contemporary archwires: their properties and characteristics. The Angle Orthodontist. 1997 Jun 1;67(3):197-207.
14. Miura F, Mogi M, Ohura Y, Hamanaka H. The super-elastic property of the Japanese NiTi alloy wire for use in orthodontics. Am J Orthod Dentofacial Orthop. 1986;90:1–10.
15. Burstone CJ. Chinese Ni-Ti wire: a new orthodontic alloy. Am J Orthod. 1985;87:445–452.
16. JIOS interviews Dr Rohit Sachdeva on diagnosis, anterior esthetic finishing and newer wires. J Ind Orthod Soc 1996; 279(2):74-80.
17. Kusy RP, The future of orthodontic materials: The long-term view. Am J Orthod Dentofacial Orthop 1998;113: 91-95.
18. Talass MF (1992) Optiflex archwire treatment of a skeletal class III open bite. J Clin Orthod 26: 245-252.
19. Kaur S, Singh R, Soni S, Garg V, Kaur M. Esthetic orthodontic appliances—A review. Annals of Geriatric Education and Medical Sciences. 2018 Jan;5(1):11-4.
20. Nathani R, Daigavane P, Shrivastav S, Kamble R, Gupta D. Esthetic arch wires- A review. IJAR 2015;3(12):743-51.
21. Philip N, Sunny S, George LA, Antony PJ. Newer orthodontic archwires: Imparting efficacy to esthetics. International journal of Oral health Dentistry; April-June 2016(2):102-5.
22. Agarwal A, Agarwal DK, Bhattacharya P. Newer orthodontic wires: a resolution in orthodontics. Orthodontic Cyber J 2011. p. 1-17.