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Introduction :

Cosmetic dentistry has occupied the major branch of dentistry recently because of the wide spread of the top stories and the advertisement throughout the media worldwide. Consequently, children, adolescents and their parents has become more concerned about esthetic problems and ask for solutions for major as well as minor esthetic concerns.

It is essential that health care providers understand how dental health and appearance fit into the larger picture of overall health and wellbeing. Yet, to our knowledge, there are no data on the psychosocial influence of severe hereditary dental defects. [Coffield et al.,2005] Coffield et al 2005 undertook a potentially innovative study to provide information regarding the importance of teeth and oral esthetics in normal psychosocial development and in amelogenesis imperfecta patients. The results indicated that having AI has a marked impact on the psychosocial health of affected people comparable with the impact of systemic health conditions, especially at younger ages.[Coffield et al., 2005] There is another study shows that younger children are significantly more critical to their teeth shade than older children. [Shulman et al.,2004]

There are many reasons which indicates esthetic solutions in children and adolescents. such as developmental defects including MIH, flourosis, tetracylcin staining, enamel defects because of infected or traumatized related primary tooth. Fractured incisors due to trauma or discoloration due to loss of vitality are also common causes for esthetic problem in younger ages.

With treatments ranging from bleaching to microabrasion to porcelain veneers and lumineers, a healthy, attractive smile, well valued in our society is reachable nowadays .

Tooth discoloration:

Teeth are made up of many colors, with a natural gradation from the darker gingival third to the lighter incisal third of the tooth. Typically, canine teeth are naturally darker than central and lateral incisors and teeth become darker with age, whereas lighter teeth are common in younger people, especially in the primary dentition.

Table 1. Colours produced by various causes of tooth discolouration Sulieman 2008

Colour produced	Types of discolouration
	Extrinsic (direct stains)
Brown to black	Tea, coffee and other foods
Yellow⁄brown to black	Cigarettes⁄cigars
Yellow⁄brown	Plaque⁄poor oral hygiene
	Extrinsic (indirect stains)
Black and brown	Polyvalent metal salts and Cationic antiseptics (e.g. chlorhexidine)
	Intrinsic
	Metabolic causes
Purple⁄brown	(e.g. congenital erythropoietic porphyria)
Brown or black	**Inherited causes** (e.g. amelo⁄
Banding appearance	dentinogenisis)
	Iatrogenic causes
Classically yellow, brown, blue, black or grey	Tetracycline
White, yellow, grey or black	Fluorosis
Brown	**Traumatic causes**
Grey black	Enamel hypoplasia
Pink spot	Pulpal haemorrhage products
Yellow	Root resorption
	Ageing causes
	Internalized
Orange to brown	Caries
Brown, grey, black	Restorations

Munther sulieman 2008, has classified the tooth discolorations as extrinsic "direct", extrinsic "indirect", and intrinsic discolorations as in the adjacent table.

Extrinsic "direct" Stains are defined as direct staining by compounds incorporated into the pellicle layer and producing a stain as a result of the basic color of the chromogens. It is the polyphenolic compounds found in food that are thought to give rise to the color of the stain.

Extrinsic "indirect" stains where there is chemical interaction at the tooth surface with another compound that produces the stain.

Interestingly, chromogenic bacteria have also been implicated in extrinsic staining in children who have poor oral hygiene (causing green and orange stains) and in those who have good oral hygiene (causing black–brown stains) but the mechanism involved has not been established. [12]

Both extrinsic direct and indirect stains are removed by gentle prophylaxis, and do not need further treatment unless the teeth affected have acquired or developmental dental defects.[Tredwin et al.,2005] The developmental defects will make the take up of extrinsic stains more apparent and deeper in the porous affected enamel. While acquired defects result from tooth wear (e.g erosion) will make the enamel layer thinner; this will lead to darker yellowish appearance of teeth. Another acquired defects from dental caries and restorations can result in variable degrees of discoloration that some time need surgical intervention and excavation of affected dental tissue. [Suleiman 2008]

Intrinsic discoloration of teeth occurs following a change to the structural composition or thickness of the dentinal hard tissues during tooth development. [Suleiman 2008]

Some metabolic diseases can cause intrinsic teeth discoloration; alkaptonuria is an inborn error of metabolism that results in a brown discoloration of the permanent dentition.[Suleiman 2008]

Congenital erythropoietic porphyria, a rare, recessive, autosomal metabolic disorder, gives a red-purple-brown discoloration of teeth. The clinical condition is due more to the accumulation of uroporphyrinogen and its derivatives in the feces, urine, erythrocytes. hone marrow, teeth, and skin. [Fayle et al., 1994]

A case report presented by Fayle et al 1994 reported a 4 years old child with this disease. The oral manifestations of this child included; all teeth exhibited varying degrees of discoloration, the maxillary and mandibular incisors had a deep yellow-brown discoloration that was most marked cervically but gradually reduced in severity toward the incisal edge. The canines and molars exhibited a different, more reddish discoloration, again reduced toward the occlusal surface of the tooth.

Hyperbilirubinemia is another metabolic disease that causes intrinsic teeth discoloration; in this condition excess levels of the bilirubin are released into the blood in a number of conditions. Teeth developing during periods of hyperbilirubinemia may have blue-green discoloration of teeth, although some times might be brownish. Interestingly this discoloration is gradually reduced, the fadingis most noticeable in anterior teeth. [McDonald's textbook, 8th edition]

Teeth discoloration in Cystic Fibrosis patients is reported in literature [Landon et al., 1987]. Zegarelli et al. 1967 have suggested that this discoloration could be as result of the disease it self, the accompanying drugs the patient take (specially tetracycline), or due to both factors together.

Inherited disorders can affect either enamel "amelogenesis imperfecta AI" or dentin "dentinogenesis imperfecta DI" are causes of teeth discoloration in variable degrees. In AI the color of the teeth is presumed to reflect the degree of hypomineralization of the enamel: the darker the color the more severe the degree of hypomineralization. In DI the appearance is an amber, grey to purple/blue discoloration or opalescence, thought to be a result of the absorption of chromogens into the porous dentine after exposure of the dentine. This condition is clearly demonstrated by opalescence on transillumination. [Suleiman, 2008]

Traumatic injuries are very common reasons for discoloration of teeth in many ways; it can be due to accumulation of hematin molecules due to pulpal injury, dentin absorption to these molecules will cause the tooth to be discolored, Suleiman 2008 considered this reason the major cause of discoloration due to trauma.

Root resorption following trauma often presents as a pink spot lesion at the cemento–enamel junction in an otherwise symptomless tooth. Enamel hypoplasia in permanent teeth may be the result of disturbance of the developing tooth germ following trauma or infection of the deciduous tooth, giving rise to a localized enamel defect.

Pulp canal obliteration as a reaction after trauma can result in decreases in translucency and the tooth becomes yellow or yellow–brown in color but is still vital. [Adeleke et al., 2009]

Numerous drugs are noted to have the capability to produce tooth discoloration, and this can either be extrinsic or intrinsic discoloration

Drug-induced extrinsic tooth discoloration which can be removed by polishing and teeth prophylaxix includes chlorhexidine, iron salts in liquid form, essential oils, and camoxiclav. [Tredwin et al., 2005] From January, 1991, until June, 1995, 25 cases were reported to have yellow to brown tooth discoloration following the oral use of liquid

medication; 84% involved antibiotics, of which 14 were amoxicillin. [Meyboom *et al.*, 1996]

Drug-induced intrinsic teeth discoloration are permanent and need more complicated intervention for treatment. Most popular is staining due fluorosis and tetracyclins. Both will be discussed later in this review.

Minocycline may cause abnormal pigmentation of the skin, thyroid gland, nails, bone, sclerae, and conjunctivae in adults. It has also been shown to cause tooth and bone discoloration in a few patients. [Tredwin et al., 2005]

Although it might be sometimes difficult to differentiate between minocyclin and tetracycline stain, some differences are still distinguishable and can aid in correct diagnosis, these differences are summarized in the following table [Tredwin et al., 2005]:

	Tetracycline	**Minocyclin**
Color	Yellow to brown/grey	Green/grey, blue/grey
Pattern	Gingival margin or cervical third of crown. A band relating time of drug administration is apparent.	Incisal edge and, most intensely, the middle third
Severity	Severe	Less severe

Ciprofloxacin has been associated with greenish discoloration of the teeth when they erupted, and the discoloration could not be removed[Tredwin et al.2005]

Factors to consider before bleaching:

A typical dental examination begins with a health and dental history. Intra-oral examination of the hard and soft tissues of the mouth and extra-oral examination of the head and neck are also conducted to assess the patient for oral health problems as well as lumps, sores, or other signs of disease such as cancer or infection. A history of allergies (which may include ingredients in bleaching materials) must be taken. Some tooth

discolorations may be the result of a disease or condition that requires endodontic therapy, restorations or dental surgery. The American Dental Association has assigned pre-requisites before the dentist takes the decision of teeth whitening for a patient as follows:

"A dental examination with appropriate radiographs or other screening or diagnostic tests is recommended prior to considering tooth bleaching.

Bleaching discolored teeth in which the color change is the only visible indication of an underlying abnormality may change tooth color, but will not remove any underlying abnormality. This masking effect can result in tooth loss or other complications depending on the underlying condition since the true cause of the discoloration may go untreated. Dental caries or leaking restorations are two common conditions that may cause teeth to appear dark. Patients should be advised that bleaching treatments will not remove tooth decay that may subsequently progress and result in the need for more extensive and expensive treatments.

Examination of tooth function and para-function may reveal conditions such as bruxism or temporomandibular dysfunction that may be aggravated by use of bleaching trays. Radiographs may be necessary to aid in screening and diagnosis of diseases or conditions that may manifest as tooth discoloration, such as pulp necrosis with or without infection, anomalous pulp chamber size and anatomy, calcific metamorphosis, root resorption, etc. A history of tooth sensitivity should be investigated carefully to determine the cause(s) and whether treatment before tooth bleaching will benefit the patient.

A dental examination will help to identify and record the presence and locations of existing tooth restorations. This step may be quite important to an acceptable tooth bleaching outcome, since restorations do not change color. Dental restorations can also be a cause of tooth discoloration: metallic and other restorative materials may influence tooth color significantly depending on the translucency and thickness of the remaining tooth structure.

Patient expectations may be unrealistic unless cosmetic issues with existing restorations are addressed initially. Additional examination considerations include: tooth/enamel cracks and related sensitivity; exposed root surfaces (that resist bleaching); and other smile considerations such as translucency or defects in tooth form or anatomy.

Patient habits and lifestyle, as well as the presence of removable or fixed appliances or prostheses, should also be considered during an examination. Pre-treatment photographs and shade guides are often helpful to record a baseline to better assess treatment success.
Upon completion of the dental examination and diagnosis, treatment may be recommended and prioritized. Although the patient's primary concern may be tooth discoloration, bleaching procedures may not be recommended (or effective) until other problems are addressed. If dental restorations are present, often the expense and/or the risks related to the replacement fillings or crowns to match post-bleaching tooth color may contraindicate bleaching. "

[Adopted from ADA "Tooth Whitening/Bleaching: Treatment Considerations for Dentists and Their Patients / ADA Council on Scientific Affairs"]

Bleaching for Vital Teeth in Children and Adolescents:

After discussing the emergence of the importance of esthetic dentistry nowadays it should be mentioned that only a small amount of published literature about bleaching in children and adolescents are available. [AAPD] [Lee et al.,2005]

Materials used for bleaching:

Hydrogen peroxide and carbamide peroxide have been deemed safe and effective tooth whitener. Peroxide-containing whiteners or bleaching agents improve the appearance by changing the tooth's intrinsic color. [AAPD]
The mechanism by which carbamide peroxide lightens teeth is not completely understood. However, it is known that 10% carbamide peroxide degrades into 3% hydrogen peroxide and 7% urea. Oxidation by the hydrogen peroxide component is thought to cause the bleaching action by lightening the interprismatic organic matter and possibly removing some of it. If bleaching occurs by such action, it is understandable why deeper dentinal discolorations, such as tetracycline staining or dentinogenesis imperfecta, would not be affected by carbamide peroxide solution.[Croll et al., 1994][Lee et al.,2005]

Factors influencing tooth whitening:

Some factors can alter the speed of whitening process, although they are not precisely predictable, but they should be in consideration. Surface cleaniless is considered the basic factor before starting any bleaching procedure; this indicates that teeth prophylaxis is advised before bleaching, however, it is preferable that prophylaxis must precede whitening few days ahead. [Marshall et al., 20110] Any remaining organic proteinaceous material on the tooth surface will interact chemically with the bleaching agent, and also reduce its penetration into the enamel, reducing its effectiveness. Conventional prophylaxis and polishing pastes must not be used, since the oils which they contain can coat the tooth surface and impair the generation of oxygen free radicals.[Walsh et al., 2004]

The higher the peroxide concentration the faster the action but this relation is not linear. Higher concentrations are more likely to result in increased tooth sensitivity. A 10% carbamide peroxide concentration is equal to approximately 3.4% concentration of hydrogen peroxide. [Marshall et al., 2010] In the majority of tooth whiteners in the market , the peroxide concentrations ranges from 3% to 38%. [AAPD]

Temperature of the agent is another important factor affects whitening; the higher the agent's temperature, the faster the oxygen release, which speeds the reaction but the speed of the color change may not be necessarily altered, and the rise in temperature may cause more pulpal sensitivity.[Marshall et al., 2010] The increased speed of the chemical reaction achieved by increasing the temperature may help explain the effect of some bleaching lights used with in-office procedures. The light's benefit may be partially a product of its heat, not its specific light wave. [Abu-almajd et al., 2009][Marshall et al.2010]

Agents with low pH can produce tooth-surface alterations. This can be avoided by using agents with a pH in the range of 7. The urea released during carbamide peroxide breakdown raises the pH above 8 for several hours. Hydrogen peroxide has an optimal range of 9.5 pH to 10.8 pH. [Marshall et al.,2010] it is also important to consider that the

longer the duration of material application, the greater the degree of whitening is. However, extended periods may increase the likelihood of sensitivity.

In-office bleaching needs higher concentration of peroxide and needs coverage of the gingiva by rubber dam to prevent its irritation.

Primary teeth bleaching:

Bleaching for primary teeth is uncommon but still existed in literature but rarely before age of 6 years. Primary teeth have special concerns regarding whitening since primary teeth have thinner dentine and enamel , and larger pulp horns; which expects more sensitivity than permanent teeth in theory. [AAPD] It is well known also that primary teeth are whiter in color than permanent teeth.

Primary teeth bleaching is not indicated unless parents of those children reported that teeth discoloration is bringing them negative attention. [AAPD] It is manadatory that whitening of primary teeth should always be provided or authorized by dentists, and should be only limited to children suffer emotionally from the bad appearance of their teeth. In this case parents should agree, sign an informed consent and closely monitor their children who should have maintain meticulous oral hygiene.[Lee et al.,2005]

Permanent teeth bleaching:

Children permanent teeth are easier to bleach than adult teeth because of two reasons; they have thinner enamel and their enamel has higher permeability. [Lee et al.,2005] However, these two characteristics increase post-bleaching sensitivity. [Lee et al.,2005]

Home bleaching for teenagers carries a high risk of material abuse because the dentist would have less control and the patients of this age are usually not compliant.

Bleaching of the teeth have some complications and side effects, however, they are almost all considered temporary and does not have any serious impact on teeth. Lee 2005 has talked about reduction of microhardness but he mentioned that saliva will restore the tooth original microhardness. Overoxidation with carbamide peroxide will cause calcium loss, which means tooth degradation, theoretically speaking primary teeth would be more

prone to this side effect but there is no evidence to support this issue.[Lee et al.,2005] On the other hand, and according to Sapir & Shapira 2007, they considered bleaching a way to conserve tooth substance in comparison with microabrasion .And they reported that the application of CPP-ACP may enhance enamel remineralization, improve esthetic results, and diminish tooth sensitivity after tooth whitening and enamel microabrasion. [Sapir & Shapira 2007]

Bleaching protocols for children :

AAPD encourages the judicious use of bleaching for this age group but discourages full arch cosmetic bleaching in the mixed dentition. [AAPD]

Home bleaching:

Theodore 1994 suggested a protocol for bleaching in young patients. He recommended microabrasion as a first step; microabrasion will eliminate the decalcified superficial layer from the enamel. Then after 6 – 8 weeks bleaching process could be carried on. Home bleaching custom made vinyl trays are then prepared for the patient with noting that although some practitioners advocate placement of some type of filler material to enlarge labial tooth dimension so that the custom trays can hold more bleaching solution. such fluid "reservoirs" in bleaching trays for young patients are not recommended in this protocol. Artificially enlarging the trays in this manner sometimes affects fit of the tray and tends to cause more leaking of the bleach.. [Croll et al., 1994] While it appears logical to create space for extra bleaching agents for prolonged increased action, Marshall et al 2010 reported in their review that there is no research confirms its effectiveness. On the other hand, one study found that the amount of gingival inflammation is increased when trays are fabricated with reservoirs compared with non-reservoir trays. [Marshall et al.,2010]

The material used in this protocol is 10% carbamide peroxide. A drop of no more than 2 mm in diameter must be injected into the tray space for each tooth. The patient then is instructed to fit the tray under parent supervision and after teeth brushing and flossing. The simplest method is to wear the tray during the sleeping period of the patient daily

from 7 – 10 days. Another 14 days could be continued if the desired result was not achieved after dentist consultation. [AAPD]

In office "power" bleaching:

In this method high concentration of hydrogen peroxide is used 25 -38 %. This high concentration makes gingival coverage critical and essential.

Although the original in-office bleaching agents were applied without any other aids, some companies now advocate procedures involving specially designed lights to enhance the effects. The present-day systems are activated by a variety of light sources: plasma arc lamps, Xenonhalogen, light emitting diode (LED) light and diode lasers. However, light sources are not essential and there are systems that require chemical activation only and are merely painted onto the teeth with the usual use of gingival and mucosal isolation. [Suleiman 2008]

A clinical trial measured the tooth whitening and the surface and intrapulpal temperature increase in vitro on freshly extracted upper human central incisors after chemical, Zoom AP light and diode laser activated bleaching. The conclusion of this trial addressed that chemical bleaching produces the same whitening effect as Zoom AP light and laser, with no surface or pulpal temperature rise. Laser application is faster and produces less surface and pulp temperature increase than Zoom AP light. Diode laser used to activate bleaching gels is not considered dangerous to the vitality of dental pulp using power settings of 2W. [Abu-almajd et al., 2009]

Other articles have also reported limited evidence concerning the actual benefits of the lights is available. [Croll 1994] [Marshall et al.,2010]

The bleaching agent is applied to the target teeth, and then the teeth are exposed to the light for 15 to 20 minutes. The bleaching material then is rinsed and renewed. This procedure is repeated two to three times during the appointment. [Marshall et al.,2010]

Russo et al., 2010 conducted an in vitro clinical trial to assess color stability over time for teeth bleached by (Zoom 2). They concluded that Zoom 2 produced immediate and long lasting bleaching results, however, polishing of teeth after bleaching is recommended in order to obtain a smooth enamel surface that does not retain staining substances. On the other hand Kugel et al., 2010 reported that clinical research on the in-office use of light and a peroxide gel alone or in combination showed significant immediate color change and post treatment color rebound in all groups.

Gurgan et at., 2010 reported that bleaching with diode laser resulted in less tooth and gingival sensitivity than the other bleaching systems.

AAPD has assigned some advantages of this technique over home bleaching including soft tissue protection, increased professional control, less patient compliance is needed, and rapid stable results are seen directly by the patient.

Over the counter:

These products have been spread widely recently in the forms of tooth pastes, mouthwashes, painting materials. All of which are considered a waste of money since they do not have enough contact time with tooth structure so cannot perform their action. There is lack of clinical evidence regarding the safety and effectiveness of these products, being most of the studies supported by the manufacturers'. [Demarcco et al., 2009]

One single product has proven its efficacy since 15 years, which is manufactured by Crest in the form of "whitening strips".[Marshall et al.,2010] Strips present similar esthetic results and side-effects, compared to bleaching with 10% CP using trays; however, some authors claim that the studies have financial support from the manufacturers and were based on short term evaluations. [Demarco et al., 2009] Although it works efficiently but it still has some draw backs; the strip could only cover from canine to canine, and it may be difficult to be fixed on mal-aligned teeth. [Marshall et al.,2010] Disposable trays that are prefilled with 9% hydrogen peroxide with inbuilt gingival protection have recently been introduced also. [Suleiman 2008]

Concerns have appeared due to the potential abusive use of these self-medication agents, especially in young patients, with potential harmful results. Dentists should be acquainted with this kind of products to be able to inform their patients. [Demarrco et al., 200]

Risks and side effects of bleaching materials and methods:

Teeth sensitivity is the most common side effect and occurs in at least 50% of patients.[Marshall et al.2010] Luckily, it is a temporary side effect that rarely lasts for more than 4 days .[Tredwin et al.,2006] And thought to be caused by reaching of the peroxide products from enamel to dentin to pulp tissue or because of dehydration of dentinal tubules. [Tredwin et al.,2006] Although there is a widely held belief that higher concentrations of bleaching agents produce a greater prevalence of tooth sensitivity, studies reported disprove this theory. [Suleiman 2008]

Persistent sensitivity, especially if severe, can be treated with 5% potassium nitrate with fluoride incorporated into a gel similar to bleaching gel or with amorphous calcium phosphate. Potassium nitrate has a numbing or calming effect on nerve transmission. Fluoride acts as a tubule blocker to limit the fluid flow to the pulp. It is placed into the bleaching tray in the same way as the bleaching agent. [Marshall et al.,2010] Lees 2005 mentioned in his review that one researcher has documented that children who received fluoride after bleaching has a slight reversion with the shade color in comparison with those who did not receive this therapy. [Lee et al.,2005]

A clinical trial suggested that the use of a 3% potassium nitrate and 0.11% fluoride desensitizing agent for 30 min prior to whitening may decrease tooth sensitivity when compared with a placebo gel. [Leonard et al. 2004]

High concentration bleaching agents can produce chemical burns when contacting the soft tissues, these chemical burns turns the tissues temporarily white and get back to normal once they rehydrate. [Tredwin et al.,2006]

Enamel microhardness is affected directly after bleaching, but once reminerlization with saliva took place it will return to its normal measures. [Shulman et al., 2004] there is a lack of agreement on the overall effect of bleaching. The results range from no effect on tooth wear [White et al., 2001] to a significant decrease in the hardness and fracture

resistance of enamel . Bleaching does not cause any perceptible etching of the teeth, and morphological changes in the outer 25 microm of the enamel are clinically insignificant. [Suleiman 2008]

Peroxides will cause enamel topography to be roughened, consequently it will be more prone to extrinsic stains and bacterial adherence. But it should be mentioned that this alteration in enamel structure is less severe than that caused by etching the enamel with phosphoric acid.[Tredwin et al.,2006]

A number of studies have reported adverse effects of bleaching procedures on dental hard tissues, including decreased hardness, fracture toughness, flexural strength, and other changes in the mechanical properties.[Tredwin et al.,2008] however, Khoroushi et al 2011 have proved in a clinical trial on bovine bleached teeth that treating those teeth with CPP-ACP could compensate for this decrease. [Khoroushi et al., 2011]

To date, there is little published evidence documenting adverse effects of dentist-monitored, at-home whiteners on enamel, but two clinical cases of significant enamel damage have been reported, apparently associated with the use of OTC whitening products. This damage may be related to the low pH of the products and/or overuse.[ADA]

There is inadequate evidence to prove the carcinogenicity of hydrogen peroxide. [Lee et al., 2005] Tredwin et al 2006 has mentioned several carcinogenesis studies, including the hamster cheek pouch model, indicated that hydrogen peroxide (H2O2) might possibly act as a promoter. Until further clinical research is concluded to address the question of possible carcinogenicity, he recommended that: tooth-bleaching products using concentrated H2O2 should not be used without gingival protection; and that H2O2 containing products should be avoided in patients with damaged or diseased soft tissues. For home vital bleaching, minimal amounts of low dose H2O2 in the form of carbamide peroxide are preferred, thereby avoiding prolonged and concentrated exposures.

Hydrogen peroxide has been found not to be carcinogenic, mutagenic or teratogenic, and concerns of toxicity or serious damage to soft tissues appear to be unfounded . Initially, concerns were raised about the role of hydrogen peroxide in mutagenesis on the basis of some in vitro tests that were not reproduced in vivo. In fact, the frequency of genetic

mutation induced by 10% carbamide peroxide is not significantly different from that of a physiological saline control. [Suleiman 2008]

However, after discussing all the risks of bleaching materials, and according to Suleiman 2008, *the evidence on safety published to date on the whole tend to suggest that bleaching is a relatively safe procedure.*

An interesting finding reported in Sulieman review 2008; is that a number of studies have reported an increase in gingival health following bleaching procedures , and two reasons have been put forward for this. The first is that the bleaching solution is toxic to the bacteria within the gingival crevice. The second is that patients undergoing bleaching might take more interest in their teeth and as a result may improve their oral hygiene during the treatment.

Effect of bleaching material on existing restorations:

An in vitro study found that vital tooth bleaching with carbamide peroxide gel has an adverse effect on marginal seal of dentinal walls of existent composite resin restorations bonded with one kind of self-etch adhesive. But it was also found no effect with other two types of bond. So, further research is needed. [Mortasavii et al.,2011]

A decrease in surface microhardness of both microhybrid and resin composites has been noted after exposure to "Crest Night" Effects, "Colgate Simply White" Gel , and "Opalescence". Polishing restorations prior to and after exposure to bleaching agents is recommended. Another point must be taken into consideration that restoration will not be lightened in color after bleaching so they might appear darker and need to be changed. [Marshall et al.,2010]

In vitro studies suggest that dental restorative materials may be affected by tooth bleaching agents. These findings relate to possible physical and/or chemical changes in the materials, such as increased surface roughness, crack development, marginal breakdown, release of metallic ions, and decreases in tooth-to-restoration bond strength.[ADA]

Effect of bleaching material on enamel and dentin bonding to resin based restorations:

Following bleaching, H2O2 residues in the enamel may inhibit the polymerisation of resin-based materials and reduce bond strength. Thus tooth-bleaching agents should not be used for 24 hours prior to treatment with resin-based materials. [Tredwin et al.,2006] Resin tags in bleached enamel are less numerous, less well defined and shorter than those in unbleached enamel. [Suleiman 2008]

According to Walsh et al 2004, there must be a delay of 2 weeks to allow oxygen levels in the enamel to return to normal before attempting to bond to the tooth, otherwise oxygen inhibition of resin polymerization will compromise the replacement restorations. Exposure of enamel to 35% hydrogen peroxide for 5 to 30 minutes has been shown to cause a significant reduction in the adhesive bond strength of composite resin to enamel. Scanning electron microscopic examination of fractured peroxide-treated specimens has revealed that the bond failures occur primarily at the bonding resin-enamel interface, and that they are associated with areas of resin nonattachment and altered resin quality. These changes are caused by the presence of residual peroxide or reactive oxygen species at or near the enamel surface. Lower shear bond strengths to enamel are the direct result of oxygen reactive species in the enamel surface changes. The decrease in the adhesive bond strength of resin to 35% hydrogen peroxide-treated enamel is not caused by a change in the elemental composition of treated enamel surfaces. No major changes occur in the elemental composition of enamel exposed to 35% hydrogen peroxide, other than an increase in nitrogen content. [Walsh et al.,2004]

Effect of bleaching material on pulp:

Although dental hard tissues exhibited substantial permeability to hydrogen peroxide, especially with the application of heat, the quantities that diffuse into the pulp chamber were in the order of only micrograms: too low to produce inhibitory effects on enzymes and therefore unable to cause permanent pulpal damage . The effects of carbamide

peroxide penetration were also studied and it was found that for the same effective concentration, there was less penetration of the pulp from carbamide peroxide than from free hydrogen peroxide.[Suleiman 2008] An in vivo study conducted by Kina et al 2010 concluded that professionally applied vital tooth bleaching with a 38% H2O2 gel with or without activation by a halogen light source did not cause damage to the pulp tissue of sound human premolar teeth. [Kina et al.,2010]

Up to date, there have been no reported long-term adverse pulpal sequellae when proper techniques are employed.[ADA]

Special considerations in bleaching teeth with tetracycline stains:

Tetracycline compounds bind to dentine and enamel by calcium chelation, and become incorporated into teeth and bones during calcification. They cause a range of discolourations ranging from yellow to brown, and grey. The most cosmetically important teeth, the permanent anterior teeth, are susceptible to staining from tetracycline during their formation, ie, between the ages of 3 months and seven years. During this “window of susceptibility”, the severity of staining is related to the dose and duration of use of the medication. The exact colour depends on the particular tetracycline analogue and its dose, for example, Aureomycin gives a grey-brown colour, while Achromycin gives a more yellow colour. There is strong evidence that dentine mineralization is affected by systemic tetracycline therapy, and that tetracycline can be incorporated into peritubular dentine after mineralization of the primary dentine matrix. [Walsh et at 2004]

Marshall et al 2010 suggested a procedure for whitening these teeth may involve both in-office and at-home whitening procedures. The in-office procedure with 33% hydrogen peroxide serves as a "jump-start" to initiate the process. This is followed by at-home whitening, as previously discussed. The at-home treatment can be interspersed with occasional in-office "boosts" to the process. The patient must be informed that the incisal two thirds of the tooth will likely demonstrate the greatest color improvement, this is

attributed to the fact that the cervical third has too thin enamel to be bleached. [Marshall et al.,2010]

Walsh et al 2004 reported in his article a method using KTP or argon laser whitening, and considered it as an important advance in the treatment of patients with tetracycline staining. They claimed in their report that laser whitening can photo-oxidize the stain and thus provide a cosmetic benefit without destruction of the teeth.

Non-vital tooth bleaching:

There are many causes contribute to the discoloration of a non vital tooth; trauma, endodontic treatment, and restorative treatment. This occurs as result of either medicaments and materials used during treatment or because of erythrocyte destruction and hematin absorption by enamel and dentin following traumatic injury to the tooth.

There are many methods described to bleach a non-vital discolored tooth such as; inside/outside bleaching technique, non-vital power bleaching, walking bleaching technique, and night-guard bleaching.

Inside/outside bleaching technique:

Settembrini *et al* (1997) was the first one who described the inside/outside bleaching technique. As its name implies, bleaching takes place within the tooth and on the outside of the tooth simultaneously. [Leith et al.,2009]

Grey-brown intrinsic discolouration of pulpal origin is most amenable to the inside/ outside bleaching technique.[Leith et al.,2009]

Inside/outside tooth preparation requests removal of any existisng restoration ,adequate access to the pulp cavity then removal of 2-3 mm of gutta percha below cemento-enamel junction . Seal the gutta percha with glass ionomer and etch the tooth with 30% phosphoric acid. Deliver 10% carbamide peroxide to the patient with the tray and give firm clear instruction to put pea sized volume of the bleaching material in the

corresponding site in the tray. Change of the bleaching material must take place every 2-4 hours during the day and before sleeping.

Although this technique has proved its efficacy in young permanent discolored teeth, it still has some drawbacks; the protocol of this technique requires highly compliant patient, endangers the root canal to bacterial contamination, requires element of manual dexterity, and risk of unwanted color change or sensitivity in adjacent teeth. [Leith et al.,2009]

Walking bleaching technique:

This technique was advocated by Nutting and Poe in the following manner; protect the gingiva by a layer of petroleum jelly, and apply the rubber dam then. The palatal-access restoration must be removed. Remove the remaining pulp chamber restoration. Remove the gutta-percha to a level 1 mm below the dentogingival junction. Once the required level reached, 1 mm of a zinc phosphate lining was placed over the gutta-percha to completely cover the root restoration. The dentin inside the pulp chamber gently freshened with a slowly rotating round steel bur. Etch the surface with 37% phosphoric acid. Fill the etched pulp chamber with 30% hydrogen peroxide mixed with sodium perborate and close the cavity with glass ionomer for 2 weeks.[Leith et al.,2009]
Hydrogen peroxide mixed with sodium perborate potentiates its effect and produces a better bleaching effect. [Suleiman 2008]

Risks and side effects from non vital bleaching:

Although it has been said that younger teeth are easier to bleach, because the tooth substance has relatively greater permeability, a review by Maclssac and Hoen indicated that the greater permeability of younger teeth may increase the risk of external cervical resorption.[Leith et al.,2009] Therefore, it is recommended that a protective barrier be used over the canal filling to prevent leakage of bleaching agents. Glass-ionomer (GI) is commonly used as a coronal barrier before nonvital bleaching. Because mineral trioxide aggregate (MTA) creates high alkalinity after mixing with water, using MTA as a protective barrier over the canal filling may not only prevent leakage of bleaching agents

and microorganisms, but may also prevent cervical resorption. [Vosoughhosseini et al., 2011]

AAPD has suumerized the common side effects from internal and external bleaching of nonvital teeth. The most common side effects from internal bleaching are external root resorption and ankylosis. With external bleaching of nonvital teeth, the most common side effect is increased marginal leakage of an existing restoration. One of the degradation byproducts of hydrogen peroxide or carbamide peroxide results in a hydroxyl-free radical. This byproduct has been associated with periodontal tissue damage and root resorption. Due to the concern of the hydroxyl free radical and the potential side effects of dental bleaching, minimizing exposure at the lowest effective concentration of hydrogen peroxide or carbamide peroxide is recommended.

Microabrasion :

Microabrasion treatment is based on the principles described by Croll. It is a safe, efficient, atraumatic method of removing superficial enamel defects. Using a paste made of acid and pumice uniformly remove up to 0.2 mm of enamel surface using a combination of chemical erosion and mechanical abrasion.

Indications of microabrasion are limited to teeth has superficial stains like; fluorosis, postorthodontic demineralization, localized hypoplasia, and idiopathic hypoplasia where discoloration is limited to the outer enamel layer. Microabrasion is not as likely to succeed in deep lesions caused by amelogenesis imperfecta.

This technique has been developed since early 1990s with different methods having the same principle of using acid and pumice. In 2001, the United Kingdom National Clinical Guidelines in Paediatric Dentistry recommended the use of microabrasion to treat fluorosis, postorthodontic demineralization, localized hypoplasia and idiopathic hypoplasia where the discoloration is limited to the outer enamel layer. [Price et al.,2003] But proper patient selection is imperative in choosing the correct treatment option and determining the pretreatment prognosis.

Microabrasion technique :

The method mentioned in this report as described by Benbachir et al 2007 .

The eyes of the patient, clinician, and dental assistant must be shielded with protective glasses. Perform ordinary scaling and polishing then apply a rubber dam for chemo-mechanical reactivation of the superficial enamel substrate.

Start microabrasion now with an abrasive watersoluble paste containing 6.6% hydrochloric acid and silicon carbide microparticles by applying a small amount of paste to the affected tooth surfaces and use a special rubber cup to abrade the tooth surface with slight pressure for 60 to 120 seconds.

Whenever necessary, a small drop of the product can be added and the abrasion repeated, several applications may be required and the effect must be optically evaluated after water rinse after each application.

To enhance enamel remineralization, a highly concentrated (12,500 ppm) basic fluoride gel must then applied to the treated enamel surface.[Bin-bashir et al.,2007]

Research indicates that 1-minute applications of commercially available microabrasion compounds remove 12 microm on the first application and 26 micro m on subsequent applications. The explanation for why the first application removes less enamel than subsequent applications is associated with the fluoride rich enamel that is at the enamel surface. Evidence in the literature has approved that the new polished surface is less susceptible to bacterial colonization and demineralization than natural nonabraded enamel. [Donley et al.,2008]

The microabrasion process abrades surface enamel while compacting calcium and phosphate into the interprismatic spaces. This polished surface reflects light differently than natural enamel. Therefore, a portion of the whitened enamel is removed and a portion is camouflaged by the highly polished surface. [Donley et al.,2008]

Microabrasion for postorthodontic hypomineralization:

Postorthodontic lesions are white spot lesions found adjacent to brackets and the free gingival margin area.

Postorthodontic white spots can be either remineralized or even demineralized areas of enamel. When enamel remineralizes, fluoride, calcium, and phosphate ions penetrate the surface zone and precipitate on sound enamel at the margins of the subsurface demineralized lesion. The lesion becomes smaller with the center of the subsurface enamel being the final area to remineralize. The remineralization process does not recreate enamel prisms that extend from the dentin to the tooth surface, as normal enamel appears. There is merely a highly dense compaction of calcium, phosphate, and fluoride, which has more mineral content than natural enamel and is more difficult to demineralize than natural enamel. Due to this remineralization process, remineralized enamel is often viewed as having a whiter color than natural enamel, appearing similar to a white spot lesion. [Donley et al.,2008]

Donley et al 2008 described different bleaching procedures for postorthodontic hypominerelization; patients who exhibit generalized yellowing of the teeth can experience significant whitening with tray-based whitening systems used overnight or with over-the-counter polyethylene strips that carry varying doses of hydrogen peroxide within a gel whitening system, while white spot lesions adjacent to brackets and the free gingival margin area needs topical fluoride therapy to be sure that remineralization of enamel has occurred. Mild whitened enamel can often be camouflaged by bleaching with standard tray-based whitening systems used overnight or with whitening strips. If 2- to 4-week bleaching with these regimens is ineffective at camouflaging this whitened enamel, microabrasion followed by bleaching is recommended.

Microabrasion has been mentioned repeatedly in the literature to treat MIH and postorthodontic hypominerelization. Although most of the times it was mentioned as a combination with other treatment modalities like bleaching, and veneers. Microabrasion is generally performed before bleaching so that superficial white discoloration is eliminated and the enamel surface is smooth and lustrous. White dysmineralization spots or decalcification defects are not improved by dental bleaching, but often times can be permanently eliminated with enamel microabrasion. [Croll 1994]

Special considerations in treating teeth with Fluorosis:

Dental fluorosis is a kind of enamel hypoplasia clinically characterized by white opacities that vary from minor striations to extensive areas of lusterless enamel. The changes are symmetrically distributed within the oral cavity, but the severity varies among the different types of teeth. Fluorotic areas of discoloration on permanent teeth often create an esthetically compromised appearance.[Silva et al 2002]

Fluorosis may be the result of the natural occurrence of fluoride in water supplies or from fluoride in mouthrinses, tablets or toothpastes. This type of staining is most often confined to the enamel, varying from areas of flecking to diffuse opaque mottling superimposed onto a chalky white or dark brown–black background. The dark discoloration is thought to be post-eruptive by a process of internalization of extrinsic stain into the porous enamel. The severity of the discoloration is related to the age and dose administered and can affect both the primary and secondary dentitions in endemic cases of fluorosis.[Suleiman 2008]

Silva et al. 2002 described a case report -for a 9 year old girl suffer from fluorosis- microabrasion using two materials; Premier Dental compound, and 37% phosphoric acid. The results showed both techniques for microabrasion; phosphoric acid pumice and Prema Compound, are effective and simple but require proper indication. The phosphoric acid pumice technique presents some advantages: It is quicker and requires the use of materials usually available in general dental practice.

Croll et al 1990 described a strange case report; in which he documented the effect of a microabrasive material when it was intentionally placed on the gingiva of the senior author. In this subject, 15 seconds of gingival exposure to PRËMA microabrasive compound followed by 30 seconds of water rinsing was harmless. However, in the same subject, 30 seconds of exposure of two gingival sites to the same compound caused soft tissue ulcerations. The gingival lesions produced by 30 seconds of exposure to the microabrasive compound healed without visible trace within 7 days. The manufacturer's

safety recommendations about the use of the compound for enamel microabrasion are warranted. This is especially true in regard to use of the ruhber dam.

Microabrasion may be safely used in children, if proper protection is provided for the patient and the child is cooperative.

New era of veneers and lumineers:

When treating a patient complaining from discolored teeth minimally invasive procedure such as dental bleaching always should be an option specially when color is the main concern, but the patient must be informed that this treatment procedure is characterized by unpredictable final results, might be unstable, and may not reach the patient high expectations. Placement of all-porcelain crowns involves the removal of large amounts of sound dental structure and does not always represent a satisfactory option. The development of adhesive dentistry has made it possible to perform treatments that were not even imagined in the recent past. The introduction of ceramic acid etching, reported by Horn, in the early 1980s allowed the first porcelain veneer restorations.[Felho et al 2005]

Interest in esthetic dentistry is motivating the public to visit the dentist. Veneers offer an alternative to full-crown coverage of (1) intrinsically stained teeth not amenable to bleaching, (2) hypocalcified teeth, (3) severe tetracycline discoloration, or (4) closure of spacing between anterior teeth. Veneers requiring little or no removal of tooth structure are especially comfortable to patients.[Ciancio et al. 2006]

Advantages of veneers are many, some of which are mentioned here; no anesthetic agent in most cases is needed, no pain resulted because of the very minimal or no tooth preparation perormed. Veneers provides a long-lasting and cost-effective restoration.

A number of clinical studies have concluded that bonded porcelain laminate veneer restorations delivered good results (over 90% survival) over a period of 10 years. Among the failures, different kinds of fracture types were observed: cohesive fractures of the ceramic or adhesive failures between the tooth and the restoration surface. The majority of the failures were however observed in the form of fractures of the restor ation. Adhesive failures are rarely seen when enamel is the substrate. In principle, bond strengths of luting cements to enamel are sometimes exceeding the cohesive strength of the enamel itself. Other failures seen with laminate veneers are related to microleakage. Marginal defects were often noticed when the laminate veneers ended in existing direct composite restorations. However, with the new composite surface conditioning techniques examined with *in vitro* studies, the problem of failures involving adhesive cementation to aged resin composite restorations could be solved. Unfortunately, the clinical studies often do not provide information on the conditioning of such underlying composite restorations. [Gresnigt et al., 2011]

In children, porcelain veneers provide a simple means of splinting traumatized anterior teeth which have coronal fractures either for the immediate or the long term. [Margolis 2010]

As preparations of porcelain veneers are mostly limited to enamel, the thickness of these restorations does not usually exceed 0.6 mm, giving them a commonly used name of porcelain shells. In such a thin section, porcelain veneers are required to mask the underlying color of the tooth structure in addition to providing the required shade (usually a lighter shade as requested by many patients), Human dentin has a wide range of natural colors that vary among patients as well as ethnic groups. [Dozic et al.2010] The color of natural dentin could influence the final shade match of thin and transparent porcelain veneers, leading to shade mismatch compared with the selected aimed color. Therefore, and nowadays, resin cements are supplied in different shades to enhance final color match. Some manufacturers also supply special opaque resin cements to mask the underlying dark or discolored dentin.[Dozic et al., 2010]

However, an in vitro clinical trial concluded that different shades of resin cement did not influence the overall color of porcelain veneers, as the color parameters of the seven shades used with one colored resin die were almost identical. This could be related to the limited thickness (30 μm) and translucency of resin cement under the cemented veneers not being effective in creating effective color shifts. But the author still considers it can improve the end result. Under reflected light conditions, the color of the underlying tooth structure was more dominant than the color of resin cement. [Dozic et al.,2010]

As for gingival health following the fabrication and seating of the porcelain veneer, Peumans, et al, concluded that “the porcelain veneers had no adverse effects on gingival health in patients with optimal oral hygiene."[Margolis 2010]

According to Margolis 2010, The Cerinate Lumineers (Den-Mat) are made from pressed ceramic crystals with reinforced leucite crystals which can be as thin as 0.2mm. Thus, these veneers can be placed with little or no removal of tooth structure. In a study by Strasseler and Weiner it has been shown that 94% of the no-prep Cerinate Lumineers (Den-Mat Corporation) have been clinically successful and 100% retention for over 20 years. [Margolis 2010]

New compatible ceramic systems, and strong adhesion provided by new luting systems eliminated the initial thoughts for clinicians who looked at these veneers as merely sophisticated temporary restorations, to be replaced in the future by full coverage. A resistant and reliable bond between resin composite and ceramic is actually created by two mechanisms: micromechanical attachment, provided by hydrofluoric acid (HF) etching and/or grit blasting, and chemical bonding by a silane coupling agent. The positive feedback in literature about these cements made porcelain veneers an increasingly popular technique to treat unesthetic teeth. In addition, the bioemetic behavior of porcelain allowed the recovery of the visual and biomechanical properties of a natural tooth, maintaining or sometimes increasing the rigidity of its crown.[Felho et al., 2005]

Avoid eugenol-containing temporary cements and thoroughly clean the preparation before bonding. Eugenol-containing temporary cement reduces the bond strength of etch-and-rinse, self-etch, and self-adhesive resin cements. Furthermore, a recent study showed that even dentin contaminated with eugenol-free temporary cement decreased the bonding of adhesive cements. Therefore, more important than the type of temporary cement used is proper cleaning of the preparation before bonding. Cleaning can be effectively performed with low pressure and small-particle air abrasion, followed by strong water spray. The long-term effect of aluminum oxide cleaning and tribochemical coating on prebonded dentin is detrimental to the bonded interface. [Duarte et al.,2011]

Before cementation, apply local anesthesia with vasoconstrictors. Local anesthesia decreases transdentinal flow by 70%.89 Consequently, the pulpal pressure diminishes during adhesive restorative procedures. [Duarte et al.,2011]

All porcelain esthetic crowns are also indicated when the defects, malformations, and esthetic problems are major and could not be corrected by one surface veneers.
If the teeth are already compromised by the presence of extensive carious lesions, wear, old restorations or endodontic treatment, placement of a crown is the more prudent choice. [El-Badrawi & El-Mowafey 2009]

According to AAPD full-cast metal crowns or porcelain-fused-to-metal crown restorations may be utilized in permanent teeth that are fully erupted and the gingival margin is at the adult position. [AAPD]

El-Badrawi & El-Mowafey compared porcelain veneers to full coverage porcelain crowns in two selected cases, one illustrating an ideal situation for veneer restorations and the other illustrating an ideal situation for crowns. When considering treatment of the maxillary anterior teeth for esthetic purposes, the dentist must consider each case on its own merits. The choice between porcelain veneers and crowns will depend on the condition of the teeth. If the use of crowns would be beneficial in terms of providing

support (bracing) to the lingual tooth structure, to prevent future failure, then crowns are preferable to veneers. Veneer restorations do not typically provide coverage or protection for the lingual tooth structure, but they definitely improve labial esthetics.

New modalities in shade selection:

To date, there is no systematic training on visual shade determination for dental technicians or dentists. Therefore, all attempts to improve the color communication fail at this barrier. Many concepts, attempt to improve shade communication, however, and various color standards are available from market leaders such as Vita Classic, Vita 3D Master, Chromascop, and Biodent. Those color standards are based solely on observations and represent a relatively small spectrum of the color variations that are present in nature and are further complicated by the fact that color interpretation by the human eye is influenced by a variety of factors including; light conditions, gingival shade, influence of the surrounding individuals and other opinions that might or might not be relevant. Type and arrangement of the shade guide and the position of the shade tab can also affect the final shade selection.[Egger 2010]

The communication of shade between the dentist and the technician at a remote dental laboratory has always been challenging. While the contour, length, and width of an indirect restoration can be easily and accurately expressed through a study model, there had been no similarly direct orientation for shade matching in dentistry.
On the contrary, different types of digital tooth-color measuring devices, which operate independently of most external factors, have shown excellent performance and good repeatability under clinical circumstances. Therefore, they can also be used to reduce human mistakes during the color-evaluation process. [Dozic et al. 2010]

Digital shade matching units standardize the measurements of hue, value, and chroma (the parameters used in the Munsell color system), so that technicians at a remote dental

laboratory can apply these readings to existing porcelain formulas and achieve accurate results based on the information supplied. In other words, much of the guesswork inherently involved in shade matching for indirect dental restorations has been eliminated through the controls introduced by these products.

Almost all digital shade matching devices are hand held products, each containing a color analyzer with its own light source that has accompanying software for the downloading, evaluation, and transmission of the relevant color data recorded. The program's interpretation of this shade record, when downloaded on the doctor's computer, can be used in selecting the shade of the provisional restoration fabricated chairside, and then be transmitted via email to the laboratory where the definitive restoration will be made. [Eggers.,2010]

Dozic et al. 2010 used a digital system "Spectrophotometers" collect spectral data from reflected light and automatically translate these data into the three color coordinates. The spectrophotometer,(SpectroShade) has a built-in aiming feature (represented by a horizontal green line) that enables reproducible positioning of the device perpendicular to the facial surface of the tooth. To ensure equal measurement conditions, it is necessary to record adequate tooth frame.

Another clinical trial compared between conventional visual and spectrophotometric methods for shade selection , the conclusion of this study Vita Easyshade spectrophotometer was more likely to match the shade compared to visual method. Nevertheless, this system needs further refinement, as well as software upgrades. Shade-matching devices could help clinicians and technicians achieve a better shade choice. The combination of visual shade analysis and digital shade measurement together lies in the precise predictability of the miscibility of shades. [Judeh et al., 2009]

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