# No Carious Cervical Lesions: Abfraction

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**ABSTRACT**

Abfraction or Theory of Abfraction is a theory explaining the non-carious cervical lesions (NCCL). It suggests that they are caused by flexural forces, usually from cyclic loading; the enamel, especially at the cementoenamel junction (CEJ), undergoes this pattern of destruction by separating the enamel rods. Clinical aspect importance of these ineart lesions are at most important to be detected for early intervention and treatment modalities as options during the progression of the disease.

**Key Words:** Abfraction, cervical lesions, non-carious lesion, wear, wasting diseases.

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## Introduction

Abfraction means 'to break away'[1] and the term is derived from the Latin words 'ab,' or away, and 'fractio,' or breaking by J. O. Grippo.[2-3] It is usually observed on the buccal surface at the cementoenamel junction (CEJ) of teeth, with prevalence ranging from 27 to 85%.[3] These lesions vary from shallow grooves to broad dished-out lesions or large wedge-shaped defects with sharp internal and external line angles.[4-5]

## History

The term 'abfraction' evolved from the work by McCoy[6](1982), Lee and Eakle[7] (1984), and J. O. Grippo[2] (1991). It describes a theoretical process according to which occlusal forces create stresses in enamel and dentin along the cervical area and predispose it to erosion and abrasion. In the early 1980s, McCoy[6-7] questioned the role of toothbrush abrasion in the etiology of what previously had been referred to as "cervical erosion." Thus McCoy[8-9], and in the early 1990's, Grippo[10] proposed that bruxism may be the primary cause of angled notches at the CEJ.

Grippo[10] concluded that the flexure resulted in damage to the enamel rods at the CEJ resulting in their loosening and consequent flaking away of the tooth structure. He named this type of damage 'abfraction'in his paper published in 1991. He suggested that abfraction is the basic cause of all NCCLs, whereas Lee and Eakle[8] proposed a multifactorial etiology, with a combination of occlusal stress, abrasion, and erosion.

Spranger[11] supported the multifactorial etiology of the cervical lesions and suggested that the wear was related to the anatomy, the distribution of forces calculated from elastic deformation studies, development of caries, and occlusion and parafunction.

Grippo[12] has defined abfraction as the pathological loss of tooth substance caused by biomechanical loading forces that result in flexure and failure of enamel and dentin at a location away from the loading. He first used the term abfraction to refer to a process of cervical tooth structure loss, based on work completed by McCoy[7] and Lee and Eakle.[8]

**Theory of Abfraction**

The theory of abfraction is based primarily on engineering analyses that demonstrate theoretical stress concentration at the cervical areas of teeth[13]. Few controlled studies demonstrate the relationship between occlusal loading and abfraction lesions. The role of occlusal loading in NCCLs appears to be part of a multifactorial event that may not necessarily follow the proposed classic abfraction mechanism.

Nearly all the research on the relationship of occlusal forces (bruxing) to cervical lesions shows that teeth do, indeed flex in the cervical region under bruxing loads, but none seems to cite actual damage caused by this deformation without an abrasive or erosive component applied as well. Nevertheless, the abfraction theory argues that bruxing forces alone can cause the erosion of the tooth structure on buccal surface, especially in the cervical region.

Many dispute the theory of abfraction, blaming this type of damage on what is commonly called "toothbrush abrasion".[8] This harks back to the early work of W.D. Miller in 1917, however it has been confirmed by more recent studies by T.C. Abrahamsen[14] which have shown that toothpaste (not the toothbrush) is abrasive enough to cause this type of damage if the patient is too aggressive in brushing the teeth in a very hard and vigorous "sawing" motion. Abrahamson suggests that the term "toothbrush abrasion" be replaced with the term "toothpaste abuse".[8,14]

His studies using mechanical "tooth brushing" machines have shown that the toothbrush alone does not cause this type of tooth damage, but the addition of toothpaste to the bristles does. Toothbrushes without toothpaste do cause soft tissue damage and indeed, overly vigorous tooth brushing without toothpaste leads to gingival recession.[14]

Grippo[2] has suggested that abfraction is the basic cause of all NCCLs. There is some evidence supporting the tooth flexure theory: presence of class V non-carious lesions in some teeth but adjacent teeth (not subjected to lateral forces) are unaffected;[12-13] the lesions progress around restorations that remain intact and under the margins of complete crowns;[12] the lesions are rarely seen on the lingual aspect of mandibular teeth.[13] However, other studies have proposed a combination of occlusal stress, parafunction, abrasion, and erosion in the development of lesions, leading to a conclusion that the progression of abfraction may be multifactorial.[11,15] Thus the theory of abfraction is not yet proven.

**Clinical Features**

Abfraction lesions present primarily at the cervical region of the dentition and are typically wedge-shaped, with sharp internal and external line angles. Subgingival lesions have also been observed.In theory, the shape and size of the lesion are dictated by the direction, magnitude, frequency, duration and location of forces that arise when teeth come in contact.[16]

Lee and Eakle[8] first described the characteristics of the lesions resulting from tensile stresses. They concluded that an abfraction lesion should be located at or near the fulcrum in the region of greatest tensile stress concentration, be wedge-shaped, and display a size proportional to the magnitude and frequency of tensile force application.

They proposed that the direction of the lateral forces acting on a tooth determines the location of the lesion. Two or more lateral forces result in an NCCL composed of two or more overlapping wedge-shaped NCCLs. Abfraction is postulated to be responsible for chronic sensitivity of the teeth to cold foods and liquids.[8,17]

Tooth Wear Index proposed by Smith and Knight[18] is the most accepted index to categorize tooth wear in the cervical region and it is as follows:

The classifications on this index are as follows:

0 = no change in contour;
1 = minimal loss of contour;
2 = defect < 1 mm deep;
3 = defect 1 mm to 2 mm deep;
4 = defect > 2 mm deep, or pulp exposure, or exposure of secondary dentin

**Treatment**

Determination of activity of abfraction lesion can be done by using 12 scalpel blade. Loss of scratch made by the blade signifies active abfraction lesion. In an attempt to reproduce the phenomenon of stress distribution in teeth and their anatomic support structures, a variety of methodologies have been used.The engineering studies cited by McCoy[19] and Lee and Eakle[15] employed finite elemental analysis (FEA), or photoelastic methods. They used computerized geometric or plastic models, respectively. By using FEA, each factor can be rapidly modified and the stress distribution can be investigated in two-dimensional (2D) or three-dimensional (3D) models.[19-20]

When abfraction lesion is less than 1mm in depth[17], only monitoring at regular intervals is enough. Restoring NCCLs improves the maintenance of oral hygiene by the patient. It also helps in decreasing thermal sensitivity, improving esthetics and strengthening the teeth. Along with restoration, a variety of treatment strategies have also been proposed like occlusal adjustments, occlusal splints, elimination of parafunctional habits,[21] altering toothbrushing techniques etc.

For restoring abfractions, many materials and techniques have been tried till date. The following materials are indicated for restoring the lesions: Glassionomer cements (GICs), Resin-Modified GICs (RMGICs), Polyacid-modified resin-based composites (compomers), composites resins and a combination of the techniques.[22-24] According to Tay[25], RMGIC should be the first preference. RMGIC/ GIC liner or base with resin composite should be used wherever aesthetics is concerned. Matis et al[26] found that retention was same for GIC and microfilled resin. GICs have been found to perform better than the composites because of their greater resilience allowing the material to flex with the tooth. RMGICs give better esthetic results than conventional GIC.

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# CASE REPORT

## MANAGEMENT OF INTRINSIC DISCOLORATION - ADVANCED TREATMENT OPTIONS: CASE REPORT

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**SUMMARY:** Aesthetics of the teeth is of great importance to patients, including tooth color. Of the various causes of tooth discoloration fluorosis, enamel hypoplasia, medication staining etc. is commonly encountered. The treatment options for discoloration are varied depending on individual case basis. The purpose of this article is to report the advanced treatment options for generalized intrinsic discoloration encompassing power bleaching to veneers to full mouth rehabilitation with porcelain laminates and ceramic crowns.

**KEYWORDS:** Intrinsic discoloration, fluorosis, tetracycline staining, bleaching, veneers.

**INTRODUCTION:** Today's dental patients are better educated than in the past as various media have provided our patients with insights on the latest advances and research. One major area that our patients are requesting more information on is esthetic dentistry. Dental services to enhance personal appearances have increased over recent years. Patients are also no longer satisfied with simple bleaching procedures and insist on pearly white teeth as the final outcome.[1]

The type of treatment instituted for patients with discoloration depends on patient's motivation towards dental treatment, the depth of discoloration and expectation of outcome.[2] Here, three case reports are presented of patients with different degrees of discoloration and expectation of outcomes treated by power bleaching, composite veneers and porcelain veneers and full crowns respectively.

**CASE REPORT A:** A patient named Dijeesh aged 26 reported with a complaint of severely discolored teeth. He presented a history of discoloration since childhood. On examination the case was diagnosed as moderate to severe fluorosis according to Dean's fluorosis index. [Fig.1 (A)]

The case was treated by Power bleaching using Laser power and 35% hydrogen peroxide as bleaching agent.[3, 4] Following oral prophylaxis, isolation was achieved using Opal dam and tissue retractors. Vaseline was used on the lips. Isolation from the caustic acid is of utmost importance in power bleaching. In this technique, laser light activates the bleaching agent. A fresh mix of gel was placed over the teeth and left in cycles of 10 mins each. [Fig 1(B)] The gel was suctioned off the teeth and the teeth wiped using damp gauze. A further fresh mix was then applied, activated and left for the same length of time. [5] At the end of three activation cycles of 10mins each, the patient was happy with the results [Fig 1(C)].

**CASE REPORT B:** Manohar, aged 28, reported to our hospital with a complaint of rough discolored teeth. On examination the case was found to be moderate to severe fluorosis according to Dean's fluorosis index with pitting and banding of enamel observed. [Fig.2 (A)]

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Treatment was carried out by giving direct composite resin veneers from 13 -23 because of the time and financial constraints of the patient and his expectation out of the treatment for smoother whiter teeth [6]. Bleaching was not an option in this case due to the surface roughness and banding present which dictated an invasive procedure[7]. The treatment involved veneer preparation (window preparation)[8], [Fig 2(B)] etching and bonding with Prime & bond followed by buildup using nano-composite ceram-X duo (Dentsply India) and polishing with Super snap (Shofu Inc., Japan). The patient got the desired result and was satisfied with the treatment. [Fig 2(C)]

**CASE REPORT C:** Patient named Shabbir, aged 29 reported with a complaint of severely discolored teeth. He was aware that his discoloration was due to the medication Tetracycline. On examination severe brownish to bluish discoloration of tooth with banding was observed. [Fig 3(A)].

The discoloration was generalized and the patient had high expectations out of the treatment with respect to alteration of the esthetics. Hence the treatment plan was construed to go ahead with Porcelain laminates for the upper anteriors from 13-23 and all-ceramic crowns for the lower anteriors 33-43 and first premolars as his occlusion was not favorable for laminates with lower.[9, 10] Pre operative impressions were taken, veneer and crown preparations were carried out followed by temporaries given on the same day[11].The veneers and crowns were luted in the next sitting using Rely X U-100 adhesive resin cement[12].[Fig 3(B)] The patient got the desired results and was happy with the treatment.[Fig 3(C)]

**DISCUSSION:** In case A, power bleaching was opted for as it gives immediate results in about an hour. In this technique, heat source, is replaced with plasma arc lamps, LED lights, or lasers. The dentist here has complete control throughout the procedure and is able to stop when the desired shade is achieved. Power bleaching works by the permeation of oxygenating per hydroxyl free radicals through enamel micro pores along a diffusion gradient and into the dentine where it oxidizes the stains and thereby bleaches the teeth.[3, 4] The main advantages of this technique are that it produces immediate results and avoids problems with home bleaching procedures such as gag from trays and there is no problem of distaste as for home bleaching gel. The biggest disadvantage is the caustic nature of the 35-50% hydrogen peroxide. The need for a meticulous protocol in handling, applying, removal and disposal of these materials is essential.[5]

In case B, Because of the time and financial constraint given by patient, direct composite veneer treatment option was selected[6]. Veneers have been successfully employed for management moderate grade fluorosis. Advantage of direct composite veneer is that it is done with minimal chair time compared to indirect veneers. The only disadvantage being its wear & color stability which the patient was made aware of, that it might have to be replaced over the years [8].

In case C, patient had severe discoloration and a high motivation to undergo the best treatment. The treatment of restoring severe tetracycline discoloration patients with porcelain laminates and metal free crowns requires careful preparation.[12] Sensitivity of the teeth should be observed for and preparation should be limited to minimal depth required. It is very important to ask the lab to place a masking layer while fabricating the laminates. Bleaching prior to tooth preparation is also an option in case of mild discoloration.[9] Advantage of this procedure is that the desired aesthetic results and functional efficiency is achieved on a long term basis.

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In each of the treatment options described above, each one has its own advantages and disadvantages. A good clinician should be aware of all the treatment options available, assess its merits and demerits and select the best treatment option according to individual patient needs and desires.

**CONCLUSION:** Intrinsic discoloration of teeth is a major aesthetic problem. Our society tends to dislike yellowing of teeth that comes with age or stains. White teeth are not only attractive but are also indicative of nutritional health, self-esteem & hygiene[1]. The purpose of this article was to report various advanced treatment options for discolored teeth from a conservative bleaching management to extensive full veneer/crown restorations. So it is in the interest of both patient and dentist that the dentist be aware of all the treatment modalities available to us. Newer treatment options which combine these various treatment modalities are also emerging. However, the severity of the lesion alone determines the treatment option.

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**Fig. 1: Intraoral photograph showing Laser Bleaching.**


**Fig. 2: Placement of Composite veneers.**

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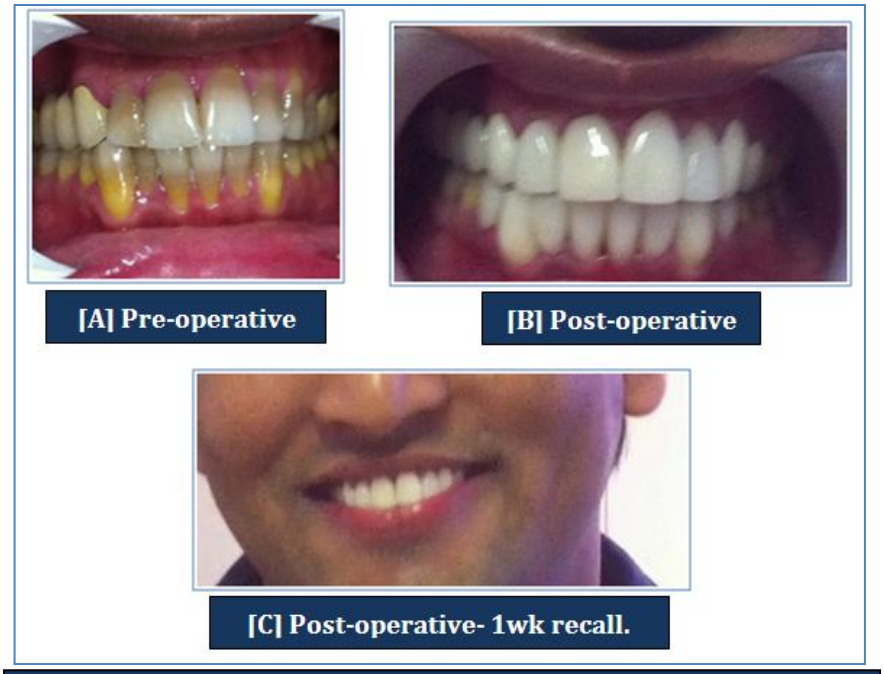


**Fig. 3: Treatment of Tetracycline staining – Porcelain veneers.**

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