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Esthetic Conservative Procedures in Dentistry

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

In contemporary society, aesthetics holds significant sway in shaping an individual's identity. The prominence of one's face, especially the mouth and teeth, has intensified the attention given to dental aesthetics. Consequently, dentistry has shifted its focus from solely preventing and treating diseases toward a need-based approach centered on aesthetic enhancement. Presently, a person's smile greatly influences their aesthetic appeal, and any dental affliction jeopardizing it often leads to diminished self-esteem and this significantly affects the overall health, both physically and mentally, of the patient. It's imperative to give importance to maintaining the natural structure of teeth to ensure functional form and integrity in addition to aesthetics.

To gather pertinent information on this subject, a thorough exploration was conducted using PubMed and related reviews. This article aims to delve into both fundamental principles and recent advancements in conservative aesthetic dentistry, highlighting various treatment options for common clinical scenarios. The primary objective is to ensure patients receive optimal care and treatment.

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1. INTRODUCTION

The process of smile enhancement encompasses the assessment of multiple facets such as facial features, dental structure, and gum positioning, all of which are interlinked; any alteration in one aspect can affect the others. Among these considerations, tooth color stands out as a crucial determinant in achieving an aesthetically pleasing smile [1].

In recent years, the utilization of composite resins in cosmetic dental procedures has seen a significant rise, attributed to advancements in adhesive technologies and the development of superior composite resin materials [2].

Botulinum toxin (BTX)-A has emerged as an option for addressing gummy smiles [3], while various non-surgical approaches exist for treating gingival hyperpigmentation, including methods involving ascorbic acid (Vitamin C), phenol, salicylic acid, glycolic acid, trichloroacetic acid, and alcohol. Research has indicated comparable efficacy between Vitamin C mesotherapy and the scalpel technique in reducing gingival hyperpigmentation [4].

Crown lengthening, a widely practiced procedure for enhancing aesthetics, has seen advancements in minimally invasive techniques using electrosurgery and piezoelectric inserts to effectively reposition the gingival margin in a stable and predictable manner [5].

Another non-invasive approach involves the local application of Vitamin C coupled with micro-needling, showing promise in regenerating deficient interdental papilla, commonly known as "black triangle disease." This condition not only causes cosmetic concerns but also contributes to periodontal issues [6].

The modern digital era has brought forth numerous computer software applications specifically tailored for digital smile design (DSD), facilitating simpler diagnosis and enhancing communication with patients. These tools offer minimal invasive techniques for enhancing smiles, integrating seamlessly into clinical practice and research [7].

This article aims to conduct a literature review focusing on various conservative esthetic procedures sought after by patients, emphasizing a conservative approach throughout.

2. HARD TISSUE ESTHETICS

2.1 Bleaching

There are different types of dental bleaching procedures which include [8]

2.1.1 Vital tooth bleaching

2.1.1.1 In-office bleaching: (Fig. 1)

It employs concentrated tooth-whitening agents (25–40% hydrogen peroxide) to achieve its effects [8].

Indications for in-office vital tooth bleaching: [10]

- Discoloration resulting from mild fluorosis and tetracycline stains.
- In cases of severe discoloration, bleaching may be conducted to lighten the tooth shade before employing bonded resin, porcelain veneers, or crowns for restoration.
- To achieve color matching with existing crowns that are lighter than the natural teeth.

Contraindications for in-office vital tooth bleaching: [10]

- Superficial stains removable with rubber cup and prophylaxis paste.
- Teeth with caries or dark-colored resin restorations.
- Hypersensitivity in teeth.
- Children with enlarged pulp chambers.
- Pregnant or lactating individuals.
- Exposed root surfaces.

2.1.1.2 At-home bleaching or night-guard bleaching: (Fig. 2)

This approach utilizes a lower concentration of bleaching agent, for instance, 10% carbamide peroxide applied over 8-hour periods daily, or 15–20% carbamide peroxide applied for 3–4 hours daily, consistently for at least 2 weeks [8].

Indications of at-home night-guard bleaching: [10]

- Surface-level enamel discolorations.
- Slight yellow and brown stains due to fluorosis.
- Discolorations associated with aging.

Contraindications of at-home night-guard bleaching: [10]

- Extensive enamel erosion.
- Teeth overly sensitive to stimuli.
- Teeth grinding or bruxism.
- Occurrence of cavities.
- Faulty or inadequate dental fillings.
- Sensitivity or allergic reaction to bleaching gels.

2.1.1.3 Bleaching with over-the-counter (OTC) products: (Fig. 3)

These products consist of a gentle concentration of leaching agent, typically around 3–6% hydrogen peroxide and are designed for self-application onto the teeth using methods such as gum shields, strips, or topical paint-on solutions. They come in various formats such as dentifrices, pre-fabricated trays, strips, and toothpaste [8].

2.1.2 Non-vital tooth bleaching

2.1.2.1 Walking bleach: (Fig. 4)

This method includes the application of a combination of sodium perborate bleaching agent along with water into the pulp chamber of the concerned tooth. The process is performed periodically with the aim of achieving the desired bleaching results [8].

Indications of walking bleaching: [10]

- Staining within the pulp chamber.
- Discoloration of the dentin.
- Stains that are not responsive to external bleaching techniques.

Contraindications of walking bleaching: [10]

- Surface-level enamel staining.
- Irregular enamel development.
- Extensive loss of dentin.
- Tooth decay or cavities.
- Discoloration in dental composite materials.

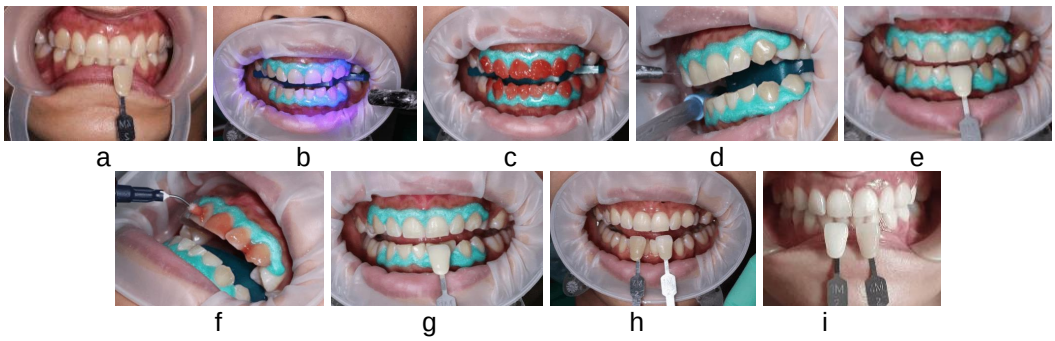

Fig. 1. In-office bleaching procedure involves various steps: (a) Clinical photo before the procedure. (b) Applying a gingival barrier. (c) Administering the bleaching agent. (d) Cleaning the bleaching agent. (e) Assessing the results after the first in-office bleaching cycle. (f) Applying the bleaching agent for the second cycle. (g) Evaluating the results after the second cycle. (h) Comparing the color change before and after treatment. (i) Conducting follow-up evaluations [9]

Fig. 2. At-home or dentist-supervised night-guard bleaching [11]

Fig. 3. Over-the-counter (OTC) bleaching products [10]

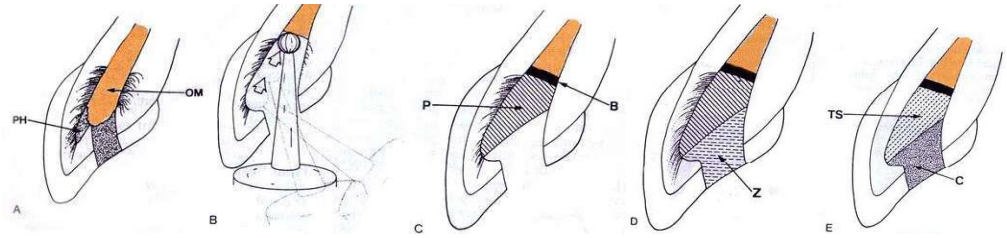

Fig. 4. (a) Dentin internal staining caused by residues of obturating materials (OM) and pulp horn (PH) tissue debris. (b) Complete removal of the coronal restoration. (c) Application of a protective cement base (B) on gutta-percha. Placement of a paste (P) comprising sodium perborate and hydrogen peroxide. (d) Sealing of access using a thick mixture of temporary cement (Z). (e) During a subsequent appointment, once the desired shade is achieved, permanent cement (TS) is applied to the pulp chamber, and composite resin (C) is used to seal the access [10]

2.1.2.2 Modified walking bleach

This method involves a modification wherein a blend of 30% hydrogen peroxide and sodium perborate is enclosed within the pulp chamber for a duration of 1 week, commonly referred to as the modified walking bleaching [8].

2.1.2.3 Non-vital power bleaching

Within this method, a hydrogen peroxide gel in a concentration of 30–35% is introduced into the pulp chamber, then activated through either light exposure or the application of heat, typically maintaining a temperature range of 50°-60°C for a duration of 5 minutes. Afterward, the tooth is given an additional 5 minutes to cool down. Subsequently, the gel is removed, followed by the drying of the tooth, and then the 'walking bleaching method' is applied in intervals until the follow-up after two weeks to assess the need for additional treatment [8].

2.1.2.4 Inside/outside bleaching

This technique integrates the internal bleaching process for non-vital teeth with the home-based bleaching approach [8].

2.2 Resin Infiltration

The resin infiltration technique (Fig. 5) represents an innovative approach that addresses both the prevention and repair of caries within the one-third of dentin i.e. D1, while also effectively concealing aesthetically displeasing white colored lesions present buccally on the tooth surface. This method works by the principle of infusing resin into the porosity on enamel surace through capillary action. Thus, it halts the progression of lesions by sealing off the micropores responsible for facilitating the passage of acids and dissolved substances [12].

Indications of Resin Infiltration: [14]

- Prominent white marks and bands on the tooth.
- Lesions associated with molar incisor hypomineralization (MIH).
- Smooth-surfaced white decalcification on the tooth, often observed post-orthodontic treatment due to plaque stagnation.
- Stains resulting from hypoplasia due to traumatic injuries.
- Mild to moderate instances of fluorosis.

Contraindications of Resin Infiltration: [13].

- Utilizing bitewing images to classify the depth of deeper lesions (D2–D3) based on radiographic lesion depth.
- Within cavitated enamel (enamel imperfections).
- When there are known allergies to specific material components.
- Inadequate oral hygiene practices.
- In instances where the patient is not cooperative.
- Cases involving moderate to severe fluorosis.

2.3 Veneers

A veneer refers to a tooth-colored layer applied to restore esthetic issues, intrinsic discolorations, or localized defects. It acts as a thin protective or aesthetic layer placed over a tooth's surface to enhance its appearance or shield a damaged surface [15].

Porcelain Veneers: These veneers are slender ceramic prosthetics that commonly comprise thin porcelain shells. These shells are prepared by etching the fitted surface with hydrofluoric acid (HF) along with application of a silane coupling agent [17].

Indications for porcelain veneers: According to Magne P., Belser UC. (2002) [17]

- Type I: Teeth resistant to bleaching.
  - Type IA: Tetracycline discoloration
  - Type IB: Teeth that are unresponsive to bleaching
- Type II: Major morphologic modification.
  - Type IIA: Conoid teeth.
  - Type IIB: Diastema or interdental triangles to be closed.
  - Type IIC: Augmentation of incisal length or facial prominence.
- Type III: Extensive restorations.
  - Type IIIA: Extensive coronal fracture.
  - Type IIIB: Extensive loss of enamel by erosion and wear.
  - Type IIIC: Generalized congenital malformations.

Contraindications for porcelain veneers: [18].

- Anterior teeth that have undergone endodontic treatment and are structurally compromised often require the reinforcement offered by full-coverage crowns to uphold their integrity.
- Teeth extensively restored with insufficient enamel may not retain porcelain veneers adequately, as enamel primarily ensures their retention.
- In instances of insufficient posterior dental support, compromised oral hygiene, and existing parafunctional habits like bruxism, the suitability of veneers may be limited.

Varieties of porcelain employed in the fabrication of porcelain veneers: [18].

1. Conventional Powder-slurry Ceramic (Feldspathic Porcelain)
2. Heat-pressed Ceramic/Glass-based Ceramics

They can be further categorized as:

- High Leucite containing glass. Eg. IPS Empress, Optec HSP, Finesse.
- Lithium disilicate glass ceramic. Eg. IPS Empress II and IPS e Max.

3. Machineable (CAD/CAM) Ceramics (e.g. CEREC)

Luting Cements: [19].

The effectiveness of laminate veneers in clinical practice relies significantly on the process of cementing the indirect restorations.

Composite veneers: [20].

Resin-based composites, as restorative materials, typically consist of three primary components: a resin matrix, inorganic filler content, and a coupling agent. The bonding between the resin and filler is facilitated by coupling agents such as salines, with γ-MPTS being a commonly utilized agent in resin composites.

Composite veneers serve as one of the conservative as well as aesthetically pleasing treatment option for the anterior teeth. These are commonly applied using the direct technique, although a modern approach involving the direct-indirect technique is gaining traction.

2.4 Composite Restorative Resin

Composites are a blend of two materials, wherein one—known as the reinforcing phase-that is integrated into the matrix phase [21].

Recent advancements in composites [21]:

Direct Composite Resin:

2.4.1 Condensable or polymeric rigid inorganic matrix material

Typically comprises aluminum oxide, silicon dioxide glass particles, barium aluminum silicate, or strontium glasses. These components are fused to create molten glass, which is then extruded through a die to form slender glass fibers.

2.4.2 Flowable Composites

These composites are designed for injection into a cavity using a syringe with a needle tip. These are traditional composite materials that have undergone a reduction in filler content, dropping from a range of 50–70% to a range of 37–53% by its volume.

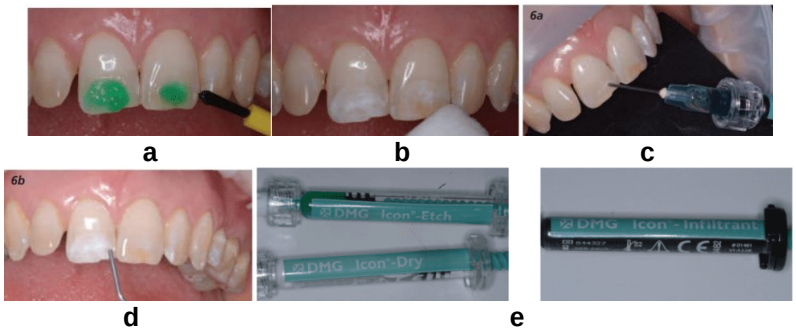

Fig. 5. (a) Directly applying 15% hydrochloric acid gel to the white spots' surface for a duration of 2 minutes. (b) Outcome post-rinsing: The teeth exhibit an etched appearance where the gel was placed, enabling the pores to receive the TEGMA resin. (c) Application of alcohol after the resin is directly applied to the tooth using a specialized applicator. The resin is applied slowly to ensure gentle infiltration. (d) Utilizing syringes with applicators containing Icon etch, followed by an application of Icon dry (alcohol) from DMG. (e) Applying the Icon resin infiltrant [13]

Table 1. The LeSage veneer classification categorizes veneers according to the remaining enamel and the exposed dentin: [16]

Reduction	Facial surface	Enamel residue	Dentin Exposure
CL-I No-Prep or Prep-less veneers	Visible under magnification, ranging from 95-100%, with or without a gingival finish line.	95-100%	0%
CL-II Minimally Invasive or Modified Prep-less veneers	Less than 0.5 mm	80-95%	10-20%
CL-III Conservative veneers prep	0.5-1 mm	50-80%	20-50%
CL-IV Conventional All-Ceramic veneers prep	More than 1 mm	Less than 50%	50%

Enamel surrounding area comprising a minimum of 70%

Table 2. Ceramic Material and Surface Preparation Guidelines [19]

Ceramic material	Surface preparation procedure
Feldspathic	Treatment involves 9.5% hydrofluoric acid for 2-2.5 minutes; followed by a 1-minute rinse; and application of silane.
Leucite-reinforced	Procedure includes 9.5% hydrofluoric acid for 60 seconds; followed by a 1-minute rinse; and application of silane.
Lithium disilicate-reinforced	Process entails 9.5% hydrofluoric acid for 20 seconds; followed by a 1-minute rinse; and application of silane.

2.4.3 Indirect Composite Resin (IRCs)

Restorations created on a die rather than placed directly over the tooth exhibit improved adaptation, proper contour, and contact. In the beginning, early versions of IRCs (Indirect Resin Composites) had a composition akin to direct resin composites used for inlay composites. An extra or secondary curing procedure is applied externally, enhancing conversion and reducing polymerization shrinkage. The second generation of composites utilizes 'microhybrid' fillers, containing double the filler content compared to the organic matrix, consequently minimizing polymerization shrinkage.

2.4.4 Nanocomposites

By harnessing nanotechnology, composite resins employ diminutive filler particles, promoting a stable and authentic connection with the hard mineralized tissues of the tooth.

2.4.5 Antimicrobial Composite

Recent experiments involve incorporating antimicrobial nanoparticles like quaternary ammonium polyethylenimine, Silver, Zinc Oxide, Titania, and Chitosan nanoparticles into composites to imbue them with antimicrobial properties.

2.4.6 Stimuli responsive composite

Known as "smart materials," these composites release fluoride, calcium, and hydroxyl ions depending on the surrounding pH, especially increasing significantly when the pH is below 5.5.

2.4.7 Fiber reinforced composite

Utilizing fibers composed of glass, carbon, polyethylene, and aramid, etc., these fibers can be arranged in various orientations within the resin matrix (e.g., unidirectional, weave type, mesh type) to improve the physical and mechanical properties of composites.

2.4.8 Self-healing composite

This composite system, based on epoxy, contains resin-filled microcapsules that release resin to fill cracks during epoxy resin crazing.

2.4.9 Compomers (Polyacid Modified Resin Composites)

Compomers, a blend of composites and glass ionomer cements, exhibit a dual-setting mechanism. The primary setting reaction involves resinous photopolymerization, while the acid–alkali reaction gains importance after water absorption.

2.5 Crown Lengthening

Clinical crown lengthening involves techniques intended to increase the visible portion of tooth structure above the gum line, typically performed for restorative or aesthetic purposes [22].

The reasons for performing crown lengthening include: [22]

- Addressing restorative requirements.
- Restoring lost clinical crown height due to decay, fractures, or erosion.
- Gaining access to subgingival cavities.
- Creating a 'ferrule' for restoration purposes.
- Reaching a perforation in the root's coronal third.
- Adjusting restoration margins that encroach upon the biological width.
- Aesthetic enhancement.
- Correcting short teeth.
- Balancing uneven gingival contours.
- Resolving a gummy smile.

Contraindications: [22]

- Insufficient crown to root ratio.
- Restoration unfeasible due to caries or root fractures.
- Elevated furcation.
- Limited predictability.
- Inadequate tooth arch relationship.
- Potential compromise to adjacent periodontal structures or aesthetics.
- Lack of adequate restorative space.
- Unachievable maintainability.

Recent Advances in Crown Lengthening Procedures:

2.5.1 By piezo surgery: (Fig. 6)

Piezosurgery involves the use of controlled electrically induced vibrations to precisely cut hard tissues, minimizing or preventing damage to surrounding soft tissues [23].

2.5.2 By Lasers: (Fig. 7)

Upon exposure to a laser beam, tissue experiences a temperature range from

approximately 37˚-60˚C for warming, 70˚-900˚C for welding, 100˚-150˚C for vaporization, and around 200˚C for carbonization. The swift cell vaporization causes the discharge of intracellular fluid, chemical mediators, and protein denaturation, resulting in a localized inflammatory reaction that is relatively less severe, thereby reducing both pain and swelling [24]. This rapid vaporization of cells leads to the release of intracellular fluid, chemical mediators, and denaturation of proteins, resulting in a localized inflammatory response that is comparatively less intense, leading to reduced pain and edema [24].

2.5.3 Orthodontic extrusion: [25]

- Low orthodontic force: Gradual tooth extrusion allows for the slow movement of the tooth, simultaneously affecting the alveolar bone and gingiva. Once the tooth reaches the desired position, surgical intervention is utilized to rectify the alveolar bone and gingiva levels.
- Rapid orthodontic extrusion: Supercrestal fibrotomy is performed on a weekly basis to impede tissue and bone effects. This approach obviates the necessity for osseous reduction, enabling straightforward excision for the removal of soft tissue **(Fig. 8)**.

2.5.4 Periotome extrusion (Fig. 9)

This approach provides an alternative tactic to periodontal surgeries that entail extrusion of teeth orthodontically and reshaping of bone structure. It notably averts the development of functional or aesthetic abnormalities, specifically within the aesthetic anterior region [27].

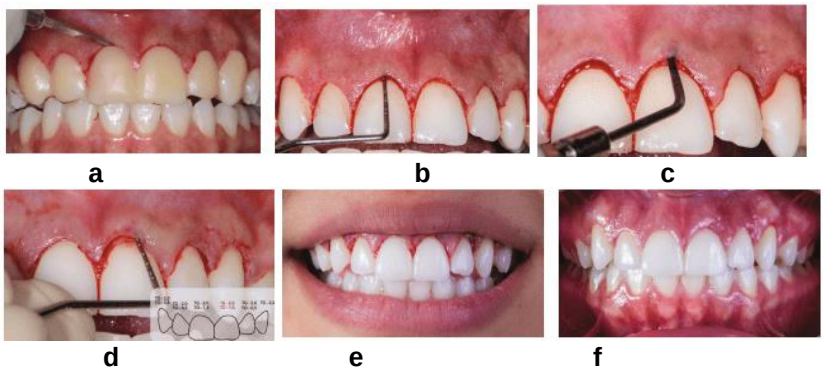

Fig. 6. (a) Initial incision guided by mockup for elimination of gingival tissue. (b) Upon examining with a probe, confirmation of the 1mm distance between the gingival margin to the upper most part of the bone crest, indicating the necessity for osteotomy. (c) Utilization of piezoelectric ultrasound for osteotomy without flap elevation, ensuring no interference with interdental papillae. (d) Eliminating 1mm of bone to reinstate the biological width. (e) Immediate postoperative phase. (f) Follow-up after 6 months displaying the fully healed periodontal tissue [23]

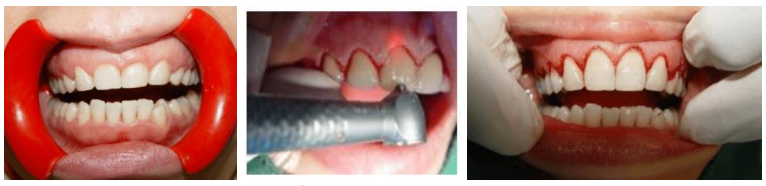

Fig. 7. (a) Clinical photograph before the procedure. (b) Crown lengthening procedure conducted on teeth 11, 12, 13, 14 & 21, 22, 23, 24. (c) Photograph after completion of procedure [24]

Fig. 8. Rapid orthodontic extrusion by supercrestal fibrotomy [26]

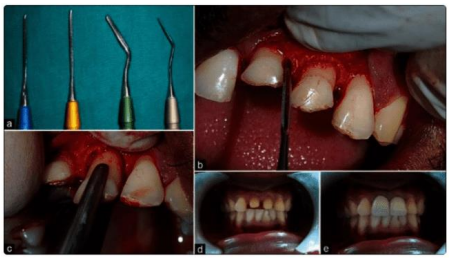

Fig. 9. (a) Instruments used for periotomy. (b) Disruption of the periodontal ligament occurs by placing the periotome within the space occupied by the ligament. (c) Utilizing tissue forceps to extrude the tooth to the intended length. (d) View of the area 3 months post-operation. (e) Follow up after 6 months of the prosthesis placement [27]

3. SOFT TISSUE ESTHETICS

3.1 Gingival (Pink) Esthetics

Conservative treatment approaches for pink esthetics:

3.1.1 Gingival recession

- Gingival veneers **(Fig. 10)**
- Gingival/ Pink colored composites **(Fig. 11)** [29].

3.1.2 Gingival hyperpigmentation

Gingival hyperpigmentation refers to an abnormal darkening of the gums beyond the usual color spectrum. This condition arises from heightened melanin production and discharge by melanocytes found in both the basal and suprabasal layers of the epithelium [4].

3.1.3 Excessive gingival display (Gummy smile)

A typical smile typically reveals 1 to 2 mm of the gums, which is considered within the normal range. However, an excessive display of the gingiva, often referred to as a 'gummy smile,' occurs when there is an overexposure of the upper gum line (maxillary gingiva) during smiling [26].

3.1.4 Gingival interdental papilla defects (Fig. 12)

When the interdental papilla is lost, it can result in the creation of a black triangle, leading to issues such as food impaction and the buildup of plaque. Various treatment choices are available for addressing gingival black triangles, encompassing orthodontic or restorative approaches, along with periodontal surgical interventions [31].

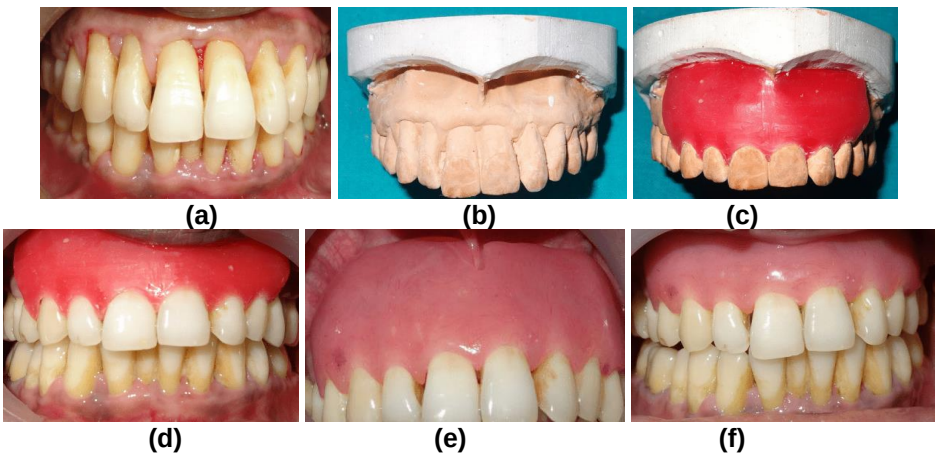

Fig. 10. (a) Photograph after scaling and root planning. (b) Upper cast of the maxillary area. (c) Veneer wax pattern fashioned on the cast. (d) Trial of the acrylic wax pattern. (e) Frenum relief within the acrylic veneer. (f) Gingival veneer displaying favorable adaptation on the teeth and enhanced aesthetics [28]

Table 3. Indications and contraindications for the use of gingival veneers [28]

Indications	Contraindications
Poor aesthetics with interdental "black triangles," exposed root surfaces	Poor oral hygiene
Food packing in interdental spaces	Limited manual dexterity
Lack of saliva control	High caries activity/risk
Impaired speech	Incomplete periodontal therapy
Interference with lip and tongue	Uncontrolled periodontal disease
Loss of lip support	Individuals with a prominent labial frenulum
Root-dentine sensitivity	Allergy to fabrication materials

a b

Fig. 11. (a) Display of an open gingival embrasure between upper and lower teeth. (b) Application of pink gingival composite surrounding teeth numbered 16, 15, 14, 13, 12, 11, 21, 22, 23, and 24 [29]

Table 4. Various methods are available for gingival depigmentation, including both surgical and nonsurgical approaches [4]

Surgical techniques	Nonsurgical techniques (peeling of gingiva)
Scalpel technique	Ascorbic acid i.e. Vitamin C
Electrosurgery	Phenol
Lasers	Salicylic acid
Gingival abrasion/ surgical stripping	Glycolic acid
Cryosurgery	Trichloroacetic acid
Concealment using free gingival autografts or acellular dermal matrix allografts	Alcohol

Table 5. Several techniques are available for addressing excessive gingival display [30]

Non-surgical procedures	Surgical procedures
Botulinum toxin type A injection	Lip repositioning
Orthodontics	Orthognathic surgery following orthodontics
Lip training exercises in deficient lip length	Esthetic crown lengthening

(a) (b) (c) (d)

Fig. 12. (a) (a) Initial view displaying recession of inter-dental papilla between teeth 11 and 21 (b) Administered hyaluronic acid filler injection (c) Follow-up view illustrating regeneration of papilla in 11 and 21 after 3 months (d) Follow up after 6 months [31]

Table 6. Coachman et al. (2017) [33] proposed the evolution in generations of DSD as

Generation	Advancement
Generation 1	Analogue drawing over images and no link to the analogue mock up
Generation 2	Digital 2D drawing and visual link to the analogue mock up
Generation 3	Digital 2D drawing and analogue link to the mock up
Generation 4	Digital 2D drawing and digital link to the 3D mock up
Generation 5	Complete 3D workflow
Generation 6	The 4D concept

4. DIGITAL SMILE DESIGN (DSD)

The Digital Smile Design (DSD) serves as a technological instrument utilized for digitally designing and altering patients' smiles. It aids in providing patients with a preview of their prospective smile by generating and presenting a digital mock-up before the commencement of physical treatment [32].

A variety of commercially accessible DSD software options comprise: [33]

- CEREC Smile Design (SIRONA)
- Digital Smile System (DSS)
- Smile Design Pro (TASTY TECH)
- G Design (HACK DENTAL)
- Romexis Smile Design (PLANMECA)
- Smile Composer (3 SHAPE)

Limitations: [33]

- Expensive equipment and software.
- DSD has lot of advantages but handling and training for few software are time consuming and costly.
- The diagnosis and treatment plan entirely depends on photographic and video documentation therefore even a minor inadequacy may result in incorrect diagnosis and planning [34].

5. CONCLUSION

A person's smile, showcasing beautiful teeth, is considered one of their most valuable features. Addressing dental issues can result in significant transformations in appearance, often leading to enhanced confidence, personality, and social interactions.

Presently, there is a significant emphasis on aesthetics while aiming to preserve the healthy tooth structure as much as possible. The focus lies in restoring the shape, size, and function of a damaged or infected tooth, all while prioritizing patient comfort. Advances in dental tools, methodologies, and materials enable the use of adhesive restorations, reducing the necessity for extensive preparations.

While a grasp of fundamental artistic principles is crucial for successful placement of aesthetic restorations, it's equally important to address specific clinical considerations to ensure the overall quality of the restoration.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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