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Corrosion in Titanium dental implants – a review

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ABSTRACT

Titanium (Ti) is the most widely used biomaterial for dental implants as it exhibits excellent mechanical properties and biocompatibility. The biocompatibility of titanium is related to thin, protective surface titanium dioxide (TiO_2) layer, which forms a boundary at the implant-biological medium interface, reducing its reactivity with the surrounding biological environment and prevents corrosion. However, the metallic materials used as implants are susceptible to corrosion due to variations in the internal electrolyte environment. The surface oxide layer can be destroyed during insertion of implant or micro-motion between implant and bone under loading conditions. The localized destruction causes corrosion of the implant and induces leak of metallic particles or ions into surrounding tissues. The presence of metallic particles in peri-implant soft and hard tissues may be due to frictional wear or corrosion, or simultaneous occurrence wear and corrosion, which is known as tribocorrosion. The released metal ions may remain in the intercellular spaces near the site where they were released, or maybe taken up by macrophages, or they can migrate systemically. This review article highlights various aspects of corrosion, biological response to corrosion products and prevention of corrosion of titanium dental implants.

KEYWORDS

Dental implant

Biocompatibility

Titanium corrosion resistance

Tribocorrosion

1. Introduction

Most of the commercially available implant systems are made of pure titanium or titanium alloys Ti-6Al-4V [1-3]. Commercially pure titanium is available in four grades, based on the content of interstitial elements. Grade 1 is the most pure, and grade 4 contains the greatest amount of interstitial elements/impurities and has the highest mechanical resistance. The addition of Aluminum and Vanadium increases strength and fatigue resistance and might affect the corrosion resistance properties resulting in the release of metal ions [2]. Titanium (Ti) and titanium alloys exhibit superior biocompatibility, high strength to weight ratio, low modulus of elasticity (MoE)

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and enhanced mechanical properties such as high fatigue strength and fracture toughness [1, 2, 4-7]. The corrosion resistance of Ti & Ti alloys results from the high affinity of Ti towards oxygen, which results in the formation of a thin and stable passive oxide layer that protects the bulk material from reactive species [1-4, 8, 9]. The oxide layer formed on Ti alloys typically consists of titanium dioxide (TiO_2) but may coexist with other titanium oxides such as TiO and Ti_2O_3 [1, 2, 4, 7]. The passive surface oxide layer consists of anatase crystalline form or mixture of anatase and rutile. The thickness of the surface oxide film is approximately 4 nm, which offers protection against chemical attacks, acidic solutions and oxidising environments thereby making Ti-based implants highly corrosion resistant in the oral environment [2-4, 10]. Corrosion is the gradual deterioration of a metal due to interaction with the surrounding environment, resulting in the release of ions into the surrounding tissues [2, 11]. The metallic nature of the dental implants, corrosive environments in the oral cavity and cyclic, continuous loading of implants may initiate and accelerate corrosion process leading to release of metal particles into the peri-implant region [1, 12].

2. General concepts related to corrosion

The characteristics that determine corrosion of metallic materials are [2, 3, 13];

a. Thermodynamic forces correspond to the energy required or released during a reaction, which causes corrosion either by oxidation or reduction reactions.
b. Kinetic barriers to corrosion correspond to factors that prevent corrosion. The formation of metal oxide film on metal surface or passivation is an example of a kinetic barrier to corrosion.

3. Types of corrosion

The most common types of corrosion found in metallic dental implants are galvanic, fretting, pitting/crevice corrosion, and environmental induced cracking (EIC) [1, 3, 14, 15].

Galvanic corrosion occurs due to direct contact of two dissimilar metals in an electrolytic solution. The difference in electrochemical potential of the two metals promotes oxidation of the more reactive metal, which becomes the anode that generates flow of electrons and ions to the cathode. The surrounding tissue acts as a medium for electrical flow between metallic dental implants, and other types of alloys used intraorally for restorations, metal inlays, onlays, crowns and orthodontic devices. Though galvanic corrosion is not common in titanium dental implants because of the presence of protective, passive surface oxide layer, it could amplify the rates of corrosion initiated by other mechanisms.

Fretting corrosion is caused by repeated micromotion or friction of metal surfaces that cause mechanical wear and rupture of the passive surface oxide layer. Fretting can occur between dental implants and bone during implant placement and exposure to cyclic loads during chewing and parafunctional habits [15]. The release of metal debris and ions has been linked to inhibition of cell differentiation, cytotoxicity, phagocytosis of Ti particles by macrophages and other cells, inflammation, and neoplasia. Recent studies have shown that fretting and oxide disruption at the surface of load-bearing implants can cause an increase in corrosion. Abnormal electrical signals may affect the response and stability of the adjacent tissue, and fretting corrosion may amplify other types of corrosion by causing rupture of the passivating film and exposing bare titanium.

Pitting corrosion occurs as a result of the breakdown of the passive oxide film on a flat and evenly exposed area. Crevice corrosion is localized corrosion due to geometric confinement in the design of the device or from a previously corroded region on the surface. In pitting or crevice corrosion, the region undergoing active corrosion has restricted solution flow due to geometric confinement. It initially depletes local oxygen concentration, generating high levels of metal ions and electrons that are consequently consumed by the surface exposed to high levels of oxygen [15].

EIC is the brittle mechanical failure of metallic devices under stress levels significantly lower than their ultimate tensile strength. This occurs in susceptible materials in corrosive environments and under continuous loading. The magnitudes of the forces that can cause EIC to vary over a wide range. EIC include forces which would be considered negligible under non-corrosive conditions. EIC is the most common cause of corrosion in implants for bone applications, because of its localized nature, may go unnoticed until catastrophic failure.

4. Mechanism of degradation of Titanium dental implants

According to the theory of passivity, the surface oxide film inhibits dissolution of metal ions and is not always stable in the human body [16, 17]. Microscopically, the composition of oxide film changes due to the continuous process of partial dissolution and re-precipitation[18]. The surface oxide films must have certain characteristics to limit further oxidation [12, 13]; a) non - porous, b) atomic structure that will limit the migration of ions and electrons across the metal oxide-solution interface, and c) high abrasion resistance. After mechanical or electrochemical disruption of the surface titanium oxide layer, it can be reformed and easily leading to spontaneous re-passivation [12]. Any damage/wear of the surface oxide layer can occur due to low pH in peri-implantitis conditions. ISmplant micro movement resulting from extreme mechanical forces on implant and proximity of implant with other metals such as amalgam, gold, or chromium-cobalt alloys, leading to corrosion of Ti implants. [10, 13, 18].

The presence of protective oxide layer keeps the current flow and the release of corrosion products at a very low level. However, no metallic material is completely resistant to corrosion or ionization within living tissues [8]. The possible degradation mechanisms of surface oxide layer are wearing, corrosion or combination of both, i.e., which causes deterioration of the metal surface and release of metal ions/ debris into the peri-implant region [8, 19]. The implants are exposed to the electrolytic environment of blood and other body fluids which contain water, various anions such as chloride, phosphate, bicarbonate ions and cations like Na^+, K^+, Ca^{2+}, Mg^{2+} etc. proteins and dissolved oxygen [2]. The biological molecules disturb the equilibrium of the corrosion reactions of the implant by consuming the products of anodic or cathodic reaction [12]. Proteins can bind to metal ions and transport them away from the implant surface and disturb the equilibrium across the double surface layer formed by electrons on the surface and excess cations in the solution. Also, proteins absorbed on the surface found to reduce diffusion of oxygen at certain regions and can cause corrosion at those regions. Hydrogen formed by cathodic reaction acts as a corrosion inhibitor and the presence of bacteria in the vicinity of the implant enhances corrosion by absorbing the hydrogen. The literature described the presence of fluoride ions as a cause for the reduction in the protective quality of the oxide film [12, 20]. The composition of the surface oxide film changes according to reactions between the surfaces of the metallic implant and living tissues. According to literature, low concentration of dissolved oxygen, inorganic ions, change in pH values, proteins, and chemical properties of food and liquids may accelerate the release of metal ions from the implants leading to corrosion process [12, 16].

Many types of electrochemical corrosion are possible in the oral environment as the saliva contains aggressive anions such as chlorides which causes dissolution of the oxide layer and leads to the release of metal ions into the surrounding tissues. The electrochemical behaviour of Ti-based implants is dependent on various factors such as composition, the concentration of anions, pH, buffering capacity and surface-related properties of the implant [21]. Wear refers to the deformation of the surface of materials as a result of mechanical interaction between two opposite surfaces. The wear resistance of artificial dental materials is essential for the long-term stability of the implant. Generally, wear resistance is dependent upon the hardness, roughness, fracture toughness and Young's modulus of the interacting materials. As wear measurements in vivo are highly complex and time-consuming, wear analysis is usually performed in simulators in the presence of artificial saliva. Fretting corrosion refers to the small oscillating movements between two interacting materials (bone-implant, plates-screws) in the presence of corrosive oral environment [12]. Fretting results in the rupture of a protective oxide layer, initiation of cracks and formation of reactive metal atoms on the surface that are susceptible to corrosion [13, 14]. Simultaneous action of electrochemical and mechanical interaction occurring on materials subjected to relative movement is referred to as tribocorrosion [12, 22, 23].

5. Local effects of wear and corrosion of titanium dental implants

Despite high corrosion resistance of Ti, increasing evidence is found regarding the release of titanium related ions into surrounding peri-implant tissues[20]. During the healing process, a significant decrease in pH values (pH=4) has been found as a result of local inflammatory processes [14, 16, 24, 25]. The reduction in pH stimulates corrosion of metals by increasing aggressiveness of tissues towards metallic materials. The corrosion process may compromise the resistance of metal to fatigue, which eventually cause fracture of the implant. It has been reported that saliva leaking between suprastructure (Ni-Cr) and implant (Ti) may trigger galvanic corrosion due to differences in electrical potential. This generates leakage of ions such as nickel or chrome from crown or bridge to the peri-implant tissues, with consequent bone resorption and may compromise the mobility of the implant and its subsequent fracture [26].

5.1 Tissue response at the implant-bone interface and peri-implant soft tissues

Peri-implant mucosa consists of well keratinized oral epithelium, sulcular epithelium, and junctional epithelium with underlying connective tissue. The corrosion products may cause discolouration of peri-implant soft tissues [12], or type IV hypersensitivity reactions, where titanium microparticles are found inside macrophages [27-30]. Gingival hyperplasia, mucositis, and peri-implantitis have been described as the soft tissue complications associated with dental implants [10]. The reactive lesions of peri-implant mucosa reported in the literature were inflammatory angiohyperplastic granuloma and peripheral giant cell granuloma, in which the presence of metallic particles has been confirmed from histologic sections [31].

Numerous case reports in the literature describe histological evidence of the presence of metallic particles in the tissues adjacent to dental implants, orthodontic mini-implants, internal fixation devices for maxillofacial surgeries, orthopedic prostheses of titanium or titanium-based alloys [21,24]. The literature describes histologic evidence of inflammatory response and presence of metallic particles in the peri-implant soft tissues, osseointegrated bone tissue and bone marrow of failed dental implants, indicating the occurrence of corrosion process [21]. The size of Ti particles identified in peri-implant tissues ranges from 100 nm (or 0.1 μm) to 54 μm. Significant concentrations of Ti particles were noted around compromised implants than healthy implants. Microchemical analysis using X-ray dispersion (EDX) confirmed the presence of titanium in peri-implant soft tissues [24,30]. The presence of corrosion and wear products in the peri-implant tissues may cause per implant bone loss and aseptic loosening of implant. The decrease in the percentage of osseointegration was also noted in the areas corresponding to pits or surface defects on implant surface [24]. The observation of metal particles located intracellularly or in association with blood vessels may represent a biologic response aimed at eliminating the foreign material [33]. It was observed that increased mechanical stability during healing might reduce micromotion at the bone-implant interface and reduces fretting corrosion.

The presence of titanium particles has been found in saliva and gingival crevicular fluid of patients with titanium dental implants. The localized areas of gingival hyperplasia surrounding the transmucosal portions of titanium implants may be due to poor hygiene, lack of attached gingiva, and titanium allergy [28, 34-36]. In a case report, it has been emphasized that periodontal surgical procedures and chemotherapeutic agents failed to control the hyperplasia of epithelial tissue surrounding endosseous titanium dental implants. The hyperplastic response was reduced after replacement of titanium abutments with custom-fabricated gold abutments [28].

5.2 Dissemination of titanium to other biological compartments

The local effect of corrosion resulting in the passage of metal particles to the peri-implant tissues may compromise other biological compartments [24]. Experimental studies conducted on animal models showed titanium deposits in liver, spleen and lung with macrophagic activity [37, 38]. The detection of titanium in the blood cells and/or plasma of patients with titanium dental or medical prostheses could be used as an indicator of the possibility of corrosion process of the metal structures. It is known that traces of metal can increase the physiological production of reactive oxygen species, without a compensatory increase in antioxidant species, further leads to tissue damage.

6. Clinical significance of corrosion

Since titanium is highly reactive metal and corrosion-resistant; the superstructure is the probable cause for the initiation of the corrosion process. When titanium is coupled with other metals, may accelerate galvanic corrosion of less noble metal due to difference in electrolytic potential which can be minimized by fabricating the superstructure from a metal alloy that has similar/close electrolytic potential to that of titanium [12]. A case report from the literature reported metal fatigue is the cause for implant fracture, which is confirmed from metallurgical analysis and corrosion has been observed on the surface of Ni-Cr crown [13, 39].

The metallic ions released from the implant due to the corrosion process affects the peri-implant tissues. The dissolution of metal ions may lead to surface erosion which in turn leads to brittleness and fracture of the implant. As the implant fractures, corrosion gets accelerated due to the increase in the amount of exposed surface area and loss of protective oxide layer [11, 40]. If the fractured implant is not surgically removed, further dissolution and fragmentation can occur, which may result in inflammation of the surrounding tissues. The metal debris activates a cascade of signaling molecules that result in the activation and differentiation of osteoclast cells and leads to bone resorption/osteolysis of the peri-implant region [8, 11]. As a result, the bonding between the bone and implant is lost and results in implant loosening. The occurrence of implant loosening in the absence of bacterial infection is referred to as aseptic loosening. Metal ions such as Ti^{4+}, Co^{2+}, and Al^{3+} have been shown to decrease DNA synthesis, mitochondrial dehydrogenase activity, mineralization, and mRNA expression of alkaline phosphatase [1]. Smaller sized wear debris combines with biomolecules and elicit Type IV immunogenic response and causes eczema, prolongs bone healing and is also accompanied by pain [41]. Also, it has been found that the titanium implanted region turns black. This colour change is due to the surface of titanium undergoes repassivation when the oxide layer is disrupted. In certain conditions, the repassivation process forms so much TiO_2 oxide layer that the region turns blacker. This process is referred to as metallosis and has been considered to be harmful [41, 42]. It is therefore important to study the dental implants in-vitro under the physiological condition to understand their behaviour in the oral environment and develop strategies to combat the issues that lead to implant failure.

7. Prevention of wear and corrosion of Titanium dental implants

Bone-implant interface is considered to be significant in the retention of any implant and loss of metal ions from titanium implant surface may lead to corrosion, wear and poor osseointegration. Modification of implant surface microstructure improves biological response, chemical and mechanical properties, thus reducing the friction and corrosion of metallic implants [2, 4, 43-45]. Implant surface biomodification is a process limiting the loss of metal ions. It can be achieved by various implant surface modifications such as surface machining, sandblasting, acid etching, anodic oxidation, plasma-spraying, nitriding and biocompatible/biodegradable coatings [1, 11, 12, 45,46]. Literature states that biocompatible inorganic coatings, such as hydroxyapatite (HAP) can lead to delay in corrosion, wear and also minimizes the aseptic loosening of implants. Recently, nanoceramic hydroxyapatite coatings are becoming popular to promote osseointegration. These coatings prevent surface degradation of titanium dental implants.

CP-Ti has low wear resistance and strength than Ti alloys, and the mechanical properties of CP-Ti can be improved by different processing techniques to obtain nano-crystalline materials, which exhibit high strength and superior biocompatibility. The corrosion resistance of CP-Ti is improved when coated with nano Al_2O_3-TiO_2, and fretting wear also has been decreased by seven times [47].

Recently, laser-etching of dental implants is used to produce a high degree of purity with adequate roughness for better osseointegration. The corrosion resistance of Ti-6Al-4V alloy has been increased by seven times when the implant surface modified using the excimer laser [48]. Despite ceramics disadvantages like brittleness and high elastic modulus, these are becoming popular for their high biocompatibility and corrosion resistance.

8. Conclusion

Titanium is a promising metal in the field of implant dentistry. The potential risk of corrosion and release of corrosion byproducts into the surrounding environment is of clinical importance. The local biological effects caused by the presence of ions/particles in the peri-implant tissues might affect the implant outcome. If the corrosion resistance of titanium can be controlled by limiting the exchange of metal ions, may improve ultimate osseointegration. Implant surface modifications by addition or subtraction of metals to enhance the biocompatibility of the metal with the surrounding tissues and also to provide corrosion resistance by preventing the loss of metal ions from the surface.

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The amazing spectrum of light – LASER

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Photodynamic therapy

ABSTRACT

“In right light at right time everything is extraordinary”- says Aaron Rose. This is very true with respect to lasers. Discovery of lasers from the spectrum of light has revolutionized the technology in many fields. The word “LASER” means Light Amplification by Stimulated Emission of Radiation. They offer many useful clinical applications for general dentists in the diagnosis and treatment of patients. There are many clinical, aesthetic, and psychological reasons to use lasers. Herein we present a brief overview of “THE AMAZING SPECTRUM OF LIGHT”.

1. Introduction

Theodore Maiman, in 1960, developed the first working laser device, with Hughes Aircraft Corporation, which emitted a deep red-colored beam from a ruby crystal [1]. Dr. Leon Goldman, a dermatologist was experimenting with tattoo removal using the ruby laser. He focused two pulses of that red light on a tooth of his dentist brother, resulting in painless surface crazing of the enamel [2].

In 1970s and 1980s CO_2, neodymium YAG (Nd:YAG) were studied and they are thought to have better interaction with dental hard tissues. The medical community in 1970s had begun to incorporate lasers into the soft-tissue procedures. Frame, Pick and Pecaro stated the benefits of CO_2 laser treatment of oral soft-tissue lesions and periodontal procedures [3,4,5]. In 1989, Myers and Myers received permission from the US Food and Drug Administration to sell a dedicated dental laser, the Nd:YAG. Since then, numerous instruments have been made available for dental use, and more are being developed [6].

At present, lasers are indicated for a variety of dental procedures. The clinician must be familiar with the fundamentals of laser physics and tissue interaction so that the proper laser device is used to obtain the treatment objective safely and effectively.

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2. Classification

2.1. Based on power, lasers can be classified into the following three categories [7];

2.1.1 High - Power Lasers (Hard, Hot)
These produce heat by increasing the tissue kinetic energy. Because of this, they produce therapeutic effects through thermal interactions like necrosis, carbonization, vaporization, coagulation and denaturation. The output power of these lasers is usually more than 500 mW.

2.1.2 Intermediate - Power Lasers
These produce therapeutic effects without producing significant heat. They have output powers ranging from 250-500 mW.

2.1.3 Low - Power Lasers (Soft, Cold)
They have no thermal effect on tissues. They produce reaction in cells through light by a process called photo bio-stimulation or photo biochemical reaction. These have output power less than 250 mW.

2.2 Based on form, lasers are further classified as [1];
2.2.1 Gas lasers
- Argon
- Carbon-dioxide

2.2.2 Liquid
- Dyes

2.2.3 Solid
- Nd:YAG
- Erbium: yttrium aluminum garnet (Er: YAG)
- Diode

2.2.4 Semiconductor
- Hybrid silicon laser

2.2.5 Excimers
- Argon-fluoride
- Krypton-fluoride
- Xenon-fluoride

2.3 Classification based on light spectrum [8]
- UV Light spectrum ranging from 100nm–400nm.
- Visible light spectrum ranging from 400nm- 750 nm.
- Infrared light spectrum ranging from 750nm-10000 nm.

2.4 Lasers are also classified as soft lasers and hard lasers [8]

2.4.1 Soft lasers are believed to stimulate cellular activity. The Clinical application includes healing aphthous ulcers, healing localized osteitis, treatment of gingivitis and reduction of pain. The currently used soft lasers are Gallium- arsenide (Ga-As) and Helium-neon (He-N).

2.4.2 Hard lasers (surgical) can cut both soft tissues and hard tissues. Latest variety of hard lasers can transmit their energy through a flexible fiber optic cable. Currently used hard lasers are Argon lasers (Ar), Carbon-dioxide lasers (CO2), Neodymium-doped yttrium aluminum garnet (Nd:YAG), Neodymiummyttrium-aluminum-perovskite (Nd:YAP), Erbium, chromium, yttrium-slenium-gallium-garnet (Er,Cr:YSGG), and Holmiumyttrium-aluminum-garnet (Ho:YAG).

3. Mechanism of action

Laser is a monochromatic light and consists of a single wavelength. It has three principal parts: An energy source, an active lasing medium, and two or more mirrors that form an optical cavity or resonator. Pumping mechanism such as a flash-lamp strobe device, an electrical current, or an electrical coil supplies energy to laser system for amplification. The energy thus produced is pumped into an active medium which is contained in an optical resonator, producing a spontaneous emission of photons. Consequently, amplification by stimulated emission takes place when the photons are reflected back and forth through the active medium by the highly reflective surfaces of the optical resonator, prior to their exit via output coupler. The laser light in dental lasers is delivered via fiber-optic cable, hollow waveguide, or articulated arm. A cooling system, focusing lens and controls complete the system. The properties of the laser are primarily determined by the composition of an active medium, which can be a gas, a crystal, or a solid-state semiconductor.

The energy produced by a laser light may have different interactions with the target tissue like Transmission, Absorption, Scattering, and Reflection. Absorption results in elevation of temperature thereby producing photochemical effects depending on the water content of the tissues. Vaporization of the water within the tissue occurs when a temperature of 100°C is reached. This process is called ablation. At temperatures below 100°C and above approximately 60°C, there is no vaporization of the underlying tissue whereas proteins begin to denature. Conversely, at temperatures above 200°C, the tissue is dehydrated and then burned, resulting in carbonization [9,10].

Absorbers of light are known as chromophores. They have a specific affinity for certain wavelengths of light. The primary chromophores in the intraoral soft tissue are Hemoglobin, Melanin and Water. Whereas, in dental hard tissues Water and Hydroxyapatite constitute chromophores. With respect to these primary tissue components different laser wavelengths have different absorption coefficients making the laser selection procedure-dependent [11,12].

4. Common types of lasers in dentistry

4.1 Argon lasers

These lasers have ionized argon as their active medium and deliver laser light in continuous wave and gated pulsed modes. Two wavelengths are being used in dentistry: 488 nm (blue) and 514 nm (blue green). These two wavelengths are poorly absorbed by the enamel and dentin. This provides an advantage during cutting and sculpting gingival tissues as they don't cause any damage to the tooth surface. Both wavelengths can be used as an aid for caries detection. When the argon laser light illuminates the tooth, the carious area appears as a dark orange-red color discriminating it from the surrounding healthy structures [1].

4.2 Diode lasers

These are manufactured from semiconductor crystals made from a combination of aluminum (wave length of 800 nm) or indium (900 nm), gallium and arsenic. These wavelengths can penetrate deep into the mucosa and they are highly attenuated by the pigmented tissue. These lasers are excellent for soft tissue surgical procedures like gingivoplasty, sulcular debridement and deeper coagulation process on gingival and mucosa as they are poorly absorbed by the dental hard tissue. These lasers can stimulate fibroblastic proliferation when operated at low energy levels[13].

4.3 Nd-YAG Lasers

These lasers have garnet crystal as the solid active medium combined with rare earth elements like aluminum and yttrium, doped with neodymium ions. They have wavelength of 1064 nm which is indicated for various soft-tissue procedures. This laser provides good hemostasis and thereby a clear operating field during soft-tissue procedures. This laser is also indicated for the removal of incipient. These lasers can penetrate several millimeters which can be used for treatment of aphthous ulcers and pulpal analgesia when used in a non- contact, defocused mode [14].

4.4 The Erbium family lasers

They consists of Erbium Cr:YSGG, Erbium:YAG.

4.4.1 Erbium:YAG laser: It's been used on hard tissues like enamel, cementum and bone but not extensively on soft tissues. Its wavelength of 2,940 nm is ideal for absorption by hydroxyapatite crystals and water thereby making it more efficient in ablating enamel and dentine. There is no marked thermal effect on tissues of this laser because the energy produced at this wavelength is absorbed by water and thus there is minimal rise in temperature. In the fiber optic delivery system helium neon laser is used as aiming beam.

4.4.2 Er:Cr:YSGG laser (Erbium: Chromium: YSGG): It is also known as water pulsed laser. It works on a power range of 0-6 W with wavelength 2.78 microns. It works by Hydro-kinetic tissue cutting system to energize water for the use on soft and hard tissues. The laser energy is delivered through a flexible fiber optic system. The laser energy excites the fiber and encounters a mist of water droplets. These droplets absorb energy and are instantly reduced to particulates and propelled with such force that they are capable of cutting hydroxyl-apatite crystals of enamel and the osseous skeleton of the bone. The energized water removes hard tissue with great efficiency [8].

4.5 CO_2 lasers

These lasers contain a gaseous mixture with Carbon-dioxide molecules which helps in producing a beam of infrared light. The light energy, with a wavelength of 10,600 nm, is absorbed by water and is delivered in gated pulsed or continuous mode through a hollow tube-like wave guide. The wavelength of carbon-dioxide lasers is useful in cutting and coagulation of soft tissue. Because of its limited penetration depth this laser is indicated for the treatment of mucosal lesions. Pain usually is minimal to none postoperatively. Delayed wound healing and loss of tactile sensation are the major disadvantages of this lasers [15].

5. Applications of lasers in dentistry

5.1 Soft tissue applications [16]

5.1.1 Disinfection using lasers

Oxygen-releasing dyes are photochemically activated with low power laser energy that causes membrane and DNA damage to the microorganisms. This technique can be performed using a system of visible red semiconductor diode lasers and tolonium chloride dye. This technique has been effective in killing bacteria in complex biofilms, such as subgingival plaque, which are typically resistant to the action of antimicrobial agents and can be made species-specific by tagging the dye with monoclonal antibodies. This dye can be applied effectively for killing both Gram-positive and Gram-negative bacteria, fungi, and viruses. The major clinical applications include disinfection of root canals, deep carious lesions, periodontal pockets and sites of peri-implantitis.

5.1.2 Wound healing

Low doses of laser application like 2 J/cm^2 stimulates proliferation, whereas suppressive action is seen at high doses like 16 J/cm^2. In a culture of gingival fibroblasts treatment with Low-level laser treatment (LLLT) has shown to induce transformation in myofibroblasts which are useful in wound contraction as early as 24 hours' post laser treatment. There have been recorded positive effects of LLLT on the healing of lesions of recurrent aphthous stomatitis. There are few cases, which show that LLLT promotes healing and dentinogenesis following pulpotomy.

5.1.3 Photodynamic therapy (PDT) for malignancies

This therapy has been employed in the treatment of malignancies particularly multi-focal squamous cell carcinoma of the oral mucosa. It acts with similar principle like PAD, generating reactive oxygen species, which in turn, directly damage the cells and the associated blood vascular network, resulting in both necrosis and apoptosis. Thereby the host's immune response is activated and promotes anti-tumor immunity through the activation of macrophages and T lymphocytes. There is also direct evidence of the photodynamic activation of production of the tumor necrosis factor-α which is a key cytokine in host anti-tumor immune responses. Clinical studies have reported results for the PDT treatment in carcinoma in-situ and squamous cell carcinoma, of oral cavity, with approximately 90% response rates.

5.1.4 Aesthetic gingival re-contouring and crown lengthening

Advent of the diode lasers made clinicians choose them to include optimization of gingival aesthetics as part of the comprehensive orthodontic treatment, instead of conventional gingivectomy which is associated with pain, discomfort, and bleeding.

5.1.5 Post herpetic neuralgia and apthous ulcer

Photostimulation of aphthous ulcers and recurrent herpetic lesions have shown to provide pain relief and accelerated healing with low levels of laser energy (HeNe). In recurrent herpes labialis, photostimulation during the prodromal (tingling) stage have shown to arrest the lesions before vesicles formation, accelerate the overall healing time and decrease the frequency of recurrence.

5.1.6 Removal of inflamed, hypertrophic tissue

The diode laser is very useful for a number of isolated applications such as removing tissue that has overgrown mini-screws, springs and appliances. It can also be used as a replacement for tissue punch when placing mini-screws in the gingiva.

5.1.7 Frenectomies

Laser assisted frenectomy could be the best performed procedure after the diastema is closed. Lasers permit excision of the frenum painlessly, without bleeding or suture and there is no need for postoperative care.

5.1.8 Exposure of unerupted and partially erupted teeth

Using lasers an impacted or partially erupted tooth can be exposed allowing for reasonable positioning of a bracket. It gives advantage in the way that the attachment can be placed immediately with no bleeding and pain at all.

5.2 Hard tissue applications [16]

5.2.1 Laser fluorescence

Orthodontic treatment with fixed appliances have enamel demineralization with white spot formation on the buccal surfaces of the teeth as a relatively common side effect. However, there is evidence that such small areas of superficial enamel demineralization may be re-mineralized using lasers.

5.2.2 Photochemical effects

The argon laser can initiate photopolymerization of light-cure restorative materials, which use camphoroquinone as the photo-initiator. The radiation of these argon lasers is also able to alter the surface chemistry of enamel and root surface dentine, permitting the

the reduction in probability of recurrent caries. Argon and Potassium Titanyl Phosphate lasers can achieve good results in cases that are completely unresponsive to conventional photothermal 'power' bleaching.

5.2.3 Treatment of dentinal hypersensitivity

Er: YAG laser have shown to close dentinal tubules near cervical region of tooth more effectively compared to other desensitizing agents. The effect shown has lasted for a comparatively longer period of time.

5.2.4 Cavity preparation, caries, and restorative removal

Er: YAG laser can be used for removing caries in the enamel and dentine by ablation. This procedure can be achieved without rise in temperature on the pulp, and even without water-cooling. The Er: YAG laser is capable of removing few restorative materials like cement, glass ionomer and composite resin.

5.2.5 Etching

Laser etching (Er, Cr: YSGG) can be used as an alternative to acid etching of enamel and dentine. Enamel and dentine surfaces etched with lasers show micro-irregularities with no smear layer formation.

Various types of lasers used for different dental procedures are described in the table 1.

6. Safety

Safe and effective operation of lasers require certain precautions. The laser should be in good working order, with all manufacturer safeguards in place. First and foremost is protective eyewear. Eyewear should have worn by everyone in the vicinity of the laser, while it is in use. They may include the doctor, chairside assistants, patient or any observers such as family or friends. It is very critical that eyewear worn is wavelength-specific. Accidental exposure to the non-target tissue can be prevented by the use of warning signs posted outside the nominal hazard zone and by limiting access to the surgical environment. The number of reflective surfaces should be minimized. In order to prevent possible exposure to infectious pathogens, apart from following normal infection protocols, a high-volume suction should be used to evacuate any vapor plume created during tissue ablation. Each office should have a designated Laser Safety Officer who should regularly supervise the proper use of the laser, coordinate staff training, oversee the use of protective eyewear, and should be familiar with the pertinent regulations.

Dental procedure	Possible types of lasers
Laser Doppler flowmetry	*He Ne, diodes*
Laser fluorescence	*He Ne, diodes*
Photodynamic therapy to release fibrotic bands in osmf	*ErCr: YSGG*
Frictional keratosis, leukoplakia, verrucous carcinoma	*Diode*
Hemostasis	*Co_2*
Tuberosity reduction, alveloplasty, bone and flap removal	*Erbium*
Dentine hypersensitivity	*Er:YAG*
Cavity preparation	*Diode*
Composite curing	*Co_2, Nd:YAG, Er:YAG*
Removal of defective composite restoration	*Argon, Er:YAG*
Root canal treatment, apicoectomy	*Co_2, Nd:YAG*
Laser assisted curettage	*Nd:YAG, diode*
Gingivectomy and gingivo plasty	*Co_2*
Analgesic effect and bio- stimulation of wound healing	*He Ne, diode, Nd: YAG*

Table 1. Types of lasers for different dental procedures [17]

7. Limitations

1. Additional training and education are required for various clinical applications of lasers.
2. Cost of equipment is high.
3. Various procedures require different wavelengths thereby increasing the need for more than one type of laser.

8. Conclusion

Lasers have acquired a specialized place in all disciplines of dentistry making it an AMAZING SPECTRUM OF LIGHT. Many types of lasers are available for various clinical purposes. They are activated at different power setting modes, and pulse for soft and hard tissues. Greater numbers of dentists are now using this technology to provide precision treatment to the patients as the applications of the same are being increasing day by day. In the emerging future laser technology, might become an essential component in contemporary dental practice.

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Fiber reinforced composite and surface coated esthetic archwires - a review

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ABSTRACT

Orthodontic treatment has undergone drastic transformation since few years. Many patients present with a set of challenges to orthodontists in terms of esthetics while undergoing orthodontic treatment. Introduction of composite & ceramic brackets has led to the development of esthetic archwires to meet the increased demand for esthetics during orthodontic treatment. This article discusses about widely used esthetic archwires used in orthodontic treatment.

1. Introduction

The number of adult patients seeking orthodontic treatment has been increased from the past few years. Esthetics, while undergoing orthodontic treatment, is one of the primary concerns in the present era due to the metallic show of the brackets and wires [1]. Although adult patients are better co-operative, their interest in esthetic brackets and wires have been increased significantly. Due to the increased demand for esthetics during orthodontic treatment, esthetic brackets and wires were introduced. Hence, this article is focused on giving an overview of various esthetic archwires available for the clinician to meet his/her patients' needs.

2. Manufacturing process of esthetic arch wires

The different manufacturing processes of esthetic archwires are described in the following sections.

2.1 Ion Implantation

The expedition of ions with the guidance of electric field, to implant them off the surface of solid (metal) [2].

2.2. Surface Coating

The surface of the archwires is coated with a polymer that masks the underlying metal component of the wire and making them aesthetic. Nitinol (Ni-Ti) and stainless steel (SS) wires are coated with Polytetraflouroethylene (PTFE), Epoxy Resin, to give the natural appearance of enamel. These wires possess excellent aesthetics and ensuring maximum efficiency.

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2.3 Pultrusion

It is the process of manufacturing components having continuous lengths and a constant cross-sectional shape. In this, bundles of continuous fibres are pulled through an extruder and impregnated with a polymeric resin (figure 1). These resin fibre bundles are cured followed by imparting the precise circular or rectangular shape.

2.4 Beta staging

It is an intervening process in which partially cured resin and the bundles of continuous fibres change their form after which the curing is completed. Preformed arch wires are possible by this process.

3. Composite archwires

Numerous advancements are made in the archwires without affecting their critical properties to meet the aesthetic demands [3]. Progress in the composite technology led to the development of transparent polymeric composite archwires.

3.1 Self-reinforced archwires

These are fibre free and Polyphenylene based polymers. They exhibit high yield strength, ductility and spring back.

3.2 Fibre reinforced composite archwires (FRC)

These archwires are manufactured by the "Pultrusion" Process. FRC archwires possess excellent esthetics with superior tensile strength and elastic recovery. Further, FRC archwires are biocompatible as they are nickel-free. In certain situations, these arch wires can be bonded directly to teeth, thus, eliminating the need for brackets. In addition, welding and soldering of attachments to these wires are not required as attachments can be bonded directly. These wires are available in various shapes and dimensions. These archwires have a higher coefficient of friction compared to Stainless steel wires but lesser compared to Nickel-Titanium wires and Beta-Titanium wires. Abrasive wear of composite was noted at high forces at bracket-archwire interface.

A new FRC wire such as "Splint it" was introduced, recently. Splint it archwire consists of S2 glass fibres [4] in Bis-GMA matrix. These archwires are pre-polymerized during the manufacturing process and are polymerized to its full extent during treatment. They are used as retainers for retention and to reinforce anchorage [5] as they can be bonded directly to teeth. The significant advantages of this wire include superior flexibility, ease of adaptation and contouring over the teeth.

Optiflex is a most aesthetic orthodontic arch wire designed by Dr. Talass [6] and manufactured by ORMCO. It possesses superior aesthetic appearance as it is made of clear optical fiber. This optical fiber is composed of 3 layers. Inner core is silicon dioxide core, middle layer is made with silicon resin and the outer layer is nylon layer. Core provides the force for moving tooth, middle layer protects the core from moisture and also provides strength and the outer layer prevents damage to the wire and also further increases the strength [7] Optiflex is very flexible and is effective in moving teeth using light continuous force [8].

4. Surface coated archwires

The surface of metallic archwire was coated with a polymer to ensure maximum esthetics (Figure 2). Initially, these coated archwires were used in 1970's.

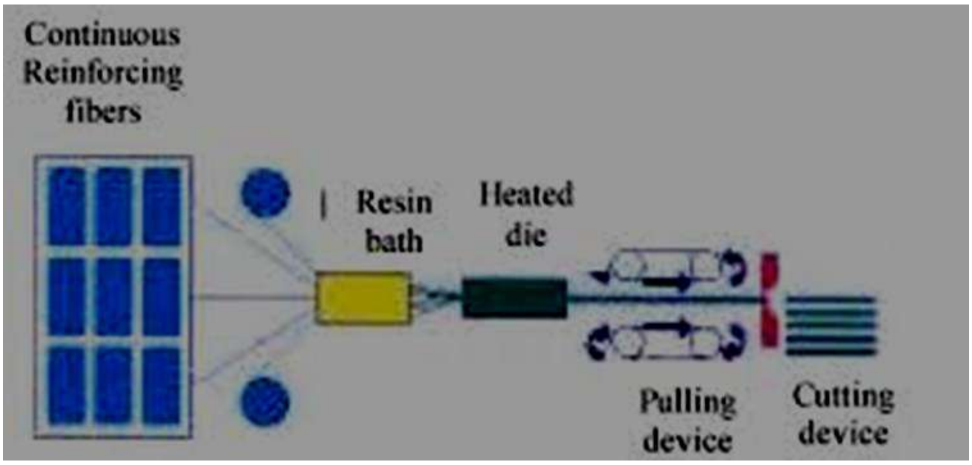

Figure 1: Pultrusion process

Figure 2: Surface coated arch wire

However, their usage was decreased later due to chipping of these coatings and denudation of the metal. Commonly used coated archwires are Teflon coated, and Epoxy resin Coated wires.

4.1 Teflon coated archwires

DuPont Co. introduced Teflon coated arch-wires. These wires are manufactured either by electrostatic technique or by thermal spraying. This coating protects the wire from corrosion. The molten material is sprayed on to the surface of the metallic archwire to ensure a coating. Nickel- Titanium and stainless steel wires are coated with Polytetrafluoroethylene (PTFE) and are called as Teflon coated wires. Usually, the thickness of the coating is 0.002 inches. These archwires are available in natural tooth shades with the hue that is comparable to that of the tooth. Hence, these wires possess excellent esthetics. These archwires are also available in different colours including, blue, green and purple. These wires have the lowest coefficient of friction and can be used for sliding mechanics.

Marsenol is a tooth coloured elastomeric poly tetra fluroethyl emulsion (ETE) coated nickel-titanium wire. The working characteristics of these wires are similar to an uncoated super-elastic Nickel-Titanium wire [8].

4.2 Epoxy coated archwires

Epoxy is a synthetic resin material with an excellent adhesion capability to the metal surfaces. This unique bonding character made this material to use frequently for coating of metallic wires. The electrostatic coating method is used to apply epoxy resin on the Nickel-titanium or stainless steel wires. The thickness of the coating is limited to 0.002 inches, as the increased thickness may affect the mechanical properties [9,10]. These wires are tooth-coloured and have colour stability which lasts for 6-8 weeks. These wires have excellent dimensional stability, chemical resistance and better stain resistant compared to other esthetic archwires. The esthetics of these wires is very much close to that of the colour of the natural tooth as they blend with the ceramic or plastic brackets [11]. All the coated archwires are available in various sizes and shapes.

Lee white wires were manufactured by LEE pharmaceuticals. It is resistant stainless steel or Nickel titanium archwire bonded to a tooth-colored epoxy coating. The completely opaque epoxy coating opaque does not chip, peel, scratch or discolour [8].

5. Conclusion

Esthetic archwires are visually perceptive and pave the way for clear labial orthodontic treatment by meeting the patient needs. Although there are few inhibitions concerning to mechanical wear, with the advanced technology these constraints shall be overcome, making esthetic archwires more widely accepted for treatment.

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Fabrication of feeding plate prosthesis for a six days old neonate: a case report

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ABSTRACT

Feeding a newborn baby with complete cleft lip and palate is a problematic pursuit because of the association between the oral cavity and the nasal cavity. A multidisciplinary approach is needed to manage the complex problems involved in the case of such neonates and their families. The present case is of a 6-day-old neonate having complete right unilateral cleft lip and palate (Veau class C) for which palatal obturator was constructed. In this case report a stepwise simple, secure, and uncomplicated procedure for making accurate impressions, maxillary cast, and fabrication of palatal obturator in infants with cleft lip and palate have been presented.

1. Introduction

Most common congenital craniofacial anomalies that are seen in a newborn are Cleft lip and palate with an incidence of 0.28 to 3.74 per 1000 live births globally [1]. Cleft palate is a gap within the roof of the mouth caused due to failure of palatal shelves to fuse throughout the first months of development as an embryo [2]. The challenges and problems of cleft lip and palate patients include physiological activities such as swallowing, speech, etc. which are performed by the oral and nasal cavities. Oro-nasal communication i) diminishes negative pressure, necessary for suckling [3-6] ii) causes nasal regurgitation of food, frequent burping, and choking because of excessive air intake. Because of this, communication time for feeding is usually significantly longer and fatigues for both baby as well as mother [7].

Treatment of cleft lip and palate involves the teamwork of a surgeon, prosthodontist, paediatrician, and speech therapist. Lip repair is done at 2 to 6 months age, and palatal repair is done from 12 months to 2 years of age. Early repair of the palate may have a negative effect on the growth and development of the maxilla due to the resulting scar tissue formation [8]. Until the surgical correction, maintenance of adequate nutrition is essential for the healthy growth of the newborn and to prepare the infant for the corrective surgery, which requires a feeding plate. There are different approaches to feed babies with cleft palate. Orogastric and nasogastric tubes may be effective but should be used only for a limited time. Specially designed nipples with enlarged openings can be used to allow the flow of fluids with minimum effort, but this option may not be the right choice for some patients.

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The feeding plate occludes the cleft and restores the separation between oral and nasal cavities. According to GPT-9, feeding prosthesis is an ancillary prosthesis constructed for newborns with cleft palates to permit normal sucking and feeding. Cleft plate prosthesis facilitates feeding, reduces nasal regurgitation, reduces the incidence of choking, and shortens the length of time required for feeding. Further, the obturator also prevents the tongue from entering the defect and interfering with the natural growth of palatal shelves towards the midline. This prosthesis also helps to position the tongue in the right position to accomplish its functional role in the growth of jaws and contributes to speech development. The obturator helps in reducing the passage of food into the nasopharynx, thus reducing the incidence of otitis media and nasopharyngeal infections. The feeding plate restores the essential functions of mastication, deglutition, and speech production until the cleft lip and/or palate can be surgically corrected [8].

2. Case report

The department of paediatrics referred a six-day-old female child, who weighed 2.5 kg to the department of Prosthodontics and crown & bridge for the fabrication of feeding plate. On examination, it was observed that the child was born with right unilateral cleft lip and palate with approximately 1.5 – 2.0mm communication openings. After a complete examination of the patient, it was decided to fabricate a feeding plate for the patient, so that it reduces the feeding problem (figure1).

3. Procedure

The preliminary impression of the maxillary arch was made with polyvinyl siloxane putty material washed with medium body addition silicone with the help of a plastic ice cream spoon. The infant was held upright by the mother to prevent the aspiration of impression material. The putty addition silicone (GC Flexceed Kit) was adapted until the impression material adequately covered the anatomy of the upper gum pads. Once the impression material was set, the putty tray was removed, wash impression with medium body addition silicone (Aquasil monophase tube refill 180mL) was made (Figure2), and the mouth was examined for residual impression material. The impression was then poured with Type IV dental stone (Pearl stone) to obtain an accurate cast (Figure3). The feeding plate was made up of an adapted vacuum-formed thermoplastic sheet of 5mm (Soft Eva Keystone Industries).

The suturing thread (Silk suture braided, Non-absorbable Teleflex medical OEM) was attached to the feeding appliance because it prevents swallowing and aids in easy retrieval of the appliance (Figure 4). Finally, the appliance was inserted in the child's oral cavity, necessary corrections were done, and the child was fed.

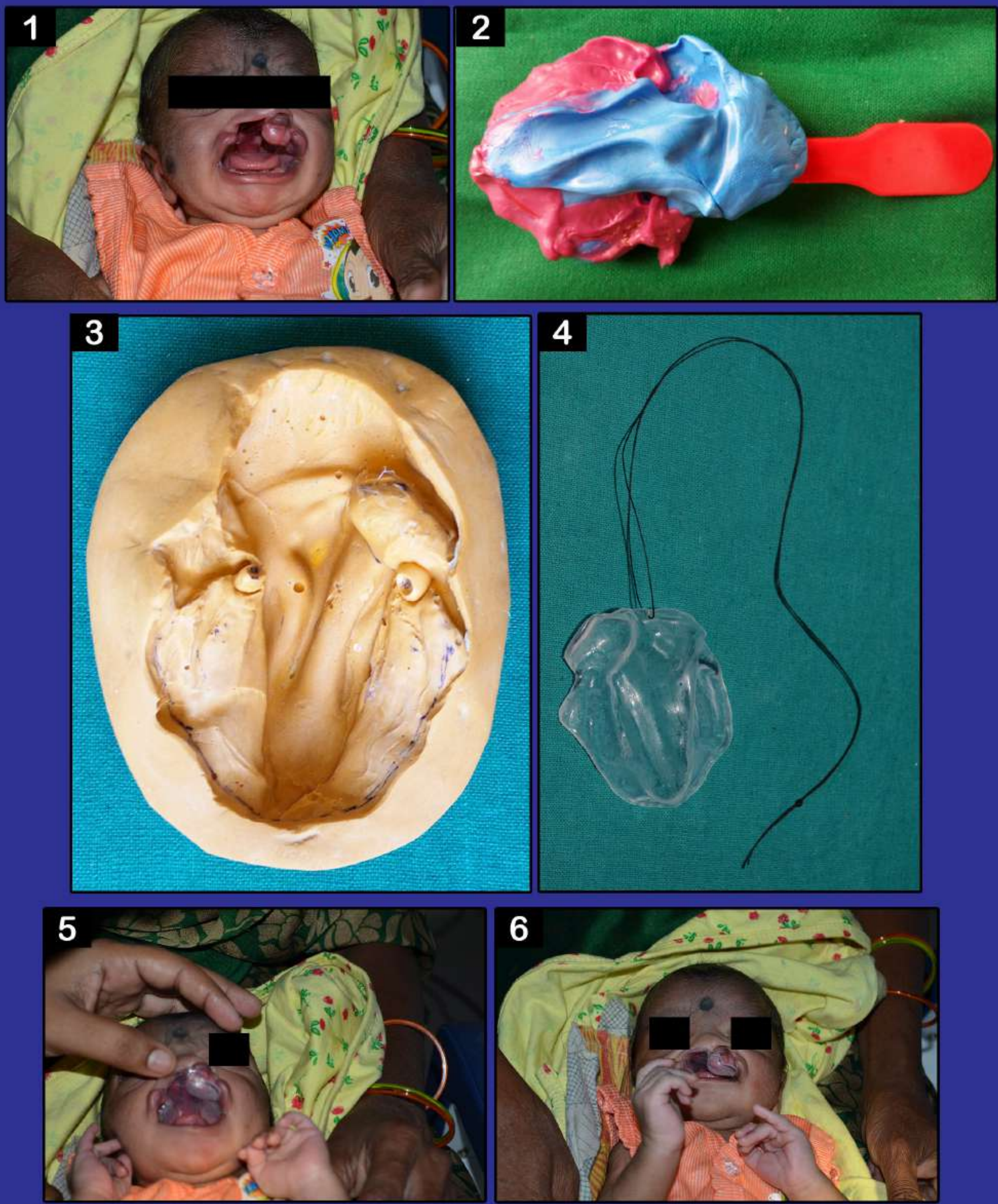
Instructions were given to the parents about using and cleaning the plate. Initially, it may take longer to feed the child with the plate, and even it is uncomfortable for the child, gradually, it should be adjusted.

4. Discussion

Maintenance of adequate nutrition is essential for the growth and development of the infant because gaining weight is important for the preparation of the baby for the corrective surgery. However, a cleft palate creates an opening in the roof of the mouth, and the infants have difficulties in sucking because the necessary negative pressure cannot be produced in the oral cavity. Additionally, the expressed milk tends to escape to the nose [8].

So to prevent such nasal regurgitation various feeding devices are used like traditional feeding bottle which may be rigid or squeezable with two types of nipples (a regular Nuk or a cleft nuk), a squeezable cleft palate nurser, a traditional feeding bottle with a crosscut nipple, the Hotz plate, the Haberman feeder, a prosthetic obturator appliance, a nasogastric tube, cup and spoon -feeding, and syringe feeding[9]. In the presented case, a modified feeding plate was constructed using soft vacuum formed Biostar materials that permitted active feeding and healthy weight gain.

Impression procedure is critical in the fabrication of obturator and should be carried out in the presence of a paediatrician in the neonatal intensive care unit. Patient positioning, tray, and impression material selection are important factors to consider. A number of different positions of the infant have been adopted for CLP impression making in infants, including face down, upright, horizontal raised to sitting as the impression sets, and even inverted upside down. Addition poly silicone is the material of choice for making a cleft impression due to its good elastic behaviour, high



Figures: 1. Pre-operative photograph 2. Impression with Putty & Medium Viscosity Elastomer 3. Master Cast 4. Vacuum-formed Feeding Plate with attached Silk Suture thread 5. Try-in of the feeding plate 6. Post-Insertion phtograph

tear strength, accurate reproduction of surface details, and long-term dimensional stability which allows multiple pours [10].

The multidisciplinary approach or teamwork is essential for success in the treatment of those patients. There should be a whole team of experts of various specialities in which the dentist is also involved: phoniatrist, audiologist, speech therapist, psychologist, a social worker [11].

Feeding appliance restores palatal contour and cleft, which helps in creating sufficient negative pressure that allows adequate sucking of milk. It helps the child to compress the nipple easily because it provides a contact point and helps the infant to express milk. It facilitates feeding, reduces nasal regurgitation [12, 13].

5. Conclusion

The Feeding plate overcomes the hindrances which occur during the normal growth and development of a cleft patient and thus should be advised as early as possible after birth. It acts as an important tool for feeding, oral-facial development, development of palatal shelves, prevention of tongue distortion, nasal regurgitation and nasal septum irritation, and avoiding ear infections. It also prevents the expansion of the anterior part of the maxilla, which helps the surgeon provide proper reconstructive treatment.

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Direct composite veneers - restoring esthetics by procuring patient demand: a case report

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ABSTRACT

Restoring a patient's lost dental appearance is one of the most significant subjects for contemporary dentistry. New treatment materials and strategies have been going ahead of the scene, step by step, to accomplish such a point. Most dental specialists lean toward more conservative and aesthetic approaches, such as direct and indirect laminate veneer restorations, instead of full-ceramic crowns for anteriors where aesthetics is extremely significant.

Laminate veneers are restorations which are envisioned to correct existing abnormalities, esthetic deficiencies and discolourations. Laminate veneer restorations might be handled in two distinct ways: direct or indirect. Direct laminate veneers do not need to be prepared in the laboratory. They are based on the principle of application of composite material directly to the prepared tooth surface in the dental clinic. Indirect laminate veneers may be produced from composite materials or ceramics, which are established to the tooth with an adhesive resin. For this situation report, direct composite laminate veneer technique utilized for patients with esthetic issues is portrayed, and half year follow-up is addressed. As an end, direct laminate veneer restorations might be a treatment choice for patients with the esthetic issues of anterior teeth on the off chance that like those reported here.

1. Introduction

Re-establishing a patient's lost natural dental esthetics is among the essential topics of today's dentistry, in addition to function and phonation [1]. Colour, shape, and structural and position abnormalities of anterior teeth might lead to critical esthetic problems for patients [2]. Covering the teeth with dental crowns is the widely preferred technique to take care of the issues aforementioned [3]. However, extreme preparations of teeth and harms to encompassing tissues, for example, gingiva, are a few detriments of crowns. In this manner, as of late, laminate veneer restorations, as a progressively esthetic and conservative treatment alternative, have been utilized in dentistry [4].

Laminate veneers are the type of restorations which are envisioned to correct existing abnormalities, esthetic deficiencies and discolourations [5].

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Laminate veneer restorations might be handled in two distinct ways, such as direct or indirect. Direct laminate veneers are not prepared in the laboratory, and these are based on the principle of application of a composite resin material directly to the prepared tooth surface in the dental clinic. Absence of need for tooth preparation, ease for patients contrasted and backhanded methods and other prosthetic methodologies, reversibility of treatment and no requirement for an extra adhesive cementing system are a few points of interest of this procedure. Intraoral polishing of direct laminate veneers is simple, and any splits or cracks on the restoration might be fixed intraorally. Further, marginal adaptation is superior to anything that of indirect laminate veneer restorations [6,7]. In any case, the primary disadvantages of direct laminate veneers are low resistance to wear, staining and fractures [6]. Indirect laminate veneers with high resistance against wearing down and cracks and stains have a few points of interest contrasted with direct laminate veneer restorations. Be that as it may, long chair time, greater expense and utilization of an adhesive cementing system are the primary detriments of indirect laminate veneer restorations [2,3]. Every new material or method introduced to the field of dentistry aims to achieve esthetics and successful dental treatments with minimal invasiveness [8]. Therefore, direct laminate veneer restorations have been developed for advanced esthetic problems of anterior teeth [2,3,9]. Tooth discolourations, rotated teeth, coronal fractures, congenital or acquired malformations, diastemas, discoloured restorations, palatally positioned teeth, absence of lateral incisors, abrasions and erosions are the main indications for direct laminate veneer restorations[1-3,10].

In this case report, a direct composite laminate veneer technique was used for patient with esthetic problems, is described, and success in six-month follow-ups is discussed.

2. Case report

A 45 years old female patient reported to the department of prosthodontics with a chief complaint of rotation of upper incisors and missing lower anteriors. Examination revealed cross-bite, deep-bite in the maxilla and partially edentulous in relation to 31, 32, 41, 42 (figure 1) with good periodontal status and no radiographic evidence of hard tissue diseases. The temporomandibular jointwas asymptomatic with the non-contributing medical history.

3. Procedure

Supraginigval scaling followed by shade selection with vita classic shade guide was performed. Isolation of the operating area was achieved with the cotton roles as the patient was experiencing gagging with a rubber dam. Mock preparation was done (figure 2). Both central incisors and lateral incisors were minimally prepared with a coarse diamond bur, depth roughly equivalent to half the width of the thickness of the facial enamel ranging from 0.5 mm mid facially tapering down of about 0.2 mm along the incisal edge.

A lite chamfer finish gingival marginal line was given and preparation cleaned with pumice slurry, water-washed and dried. The preparation was etched with 34% phosphoric acid for 30 seconds, rinsed with water and air-dried. A single layer of bonding agent (Te-Econom bond) was applied according to the manufacturer's direction and cured for 10 seconds in a visible light source.

A thin layer of radiopaque hybrid composite A2-Ivoclar Te-Econom plus was incrementally applied to the tooth surface and light-cured for about 40 seconds. Finally finishing, contouring and polishing was done with a super snap mini kit (Shofu) and polishing paste at the end of the procedure (figure 3). Clinical photographs were taken to evaluate the postoperative smile design. The patient was recalled for postoperative evaluation and check-up after one week and after six months. Tooth preparation was done in relation to 33and 43 and prosthesis was given (figures 4 and 5).

4. Discussion

Direct and indirect laminate veneers, as esthetic procedures, have become treatment alternatives for patients with esthetic problems of anterior teeth in recent years [2,5]. In deciding between those two treatment options, the cost, social and time factors have to be considered [2]. Although ceramic laminate veneer restorations have a few favourable circumstances like shading soundness and high resistance against abrasion, they have a few drawbacks, including significant expense and long chair time [2,3] likewise. Also, they have a few issues, for example, need for additional adhesive cement. Also, wrong signs, dental specialist expert coordination issues during conceal harmonization,

Figures: 1. Pre-operative, 2. Mock Preparation, 3. Composite veneering done in relation to 12, 11, 21 and 22, and 4. Teeth Preparation and FPD cementation done in relation to 33-43.

failure to cover the underneath discoloured dental tissue because of the low preparation depth, particularly at the cervical region. Besides, long chair time for fixing simple cracks and straightforward negligence during cementation are as yet significant subjects waiting for solutions. Composite resins right existing lacks, increase the physical properties and are presently increasingly esthetic alternatives rather than laminate veneer applications [1]. Additionally, modern dentistry requires increasingly preservation is the treatment alternatives. In this way, composite laminate veneer restorations, which require insignificant removal of tooth structure, are outstanding amongst other treatment decisions [2,3]. With the preferences, for example, just a single appointment for the entire treatment time, extremely low expenses contrasted and the ceramics and no requirement for long laboratory techniques, direct composite laminate veneers are increasingly well known in the modern dentistry [1]. However, direct composite laminate restorations have still less resistance against abrasions and cracks contrasted and indirect composite laminate veneers and ceramic laminates [2,4]. Moreover, indirect composite laminate veneer restorations due to polymerization outside of the oral cavity, and ceramic laminate veneers due to better colour stability because of being less affected by the fluids of the oral cavity, are superior to direct composite laminate veneers.

5. Conclusion

The most preferred treatment method for anterior teeth with esthetic problems is laminate veneer restorations. However, the condition in which the direct, indirect composite resin and indirect ceramic laminate veneers are chosen is very important for the success of the treatment. The dentist has to decide after a complete review and a correct indication after a proper clinical examination. The dentist should also analyze the patient's socioeconomic status, esthetic expectations, and oral hygiene conditions thoroughly.

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