

Review Article

Esthetic Conservative Procedures in dentistry

ABSTRACT

In this modern era, esthetics plays an important role to define someone's character. Since the face is the most exposed part of the body and the mouth is a prominent feature, teeth are getting a greater share of attention nowadays. Thus, the focus of dentistry primarily on the prevention and treatment of the disease has shifted towards need-based dentistry for esthetic purposes.

Currently, the smile has a great impact on the esthetics of the patient and if it is destroyed by any dental disease, often leads to loss of self-esteem and damage to the overall physical and mental health of the patient. But long with esthetics, it is always important to conserve the tooth structure as much as possible to maintain the functional form and integrity of the natural dentition.

PubMed online research was conducted in order to identify articles regarding this subject and related reviews were performed as well for completing the research necessary in writing this review.

This review article focuses on the basic as well as the recent advances in the field of esthetic conservative dentistry particularly by discussing about the different treatment options for some common clinical situations. So that the patients should receive the best possible care.

Keywords: esthetics, conservative, dentistry, digital smile design, veneers.

1. INTRODUCTION

Smile design should involve the evaluation of certain elements like facial, dento-facial, dento-labial, dento-gingival, and dental analysis changing one will have an impact on all the others. There are also various other factors that affect the patient's esthetics, out of which the most critical aspect of an aesthetically pleasing smile is tooth color[1].

During the past decades, the use of composite resins for esthetic restorative procedures has increased owing to improvements in adhesive systems and composite resin materials[2].

There is also the use of Botulinum toxin (BTX)- A for correcting the gummy smiles[3] with several nonsurgical methods for gingival hyperpigmentation like ascorbic acid (Vitamin C), phenols, salicylic acid, glycolic acid, trichloroacetic acid, alcohol and concluded that Vitamin C mesotherapy and scalpel technique showed comparable results in the reduction of gingival hyperpigmentation[4].

Crown lengthening is one of the most common procedures for esthetic purposes and the minimal invasive crown lengthening technique with electrosurgery and a piezoelectric insert effectively reposition the gingival margin in a stable and stable and predictable manner[5].

Another non-invasive method using locally delivered Vitamin C along with micro-needling has a remarkable regenerative potential for deficient interdental papilla known as "black triangle disease" which not only causes cosmetic deformities but also leads to periodontal problems[6].

In recent years and in the new era of digitalization, several computer software programs for digital smile design (DSD) have been introduced to clinical practice and research which is

minimal invasive technique for easy diagnosis and improves communication with the patient[7].

The aim of this article is to review literature to evaluate different types of esthetic conservative procedures commonly pursued by patients performed with a conservative approach.

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 utilizes a high concentration of tooth-whitening agents (25–40% hydrogen peroxide)[8].

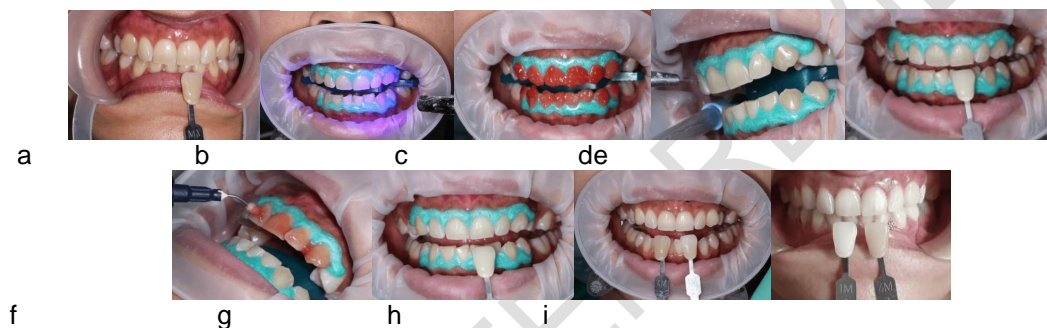


Fig. 1. In-office bleaching (a) Clinical photo pre-operative. (b) Application of the gingival barrier. (c) Application of bleaching agent. (d) Cleaning bleaching agent. (e) Evaluation of in-office bleaching cycle 1. (f) Application of bleaching agent cycle 2. (g) Evaluation of in-office bleaching cycle 2. (h) Evaluation of color before-after treatment. (i) Follow-up evaluation[9].

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

- Discolored teeth due to mild fluorosis & tetracycline stains.
- In severe discolorations, bleaching could be performed to lighten the tooth color before restoration with bonded resin or porcelain veneers or crowns.
- In order to match the existing color of crown that is lighter than natural teeth.

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

- Superficial stains that can be removed with rubber cup and prophylaxis paste.
- Carious tooth structure or dark-colored resin restoration.
- Hypersensitive teeth.
- Children with the large pulp chamber.
- Pregnant and lactating women.
- Exposed root surfaces.

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

It involves the use of a low concentration of whitening agent i.e. 10% carbamide peroxide be used 8 h per day, and the 15–20% carbamide peroxide 3–4 h per day for at least 2 weeks[8].



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

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

- Superficial enamel discolorations.
- Mild yellow and Brown fluorosis discolorations.
- Age-related discolorations.

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

- Severe enamel loss.
- Hypersensitive teeth.
- Bruxism.
- Presence of caries.
- Defective coronal restorations.
- Allergy to bleaching gels.

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

These are composed of a low concentration of whitening agent (3–6% hydrogen peroxide) and are self-applied to the teeth via gum shields, strips, or paint-on product formats, whitening dentifrices, pre-fabricated trays, whitening strips, and toothpaste[8].



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

2.1.2 Non-vital tooth bleaching;

2.1.2.1 Walking bleach:(Fig. 4)

It involves sealing a mixture of sodium perborate with water into the pulp chamber of the affected tooth, a procedure that is repeated at intervals until the desired bleaching result is achieved[8].

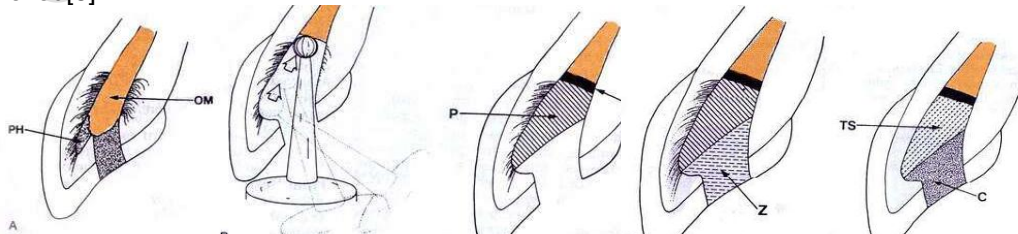


Fig. 4. (a) Internal staining of dentin due to remnants of obturating materials (OM) and tissue debris in pulp horns (PH). (b) Coronal restoration removed completely. (c)

Protective cement base (B) placed over gutta-percha. Paste (P) of sodium perborate and hydrogen peroxide placed. (d) Thick mix of temporary cement (Z) seals access. (e) at a subsequent appointment when the desired shade reached, permanent cement is placed (TS) at pulp chamber and composite resin (C) to seal the access[10].

Indications of walking bleaching:[10]

- Discoloration of the pulp chamber.
- Dentin discoloration.
- Discolorations not amenable to extra coronal bleaching.

Contraindications of walking bleaching:[10]

- Superficial enamel discoloration.
- Defective enamel formation.
- Severe dentin loss.
- Presence of caries.
- Discolored composites.

2.1.2.2 Modified walking bleach:

This technique is modified with a combination of 30% of hydrogen peroxide and sodium perborate sealed into the pulp chamber for one week, known as modified walking bleach[8].

2.1.2.3 Non-vital power bleaching:

In this technique, hydrogen peroxide gel (30–35%) is placed in the pulp chamber and activated either by light or heat and the temperature is usually between 50 and 60 °C maintained for five minutes before the tooth is allowed to cool for a further 5 min. Then, the gel is removed, the tooth is dried, and the 'walking bleach technique' is used between visits until the tooth is reviewed 2 weeks later to assess if further treatment is needed[8].

2.1.2.4 Inside/outside bleaching:

It is a combination of internal bleaching of non-vital teeth with the home bleaching technique[8].

2.2 RESIN INFILTRATION

The resin infiltration technique (**Fig. 5**) is a novel technology that bridges the gap between the prevention and restoration of carious lesions up to the first third of dentin (D-1) and can camouflage aesthetically disfiguring white lesions on the buccal surface. The principle of resin infiltration is to perfuse the porous enamel with resin by capillary action, thereby arresting lesion progression by occluding the microporosities that provide diffusion pathways for the acids and dissolved materials[12].

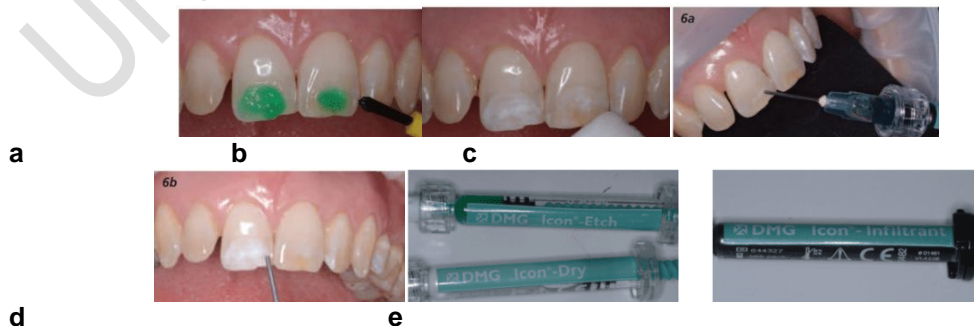


Fig. 5. (a) The direct application of 15% hydrochloric acid gel onto the surface of the white spots for 2 minutes. (b) Result after rinsing. The etched appearance on teeth

shows where gel was placed. This process opens the pores to receive the TEGMA resin. (c) After application of alcohol. The direct application of resin onto the tooth using a special applicator. This is applied slowly to let the resin infiltrate gently. (d) The syringes with applicators of Icon etch. This is followed by an Icon dry (alcohol) from DMG. (e) The Icon resin infiltrant[13].

Indications of Resin Infiltration:[14]

- Larger white marks and bands on the tooth.
- Lesions due to molar incisor hypoplasia (MIH).
- Smooth surface white decalcification on the tooth such as after stasis of plaque after orthodontic treatment.
- Hypoplasia stains due to traumatic injuries.
- Mild to moderate fluorosis.

Contraindications of Resin Infiltration:[13]

- For deeper seated lesions (D2–D3) Radiographic lesion depth classification according to bitewing images.
- On cavitated enamel (enamel defects).
- In case of known allergies to any material component.
- The patient has terrible oral hygiene habits.
- If the patient uncooperative.
- Moderate to severe fluorosis.

2.3 VENEERS

A veneer is a layer of tooth colored material that is applied to a tooth for esthetically restoring localized or generalized defects or intrinsic discolorations or it is a thin layer of restorative material placed over a tooth surface, either to improve the aesthetics of a tooth, or to protect a damaged tooth surface[15].

Table 1. Basis for LeSage veneer classification system enamel remaining and dentin exposed:[16]

Reduction	Facial	Enamel remaining	Dentin Exposed
CL-I No-Prep or Practically Prep-less	Detectable with magnification, 95% to 100% with or without gingival finish line	95% to 100%	0%
CL-II Modified Prep-less or Minimally Invasive	up to 0.5 mm	80% to 95%	10% to 20%
CL-III Conservative Design	0.5 mm to 1 mm	50% to 80%	20% to 50%
CL-IV Conventional All-Ceramic Design	1+ mm	<50%	50%

Enamel periphery of at least 70%

Porcelain Veneers:

Porcelain veneers are thin-bonded ceramic prosthetics that typically consist of thin shells of porcelain, the fitted surface of which has been etched with hydrofluoric acid and coated with 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]

- Endodontically-treated anterior teeth that are structurally compromised, as they need the bracing provided by full-coverage crowns to maintain their integrity.
- Heavily-restored teeth with inadequate enamel, as enamel is the main source of retention for porcelain veneers.
- Dentition lacking posterior support, poor oral hygiene and existing parafunctional activity, such as bruxism.

Types of porcelain used for porcelain veneer fabrication:[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 clinical success of laminate veneers depends on the cementation of the indirect restorations.

Table 2. Ceramic composition and surface treatment protocols[19]

Ceramic	Conditioning
Feldspathic	9.5% hydrofluoric acid for 2-2.5 min; 1 min washing; silane application
Leucite-reinforced	9.5% hydrofluoric acid for 60 s; 1 min washing; silane application
Lithium disilicate-reinforced	9.5% hydrofluoric acid for 20 s; 1 min washing; silane application

Composite veneers: [20]

Resin-based composites are restorative materials that have mainly the following three compositions: Resin matrix, Inorganic filler and Coupling agent.

The bonding between the resin and the filler is achieved by the use of coupling agents i.e. silanes, the most commonly one that is used in resin composite is γ -MPTS.

Composite veneers have been used as a conservative and esthetic treatment option for anterior teeth. They are generally performed by direct technique, but nowadays direct-indirect technique is also used.

2.4 COMPOSITE RESTORATIVE RESIN

Composites are mixture of two materials in which one of the materials, called reinforcing phase, are embedded in the matrix phase [21].

Recent advancements in composites[21]:

Direct Composite Resin:

2.4.1 Condensable/packable or polymeric rigid inorganic matrix material:

This mainly consists of aluminum oxide and silicon dioxide glass particles or barium aluminum silicate or strontium glasses. The glass particles are liquefied to form a molten glass which is forced through a die to form thin strands of glass fibers.

2.4.2 Flowable Composites:

These composites to be syringed into a cavity preparation with a needle tip. These composites are the conventional composites with the decreased filler loading from 50–70% (volume) to 37–53% (volume).

2.4.3 Indirect Composite Resin (IRCs):

The restoration is made on a die rather than directly on the tooth, the restoration has superior adaptation, contour and proximal contact. The first-generation IRCs had a composition identical to direct resin composite for inlay composites, an additional or secondary cure is given extraoral, which improves the degree of conversion and also reduces the side effects of polymerization shrinkage. The second-generation composites having “microhybrid” filler with a diameter of 0.04-1 μ , which has filler content twice that of the organic matrix thus reduce the polymerization shrinkage.

2.4.4 Nanocomposites:

Nanotechnology may provide composite resins with a dramatically smaller filler particle size that provide a more stable and natural interface between the material and mineralized hard tissues of the tooth.

2.4.5 Antimicrobial Composite:

Recently, antimicrobial nanoparticles such as quaternary ammonium polyethylenimine, Silver, Zinc Oxide, Titania and Chitosan nanoparticles were experimented with composites to impart antimicrobial characteristics.

2.4.6 Stimuli responsive composite:

These are also called “smart materials”. These composite materials release fluoride, calcium, and hydroxyl ions into the surroundings of the filling depending on the pH. These materials release, especially when the pH is less than 5.5, a significant number of ions than that at the neutral pH.

2.4.7 Fiber Reinforced Composite:

Glass fibers, carbon fibers polyethylene fibers, aramid fibers, etc., are the fibers that can be oriented in different directions; unidirectional, weave type, mesh type, etc., in the resin matrix to improve the physical and mechanical properties of composites.

2.4.8 Self-healing composite:

The self-healing or repairing composite is an epoxy-based system that contains resin-filled microcapsules that release the resin to fill the cracks when the epoxy resin undergoes crazing.

2.4.9 Compomers (Polyacid Modified Resin Composites):

Compomers refer to polyacid-modified resin composites, a combination of composites and glass ionomer cements (polyalkenoate acid and glass components). Compomers have a dual-setting mechanism, of which the dominant setting reaction is the resinous photopolymerization, but the acid-alkali reaction also plays an important role after the material absorbs water.

2.5 CROWN LENGTHENING

Clinical crown lengthening refers to procedures designed to increase the extent of supragingival tooth structure for restorative or esthetic purposes [22].

The indications for crown lengthening are: [22]

- Restorative needs.
- To increase clinical crown height lost due to caries, fracture or wear.
- To access subgingival caries.
- To produce a “ferrule” for restoration.
- To access a perforation in the coronal third of the root.
- To relocate margins of restorations that are impinging on biological width.
- Aesthetics.
- Short teeth.
- Uneven gingival contour
- Gummy smile.

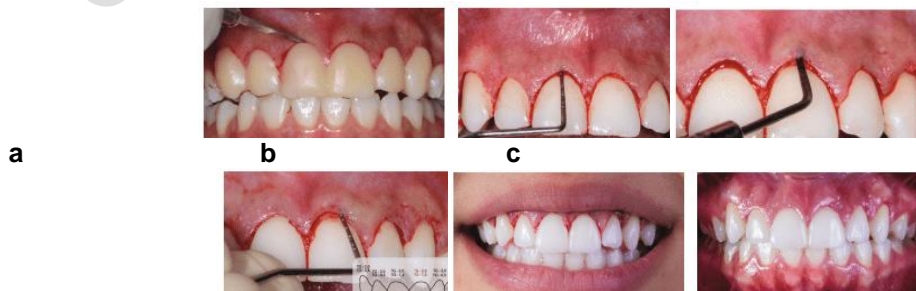
Contra-indications & Limiting Factors: [22]

- Inadequate crown to root ratio.
- Non restorability of caries or root fracture.
- High furcation.
- Inadequate predictability.
- Tooth arch relationship inadequacy.
- Compromise adjacent periodontium or esthetics.
- Insufficient restorative space.
- No maintainability.

Recent Advances in Crown Lengthening Procedures:

2.5.1 By Piezo Surgery:(Fig. 6)

Piezosurgery comprises of directed electrically generated vibrations, providing precise cutting of hard tissues at a controlled rate with no/minimal soft tissue damage [23].



d e f
Fig. 6. (a) Initial incision with mockup used as guide for gingival tissue removal. (b) During probing, the distance from gingival margin to top of bone crest (1mm) was verified, which mean osteotomy was necessary. (c) Osteotomy was performed with piezoelectric ultrasound without flap elevation and without interference in interdental papillae. (d) Remove 1mm of bone tissue to restore the biological space. (e) Immediate postoperative. (f) 6 months after the surgical procedure showing the completely healed periodontal tissue [23].

2.5.2By Lasers:(Fig. 7)

Initially when heat is applied on tissue by laser beam, tissue is subjected to warming 37°-60°C, welding 70°-900°C, vaporization 100°-150°C and carbonization 200°C. Rapid cell vaporization with loss of intracellular fluid, chemical mediators and denaturation of intracellular substance and protein results in less intense local inflammatory response also less pain and edema [24].



a b c
Fig. 7. Procedure of crown lengthening by using Lasers (a) Preoperative View. (b) Crown Lengthening (CL) of teeth 11, 12, 13, 14 & 21, 22, 23, 24. (c) Postoperative View [24].

2.5.3Orthodontic extrusion:[25]

- Low orthodontic force- The tooth can be extruded slowly, bringing the alveolar bone and gingival tissue with it. The tooth is stabilized in this new position and then is treated with surgery to correct the bone and gingival tissue levels.
- Rapid orthodontic extrusion- A supercrestalfibrotomy is performed weekly in an effort to prevent the tissue and bone. There is no need for osseous reduction and the soft tissue may be removed by simple excision (**Fig. 8**).



Fig. 8. Rapid orthodontic extrusion by supercrestalfibrotomy[26]

2.5.4Periotome extrusion(Fig. 9):

The technique is an alternative approach to the periodontal surgical procedures consisting orthodontic extrusion and osseous recontouring. It does not result in functional or esthetic deformities especially in the anterior esthetic zone [27].



Fig. 9. (a) Set of periotome instruments, (b) Severing the periodontal ligament by placing the periotome in PDL space, (c) Tooth is extruded by tissue forceps to the desired length, (d) 3 months post-operative view, (e) 6 months post-operative view with prosthesis[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)

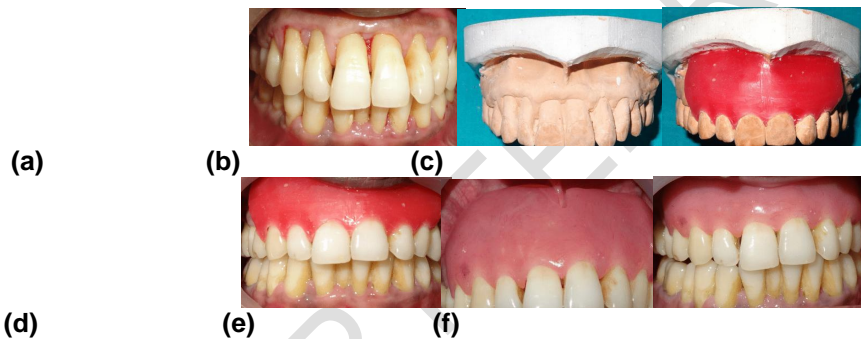


Fig. 10. (a) Photograph after scaling and root planning (b) Maxillary cast (c) Wax pattern of veneer prepared on the cast (d) Acrylic wax pattern try-in (e) Frenum relief in the acrylic veneer (f) Gingival veneer showing good adaptation on teeth and improved aesthetics [28].

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

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



a

b

Fig. 11. (a) Patient with open gingival embrasure between maxillary and mandible teeth (b) Pink gingival composite around teeth (16, 15, 14, 13, 12, 11, 21, 22, 23, and 24) [29].

3.1.2 Gingival hyperpigmentation:

Table 4. :Different techniques for gingival depigmentation, i.e. surgical and nonsurgical [4]

Surgical techniques	Nonsurgical techniques (gingival peeling techniques)
Scalpel technique	Use of ascorbic acid (Vitamin C)
Electrosurgery	Phenols
Lasers	Salicylic acid
Gingival abrasion/ surgical stripping	Glycolic acid
Cryosurgery	Trichloroacetic acid
Masking by free gingival autografts and acellular dermal matrix allografts	Alcohol

3.1.3 Excessive gingival display (Gummy smile):

Table 5. :Excessive gingival display can be managed by a variety of procedures [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

3.1.4 Gingival Interdental Papilla Defects(Fig. 12):

Loss of the interdental papilla will lead to the formation of a black triangle, which also contributes to food impaction and plaque accumulation. There are currently many treatment options for the gingival black triangle, including orthodontic or restorative intervention and periodontal surgery [31].



(a) (b) (c) (d)
Fig. 12. (a) Preoperative view of papillary recession between 11 and 21 (b) Injection of hyaluronic acid filler was given (c) Postoperative view of papillary regeneration between 11 and 21 at 3 months (d) Six months postoperative view [31].

4. DIGITAL SMILE DESIGN (DSD)

DSD is a technical tool which is used to design and modify the smile of patients digitally and help them to visualize it beforehand by creating and presenting a digital mock-up of their new smile design before the treatment physically starts [32].

Table 6: Coachman et al. (2017) [32] 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

Some of the commercially available DSD software include: [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.

5. CONCLUSION

One of the greatest assets a person can have been a smile that shows beautiful teeth. Correction of dental problems can produce dramatic changes in appearance, which often result in improved confidence, personality, and social life.

Nowadays the main concern is esthetics as well as to conserve as much of the original, healthy tooth structure as possible, while restoring the shape, size, and function of a damaged or infected tooth with lack of discomfort to patients. This is made possible through

the use of new dental instruments, techniques, and materials that allow for adhesive restorations and eliminate need for extensive preparations.

Although an understanding of basic artistic elements is imperative to successfully placing esthetic restorations, certain clinical considerations must be addressed concomitantly to ensure the overall quality of the restoration.

CONSENT

Not applicable.

ETHICAL APPROVAL

Not applicable.

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