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Esthetic orthodontic appliances – A review

Sukhpal Kaur[1,*], Riponjot Singh[2], Sanjeev Soni[3], Vikas Garg[4], Maninderdeep Kaur[5]

[1]Reader, [3]Professor, [4]Senior Lecturer, [5]Lecturer, Dept. of Orthodontics and Dentofacial Orthopaedics, Desh Bhagat Dental College and Hospital, Mandi, Gobindgarh, Punjab, India, [2]Dental hygiene student, Georgian College of Applied Arts and Technology, Barrie, Canada

***Corresponding Author:**
Email: docs284@gmail.com

Abstract
Patients seek orthodontic treatment to improve their smile and facial appearance. Traditional brackets and wire used to align teeth are very much noticeable when patients smile, laugh or talk. This can make patients feel self conscious especially during some events such as job interview, wedding ceremony or other social functions. Introduction of clear brackets, wires and invisalign system, gives solution to this problem.

Introduction
Facial esthetics is an important concern in today's social life. Dental esthetics has prime importance in overall facial appearance. A pleasing dental appearance plays a key role in framing an esthetic smile and smile is one of the prime human facial expressions and it increases value of face. It is also believed that a pleasing smile helps to win elections and sell various products for companies. Various forms of malocclusion compromise dental esthetics and lead to reduced self perception, self esteem and self confidence of patients. Patients with malocclusion do not pose their full smile because of compromised dental esthetics. Therefore malocclusions have adverse influence on quality of life and social interactions of individuals. So most of patients seek orthodontic treatment to improve their facial and smile esthetics.[1-3]

Malocclusions in most of patients treated with the help of fixed orthodontic technique using brackets and wires. Conventional metal brackets and wires have unesthetic appearance. The longer span of treatment with multiple appointments, compromised esthetics of brackets and wires are main concern for patient. Adult patients want improved esthetics even during treatment period.[4] In present time even younger patients are very much concerned about their appearance during orthodontic treatment period. Therefore esthetic appliances have been introduced such as clear brackets, archwires and invisalign system.

Brackets
Conventional brackets are made from stainless steel due to superior mechanical properties of stainless steel such as high strength and durability. But esthetic appearance of orthodontic appliances becomes more important nowadays, so tooth colored bracket materials have been introduced.[5]

Plastic brackets
Plastic brackets having better esthetics, composed of unfilled polycarbonate and introduced in early 70s. But they lack strength and stiffness resulting in tie-wing fracture and slot distortion. These brackets also have increased slot roughness and get stained due to intraoral fluid adsorption.[6,7] These brackets get distorted under constant stress so these are unable to withstand longer treatment period or transmit torque. To eliminate these limitations, polyurethane brackets and polycarbonate brackets reinforced with ceramic of fibre-glass fillers and brackets with metal reinforced slots have been introduced[8] Sadat-Khonsari et al observed in their study that plastic brackets with reinforced metal slot showed lowest degree of deformation, followed by polyurethane, pure polycarbonate, fibre glass reinforced brackets and ceramic reinforced brackets have highest degree of deformation.[9] The shape of plastic brackets was also altered to enhance resin bonding without use of primers and helping easy debonding at the end of treatment with minimum enamel damage.[10]

Ceramic brackets
In early 1980s brackets composed of monocrystalline sapphire and polycrystalline ceramic came into existence as esthetic appliances. They are superior to plastic brackets as these brackets can withstand orthodontic forces and resistant to staining in oral cavity. But still have limitations such as low fracture toughness, more friction between arch wire and bracket slot and unable to form chemical bond with resin adhesives.[11-14] Ceramic brackets are made of aluminium oxide in two different forms that are polycrystalline and monocrytalline depending on method of manufacturing. The major difference in two types of brackets is their optical clarity. Monocrystalline brackets are more translucent than polycrystalline brackets. Both types are resistant to staining and discoloration in oral cavity.[8,15] Ceramic brackets are nine times harder than stainless steel brackets and can cause enamel abrasion if there is contact between bracket and tooth.[16,17] Polycrystalline zirconia brackets, an alternative to alumina ceramic brackets have greatest toughness.[18] These brackets are

also less costly than monocrystalline ceramic brackets but these are opaque and have intrinsic colors, resulting in decreased esthetics.[19] These have good sliding properties, less plaque accumulation, and clinically acceptable bond strength. Keith et al reported that there is no advantage of zirconia brackets over polycrystalline brackets regarding to frictional properties of brackets.[20]

Esthetic Arch wires

Optiflex wires: It is non-metallic orthodontic wire designed by Dr. Talass in 1992. This wire is made up of clear optical fibre having good mechanical properties, esthetic appearance and stain resistant property.[4] It is highly effective in moving teeth with light continuous force without patient discomfort or root resorption and it has high flexibility producing wide range of action. It is used for alignment of crowded teeth in adult patients who want their braces are not be visible.[21]

The wire consists of three layers which are:

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.[4]

Limitations

Sharp bends should not be given and metal ligatures should not be used with this wire because they can fracture the glass core. Mini distal end cutters which are specially designed to cut all the 3 layers of wire are used for cutting the distal end of wire. These wires are expensive also.[1] One should avoid use of sharp instruments like scalars etc. to engage the wire in bracket slot. This wire should not be cinched back because sharp bends in wire can fracture it and also cinching back is not required because friction between wire and elastomeric ligature will eliminate unwanted sliding of wire.[22]

Organic polymer wire: hese wires are used as retainers after completion of orthodontic treatment. This wire is made up of 1.6mm diameter round polyethylene terephthalalte. It has property of elasticity that is it can be bent with plier but it will return to its original shape if it is not heat-treated for a few seconds at temperature less than 230^0C . These wires are used as esthetic retainers in patients who are esthetically more conscious.[23]

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". These wires are available in natural tooth color and also in blue, green or purple colors.[4,24] It is reported that microbial plaque accumulation on coated nickel-titanium wires is lower than uncoated nickel-titanium wires.[25]Maetani *et al* observed that coating on intra-oral instruments with teflon decreases the amount of bacterial plaque accumulation and it is easy to remove.[26]

Another study concluded that teflon coating on wire may not withstand masticatory forces and enzyme activity of oral cavity, resulting in increased friction. Also these wires have low esthetic value because the coating is nondurable in intra oral environment and present severe deterioration resulting in greater surface roughness as compared to conventional stainless steel and nickel- titanium (NiTi) wires.[22]

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. Increased thickness of coating alters the mechanical properties of the wire due to reduced thickness of nickel titanium.[22,27] Elayyan et al reported that epoxy coated ultraesthetic wires produce lower loading and unloading forces as compared to uncoated nickel titanium wires of same dimension.[28] Kaphoor et al compared load deflection properties of epoxy coated wires from 4 different manufacturers and observed similar results as explained above for Ultraesthetic, Spectra and plastic coated NiTi wire But no difference was seen for Reflex esthetic wires.[29] Alavi et al also found same results.[30]

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. Therefore increasing esthetics of brackets.[23,24]

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. These wires apply low gentle force on anteriors and increased force on posterior teeth. Force level is graded throughout the arch length according to tooth size.[4,31]

Invisalign: As Most of adult patients go for orthodontic treatment to improve their facial esthetics and to get beautiful smile. These patients want more esthetic treatment options so they do not prefer their treatment with conventional fixed appliances. In 1999, Align Technology Inc developed invisalign technique which is an alternative to fixed appliance method and esthetically acceptable. This technique makes use of computer generated clear, removable aligners to move teeth.[32] Invisalign system has become popular because of esthetics and comfort of the removable aligners. Along with its esthetic benefit, it has also other advantages such as ability to remove aligners for eating, brushing and flossing and their easy use.[33] Despite of popularity and benefits, questions still raised regarding efficacy of this system. Some limitations has been noticed due to properties of material and thermoforming process, which in some cases makes the use of aligners very difficult.[34] More relapse was reported in patients treated with invisalign as compared to treated with conventional fixed appliance.[32]Various studies reported that invisalign system is effective in treatment of mild malocclusions and is esthetically more superior than conventional fixed orthodontic appliances.[35] Align has declared that 90% of patients are candidates for invisalign including patients with mild to moderate crowding, mild to moderate spacing, non skeletal constricted arches and relapse cases.[36]

Conclusion

Because of introduction of these esthetic appliances, straight teeth and a beautiful smile can be attained without wearing old unattractive brackets and wires. These esthetic brackets, wires and invisalign enhance self esteem, self confidence and appearance of patient even during treatment period.

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