
# ISTANBUL AYDIN UNIVERSITY
# JOURNAL OF THE FACULTY OF DENTISTRY
# AYDIN DENTAL

**Year. 1 Number. 1 - 2015**

# ISTANBUL AYDIN UNIVERSITY
# JOURNAL OF THE FACULTY OF DENTISTRY
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**ISSN: 2149-5572**

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**Dili - Language**
English - Türkçe

**Yayın Periyodu - Publication Period**
Published twice a year
April and October

**Yazışma Adresi - Correspondence Address**
Beşyol Mahallesi, İnönü Caddesi, No: 38 Sefaköy, 34295
Küçükçekmece/İstanbul **Tel:** 0212 4441428 - **Fax:** 0212 425 57 97
**web:** www.aydin.edu.tr - **e-mail:** dentaydinjournal@aydin.edu.tr

**Baskı - Printed by**
Matsis Matbaacılık, Teyfikbey Mahallesi, Dr.Ali Demir Caddesi No: 51
34290 Sefaköy/İSTANBUL **Tel:** 0212 624 21 11 - **Fax:** 0212 624 21 17
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*İstanbul Aydın Üniversitesi, Diş Hekimliği Fakültesi, Aydın Dental Dergisi özgün bilimsel araştırmalar ile uygulama çalışmalarına yer veren ve bu niteliği ile hem araştırmacılara hem de uygulamadaki akademisyenlere seslenmeyi amaçlayan hakem sistemini kullanan bir dergidir.*

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*Sayın Aydın Dental Journal okurları,*
*2015 yılında Mütevelli Heyeti Başkanımız Sn. Dr. Mustafa AYDIN, Rektörümüz Sn. Prof. Dr. Yadigar İZMİRLİ ve Dekanımız Sn. Prof. Dr. Sabri Hasan MERİÇ himayesinde bilimsel araştırma ve yayın ilkelerine bağlı olarak yayınlanacak olan Aydın Dental Journal dergisi yılda iki kez Türkçe ve İngilizce dilinde olmak üzere kesintisiz olarak yayın hayatına başlamıştır.*

*Günümüzde diş hekimliği, son teknolojiye ve gelişen bilime dayalı, devamlılık arz eden bir bilim dalı haline gelmiştir. Bu gelişmeler doğrultusunda, dergimiz diş hekimliği biliminde yurt dışından ve yurt içinden akademisyenlerin ve diş hekimlerinin kendi araştırmalarını ve deneyimlerini paylaşabilecekleri bir ortam yaratacaktır. Hedefimiz kısa süre içinde geniş katılımlarla yüksek bilimsel seviyeye ulaşıp, dergimizin uluslararası indekslerde yer almasını sağlamak ve üniversitemizin adını bu alanda da duyurmaktır.*

*Gelecek sayılarımızda davetli yazar, derleme, özgün araştırma ve olgu raporlarının yayımlanmasını sağlayarak geniş katılımlarla yüksek bilimsel seviyeye ulaşmayı amaçlamaktayız.*

*Derginin yayım aşamasında bilim kurulunda yer alarak engin mesleki bilgi ve tecrübeleri ile yüksek bilimsel kalitede araştırmaların yayımlanabilmesinde destek veren çok değerli hocalarımıza, yayım aşamasında desteklerini esirgemeyen Sn. Prof. Dr. Ahmet Metin GER ve ekibine ve aynı zamanda tüm akademisyen arkadaşlarıma teşekkür eder, dergimizin yayın hayatının başarılı olmasını dilerim.*

***Saygılarımla,***
***Prof. Dr. Jülide ÖZEN***
***Aydın Dental Journal Editörü***

# *Message of the Editor;*

*Dear Aydin Dental Journal Readers,*
*The Journal of Aydin Dental, as being sticked to scientific and inquisitive publication principles, has just started to be published bi-annually under the auspices of our honorable Head of Trustees Dr. Mustafa Aydın, President Prof. Dr. Yadigar Izmirli and Dean Prof.Dr. Sabri Hasan Meric.*

*The dentistry has become a scientific field of study which complies with current technological developments and requires sustainment. In the light of these recent developments, our journal will create an opportunity to the academicians, either from Turkey or abroad, to share their studies and outcome of researches about the dentistry. Our goal is to reach the highest scientific level by achieving wide-ranging participation as soon as possible which will enable our journal to be listed among international indices journals and also contribute to the recognition of the Istanbul Aydin University worldwide.*

*We aim to publish the articles of various guest authors, compilations, peculiar researches and case reports which will lead us to highest scientific levels through a widespread participation in our future issues.*

*I appreciate the contributions of our valuable teachers who strived vigorously for the publication of high level scientific quality Journal of Aydin Dental by being part of the scientific committee during the publication period through their immense knowledge and experience. Also, special thanks to our honorable teacher Prof. Dr. Ahmet Metin Ger and his team members including whole academician colleagues who contributed to the journal. I wish a successful, long lasting publication lifespan to our journal.*

***Best regards,***
***Prof. Dr. Jülide ÖZEN***
***Editor of Aydin Dental Journal***

# *Yumuşak Dokunun Estetik Tedavi Planındaki Yeri*

***Korkud DEMİREL*[1]**

*Estetik açıdan periodontal değerlendirme:*
"Sağlam kafa sağlam vücutta bulunur"[1] deyişi gibi estetik değerlendirme yapabilmek için önce dokuların sağlıklı olması gerekmektedir. Diş eti kanamaları, mikrobiyal dental plak varlığı ve Diş etinde iltihabi süreçten kaynaklanan renk ve yapı değişiklikleri bir taraftan estetik beklentilerin karşılanmasını olanaksız kılmakta, diğer taraftan elde edilecek olası başarının zaman içerisinde korunabilmesini imkansız hale getirmektedir. Estetik değerlendirmelere geçilmeden önce söz konusu bölgede sondalanabilir cep derinliklerinin vestibül ve palatinal yüzlerde 3mm yi geçmiyor olması, ara yüzlerde ise en fazla 4mm olması gerekmektedir. Diş eti sağlığının değerlendirilmesinde ikinci aşamada sondalama sonrası cep içerisinden kanama olmaması ve Diş eti kenarında renk değişikliği ve kanama bulunmaması gerekmektedir. Periodontal hastalığın olduğu durumlarda estetik değerlendirmelere geçilmeden önce hastalığın ortadan kaldırılması gerektiği unutulmamalıdır.

*Dudakların sınırları ve gülme hattının seviyesi:*
Normal gülme hattı kavramı gülümseme sırasında üst dudağın konumu belirler. Haliyle Diş eti kenarının konumu gülümseme sırasında görülecek Diş eti miktarını etkileyecektir. Gülümseme sırasında orta keser ve köpek dişlerinde diş eti kenarının dudak tarafından örtülmesi ve yan keserlerde 1-2mm Diş eti kenarının açığa çıkması normal olarak kabul edilir (Resim 1a). Gülme hattının zaman içerisinde apikale doğru konum değiştirdiği ve normal olan bir gülme hattının zaman içerisinde düşük gülme hattına (Resim1 b) dönüşeceği unutulmamalıdır. Gülümseme sırasında orta keser ve köpek dişlerinde diş etlerinin ortaya çıkması ise yüksek gülme hattı olarak isimlendirilir (Resim 1c).

***Resim 1.*** *a,b,c: Gülme hattının belirlenmesinde Vermillon hattı ile üst ön bölgede serbest diş eti kenarının ilişkisi dikkate alınmaktadır. Normal gülme hattı yaşın ilerlemesi ile dikey yönde yer değiştirir.*

*Diş etinin sınırları, simetrisi ve biyotipi:*
Klinik kuronun en tepe noktasına *Zenith* noktası denilmekte ve bu nokta her zaman klinik kuronun mesiyal-distal yönde orta noktasına denk gelmemektedir[2] (Resim 1). Diş eti kenarının oluşturduğu çizgi orta hat rehber alındığında simetri oluşturmaktadır ve simetri orta hatta yaklaşıldığında

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daha fazla önem kazanmaktadır. Diş eti kenarı biyotipine bağlı olarak derin kavisler çizebilir veya daha ziyade düz bir çizgiyi andırabilir. Diş etinin biyotipi doku kalınlığının ölçülmesi ile belirlenir ve ince, normal, kalın olmak üzere alt gruplara ayrılır (Resim 1). Diş etinin biyotipi estetik uygulamalarda önemli olduğu kadar diş etinin sert fırçalama, subgingival kuron kenarı sonlanması veya kötü ağız bakımı gibi kronik bir uyarana vereceği yanıtın tahmin edilmesinde de önem taşımaktadır. İnce biyotipe sahip bölgelerde doku kronik irritasyona her zaman diş eti çekilmesi ile yanıt verir.

***Resim 1.*** *Klinik kuronun en tepe noktasına Zenith noktası denilmektedir. Şekilde siyah çizgi ile işaretlenen bu noktalar orta keser dişlerde ve kaninlerde klinik kuronun orta noktasına denk gelmemekte, sadece yan keser dişlerde her iki nokta çakışmaktadır.*

*İnterdental papil:*

İnterdental papil alveol kemiği, dişlerin ara yüz duvarları ve birbirleri ile temas noktaları tarafından oluşturulan boşluğu dolduran diş eti dokusudur. Ön dişlerde papilin varlığı dişler arasındaki temas noktası ve alveol kemiği arasındaki mesafe ile yakından ilişkilidir [3] (Şekil 2). Özellikle protetik uygulamalarda biyolojik sınırları zorlamadan papilin eksik olduğu bölgelerde interdental alanın daraltılmasıyla papilin boşluğu doldurması sağlanabilir.

*Diş etlerinde sık karşılaşılan estetik sorunlar:*
Estetik sorunların ortaya çıkmaması için restoratif işlemlerde öncelikle biyolojik prensiplere dikkat edilmeli ve bireyin ağız bakımı işlemlerini gereğince yapması sağlanmalıdır. Ancak kötü alışkanlıklar, aksamış ağız bakımı, iatrojenik nedenler ve gelişimsel nedenlerle de dişetlerinin ve dolayısı ile ağızın görüntüsü istenmeyen değişimler göstermiş olabilir. Bu estetik sorunların tedavisinde etyolojinin doğru saptanması tedaviden elde edilecek yararı arttıracaktır. Diş etlerinin fazla görünmesi gelişimsel nedenlere iyi bir örnek oluştururken diş eti ve papil kayıpları zararlı alışkanlıklar ve kötü ağız bakımı sınıfına girmektedir.

*Diş etlerinin fazla görünmesi:*
Dişetlerinin gülümseme sırasında fazlasıyla görünmesinin nedenleri incelendiğinde dört ana başlık dikkat çekmektedir.

Üst dudak yetersizliği, fazla gelişmiş üst çene, gecikmiş pasif sürme, dikey boyut kompensasyon sürmesi. Bunların arasında gecikmiş pasif sürme ve dikey boyut kompensasyon sürmesi kuron boyu uzatma işlemleri ile değişen miktarlarda ortadan kaldırılabilir. İskeletsel bir sorun olan maksillanın fazla büyük olması dikey yüz oranlarını etkilemekte ve orta yüz yüksekliğinin artmış olması ile karakterizedir. Bu bireylerde sadece gülme sırasında dişetleri görünmekle kalmayıp dinlenme halinde ve konuşurken de dişetleri dikkat çekmektedir.

İskeletsel bir sorun olması nedeni ile tedavisinde ortodontik ve ortognatik cerrahi yaklaşımlar önem kazanmaktadır. Kuron boyu uzatma işlemleri ve protetik işlemler ile düzeltilmesi olanaksızdır.

Dişlerdeki malpozisyonlar dişetlerinin fazla görünmesinde diğer bir nedendir ve yaygın olduğu olgularda ortodontik tedavi doğru yaklaşım olarak kabul edilmektedir. Ancak bazı olgularda özellikle tek dişi ilgilendiren minör malpozisyonlarda kuron boyu uzatma işlemi ve protetik uygulamalarla sınırlı yarar elde edilebilir.

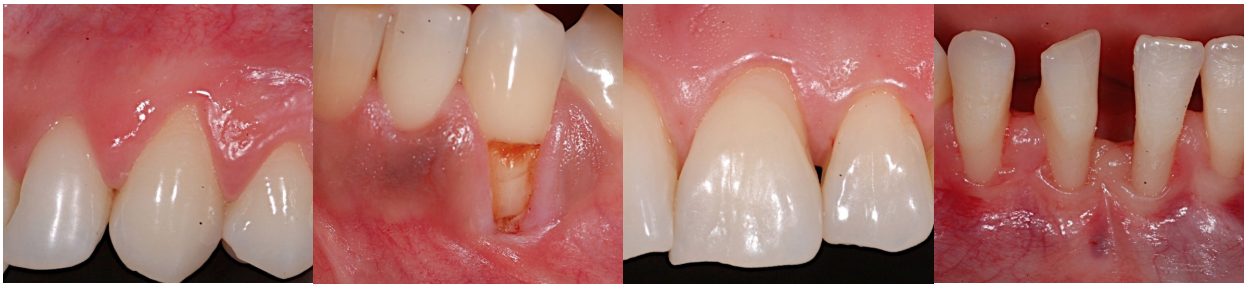
Yüksek gülme hattının en sık karşılaşılan nedenleri arasında gecikmiş pasif sürme değerlendirilmelidir. Aktif sürme tamamlandıktan sonra diş eti kenarı apikale doğru yer değiştirir ve mine sement sınırından 1 mm kuronalde veya tam sınır üzerinde nihai konumuna yerleşir[4]. Bazı bireylerde aktif sürmenin tamamlanmasına karşın diş eti kenarının bu apikale doğru migrasyonu gerçekleşmez. Sonuç olarak bu bireylerde dişetlerinin fazla görünmesi estetik soruna yol açar (Resim 2).

***Resim 2.*** *Tip1 gecikmiş pasif sürme olgusu. Dişlerde kare görüntü, iltihap olmamasına karşın diş eti kenarında kalınlaşma bu tür olgularda tipik klinik bulgulardır.*

Gecikmiş pasif sürme sonucu gerçekleşen bu estetik sorunun tedavisinde kuron boyu uzatma cerrahisi uygulanmaktadır. Gecikmiş pasif sürme iki klinik tipe ayrılmaktadır [5]. Her iki tipte de diş eti kenarı mine sement sınırının kuronalinde yer almakla birlikte Tip 1 gecikmiş pasif sürme olgularında geniş bir yapışık diş eti şeridi olmasına karşın Tip 2 olgularında mukogingival sınırın kuronalde yer alması nedeniyle yapışık Diş eti alanı daralmakta ve cerrahi işlem sırasında yapışık diş eti miktarının korunmasına özen göstermek gerekmektedir.

*Diş eti çekilmeleri:*

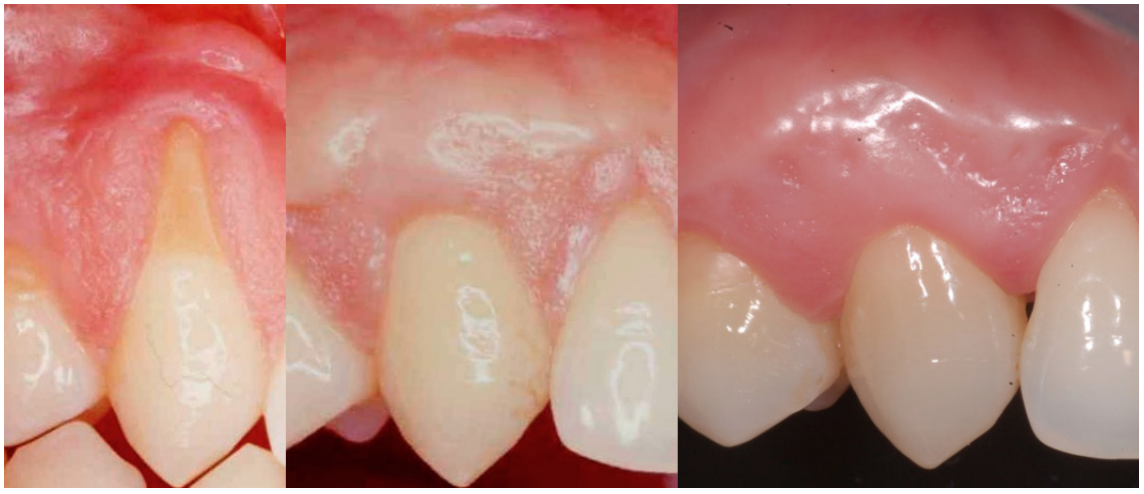
Diş eti çekilmelerinin etyolojisinde kronik mekanik travma olabildiği gibi periodontal hastalık sonucunda da diş eti çekilmeleri ile karşı karşıya kalınmaktadır. Etyolojisinden bağımsız olarak diş eti çekilmelerinin sınıflamasında kullanılan bir sistem[6] hem çekilmenin niteliğini belirlemekte, hem de tedaviden sonra çekilmenin ne kadar kapatılacağı konusunda bilgi vermektedir (Resim 3).



**a** **b** **c** **d**

***Resim 3.*** *Diş eti çekilmelerinin sınıflaması:*
***a)*** *Tip1. Diş eti çekilmesi mukogingival sınıra ulaşmamıştır ve interdental alanda yumuşak doku ve alveol kemiği kaybı görülmemektedir. Bu tip çekilmelerde kök yüzeyinin cerrahi yöntemlerle tamamen kapatılması beklenir.*
***b)*** *Tip 2. Diş eti çekilmesi mukogingival sınıra kadar ulaşmış veya geçmiştir ancak interdental alanda yumuşak doku ve alveol kemiği kaybı görülmemektedir. Bu tip çekilmelerde de kök yüzeyinin cerrahi yöntemlerle tamamen kapatılması beklenir.*
***c)*** *Tip 3. Diş eti çekilmesi mukogingival sınıra kadar ulaşmış veya geçmiştir. İnterdental alanda yumuşak doku veya alveol kemiği kaybı mevcuttur veya kök yüzeyinin örtülmesini engelleyebilecek kadar konum bozukluğu vardır. Bu tip çekilmelerde de kök yüzeyinin cerrahi yöntemlerle tamamen kapatılması beklenmez ve kısmi örtülme elde edilebilir.*
***d)*** *Diş eti çekilmesi mukogingival sınıra kadar ulaşmış veya geçmiştir. İnterdental alanda yumuşak doku veya alveol kemiği kaybı görülmekte ve/veya kök yüzeyinin örtülmesine engel miktarda dişte konum bozukluğu vardır. Bu tip çekilmelerde de kök yüzeyinin cerrahi yöntemlerle kapatılması beklenmez.*

Diş eti çekilmelerinin tedavisinde kullanılan yöntemler arasında saplı ve sapsız greft operasyonları, yönlendirilmiş doku rejenerasyonu ve rezorbe olan biyomateryaller yaygın şekilde kullanılmaktadır. Kullanılan yöntemler arasında subepitelyal bağ dokusu greftinin başarısı en yüksek olarak belirlenmekte ve doku renk uyumunun en iyi olduğu bilinmektedir [7-8] (Resim 4).



***Resim 4.*** *Tip 2 Diş eti çekilmesi. Her ne kadar çekilme mukogingival sınırı aşmış olsa da interdental alanda yumuşak ve sert doku kaybı olmaması tedavide tam başarıyı mümkün kılmıştır. Subepitelyal bağ dokusu grefti ile örtülen kök yüzeyi tedaviden 7 yıl sonra da, 15 yıl sonra da diş eti ile örtülü kalmış ve diş eti konumu hiç değişmemiştir.*

*İnterdental papil kayıpları:*

Estetik periodontal zorluklar arasında en önemli yeri tutan ve aynı zamanda da tedavisi en güç olan sorunların başında papil kayıpları gelmektedir. Papil kayıplarının etyolojisinde periodontal hastalıklar başı çekmekte ardından hatalı protetik uygulamalar ve hastanın kürdan kullanmak gibi kötü alışkanlıkları gelmektedir. Papil kayıplarının ortadan kaldırılmasında periodontal veya protetik yöntemlerden biri veya her ikisinin beraber kullanılması tercih edilebilir (Resim 5).

***Resim 5.*** *Papil kayıplarının tedavisinde sıklıkla subepitelyal bağ dokusu greftleri kullanılmasına karşın başarı her-zaman elde edilememektedir. Başarıyı olumsuz etkileyen faktörlerin başında ince diş eti biyotipi gelmektedir.*

Periodontal teknikler içerisinde papilin hacmini arttırmaya yönelik sapsız doku greftleri kullanılırken alveol kemiğin hacmini arttırmaya yönelik kemik dokusu greftleri nadir de olsa kullanılmaktadır.

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# *Effect of Tooth Whitening (Bleaching) Agent on Dentin Microhardness*

***H. Miray UYAN*[1]**
***Sema YILDIRIM*[2]**

**Abstract**

**Objectives:** The aim of this study is to investigate the effect of whitening agents on dentin micro hardness.

**Materials and methods:** 60-incisor maxillary (20 per group) tooth were applied root chanel treatment: one is control group and the others are applied to whitening products namely, whiteness super endo (Dentscare LTDA;37% Carbamide peroxide) and opalescence endo(Ultradent,USA;35% Hydrogen peroxide). Whitening agents were applied in every four days for 12 days. Hardness assessed by using Vickers test, after the end of treatment. Scanning electron microscopy (SEM) analyses performed after the end of bleaching treatment.

**Results:** The results show that the micro hardness decreased for both agents; where as, the micro hardness of whiteness superendo is less than opalescence endo.

***Keywords:*** *dentin micro hardness, intracoronal bleaching, whitening agent*

## Diş Beyazlatma Ürünlerinin Dentin Mikrosertliğine Etkileri

**Özet**

**Amaç:** Bu çalışmanın amacı diş beyazlatıcı ürünlerin dentin mikrosertleşmeleri üzerine etkilerini incelemektir.

**Materyel ve Yöntemler:** 60-kesici maksiller (grup başına 20 adet) dişe kanal tedavisi uygulanmıştır. Bir tanesi kontrol olmak üzere, diğerlerine sırasıyla şu beyazlatıcı ürünler uygulanmıştır. whiteness super endo (Dentscare LTDA;37% Karbamid peroksit) ve opalescence endo (Ultradent,USA;35% Hidrojen peroksit). Beyazlatıcı ürünler 12 gün süreyle, her 4 günde bir kez uygulanmıştır. Tedavinin sonunda sertleşme Vickers testi ile değerlendirilmiştir. Beyazlatıcı tedavinin sonunda Taramalı elektron mikroskobu ile (TEM) değerlendirmeler yapılmıştır.

**Sonuçlar:** Sonuçlar, her iki ürünün de mikro sertleşmeleri azalttığını göstermekle birlikte; whiteness superendo' nun mikro sertleşmeleri opalescence endoya göre daha azdır.

***Anahtar Kelimeler:*** *Dentin mikro sertleşmeler, intrakoronal beyazlatma, beyazlatıcı ürün*

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## 1. Introduction

The whiteness of the teeth is always an essential element of health and esthetics (1). Since the importance of esthetic considerations increasing nowadays, giving the natural appearance of the tooth to the patient by restoration has been one of the most important issues of modern dentistry (2).

Various factors can be the cause of coloration of the teeth. This situation occur direct discoloration of enamel dentin or reflection of discoloration of dentin from semi-transparent enamel (3). There are wide variety of chemical agent were used for many years to treat the discoloration of enamel dentin (4).

The bleaching agents, a more conservative method, has become a good alternative for restoration the natural color of stained teeth, instead of prosthetic applications, such as; crown and veneer. Since often usage of tooth whitening applications, there are many clinical studies has made in order to evaluate the efficacy, reliability and potential effect this method (5).

Whitening treatment is a method that aimed to reaction of the free oxygen, which emerge from whitening agents with colored molecules in order to return the natural color of the teeth(6). The most common materials used for bleaching; hydrogen peroxide, sodium perborate, and carbamide peroxide which is usually used for extra coronary bleaching where as; sodium perborate is also used for the intracoronary bleaching.

It is believed that the bleaching also causes increased brittleness of the coronal tooth structure because of desiccation of the dentin and enamel(7). However, this has not been proven conclusively because little is known about the effect of bleaching on the biomechanical properties of teeth. Since dentin constitutes a major part of the tooth structure, any change in the biomechanical properties of dentin after bleaching is likely to have an impact on the overall strength of the tooth (8).

Many studies have looked at the various biomechanical properties of dentin and some of more commonly studied properties include micro hardness and strength properties, such as tensile strength and shear strength(9). A number of recent studies have compared the biomechanical properties of dentin from vital teeth. The results of these studies indicated that endodontically treated teeth were not weaker than vital teeth. In contrast, the number of studies that examined the biomechanical properties of bleached dentin is very limited. Lewinstein et al. examined the effect of hydrogen peroxide and sodium perborate on the micro hardness of human dentin. Intact teeth were sectioned longitudinally and bleaching agents were applied to the polished dentin surfaces for up to 30 min. It was found that 30% hydrogen peroxide reduced the micro hardness of dentin after 5 min, but treatment with sodium perborate mixed with hydrogen peroxide did not alter the micro hardness of dentin at the of the observation period(10).

This study examined the effects of different bleaching agents on dentin and it is aimed to compare the results with each other.

## 2. Materials and Methods

Sixty intact human maxillary incisors extracted for orthodontic reasons were used. The teeth were placed in distilled water and the soft tissue attached to the root surface was removed with a scalpel. Endodontic access cavities were prepared using a diamond bur in a high-speed hand piece. The pulp tissue was removed ana a no.15 h type file was inserted into the root canal until the tip of the file was seen at the apical foramen. The working length was determined by subtract 1 mm from the length of the file. Cleaning and shaping was carried out using 1% sodium hypochlorite as the irrigant. The root canal was dried with paper points and filling with AH Plus and 15-40 gutha percha points. Cavit was packed into the root canal.

The teeth were randomly distributed into 3 groups, and applied different whitening agents, (Table1) Group 1, opalescense endo, 35% hydrogen peroxide -containing; Group 2, Whiteness super endo %37 carbamide peroxide-containing; Group 3, cotton pellet soaked with distilled water. Each tooth was stored in an individually labeled, capped plastic vial containing distilled water. The plastic vials were stored at 37 C for 12 days. After 12 days, the teeth were sectioned and dentine from the teeth was subjected to microhardness testing.

***Table 1.*** *Bleaching Agents*

| *Product Name* | *Opalescence Endo* | *Whiteness Super Endo* |
|---|---|---|
| Manufacturer | Ultradent Products | Dentscare LTDA |
| Manufacturer Contact Info | 505 West 10200 South, South Jordan, Utah 84095, USA | Av.Edgar Nelson Meister,474, Districo Industrial 89219-501-Joinville-SC |
| Active Substance | Hydrogen Peroxide | Carbamide peroxide, glycol, deionized water |
| Concentration (Approx) | % 35 | %37 |

The root of each was embedded in a block of acrylic resin, 2mm apical to the CEJ to facilitate subsequent sectioning and testing of the specimens. Each specimen was blotted dry and a vickers hardness test was performed using a digital variance was conducted on the data obtained. Data comparisons were conducted using Mann Whitney U tests. All statistical analyses were performed at the 0,05 level of significance.

During the experimental procedures, bleaching products were removed by suction and washed thoroughly with distilled, de-ionized water. After the bleaching procedures, samples were fixed with 2% glutaraldehyde, washed in distilled, de-ionized water, critical point dried and sputter coated with gold (120 s, 70 nm) for SEM analysis. Photomicrographs (3500-x magnification, 15 kV) were obtained from the samples and compared with group 3 by a single assessor, evaluating qualitatively the dentin surface for alterations.

## 3. Results

According to the statistical analysis, the microhardness of the control group was higher than both Opalescence Endo and Whiteness Super endo, where as; the maximum reduction in microhardness has noticed in the Whiteness Super Endo group.

The result, which is obtained by evaluation of dentin microhardness, is the proof of mineral loss or earnings on the hard tissue of tooth. There is a positive correlation between microhardness and mineral structure of teeth. Although reduction in the microhardness could decrease the fragility, when it comes to fragility of teeth there are many other factors, which should take in to consideration. Reduction in microhardness due to mineral loss in dentin, can cause weaken teeth and increase the tendency to tooth decay which is the major cause of increased the fragility of the teeth.

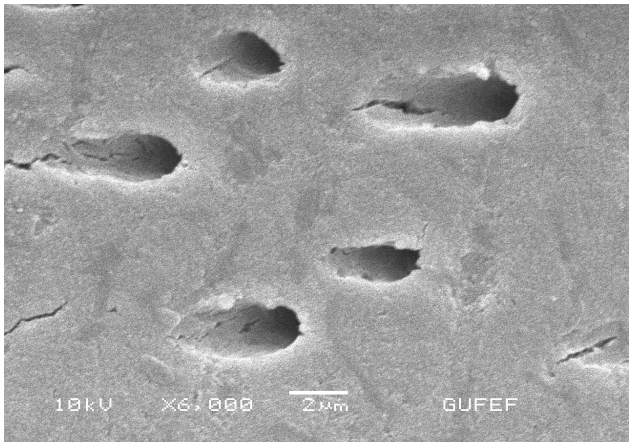


***Figure 1.*** *Control Group*

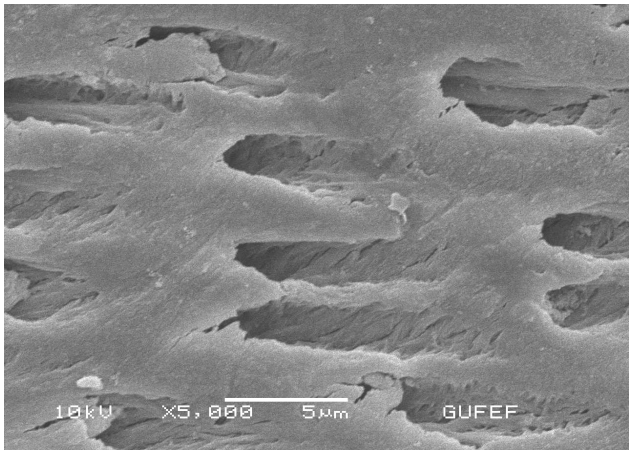


***Figure 2.*** *Opalesence Group*

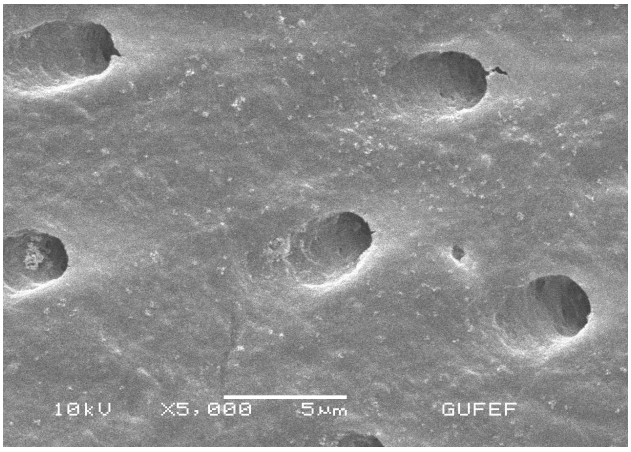


***Figure 3.*** *Whiteness Super endo Group*

It is observed that, a deep erosion area formed on the dentine tubule, due to the effect of bleaching agents, which could be the main reason for mineral loss of dentin and also reduction of microhardness which cause increase of the fragility and tendency of tooth decay.

## 4. Discussion

Various studies have shown that hydrogen peroxide, especially in high concentration, affects the biomechanical properties of dentine even after exposure for a short period. Saleh & Ettman found that irrigation with 3% hydrogen peroxide and 5% sodium hypochlorite used alternatively and left for 60 s significantly reduced the microhardness of dentine(11).

Lewinstein et al. showed that the reduction in microhardness of dentine after treatment with 30% hydrogen peroxide was time-related. In their study, the specimens were assessed at 5, 15 and 30 min after application of hydrogen peroxide and significant, progressive reduction in microhardness was observed (12).

Hydrogen peroxide and Carbamide peroxide can cause a decrease in dentin microhardness during intracoronal bleaching. In this case, the degradation of morphological structure of the dentin and the deterioration of inorganic structure is an expected result.

Although the effect of whitening agents on the dentin are not fully understood, some studies reveal that, hydrogen peroxide cause the dissolution of the inorganic material of dentin, thus affect decrease in the calcium phosphor ratio, and loss of mineral on the organic matrix of dentin due to protein denaturalization. The hardness of dentin affected from the Ph of the whitening agents, buffer capacity of the dentin, and also the density difference of dentin tubules. Some researchers investigate the effect of whitening agents and conjunction use of these agents with materials that known to be effect on dentin microhardness.

Daniel pinto de Oliveira et al. studied on the differentiation of dentin microhardness when applied whitening agents alone and conjunction with chlorhexidine gel and find out that chlorhexidine jel has no effect on dentin microhardness. However, they find out that chlorhexidine gel can be used for an antimicrobial agent in cavity during intracoronal bleaching(13). Chng et al studied the effect of the different whitening agents with different concentration on the dentin microhardness, hydrogen peroxide, sodium perborate and carbamide peroxide with different concentration was used in this study, and results show that the highest rate of reduction on dentin microhardness observed with hydrogen peroxide 35 %, carbamide peroxide 35 %(14). Zalkind et al. had reported that there is a close relationship between the enamel dentin change and bleaching effect. Studies show that, whitening agent can change the mineral composition and also micro morphology of the enamel dentin thus reduction on dentin microhardness.

The linear relationship between the calcium and phosphor loss and reduction on dentin microhardness show that hardness measurements can be used as an indicator for the relationship between mineralization degree of enamel dentin and caries enamel. Mineral loss induced by bleaching agents, occurs under the enamel surface similar to initial caries lesions. This loss of mineral content is seen as an increase in range of enamel prisms, increase in surface roughness and increase of the adhesion of Streptococcus mutants. Hosaya et al reported that streptococcus mutants colonies increased on the whitened enamel dentin, after repeated bleaching sessions bacterial adhesion growth occurred, and the maximum number of bacterial colonies formed after five bleaching sessions followed by etching(15). Caries lesions affecting dentine enamel easily move toward tissues and can cause the deeper cavities. In addition to this, caries lesions formed on the whitened enamel tissue, due to extra coronal bleaching method, can also occur on the dentin tissue during intracoronal bleaching. Intracoronal bleaching application for the teeth, which were root canal treatment, progression of caries lesions is expected without causing pain. This situation would adversely affect restorations made after.

In order to achieve optimal results in the bleaching treatment, the structure and the concentration and also preventable side effect profile of whitening agent is also important. Although has no clinical symptoms, bleaching agents can cause a chemical and micro structural changes which affect the surface properties of teeth, the degree of mineralization, and probably the development of caries-like lesions should not be forgotten.

It is observed that different bleaching agents used in this study decrease the microhardness of dentin tissue. On the contrary, the hardness has been observed higher for none bleached teeth. Although decrease in the microhardness mainly reduces the fragility, in the case of teeth, other factors must be take in to consideration.

Teeth whitening procedure damage the tooth structure, which is irreversible. The fragility of the tooth, is related with the amount of water contained in dentin, mineralization, and change of the collagen and non-collagen proteins. Especially the bleaching agents, that contain peroxide, due to dissolution and decay in the structure of dentin collagen, that weakens the tooth structure, increase the tendency to caries, and thus increases the fragility.

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# *Evaluation of Microtensile Bond Strength of Conventional and New Generation Flowable Composite Resins to Dentın Wıth Different Adhesive Systems*

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**Abstract**

**Objective:** The purpose of this study was to evaluate the effect of conventional and new generation two flowable composite resins with three different adhesive systems on bond strenght to dentin by using the microtensile bond test.

**Material and Method:** Fourty two non-carious human third molars were sectioned parallel to the occlusal plane to expose occlusal dentin. The dentin surfaces were ground with 600-grid silicon carbide (SIC) paper. Teeth were randomly divided in to six groups (n=7). Group 1-Clearfil S$^3$Bond+ Clearfil Majesty Flow, Group 2-Clearfil SE Bond+Clearfil Majesty Flow, Group 3-Prime&Bond *NT* +Clearfil Majesty Flow, Group 4-Clearfil S$^3$Bond+ReFil SDR Flow, Gorup 5-Clearfil SE Bond+ReFil SDR Flow, Group 6-Prime&Bond *NT*+ReFil SDR Flow. The restored teeth were serially sectioned to obtain 1mm$^2$ sticks. Each stick was submitted to the microtensile test performed at a crosshead speed of 1mm/minute. One-way ANOVA, and Tamhane's tests were used to compare the data.

**Results:** The results indicated that Clearfil SE Bond showed higher microtensile bond strength when compared to the other adhesives in Clearfil Majesty Flow group ($p< 0.05$). Clearfil SE Bond and Clearfil S$^3$Bond showed similar microtensile bond strength ($p>0.05$) whereas microtensile bond strength of Prime&Bond NT was significantly decreased ($p<0.05$). However, in the comparision of the microtensile bond strength values of Clearfil Majesty Flow and ReFil SDR Flow groups adhesive, it was determined a statistically significant difference between two groups for the only Clearfil S$^3$Bond ($p<0.05$).

**Conclusion:** In the experimental conditions of this study it was seen that adhesive systems may have different effects on the bond strenght to dentine tissue.

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***Keywords:*** *Flowable composites, adhesive systems, microtensile bond strength, dentin.*

## Geleneksel ve Yeni Nesil Akışkan Kompozit Rezinlerin Farklı Adeziv Sistemler ile Dentine Mikrogerilim Bağlanma Dayanımlarının Değerlendirilmesi

### Özet

**Amaç:** Bu çalışmanın amacı, geleneksel ve yeni nesil iki akışkan kompozit rezinin üç farklı adeziv sistem ile dentine bağlanma dayanımı üzerine etkisini mikrogerilim bağlanma dayanımı test yöntemi ile değerlendirmektir.

**Gereç ve Yöntem:** Kırk iki adet çürüksüz insan üçüncü büyük azı dişin okluzal minesi kesilerek okluzal dentin açığa çıkarıldı. Dentin yüzeyleri, 600-grid silikon karbid kâğıtla (SIC) zımparalandı. Dişlerden rastgele altı grup oluşturuldu (n=7). Grup 1-Clearfil S$^3$Bond+ Clearfil Majesty Flow, Grup 2-Clearfil SE Bond+Clearfil Majesty Flow, Grup 3-Prime&Bond *NT* +Clearfil Majesty Flow, Grup 4-Clearfil S$^3$Bond+ReFil SDR Flow, Grup 5-Clearfil SE Bond+ReFil SDR Flow, Grup 6-Prime&Bond *NT*+ReFil SDR Flow. Restore edilen dişler, 1mm$^2$'lik çubuklar elde edilecek şekilde kesildi. Her bir çubuk, dakikada 1 mm hızla hareket eden cihazla mikrogerilme testine tabi tutuldu. Sonuçların karşılaştırılmasında tek-yönlü ANOVA, t ve Tamhane testleri kullanıldı.

**Bulgular:** Clearfil Majesty Flow gruplarında Clearfil SE Bond daha yüksek mikrogerilim bağlanma dayanımı göstermiştir ($p< 0.05$). ReFil SDR Flow grubunda ise, Clearfil SE Bond ve Clearfil S$^3$Bond'un mikrogerilim bağlanma dayanım değerlerinin, Prime&Bond NT'ye göre yüksek olduğu bulunurken ($p<0.05$), kendi aralarında bir fark bulunamadığı belirlenmiştir ($p>0.05$). Bununla birlikte, Clearfil Majesty Flow ve ReFil SDR Flow gruplarındaki adezivlerin mikrogerilim bağlanma dayanım değerlerinin karşılaştırılmasında yalnızca Clearfil S$^3$Bond için iki grup arasında istatistiksel olarak anlamlı bir farklılık gösterdiği tespit edilmiştir ($p<0.05$).

**Sonuç:** Bu in vitro çalışma koşullarında, adezivlerin dentine bağlanma dayanımı üzerinde farklı etkilere neden olabileceği görüldü.

***Anahtar Kelimeler:*** *Akışkan kompozitler, adeziv sistemler, mikrogerilim bağlanma dayanımı, dentin.*

## Introduction

In today's dentistry; increasing emphasis on aesthetic has brought a lot of research which is based on composite resins and adhesives systems.

The importance of the bonding between hard tissue of teeth with dental materials is great at the success of composite resins which has a wide application area in the posterior and anterior region. As opposed to the bonding to the enamel the bonding to the dentine continues to cause problem for dentists due to its tubular structure and the formation of smear layer during cavity preparation.[1,2]

Composite resins are being bonded to the dental tissues micromechanically by using new generation of adhesive systems with two different techniques; the total-etch and self-etch.[3,4] Producers tended to simplify the three-step total-etch adhesives, and have developed a two-step total-etch system due to difficulty of moisture control and surplus of application steps.[5,6] Self-etch adhesives have been developed to eliminate operator errors which occur during the usage of the total-etch adhesives by reducing the number of phases of the adhesive aplication and eliminating technique sensitivity. The mixing step is eliminated with the self-etch adhesives which have been developed in recent years, resin monomer, photoinitiator, tertiaryamine accelerator was collected in a singe bottle.[7,8]

The edge compliance has a critical importance for composite resin restoration to continue its performance for a long time. Polymerization shrinkage of the resin restorations can cause accumulation of stress in the bonding surfaces and separation between the tooth surfaces and adhesives. Gaps that are formed between the cavity walls and restoration material, can cause postoperative problems such as sensitivity, pulp damage and recurrent caries.[9,10] The application of flowable composite resins as a thin layer to cavity flour, is one of the proposed method to provide a full sealing between the cavity wall and composite restorations during the polymerization shrinkage.[11] In addition, the usage of flowable composite resin under the composite resin, has been determined to significantly increase the bonding strength.[12,13]

Researchers have used different test methods to measure the bonding strength of restoration materials and adhesive systems. Sano et al.[11] have introduced the microtensile bonding strength test for the first time in 1994. Stress can be measured in the 0.25 and 1mm² sample size with microtensile bonding strength test. In addition, higher bonding strength and a very low variation coeffient are measured with conventional shear and tensile tests. Thus the more reliable results are expected to occur. Many studies indicated that the bond strength could be measured in different regions and depths of the tooth at and also multiple samples could be tested from the same tooth.[11,14-16]

The purpose of this study was to evaluate the effect of conventional and new generation two flowable composite resins with three different adhesive systems on bond strenght to dentin by using the microtensile bond test.

## Materials and Methods

Fourty two non-carious human third molars extracted with periodontal reasons were used in this study. Teeth were stored in distilled water until to be tested after cleaning tissue debris on the teeth. Occlusal enamel was cut to be perpendicular to the long axis of tooth under water cooling with diamond bur by operating at low speed. 600 grid silicon carbide paper (SIC) was applied to the surface for one minute to obtain homogeneous smear layer on dentin surfaces that was uncovered. Teeth were randomly divided in to six groups (n=7). The adhesive systems and flowable composites which is used in the research are shown in Table 1.

Group 1: After Clearfil $S^3$Bond which is one-step self-etch adhesive is applied in accordance with manufacturer recommendations to dentin surfaces, it was polymerized with LED (HS LED 1500, Henry Schein Inc, USA) light-curing unit.

***Table1.*** *The adhesive systems and flowable composites which is used in the research*

| **Materials** | **Type** | **Manufacturer** |
|---|---|---|
| Clearfil S3 | one-step self-etch adhesive | Kuraray Medical Inc., Tokyo, Japan |
| Clearfil SE Bond | two-step self-etch adhesive | Kuraray Medical Inc., Tokyo, Japan |
| Prime&Bond NT | two-step total-etch adhesive | Dentsply, Konstanz,Germany |
| Clearfil Majesty Flow | flowable composite | Kuraray Medical Inc., Tokyo, Japan |
| ReFil SDR Flow | flowable composite | Dentsply, Konstanz,Germany |

Group 2: After Clearfil SE Bond which is two-step self-etch adhesive is applied in accordance with manufacturer recommendations to dentin surfaces, it was polymerized with LED light-curing unit.
Group 3: After 34% phosphoric acid gel applying to the occlusal dentinal surface, Prime & Bond NT which is the total-etch adhesive is applied in accordance with manufacturer recommendations to dentin surfaces, it was polymerized with LED light-curing unit.

Clearfil Majesty Flow as flowable composite was light cured after being placed with a thickness of 2 mm to the dentin surface which was applied adhesive in all three in the group.

Group 4: After Clearfil $S^3$Bond which is one-step self-etch adhesive is applied in accordance with manufacturer recommendations to dentin surfaces, it was polymerized with LED light-curing unit.
Group 5: After Clearfil SE Bond which is two-step self-etch adhesive is applied in accordance with manufacturer recommendations to dentin surfaces, it was polymerized with LED light-curing unit.
Group 6: After 34% phosphoric acid gel applying to the occlusal dentinal surface, Prime & Bond NT which is the total-etch adhesive is applied in accordance with manufacturer recommendations to dentin surfaces, it was polymerized with LED light-curing unit.

ReFil SDR Flow as flowable composite was light cured after being placed with a thickness of 2 mm to the dentin surface which was applied adhesive in all three in the group.

Then the teeth were kept in the incubator for 24 hours in the saline solution. After each storage period, the bonded teeth were vertically sectioned into serial slabs and further into beams with cross-sectional areas of approximately 1 $mm^2$. Totally 30 rod was obtained for each group. Specimens were attached to microtensile testing apparatus (Micro Tensile Tester, Bisco, USA) with the cyanoacrylate adhesive (Zapit, Dental Ventures of America, Corona, CA, USA) and stressed to failure in tension at a crosshead speed of 1 mm/min. The load recorded in Newtons was retrieved in MPa.

Normal distribution assumption of conformity of the data were analyzed with the Kolmogorov-Smirnow test, it's homogeneity was examined by Levene test. Statistical differences were examined using ANOVA, Independent Samples test and Tamhane test at a significance level of 5% with SPSS 11.0 for Windows (SPSS Inc., USA)

## Results

Microtensile bond strength values of the experimental group are shown in Table 2.

As a result of evaluation of the data that is obtained, a statistically significant difference was observed in the microtensile bond strength values of adhesives that is applied Clearfil Majesty Flow (F=7.825; p=0,001) (Figure 1). In multiple comparison of microtensile bond strength values, bond strength values of Clearfil SE Bond were determined to be statistically significantly higher ($p<0.05$).

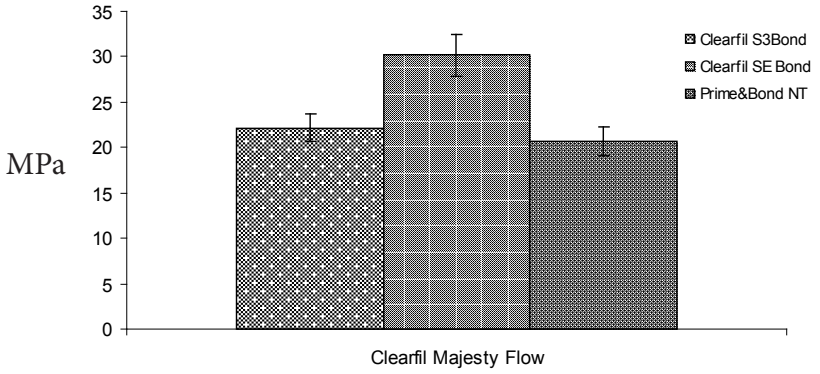


***Figure 1.*** *Mean microtensile bond strength values of adhesives that is applied Clearfil Majesty*

When microtensile bond strength values of adhesive that is applied ReFil SDR Flow are examined to of adhesive it was observed a statistically significant difference. (F=13,960; p=0,000) (Figure 2). In multiple comparison of microtensile bond strength values, bond strength values of Clearfil SE Bond and Clearfil S$^3$Bond was observed statistically significant higher than Prime & Bond NT ($p <0.05$). However, no statistically significant difference was shown in the bond strength values between the Clearfil SE Bond and Clearfil S$^3$Bond ($p>0.05$).

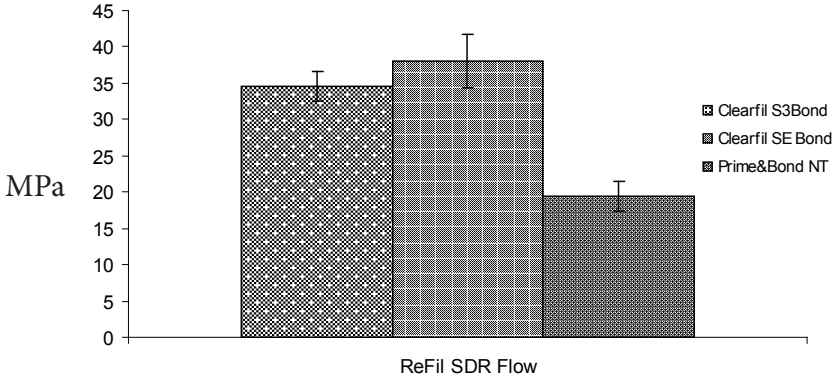


***Figure 2.*** *Mean microtensile bond strength values of adhesives that is applied ReFil SDR Flow*

In the comparison microtensile bond strength values of the adhesives that is applied Clearfil SE Bond and ReFil SDR Flow was determined a statistically significant difference between two groups for Clearfil S$^3$Bond (t=-4,909; p=0,000); there is no statistically significant difference for Clearfil SE Bond and Prime&Bond NT (p>0.05).

***Table 2.*** *Microtensile bond strength values of the experimental group*

| | Clearfil Majesty Flow | | | | | ReFil SDR Flow | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | Mean(MPa) | Standard deviation | Min. | Max | N | Mean(MPa) | Standard deviation | Min. | Max |
| Clearfil S3 | 30 | 22,116 | 8,2884 | 8,1 | 41,4 | 30 | 34,556 | 11,1343 | 11,4 | 53,6 |
| Clearfil SE Bond | 30 | 30,150 | 12,4529 | 10,5 | 53,2 | 30 | 38,060 | 19,7934 | 7,7 | 83,7 |
| Prime&Bond NT | 30 | 20,716 | 8,6193 | 4,1 | 37,4 | 30 | 19,373 | 10,9710 | 3,7 | 50,0 |

## Discussion

Clinical trials are the most appropriate way to evaluate the effectiveness of restorative materials. However, clinical research of the developing adhesive systems or resins is very difficult technically and ethically. Therefore, laboratory studies are often preferred in dentistry.[17] One of the commonly used methods are microtensile bond strength tests for the evaluation of clinical performance of resin-adhesive systems. In addition to conventional tensile testing methods, the micro test methods which is using 1 mm$^2$ surface area are also used to determine the bond strength between the dental tissues and restorative materials. It can be stated that the non-uniform stress distribution at the interface of the dental tissue and an adhesive system can be eliminated through the use of samples which have smaller surface areas in test methods. [11,17,18] In this study, microtensile bond strength test method was used by obtaining bars that have an average of 1 mm$^2$ bonding surface from samples, as in the study Sano et al[11] and Phrukkanon et al[19].

Clearfil SE Bond which we used as a two-step self-etch adhesive, has acidic primer in middle strength (pH=1.9). This adhesive system showed high bond strength to normal dentin in many studies.[20-22] Clearfil SE Bond contains filler particles that are thought to increase the adhesive's tensile capacity against shrinkage stress (silicon dioxide).[23] It was declared that theoretically, simultaneously of the emerging of collagen fibrils and the occurring of the monomer infiltration were sufficient for micromechanical bonding. Also, carboxyl and phosphate groups of Clearfil SE Bond monomers may be chemically bonded to the residual hydroxyapatite. In this way, it is claimed to exhibit high bond strengths. [20,24,25]

Clearfil S$^3$Bond that is used as one-step self-etch adhesive, has acidic primer in low strength (pH= 2.7). [26] This type of adhesive systems allow to remain hydroxyapatite around collagen fibrils by demineralizing dentin fairly shallow, and it creates a superficial hybrid layer. These adhesives behave like a permeable membrane and absorb a significantly water after polymerization due to its hydrophilic nature. Therefore, it is claimed to showed lower bond strength values from two-step self-etch adhesives. [25,27,28]

In the two-step total-etch system is the first step in creating the acid application, the second step primer and adhesive Prime & Bond NT, which constitutes one bottle united version. Although the bonding mechanism of this type of adhesive systems are same as three-step total-etch systems, in many studies, it is claimed that the application of the adhesive and the primer in one-step may reduce the hybridization. The fact that two-step "etch-and-rinse" adhesive systems are more sensitive to water and oxygen contamination, may lead to the incomplete polymerization for adhesive resin and lower bond strengths. [6,29]

This type of adhesive before depolymerization, nano-filler particles can form clusters which are large enough to prevent the infiltration come together to inter-fibrillar space of the hybrid layer of adhesive. In addition, the aqueous monomer which is the main component of the adhesive can prevent the infiltration of these particles as previously infiltrated to demineralized intertubuler matrix . This situation affects bonding negatively. [30] It is reported that may have reduced the bond strength values as a result of lack of access to the adhesive to these regions and having the greater demineralization depth which is occured in dentin.[5]

We believe that all this obtained data in our study explains the different bond strength results.

It has been reported in many studies to reduce microleakage and seen in the restoration edge spacing formation by preventing the polymerization shrinkage, as a linear usage under composite restorations of flowable composite resins having a low elasticity coefficient. [31,32] Not only the usage of flowable composite under composite resins play a role in compensating stresses caused by polymerization shrinkage, but also ıt has been reported that stress absorber is doing against the accumulated tension and compressive stress in this region task during chewing forces. [33,34] A new generation of flowable composite which has more filling rate, is claimed that find wide application due to the increased mechanical properties. [22,35] Although higher bond was observed in the new generation of flowable composite group, a statistically significant difference was detected only for Clearfil S$^3$Bond, when bond strength of the flowable composite resins is compared.

Nowadays, while many new developments occurs at the system of adhesive dentistry; following these developments on a regular basis and selecting suitable materials of dentist will improve the clinical success of restorative treatment. In this context, we believe that our study results will contribute to the different studies on the subject.

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# *Minimally Invasive Restoration of Erosive Lesions With Direct Composite Laminate Veneers: A Case Report*

***Mağrur KAZAK[1]***

**Abstract**

**Background:** Non-carious cervical lesions (NCCLs) which may be caused by erosion, abrasion, abfraction and attrition are commonly observed in clinic practice. Dental erosion is defined as loss of dental hard tissue due to a chemical irritant that does not involve the influence of bacteria. In case of such lesions progress over time, teeth hypersensitivity and aesthetical problems arise.

**Objective:** The purpose of this case report was to restore erosive lesions on maxillary central teeth with direct composite laminate veneers.

**Case Description:** A 34 years old female patient presented to Istanbul Aydın University Dental Faculty Restorative Dentistry Department because of aesthetic reasons. After clinical examination; erosive defects mainly at the maxillary central teeth and worn incisal edges were diagnosed. As a result of the patient's anamnesis, it was understood that, the patient consumes lemon regularly every week. The erosive lesions were restored with an adhesive system and a nanofill resin composite. Finishing and polishing procedures were performed immediately. After aesthetical restorations, information is given to the patient about the elimination of the factors which cause erosive lesions.

**Practical Implications:** When clinically evaluated, direct composite laminate veneers are based on the principles of minimally invasive dentistry and reversibility that can be used for the rehabilitation of NCCLs aesthetically.

***Keywords:*** *Dental erosion, non-carious cervical lesions, direct composite restoration, dental laminate veneer, minimally invasive restoration*

## Eroziv Lezyonlarin Direkt Kompozit Lamina Venerler ile Minimal İnvaziv Restorasyonu: Olgu

**Özet**

**Giriş:** Erozyon, abrazyon, abfraksiyon ve atrizyon nedeni ile ortaya çıkan çürüksüz servikal lezyonlar klinikte yaygın olarak görülmektedir. Diş erozyonu, bakteri etkisi içermeyen bir kimyasal iritan sebebi ile diş sert dokusunun kaybı olarak tanımlanmaktadır. Bu tip lezyonların zaman içerisinde ilerlemesi durumunda, dişlerde aşırı duyarlılık ve estetik problemler ortaya çıkmaktadır.

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**Amaç:** Bu olgu sunumunun amacı; üst çene santral dişlerde oluşan eroziv lezyonları direkt kompozit laminate venerler ile restore etmektir.

**Olgu Raporu:** 34 yaşındaki kadın hasta estetik sebeplerden ötürü İstanbul Aydın Üniversitesi Diş Hekimliği Fakültesi Restoratif Diş Tedavisi Bölümü'ne başvurmuştur. Hastanın yapılan klinik muayenesi sonucunda; en fazla üst çene santal dişlerde olmak üzere eroziv defetler ve kesici kenarlarda da aşınmalar tespit edilmiştir. Hastadan alınan anamnez sonucunda, hastanın her hafta düzenli olarak limon tükettiği öğrenilmiştir. Üst çene santral dişlerin eroziv lezyonları, bağlayıcı ajan ve nano dolduruculu kompozit bir rezin materyali kullanılarak restore edilmiştir. Bitirme ve cila işlemleri yapılmıştır. Estetik restorasyonlardan sonra hastaya erozyona sebep olan faktörlerin elimine edilmesi konusunda bilgi verilmiştir.

**Pratik Uygulamalar:** Klinik açıdan değerlendirildiğinde, minimal invaziv diş hekimliği ve reverzibilite ilkelerine dayanan direkt kompozit lamina venerler ile çürüksüz servikal lezyonlar estetik olarak restore edilebilirler.

***Anahtar Kelimeler:*** *Dental erozyon, çürüksüz servikal lezyonlar, direkt kompozit restorasyon, dental lamina vener, minimal invaziv restorasyon*

## Introduction

Non-carious cervical lesions (NCCLs) which may be caused by erosion, abrasion, abfraction and attrition are commonly observed in clinic practice.[1] Dental erosion is defined as loss of dental hard tissue due to a chemical irritant that does not involve the influence of bacteria.[2] A chemical irritant involves acids that reach the mouth and have extrinsic or intrinsic origin.[3] Extrinsic acids from the diet are becoming the most important source of erosive attacks due to the increasing consumption of acidic drinks.[4]

Progressive erosive lesions can be clinically difficult to diagnose at an early stage and patients often unaware of the tooth loss because of no pain or esthetic problem. More pronounced changes in macromorphology occur when the erosive damage is more severe. Once the restorative treatment is indicated, dental practitioner has to know that esthetic restorations of erosive teeth present challenges. One of the challenge is the presence of sclerotic dentin. Sclerotic dentin is a common substrate that occurs in response to tooth wear caused by attrition, abrasion, abfraction or erosion. This substrate has demonstrated to be a challenge for bonding procedures.[5] Currently, there are several options for the treatment of erosive lesions, which can range from a conservative (adhesive and composite resins restorations) to more invasive procedures (crowns, bridges, or even full-mouth reconstructions) according to the severity of the lesions.[6,7] When a restorative treatment is required, it is important to choose a material resistant to erosion that allows the preservation of the tooth as much as possible. In terms of conservative treatment options, composite resin restorations seem to the best materials for the restoration of NCCLs.[8,9]

Direct composite laminate veneers (DCLVs) are minimally invasive restorations and the teeth are prepared in a conservative manner. These restorations can be applied on a minimally prepared tooth

surface with resin composite materials directly in the dental clinic. Easy preparation available for all dentists, good aesthetic, low cost, no need for an additional adhesive cementing system and reversibility of the treatment procedure are the main advantages of this technique.[8]

The aim of this case report was to restore maxillary central teeth due to erosive lesions with DCLVs.

## Case Description

### Diagnosis and Treatment Planning

34 years old female patient referred to Istanbul Aydın University Faculty of Dentistry Restorative Dentistry Department because of aesthetic complaints. Patients' main problem was the erosive lesions especially on the maxillary central teeth (Figure 1). A detailed history was taken to determine the reasons of erosion lesions. On questioning about her eating habits related to tooth erosion, the patient declared that she had been consuming lemon regularly every week and during her pregnancy she had eaten at least one kilo of orange every day. She also stated that she was brushing very hard and clenching her teeth. On clinical examination, erosive defects mainly at the maxillary central teeth and worn incisal edges were observed. There were also NCCLs on #32,33,34,35 and #42,43,44,45 due to traumatic tooth brushing. The patient did not complain about dentin hypersensitivity. Periodontal examination revealed no signs of periodontal disease. Medical anamnesis showed of no evidence of systemic disorders.

***Figure 1.*** *Initial appearance of the maxillary central teeth with erosive lesions and worn incisal edges*

A treatment plan was made and presented to the patient. In the plan, direct composite laminate veneer restorations for #11, 12, 13 and #21, 22, 23 were recommended. After restorations, occlusal splint was also proposed due to the teeth clenching. The patient consented the treatment procedure for only the restorations of the maxillary central teeth.

### Preparation of the Teeth and Application of the Direct Composite Laminate Veneers

Prior to the preparation of the teeth, shade was selected as A2 with Vita Scale. Then, #00 sized retraction cords (Ultrapak, LOT: 400224, Ultradent Products, Inc. USA) were placed into the gingival sulcus in order to protect the gingival tissue during the preparation of the teeth. First

affected dentine was removed with a round bur and later the enamel margins were beveled. Incisal edges of the teeth were reduced 1mm in order to manage incisal edge coverage.

After preparation, the teeth were isolated with cotton rolls then for the mesial and distal proximal margins; transparent Mylar strip bands were placed and fixed with wooden wedges. Total-etch technique with 37 % phosphoric acid (Scotchbond, LOT: N431099, 3M ESPE, Dental Products, USA) was applied to the surfaces (30 seconds to enamel, 15 seconds to dentine), rinsed with water spray for 20 seconds and dried slightly. Adper Single Bond 2 dentin bonding agent (LOT:N489607, 3M ESPE, Dental Products, USA), was applied to the etched tooth surfaces by using a bonding brush and then polymerized with a light curing unit (Built in C, Guilin Woodpecker Medical Instrument CO., LTD., PRC). For the restoration of the teeth, a nanofill composite Filtek Ultimate (3M ESPE, Dental Products, USA) was chosen. First, A2 Dentine (LOT: N498646) then A2 Enamel (LOT: N535853) were applied. All of the resin composites were applied to the tooth surfaces in the form of very thin layers of less than 1mm and after every composite placement polymerization was completed according to the manufacturer's suggestions. As the restoration finished, wooden wedges and the translucent matrix bands were removed and from vestibule and palatal surfaces polymerization was repeated in order to eliminate any uncured monomers left in the composite material.

For the finishing and polishing procedures, first a green-banded then a yellow-banded needle bur was used under water-cooling. Early contacts were controlled with the articulation paper. For the advanced polishing, discs (Sof-Lex XT Discs, 3M ESPE, Dental Products, USA) were applied from coarse to fine grits. At the end, a white polishing rubber was used for the final view (Figure 2).

After aesthetical restorations, information is given to the patient about the elimination of the factors which cause erosive lesions.

***Figure 2.*** *The final view of the maxillary central teeth restored with direct composite laminate veneers*

## Discussion

NCCLs due to erosion are becoming more significant, therefore the dentist should have knowledge about its etiology and be prepared for early diagnose. When dental erosion involves dentin with pain, function and aesthetic limitation, restoration is needed.

In this case report, the patient was not complaining about dentin hypersensitivity. But loss of tooth structure, yellow color on maxillary central teeth and worn incisal edges were the reasons that made the patient refer to Restorative Dentistry Department. The erosive lesions of the patient were

mainly localized on the facial surfaces of maxillary central teeth that were caused by the extrinsic acids. The most prominenet of these extrinsic acids, citric acid, with a reported pH value of 2.5, is present in fruit juices (such as lemon juice).[7] In this case, it was determined that, the patient was consuming lemon regularly every week which explained the erosive lesions.

The treatment of tooth wear due to erosion process presents challenge in contemporary dentistry. So the choice of the restoration type is important in such cases. Even with advanced destruction, minimally invasive restoration, such as sealing or covering with composite material, should be the first therapy of choice. In this case, DCLVs were planned for the central teeth. This conservative option was chosen in order to preserve dental hard tissues. Also this type of procedure is a lower cost option when compared to indirect restorations. The reversible nature of this procedure allows for the other treatment options in the future. Also the possibility of repairing intraorally without the risk of modifying aesthetics or mechanical performance is another positive advantage of this technique.[8] Porcelain laminate veneers (PLVs) are another options for restoring these teeth. Although these kinds of restorations are long-lasting, esthetical and functional they have some handicaps as well. First of all, PLVs planed teeth are prepared with irreversible procedures. Also; more tooth preparation, more than one appointment, technical difficulties, difficult reparation and high prices are the other disadvantages.[10]

## Conclusion

As of result, it is important for the dentist to recognize the early signs and symptoms of erosive lesions and understand its pathogenesis. Preventive strategies are the essential first line in management and will include the patients' lifestyle changes.

When the restoration of erosive lesion is indicated, it should preferably, and if clinically and technically possible, be based on the principles of minimally invasive dentistry and reversibility. Direct composite laminate veneer restorations are such restorations that can be used for the rehabilitation of NCCLs aesthetically. Even after adequate treatment and patient instruction are accomplished, aesthetic restorations will only be successful if the patient complies the stated treatment and recommendations for behavioral modifications.

Minimally invasive treatment applied in this case was very satisfactory with the natural tooth like appearances and acceptable clinical performance to the patient.

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# *Rubberdam Clamp Ingestion During Root Canal Treatment: A Case Report*

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**Abstract**
Foreign body ingestion and aspiration is probably one of the most serious accidents that may occur during root canal treatment. To prevent such a danger, rubber dam isolation is mandatory. Clinically, when a foreign body is ingested, the results may vary from esophageal or gastric ruptures to peritonitis or even death. This article presents a case of rubber dam clamp ingestion during the endodontic treatment of lower right second molar. 51-year old male patient experienced a feeling of obstruction and pain in the esophageal region; he was immediately presented to otolaryngology department. Posteroanterior chest graphy showed the foreign body in esophagus. Clamp was removed under general anesthesia via esophagoscope and patient was hospitalized for 4 days.

***Keywords:*** *rubber dam, foreign body ingestion, case reports*

**Özet**
Herhangi bir yabancı cismin aspirasyonu veya yemek borusuna kaçması, kanal tedavisi sırasında olabilecek en önemli ve talihsiz kazalardandır. Bunu önlemek için 'rubber dam' kullanmak çok önemlidir. Yabancı cisim, özofagustan veya gastrointestinal sistemden geçerek peritonite sebep olabilir hatta ölüme yol açabilir. Bu vaka raporunda hastanın alt sağ 2. Büyük azı dişine yapılan kanal tedavisi sırasında; rubber dam klambini yutması sunulmuştur. 51 yaşında erkek hasta, kanal tedavisinden sonra; özofagus bölgesinde ağrı ve tıkanma hissiyle Kulak Burun Boğaz Hastalıkları Bölümüne başvurmuştur. Alınan göğüs radyografisinde, hastanın yuttuğu yabancı cismin özofagusunda olduğu gözlenmiştir. Özofagusta bulunan rubber dam klambi, genel anestezi altında alınmış ve hasta 4 gün müşadede kalmıştır.

***Anahtar Kelimeler:*** *rubber dam, yabancı cisim yutulması, vaka raporları*

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## Introduction

Even in the hardest cases of endodontics, rubberdam isolation was made obligatory since 1994 by European Society of Endodontology.[1] Without its application, the tooth may be contaminated with saliva or the patient may swallow irrigants.[2] In the worst case scenario, the patient may aspirate or ingest endodontic instruments. A study in french population showed that between the years 1994 and 2004, 44 cases of aspiration and 464 cases of ingestion had been reported by general practioners.[3]

Accidentally ingested foreign bodies present emergencies and should be taken care by an otolaryngologist, gastroenterologist or a general surgeon.[4] In the dental practice, most of the objects we use are sharp and cornered, which raises the risk of perforation.[5] Files and broaches carry this high risk. Rubber dam clamps are multi-cornered and relatively large objects, hence their perforation risk is very low. Such objects are expected to exit the gastro-intestinal canal atraumatically in 4 days-2 weeks.[6] Sharp and angled instruments generally lodge in the esophagus and if not removed, they may also get impacted.[7] Lodging of a foreign body may also result in inflammation and infection. In most of the cases ingested body should be removed surgically.[7]

Objects swallowed by patients mostly consist of endodontic files, broaches, amalgam fillings, burs, temporary crowns and orthodontic bands.[3] In this report, we present a rare case of rubber-dam clamp ingestion.

## Aim

To emphasize the possible outcomes of foreign body ingestion during root canal treatment.

## Case Report

A 51-year old male patient applied to a private clinic in Istanbul. Tooth number 47 showed clinical signs of irreversible pulpitis and the dentist began to perform a root canal treatment. When the dentist tend to place a winged clamp with a carrier, clamp became loose and fell into the mouth near uvula. This incident triggered patient's swallowing reflex and caused the clamp to move in the oropharynx. Together with his assistant he tried to remove it by Heimlich's maneuver, but it didn't help. Then the dentist convinced the patient, that the clamp would uneventfully leave the gastric canal in a couple of days, so he was not supposed to eat solid food during this time, and he was sent home.

A few hours later patient started to experience discomfort and a feeling of obstruction in the upper-chest region and applied to our department for a consultation. We immediately presented the case to the otolaryngology department in our university. After the physical examination the first diagnosis was a foreign body lodging. To determine its location, posteroanterior and lateral chest graphs were taken. The radiographs clearly showed the position of the clamp (Fig.1). The otolaryngologists concluded, that the clamp migrated to the esophagus and it should be taken out.

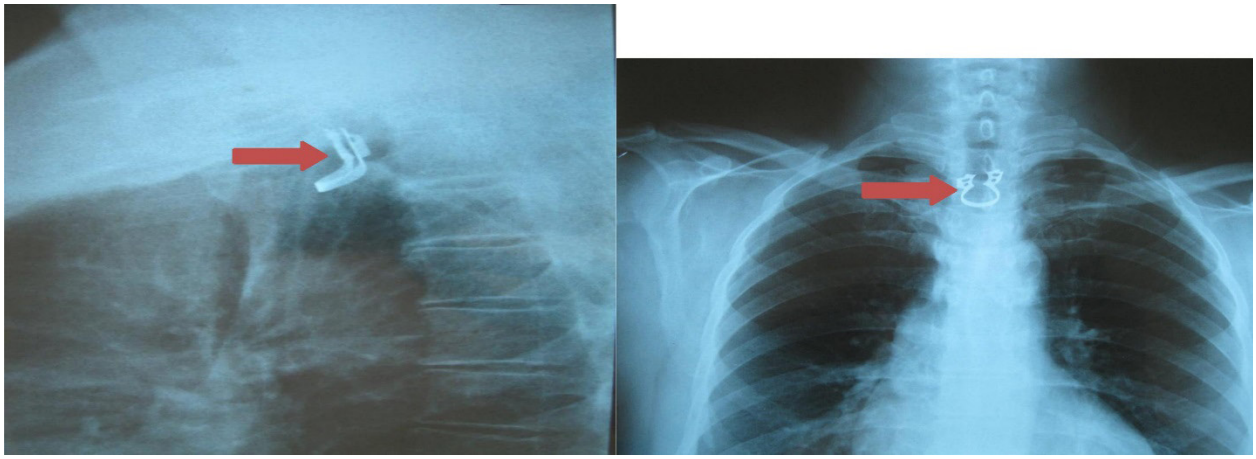

***Figure 1.*** *posteroanterior and lateral chest graphs*

The next morning, rubber dam clamp was taken out under general anesthesia via esophagoscope (Fig.2). It was precisely located laterally in the first constriction of esophagus. Post-operative findings were normal, but the patient was fed parenterally for 2 days.

On the third day, he was allowed to feed orally and he didn't experience any problems. He was discharged on the fourth day. On the one week follow-up the patient told that, he didn't feel any discomfort and he could feed himself without any problem. The otolaryngologists agreed that he was completely healed and no more follow ups were necessary. The lower right second molar was extracted due to a vertical fracture.

***Figure 2****. Ingested rubber dam clamp*

## Discussion

Rubber Dam is used in endodontics to protect the patinet from aspiration or ingestion of instruments, tooth debris, medicaments and irrigating solutions. It isolates the operating field from saliva, hemorrhage, other tissue fluids as well as oral cavity. So it reduces the risk of cross-contamination of root canal system.

A dentist must carefully follow every step of rubber dam placement procedure. Improper clamp selection or careless placement of the clamp may result in serious complications as in our case.

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# *A Multidisciplinary Approach To Localized Gingival Recession: A Case Report*

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**Abstract**

**Background:** Many techniques are available for the treatment of gingival recessions. Platelet rich fibrin (PRF) is being used for root coverage and periodontal regeneration with better wound healing.

**Objective:** The purpose of this case report is to present the treatment stages and outcomes of a female patient who referred to our clinic with the complaint of gingival recession.

**Case Description:** A 29-year-old patient with porcelain fused to metal (PFM) restorations on the maxillary incisors, had Miller Class I recession on her left lateral incisor. Initially, Phase I periodontal therapy was performed. One month later, the exposed root surface was covered with PRF and a coronally advanced flap was done. Postoperative healing was uneventful and 2 mm of root coverage was gained. Maxillary incisors were restored with zirconia crown prostheses. During 6 months follow-up no further exposure occured.

**Practical Implications:** PRF is a preferable method enhancing success rates of the operation for recession coverage.

***Keywords:*** *Gingival recession, Platelet rich fibrin, Zirconia*

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## Lokalize Dişeti Çekilmesine Multidisipliner Yaklaşım: Bir Olgu Sunumu


### Özet

**Giriş:** Günümüzde dişeti çekilmeleri için farklı tedavi seçenekleri gündeme gelmiştir. Kök yüzeyi kapatılması ve periodontal rejenerasyonun yanı sıra yara iyileşmesinin de hızlanması amacıyla trombositten zengin plazma (TZF) kullanılarak tedavi başarısı arttırılmaya çalışılmaktadır.

**Amaç:** Bu olgu sunumunun amacı dişeti çekilmesi şikâyetiyle kliniğimize başvuran kadın hastanın operasyon süreci, endodontik ve protetik tedavi aşamaları ile tedavi sonucunun sunulmasıdır.

**Olgu Sunumu:** Sol üst lateral dişinde Miller Sınıf I dişeti çekilmesi ve üst kesici dişlerinde metal destekli porselen restorasyonları var olan 29 yaşındaki kadın hastaya ilk aşamada Faz I periodontal tedavi uygulandı. 1 ay sonra kök yüzeyine TZF yerleştirilerek koronale kaydırılan flep yöntemiyle örtüldü. Postoperatif iyileşme sorunsuz olarak gerçekleşti ve 2 mm kök yüzeyi kapanması sağlandı. Üst kesici dişler zirkonya seramik kuron protezleriyle restore edildi. Olgunun 6 aylık takibi sonrasında dişeti çekilmesi gözlenmedi.

**Klinik Bağlantı:** TZF, dişeti çekilmelerinin kapatılmasında operasyon başarısını arttıran alternatif tedavi yöntemleri arasında tercih edilen bir uygulamadır ve daha fazla kullanım alanı bulmaktadır.


***Anahtar Kelimeler:*** *Dişeti çekilmesi, Trombositten zengin fibrin, Zirkonya*

### Introduction

Gingival recession is a common problem resulting from periodontal diseases. The main causes are trauma, inflammation, occlusal forces, surgical interventions or orthodontic therapy. Gingival recession usually results in hypersensitivity and caries problems. However, when the defects occur in the anterior area, esthetic concerns should be involved in treatment strategy (1). Recession defects are classified by Miller based on the periodontal tissue support and the mucogingival line. Miller Class I defects are recessions that do not extend to the mucogingival junction where hard/soft tissue loss is absent in the interdental area. Complete root coverage is obtainable in this type of defect (2).

Treatment approach includes many techniques mainly combined with coronally advanced flaps (3). Connective tissue graft combined with a coronally positioned flap is considered as a gold standard in root coverage (1). Due to the well-known obvious disadvantages of connective tissue grafts such as creating a second wound site, many attempts have been made to prevent the patient from suffering this situation. Xenografts or allografts are substitutes obtained from external sources and may have different results related to foreign body reactions. However PRF membrane is obtained from the patients' blood and has no known side effects. It is easy to prepare and use by clinicians. Studies including PRF membrane with the coronally advanced flap procedure show promising results with good esthetic outcomes and better wound healing (4, 5).

Conventional metal-ceramic restorations have been the treatment of choice for decades because of their superior mechanical properties, adequate marginal and internal fit and acceptable esthetic appearance. However, patients' growing esthetic demand for natural looking, tooth coloured restorations has led the development of various all ceramic materials with different optical and mechanical properties (6). The selection criteria for dental materials include strength, esthetics and fit. The main goal of utilizing all ceramic materials is to fabricate restorations with significant esthetic and biocompatible properties and favourable mechanical behaviour (7). Zirconia has superior machanical properties and causes less inflammatory reaction in gingival tissues than other restorative materials. In addition to its colour that is similar to natural teeth, opaque zirconia core makes it possible to cover a dischromic restoration ot tooth (8). These favourable features of zirconia allow clinicians to utilize it as a ceramic restorative material in most cases. Therefore, the purpose of this case report is to present the multidisciplinary treatment procedure and the treatment outcomes of a female patient who referred to our clinic with the complaint of gingival recession on her left maxillary lateral tooth.

## Case Report

In this case report, periodontal operation procedure, endodontic and prosthodontic treatment and maintenance of a 29-year-old patient with the chief complaint of root exposure on her left maxillary lateral incisor were presented. The patient was systemically healthy with no ongoing medication. Intraoral examination revealed Miller Class I recession defect on tooth #22 (Fig 1). Recession depth and width was 3 mm and 4 mm, respectively. Slight plaque accumulation, gingival erythema and edema were present. She had previous porcelain fused to metal (PFM) restorations on the maxillary incisors. Radiographical findings revealed a periapical pathology; well-defined radiolucent area near the left maxillary lateral tooth apex. The tooth #22 had no mobility, no response to vertical or horizontal percussion tests. It was devital according to the results of the electric pulp test. Plaque associated gingivitis and chronic apical periodontitis were diagnosed based on the clinical and radiographical examination. Following the removal of PFM restorations, Phase I periodontal treatment consisting of oral hygiene instructions, scaling and root planing, was performed by an experienced periodontist under local anesthesia. Mechanical periodontal therapy was not accompanied by any medications. The tooth #22 was endodontically treated in two sessions with rotary instrumentation.

***Figure 1.*** *Miller Class I recession defect*

Periodontal operation included a coronally advanced flap with the use of a PRF membrane. The PRF was prepared according to the protocol developed by Choukroun et al. (9) Prior to surgery, 10 ml of intravenous blood of the patient has been collected in test tubes without adding anticoagulant and immediately centrifuged at 2700 revolutions/min for 12 min. (10). The fibrin clot was easily separated from the RBC base (preserving a small part of the RBC layer) using sterile tweezers and scissors, and PRF is prepared by using a PRF box.

Following administration of local anesthesia, sulcular incisions through each recession area were given with a number 15 blade. Tunnel technique was designed first and the tip of the interdental papilla was not included in the incision. A split thickness mucoperiosteal flap was reflected, extending beyond the mucogingival junction in order to reduce the tension on the flap and facilitate coronal displacement of the tissue. However, the flap ruptured near the papilla area during the incisions. The design of the flap was then changed with a modified envelope flap. The PRF membrane was covered on the exposed root surface with the most part of it placing on the connective tissue bed, in order to gain adequate blood supply (Fig 2). Interdental sutures were placed stabilizing both the membrane and the flap (Fig 3). The suturing was made with 5/0 polyglycolide-co-lactide braided absorbable suture material (Dogsan Pegelak® 5/0, 16 mm 3/8, cutting suture, Trabzon, Turkey). Following surgical operation, naproxen sodium 2 × 1 for 5 days (Apranax Fort® 550 mg 10 film tablets, Abdi İbrahim, İstanbul, Turkey) and chlorhexidine gluconate rinse 2 x 1 for 5 days (Andorex® 120 ml Delta Vital, İstanbul, Turkey) were prescribed to the patient. Clinical healing was achieved without any postoperative complication such as pain, hemorrhage, swelling or recurrence. 2 mm of root coverage has been gained. Smile design was performed with gingivoplasty approach on maxillary incisors and right canine due to uneven margins.

***Figure 2.*** *PRF membrane on the exposed root surface* - ***Figure 3.*** *Interdental sutures stabilizing the membrane and the flap*

Maxillary incisors were decided to restore with zirconia ceramic crowns due to the esthetic and functional demands of the patient. The tooth preparation was completed using medium-grit diamond burs and a chamfer finish line was placed 0,5 mm subgingivally. Final impression was made with a combination of putty and light-body vinyl polysiloxane (VPS) elastomeric impression material (Elite HD+, Zhermack, Italy) for definitive restorations. Zirconia ceramic crowns were fabricated with a core (DC Zircon, DCS Dental AG, Allschwil, Switzerland) and veneering porcelain. Internal and marginal of the restorations were checked, proximal and occlusal contacts

were adjusted gently with low-speed rotary instruments under irrigation. The crowns were then luted via self-adhesive, dual-cure resin cement (Panavia SA Cement, Kuraray, Japan). During 6 months follow-up no further recession or inflammation was detected (Fig 4).

## Conclusion

PRF membrane is a preferable material in the management of gingival recessionss. It might be suggested as an alternative to the subepithelial connective tissue technique, especially for situations where harvesting from the palate is challenging or impossible. When needed, small 'touch-ups' could be performed by means of gingivoplasty techniques for the adjacent teeth. Zirconium dioxide ceramic crowns give clinicians the opportunity to finalize the treatment with maximum esthetic and functional outcomes.

***Figure 4.*** *Zirconia ceramic crown restorations after 6 months*

## Conflict of Interest

There is no disclosure that supported the work (no grant funds, commercial sources or funds from a contributors' institution) and authors report no conflict of interest related to this study.

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# *Resin Nano Ceramic Endocrown: An Alternative To Post-Core Supported Crowns*

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**Abstract**
**Background**
The longevity of an endodontic treatment largely depends on the selection of an appropriate restoration that is concerned with efforts to save the tooth structure. In this perspective, endocrowns can be considered as a feasible alternative for post-core restorations.

**Objective**
To evaluate the clinical efficiency of CAD/CAM resin nano ceramic endocrowns in restorating posterior teeth.

**Case description**
A 37-year-old man who reported a chief complaint of pain was referred for treatment. After clinical and radiographic examination: three endocrowns was planned for the rehabilitation of the teeth number 14, 25, 26. The endocrowns were scanned and designed by using CEREC 3D software and milled from a CAD/CAM resin nano ceramic block. At one-year follow-up, no cracks, caries or decementation of the endocrowns was seen.

**Practical implications**
Endocrowns seems as a successful treatment technique as an alternative to post-core supported crowns in restoring the posterior teeth.

***Keywords:*** *CAD/CAM, endocrown, resin nano ceramic, CEREC*

## Rezin Nano Seramik Endokron: Post-Kor Destekli Kron Restorasyonlara Bir Alternatif

**Özet**
**Giriş**
Endodontik tedavili dişlerin uzun ömürlü olması, büyük oranda diş yapısının korunduğu uygun bir restorasyonun seçimine bağlıdır. Bu perspektifte, endokronlar post-kor restorasyonlara uygun bir alternatif olarak değerlendirilebilir.

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**Amaç**
Arka grup dişlerde CAD/CAM rezin nanoseramik endokron restorasyonların klinik etkinliğinin değerlendirilmesi.

**Olgu Raporu**
37 yaşındaki erkek hasta ağrı şikayet ile kliniğimize başvurmuştur. Klinik ve radyografik incelemeden sonra, 14, 25, 26 nolu dişlere 3 adet endokron planlanmıştır. Endokronlar CEREC 3D yazılımı kullanılarak taranıp dizayn edilmiş ve CAD/CAM rezin nanoseramik blok kullanılarak kazınmıştır. Bir yıllık takip sonucunda endokronlarda herhangi bir çatlak, çürük ve desimantasyon gözlenmemiştir.

**Klinik bağlantı**
Endokronlar arka dişlerin restorasyonunda, post-kor destekli kron restorasyonlarına alternatif olarak başarılı bir tedavi tekniği olarak görülmektedir.

***Anahtar Kelimeler**: CAD/CAM, endokron, rezin nano seramik, CEREC*

## Introduction

Endodontically treated teeth are considered to have a higher risk of fracture when compared to vital teeth. In the maintenance of long-term success, those teeth present specific challenges for the restorative dentists and the prosthodontists.[1]

Although there are a number of studies on endodontically treated teeth, there is no consensus about the optimal build-up design, treatment planning and the choice of material for the restoration.[2]

In the past a common protocol of restoring such teeth has been to build up the tooth with a post and core[3], not only to retain the crown but also to recover the stiffness of the tooth.[4] Contrary to this preconceived idea, many clinical and laboratory studies have reported that placing a post will contribute to the retention of the core portion of the restoration[3] but they do not reinforce roots and may have a weakening effect on the root through loss of radicular dentin necessitated by post space preparation.[5]

Endocrowns, have been presented as an alternative to post-core supported crowns for restoration of non-vital posterior teeth regarding the advent of bonding systems, especially those which have sufficient tooth structure.[6]

Compared to conventional crowns, endocrowns' main advantage is that it is a more conservative approach, which preserves peripheral enamel and allows re-intervention in case of endodontic failure.[4] Endocrowns are easy to apply, low cost, short preparation time and less invasive preparation, minimal chair time and aesthetic properties are the other advantages of endocrowns.[7]

Additionally endocrowns can be made through computer-aided design/computer-aided manufacturing (CAD/CAM) technology by using a wide collection of ceramic materials. Although there is

a wide collection of ceramic materials has been available for CAD/CAM technology, most recently, a resin nano ceramic has been introduced for permanent CAD/CAM fabricated restorations.[3] On the other hand, the optimal material for endocrown restorations has been discussed and the issue remains controversial.[3]

With the intent of increasing the amount of information about endocrown application with resin nano ceramic, the aim of this study is to discuss the indication and use of the endocrown and present a clinical case report on the 1-year clinical follow-up of three endocrown restorations, fabricated from resin nano ceramic (Lava Ultimate™/3M ESPE) with CAD/CAM.

## Case Report

A 37-year-old male patient referred to the Department of Endodontics, Istanbul Aydın University with chief complaint of pain. Clinical and radiographic examinations revealed that maxillary right first premolar's palatal cusp was broken and teeth number 14, 25, 26 had secondary caries under large composite resin restorations. The treatment was planned in two stages including respectively endodontic and prosthodontic treatments.

According to first stage of the treatment plan, endodontic treatments were performed for the teeth number 14, 15, 25, 26. After one week waiting time all the teeth were asymptomatic. For the second stage of the treatment protocol, the teeth was examined for prosthodontic restorations. A conservative approach of restoring the teeth number 14, 25, 26 with an endocrown was decided as treatment option, as more than half the residual tooth structure was remaining and there were no occlusal wear facets. The tooth number 15 had palatal cusp fracture which was in 2mm depth subgingivally and a post-core supported full crown restoration was planned for this tooth.

For endocrown preparations temporary filling restorations removed. The preparation consisted of a circular equigingival butt-joint margin and central retention cavity into the entire pulp chamber constructing both the crown and the core as a single unit (Figure 1). After cavity preparations, flowable composite (Filtek TM Bulk Fill Flowable Restorative, 3M ESPE GmbH, Neuss, Germany) were applied into the isolated cavities to eliminate the undercuts. The appropriate reduction of the buccal and lingual walls was done and interocclusal space was carefully evaluated. Occlusal reduction was done to achieve a clearance of 2 mm.

***Figure 1.*** *Preparation of the teeth for endocrown.*

For full crown restoration, a glass fiber posts #1 (White Post, FGM, Joinvile, SC, Brazil) was cemented using an adhesive system (Adper Single Bond, 3M ESPE) and dual resin cement (RelyX ARC, 3M ESPE) and a resin composite filling core was applied with increments of resin composite (Tetric N-Ceram, Ivoclar- Vivadent AG, Schaan, Liechtenstein). Following core build-up a chamfer finish line was applied for full crown restoration.

After the completion of preparations, digital impression and bite scans were performed using both side of the maxilla with an intra-oral scanner (CEREC Omnicam, Sirona Dental Systems GmbH, Bensheim, Germany). Then endocrowns and all-ceramic crown was designed (CEREC inLab version 4.2 version Sirona Dental Systems GmbH, Bensheim, Germany) (Figure 2) and shade-A2 was selected for all the crown restorations (VITAPAN Zahnfabrik, Germany).

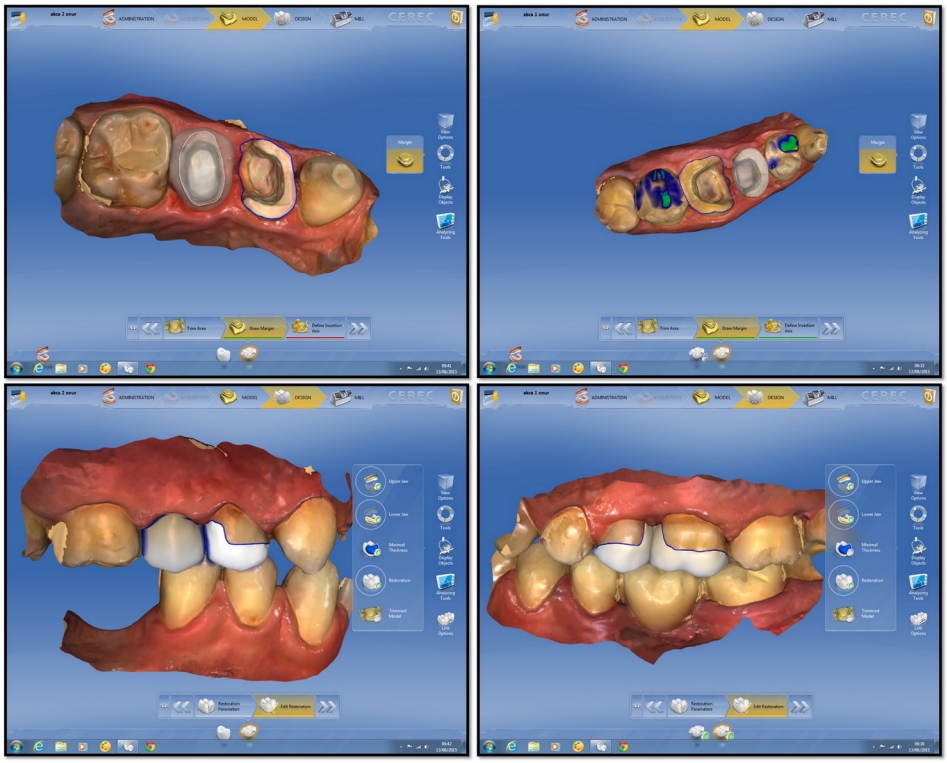

***Figure 2.*** *CEREC views*

Endocrowns were milled from a CAD/CAM composite resin nano ceramic blocks (LAVA Ultimate ™, 3M ESPE, Neuss, Germany). All ceramic crown was milled from the feldspathic ceramic block (Sirona, CEREC blocks, Vita Zahnfabrik, Bad Sackingen, Germany). Before cementation, the marginal adaptation of the crowns was checked.

For endocrown cementation, intaglio surfaces of each endocrown were sandblasted with aluminium oxide (50m Cojet™, 3M ESPE Neuss, Germany) for 5 seconds and cleaned with alcohol and dried with oil-free, moisture-free air. Single-bond Universal™ adhesive (3M ESPE Neuss, Germany) were applied intaglio surfaces for 20 seconds and air-thinned. Prepared tooth surfaces were etched with 37% phosphoric acid–etching gel for 15 seconds, rinsed for 20 seconds, and

dried with oil-free air for another 5 seconds. Single-bond Universal™ adhesive (3M ESPE Neuss, Germany) was applied for 20 seconds and dried thoroughly for 5 seconds and polymerized by a LED light-curing lamp Bluephase (Ivoclar Vivadent AG, Schaan, Liechtenstein) for 10 seconds as recommended by manufacturer. All endocrowns were cemented with Rely X™ Ultimate resin cement (3M ESPE Neuss, Germany) under a constant load of finger pressure. Excess material was removed with the help of a microbrush and restoration margins were covered with a glycerine gel (Liquid Strip, Ivoclar Vivadent) to prevent oxygen inhibition of polymerization. The resin cement was light activated at each surface for 20 seconds using a LED light-curing lamp Bluephase (Ivoclar Vivadent AG, Schaan, Liechtenstein). Then, margins of the restorations were finished with sandpaper polishing discs (Sof-Lex, 3M ESPE). For all ceramic crown cementation a dual cure resin luting agent (Variolink, Ivoclar/Vivadent, Schaan/Liechtenstein) was used.

After cementation procedure, clinical and radiographic evaluation was done (Figure 3) and a one year follow up showed no secondary caries, fracture, discoloration or loosening/decementation of the crowns.

***Figure 3.*** *Clinical view of the final restorations from occlusal aspect*

## Discussion

Endocrown restorations promote biomechanical integrity of the compromised structure of non-vital posterior teeth and appear to be a feasible option instead of post-core restorations for endodontically treated posterior teeth.[8]

Moreover, they appear to be a solution for teeth with a short clinical crown and atresic, calcified, curved, or short root canals that make it impossible to use posts.[9] The internal portion of the endocrown allows minimal tooth wear and thus strengthens the tooth, since it helps preserve root tissue and canal structures and limits internal preparation of the pulp chamber to its anatomic shape.[10]

Additionally when compared with traditional crowns supported on fiber posts, greater resistance to compression forces of endocrown restorations reported by Biacchi and Basting.[8]

Endocrowns also have clinical advantages. The clinical procedure that involves the fabrication of endocrown restorations, compared with the fabrication of crowns with cores or posts, may be considered less complex, more practical, and easier to perform[8] with the development of CAD/CAM systems and software. CAD/CAM fabricated endocrowns can be produced chairside and applied to the patient in one appointment.
Today different materials can be used to fabricate an endocrown like feldspathic and glass-ceramic, hybrid resin composite and the newest CAD/ CAM ceramic and resin composite blocks. [3]

In vitro fatigue tests showed that endocrowns made of more flexible composite resin or resin nano ceramic (RNC) materials may also have a great potential for this indication.[5]

Therefore in the presented case it was preferred to use resin nano ceramic blocks for endocrown restoration. Any esthetic and functional degredation was not seen during one year follow up. Lander and Dietschi evaluated a three-year follow-up of two Empress II endocrowns and stated satisfactory behavior in terms of esthetics, restoration stability, and tissue preservation which is smilar to our results.[6]

The success and longevity of the endocrown are directly related to case selection and correct preparation of the tooth, the selection of the most suitable ceramic options, and the choice of bonding material and correct adhesive cementation.[9] It may be concluded that endocrowns fabricated using CAD/CAM and resin nano ceramic blocks are reliable restorative options for endodontically treated teeth with advantages in terms of mechanical performance, cost, and clinical time. Long-term follow up and clinical studies are needed to confirm their overall success.

## Conflict of Interest

The authors of this article certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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# *Endodontic Systems Working With Reciprocal Movements For Instrumentation of Root Canals*

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**Abstract**

It has been accepted that instrumentation of the root canals is one of the important steps for the succes of root canal therapy. Contemporarily, the root canals arebeing instrumented with either stainless steel/nickel-titanium (Ni-Ti) handfilesmanually or with rotary Ni-Ti files used with a torque controlleddevice or handpiece. The handycaps in these methods revealed the need for the development of a new instrumentation system in endodontics. The advantages such as simplicity, low risk of cross contamination, efficacy in proper shaping, resistance to cyclic fatique of the recent reciprocating instruments showed that they are a desirable alternative forthat need. In this article, the new reciprocating systems and their clinical useswere introduced, and the findings of the related research articles were presented based on the current literature review.

***Keywords:*** *Root canal instrumentation, Ni-Ti rotary systems, endodontic resiprocal systems*

**Özet**

Kök kanallarının şekillendirilmesinin, başarılı bir endodontik tedavinin en önemli aşamalarından biri olduğu bilinmektedir. Günümüzde kök kanalları genel olarak el ile kullanılan paslanmaz çelik ve/veya nikel-titanyum (Ni-Ti) kanal aletleri ya da bir tork kontrollü motor veya redüksiyonlu anguldruva ile kullanılan Ni-Ti döner alet sistemleri ile şekillendirilmektedir. Ni-Ti döner alet sistemlerinin, avantajlarının yanısıra bazı dezavantajlarının da bulunması, yeni şekillendirme sistemlerinin geliştirilmesine neden olmuştur. Güncel resiprokal hareket ile çalışan sistemlerin; kullanım kolaylıkları, çapraz enfeksiyon risklerinin olmaması, kırılma risklerinin düşük olması ve döner sistemler kadar etkin şekillendirme yapmaları, bu ihtiyacı karşılamada iyi bir alternatif olduklarını göstermektedir. Bu derlemenin amacı,kök kanallarının şekillendirilmesinde resiprokal hareket ile çalışan endodontik sistemler ve bu sistemlerin kullanım özellikleri hakkında bilgi vermek ve bu konudaki çalışma sonuçlarını irdelemektir.

***Anahtar Kelimeler:*** *Kök kanallarının şekillendirilmesi, Ni-Ti döner alet sistemleri, endodontik resiprokal sistemler*

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## Introduction

The main purpose of root canal instrumentation is to chemomechanically remove inflamed and/or infected pulp tissue, debris and microorganisms away from the root canal system and to prepare the canal for filling.[1-4]

Peters [5]stated that the root canal treatment's success depend on many factors and one of the most important steps is root canal preparation. The canal preparation step involves mechanical cleaning, formation of a space for the delivery of disinfecting irrigants and medicaments, providing the most appropriate canal shape for obturation. Sothe canal shaping procedure influences the results of the following steps of rootpreparation.[6] For this reason, root canal preparation is not only important, but it is essential for the clinicians.

Today, conventional hand file systems with stainless steel and/or Nickel-Titanium (Ni-Ti) or Ni-Ti rotary systems with low speed hand piece and reciprocal systems are used for root canal shaping.

Therefore the aim of the present study was to compare several parameters of current root canals preparation techniques.

## Review

In this article, the new reciprocating systems and their clinical uses were introduced, and the findings in articles were compared with rotary and manual systems based on the literature.

Main criteria for the selection of instruments and shaping technique are defined as the ability to clean and shape the root canals adequately and operating safety.[7]

Because of the high elasticity of Ni-Ti alloys, the use of Ni-Ti instruments with the rotary systems provides many advantages to dentists. Some of the advantages are short treatment time and the reduction of complications like zip, ledge or transportation in the root canal.[8]Despite of their many advantages,the necessity of large number of instruments usage, high cost and high fracture possibility in the canal, made clinicians search for an alternative methods for the Ni-Ti rotary systems.[9,10]

As a result, the systems working with reciprocational movement have been developed. Inthese systems; instrument does not make a full rotation, the movement is completed in several times with clockwise and counterclockwise rotations. Stainless steel instruments are used in the first developed systems working with reciprocational movement such as SafeSider (Essental Dental Systems, S. Hackensack, NJ) and American Endodontic Technology (AET) (Ultradent, South Jordan, UT). Due to the use of stainless steel instruments, these systems are cheaper and fracture possibility is less. However these systems have some disadvantages like apical transportation and complexity of large amount of instruments.[11]

In 2008, Yared [12] has developed a new shaping technique by using only ProTaper (Dentsply Maillefer, Ballaigues, Suisse) Ni-Ti rotary system's F2 instrument with a low speed hand piece

making reciprocational movement. Yared concluded that, this system was as successful as the ProTaper rotary system including 5 different instruments, and was a easier system due to the use of a single instrument and there was no risk of cross infection.

Thereafter, an increase has been seen in the studies using this shaping technique. You and friends[13], compared the shaping time of ProTaper rotary systems and ProTaper F2 technique with reciprocational movement by using 120 lower molar teeth with curved root canals (20-45 degrees). As a result it is found that shaping was completed in 46,42 seconds on average with the ProTaper rotary systems and 21,15 seconds with the ProTaper F2 technique with reciprocational movement. The researchers stated that fracture of F2 instrument used with reciprocational movement was seen after 10 uses and it can be used in 6 canals safely.

De-Deus et al. [14]compared the effect ofinstrumentation on apical extrusion of debris. The groups was hand instruments used with crown-down technique, ProTaper rotary systems and ProTaper F2 technique with reciprocational movement. They concluded that hand instruments used with crown-down technique produced the most debris extrusion, while no statistically difference have been found between ProTaper rotary systems and ProTaper F2 technique with reciprocational movement.

De-Deus et al.[15]have used ProTaper F2 instruments in metal blocks with reciprocational and rotational movements in different revolutions and examined the fatigue resistance of the instruments. Researchers have found out that the most successful group was the one which made the reciprocational movement and the group worked in 400 rpm (revolutions per minute) was less successful than the one in 250 rpm.

In another study, De-Deus et al. [9]have evaluated the ProTaper rotary systems and ProTaper F2 technique with reciprocational movement in round and oval canals histologically. They have found out that even though there was no statistically difference in the round canals, ProTaper rotary system was more effective in the oval canals.

Paque et al. [16]have evaluated the change in the volume of root dentin, quantity of the shaped canal, transportation amount and shaping time with tomography after the use of ProTaper rotary systems or ProTaper F2 technique with reciprocational movement in the mesial canals of lower molars. As a result, no statistically difference found between the efficiency of the shaping techniques; reciprocational movement has created more transportation in the coronal dentin, however it was a faster technique.

In a similar study which You et al.[17]made, as a result of comparison of these two techniques in curved canals of lower molars, it was found out that there was no statistically difference in the amount of change in the curve, dentin volume and surface area. Researchers stated that reciprocational system doesn't cause transportation even in the apical part of the curved root canals.

These studies have played an important role in the development of new shaping techniques with a single Ni-Ti instrument and reciprocational movement. Reciproc (WDW GmbH, Munich, Germany), WaveOne (Dentsply Maillefer, Ballaigues, Suisse) and TF Adaptive (Sybronendo, West Collins CA, USA) are similar systems developed in the last years.

The shaping systems with reciprocational movement and the ones most widely used in literature are described below with their working principles.

## SafeSider System

The design of SafeSider root canal instruments are based of reamer type files. Reamers, on the other hand, are loosely twisted triangular wires that make 3 point contact with every flute. Each flute on a reamer makes less contact than a file. As a result, reamers instrument canals with less hand fatique, less distorted instruments. The flat-sided design of the EZ-Fill SafeSider reamers derives from the understanding that a reamer design is significantly better than a file design because it engages less dentin. Consequently, a relieved SafeSider designed reamer must be significantly better than a conventional reamer because it engages even less dentin at any one time and also has a thinner cross-sectional area making it more flexible. Thus SafeSider instruments may be used many more times when compared with traditional hand files, with minimum fatique even in curved canals.

Wan et al. [18] examined the effect of flute number and cross-sectional area on the cutting efficiency of 3 hand instruments of 40/0.02 used in reciprocating handpiece (Group 1, SafeSiders; Group 2, Dentsply K-Files; Group 3, Dentsply K-Reamers). They found that Safesider instruments produced a greater amount of debris than K-Files and K-Reamers. The flute number had no effect on cutting efficiency and cross-sectional area may be determining factor on cutting effiency.

In SafeSider system, .02 tapered stainless steel instruments between #08 to #40, .04 tapered #30 and .06 -.08 tapered #25 NiTi instruments are avaible. SafeSider system has a special handpiece named Endo-Express working in reciprocating motion at 2500-3000 rpm.[19]

### SafeSider Technique

- Determine the working lenght
- Instrument the apex thru a No.20 SafeSider reamer
- Use a No.2 peeso reamer to straighten and deepen the flare of the canal
- Instrument the apex thru a No.25
- Instrument the apex with No.30 SafeSider stainless steel reamer
- Instrument the apex with No.35 SafeSider stainless steel reamer
- Instrument 1mm short of the apex with No.40 SafeSider stainless steel reamer
- Now use the No.2 Gates glidden to further staighten and deepen the flare of the canal
- Instrument the apex with No.30/.04 NiTi SafeSider reamer
- Instrument the apex with No.25/.08 NiTi SafeSider reamer
- The canal is ready to receive an .08 tapered medium gutta percha point.

## Reciproc System

Reciproc system completes the rotation of 360 in several reciprocating movements. In reciprocation, the instrument is driven first in a cutting direction and then reverses to release the instrument. The angle in the cutting direction is greater than the angle in reverse direction, so that the instrument continously progresses towards the apex. Reciproc has a non-cutting tip and produced with M-Wire nickel-titanium. M-Wire technology is achieved through the use of this alloy produced in an innovative thermal-treatment process and has both greater resistance to cyclic fatique and greater flexibility than traditional nickel-titanium. Reciproc instruments are S-Shaped and marked with the ISO colour of the instrument tip size for easy identfication. R25 prepares the root canal to an ISO size 25 with taper .08 over the first apical milimeters. R40 prepares the root canal to an ISO size 40 with .06 taper and R50 with .05 taper. Reciproc instruments have a short shaft of 11 mm enabling easier root canal preparation on molar region, compared to many other instruments which have a shaft of 13 mm or longer. A reciproc instrument is designed for single use in maximum one molar. If an istrument appears to be bent after being used in a strongly curved canal, it sholud be discarded. The Reciproc system is designed for convenience and safety. Instruments are delivered ready to use, pre-sterilised in blister packaging and should be simply discarded after use, making work flow more efficient, eliminating the need to clean and sterilise instruments, considerably reducing the risk of cross-contamination.

## Reciproc Technique

- Select the correct Reciproc instrument.
- If the canal is partially or completely invisible on the radiograph, the canal is considered narrow; use an R25.
- If the canal is completely visible on the radiograph, take an ISO size 30 hand instrument; insert it passively into the canal. If it reaches working length, the canal is considered large; use the R50.
- If an ISO size 30 hand instrument does not go passively to working length, try an ISO size 20 hand instrument. If this goes passively to working length, the canal is considered medium; use the R40
- If an ISO size 20 hand instrument does not go passively to working length, use the R25
- After determining the file, place irrigant in the endodontic cavity of the root canal.
- Select the appropriate Reciproc instrument and secure it in the handpiece of the motor.
- Check that the Reciproc motor setting has been selected.
- Introduce the Reciproc instrument into the canal, Press the motor foot pedal when the instrument is at the root canal orifice.
- Move the instrument in a slow in-and-out pecking motion. The amplitude of the in-and-out movements should not exceed 3mm. Only very light pressure must be applied.
- After 3 pecks, remove the instrument from the canal. Clean the debris from the flutes.
- Irrigate the canal.
- In this way, continue with the Reciproc instrument until approx.2/3 of the working length has been reached. When using an R25 determine the working length by using an Iso 10 C-Pilot file. When using an R40 or R50 the working length should be rechecked with an apex locator.
- As soon as full working length has been reached, withdraw the instrument from the root canal.

### WaveOneSystem

The system is generally similar to Reciproc system. It also has 3 files Small, Primary and Large avaible in length of 21, 25 and 31 mm. WaveOne system has a special file geometry and M-Wire technology which are the main reasons for superior performance compared to most of Ni-Ti files on the market. They also have pre-sterilised blister packs and fitted with a non autoclavable handle. WaveOne system has tapered paper points and gutta-percha points special for the system. The manufacturer states that the root canal may be filled either with this tapered gutta-percha points and lateral condensation or WaveOne obturators.

### WaveOne Technique

- The Primary (025/08) file (025 apical size/08 taper) is designed to fully shape the majority of all root canals.
- If a K-File 10 is very resistant to movement then the size is Small (021/06) This may include mandibular incisors, MBII canals within maxillary molars, and/or canals that exhibit apical curvatures.
- If a K-File 020 easily goes length then the size is Large (040/08) This may include maxillary incisors, single-canal bicuspids and some larger diameter molar canals.
- Establish straight-line coronal access to the orifice.
- Estimate the working length using well-angulated preoperative radiographic or digital images.
- Create a glide path by gently working a 010 file, using irrigation or a viscous chelator as preferred until resistance is met and the file doesn't progress anymore. Then work until it is completely loose.
- Select proper the WaveOne file.
- Use some irrigant on canal orifice and initiate shaping procedure with 2-3 mm amplitude pecking motion.
- Withdraw the WaveOne file, remove the debris and inspect the cutting flutes, irrigate and repeat the procedure until the two-thirds of the canal have been shaped.
- Check the apical patency with a 010 K-file and use the WaveOne file to final working length.

### Twisted File (TF) Adaptive System

TF Adaptive has a R-Phase heat treatment technology. This proprietary technology optimizes the metalurgy of Ni-Ti files making them %70 more flexible and 2-3 times more resistant to cyclic fatique than the other rotary files. Twisting optimizes Ni-Ti grain structure and eliminates formation of microfractures, making the file even more durable. Other endodontic files are made by grinding flutes in the file, weakening the metal's structure which can lead to file seperation. The elements motor is a special torque controlled motor for TF system which adapts the motion based on the amount of pressure on the file. Reciprocating angles may vary to 370° forward and up to 50° backwards based on file load.

### TF Adaptive Technique

- Obtain staight line access to coronal 1/3 of the canal.
- Achieve patency and establish an apical glide path using #8 through at least a #15 hand file.
- Canal size and file sequence determination. There are two sequences for instrumentation.

Small (SM1 20/.04, SM2 25/.06, SM3 35/.04) and Medium/large (ML1 25/.08, ML2 35/.06, ML3 50/.04)

- Small Canals (SM) use tactile feel, if you struggle to get a #15 to working length then the canal size is small. Use small sequence. If #15 is loose then the canal size is medium/large. Use medium/large sequence.
- TF adaptive system:
- Use the TF adaptive setting on your motor.
- Ensure the pulp chamber is flooded with NaOCl or EDTA and make sure the file is rotating as you enter the canal.
- Slowly advance the green (SM1 or ML1) with a single controlled motion until the file engages dentin then completely withdraw the file from the canal. Do not force apically. Do not peck.
- Wipe off the flutes. Deliver irrigant to the pulp chamber and confirm canal patency with a #15 K-file.
- Repeat the procedure until working length.
- Repeat the steps with yellow SM2 or ML2 until working length. If the desired apical size is achieved sequence is complete.
- For larger apical sizes repeat steps with red SM3 or LM3.
- You may use TF Adaptive matching gutta-percha or obturators.

Barletta et al. [21] used computed tomography (CT) to assess techniques for root canal filling removal. Seventy-five roots of extracted human lower incisors were filled with zinc-oxide eugenol sealer and gutta-percha and separated into three groups before gutta-percha removal (group 1, Gates Glidden burs+ K-type hand instrumentation; group 2, K-type reciprocating instrumentation with handpiece; group 3, ProTaper rotary instrumentation). Reciprocating instrumentaion was the most effective and the manual instrumentation associated with GG burs was the least effective technigue.

Eid and Amin[22] compared the shaping ability of manual H-Files, rotary nickel-titanium ProTaper System and reciprocating SafeSiders in long oval-shaped (human lower premolars) canals under microscope. Results showed that none of the 3 instrumentation techniques completely prepared the oval root canal. Manual and rotary Ni-Ti instrumentation may perform better than reciprocating Safesider instrumentation in shaping oval canals.

Karataş et al [23] compared the incidence of root cracks after root canal instrumentaiton with TF Adaptive, WaveOne, Protaper Next and Protaper Universal systems under stereomicroscope. They concluded that the Protaper Next and TF Adaptive systems produced significantly less cracks than the ProtaperUniversal and WaveOne systems.

Hiquea et al. [24] evaluated the cyclic fatique resistance of 3 different Ni-Ti reciprocating instruments. Group 1 (WaveOne Primary), Group 2 (Reciproc R25), Group 3 (TF Adaptive ML1 instruments). The instruments were subjected to cyclic fatique test on a static model consisting of a metal block with a simulated canal with 60° angle of curvature and a 5-mm radius of curvature. Cyclic fatique of Reciproc R25 and TF adaptive ML1 was significantly higher than that of WaveOne Primary.

Karataş et al. [25] compared the effect of the TF Adaptive, ProTaper Next, OneShape, WaveOne, Reciproc, SAF on the reduction of E.faecalis in experimentally infected root canals. Analysis of results showed that the ProTaper Next, TF Adaptive, WaveOne, Reciproc and OneShape systems were significantly more effecective than the SAF system in reducing E.faecalis within the root canals.

Priya et al.[26]compared the incidence of dentinal micro cracks after instrumentation with various types of NiTi files in rotary and reciprocating motion. In their study one hundred human extracted mandibular central incisors were taken and divided into 10 groups (n=10 teeth per group). Group 1- No preparation, Group 2 - Hand instrumentation, Groups 3,4 - ProTaper files in rotary and reciprocating motion, Groups 5,6 - ProTaper Next files in rotary and reciprocating motion, Groups 7,8 - Oneshape files in rotary and reciprocating motion, Groups 9,10 - Reciproc files in rotary and reciprocating motion. Specimens were sectioned horizontally at 3,6 and 9 mm from the apex and dentinal micro cracks were observed under a stereomicroscope. They concluded that least cracks were seen in canals instrumented with Pro Taper Next files both in rotary and reciprocating motion. Full sequence rotary systems showed less cracks than single file systems and full sequence rotary systems showed less cracks in reciprocating motion than in rotary motion.

## Conclusions

As a result, day by day the new reciprocal movement systems are being developed and offered to endodontic practice.

The literature review reveals that the reciprocal systems are faster to shape root canals than the rotary systems and safe as much as them. The main advantage of current reciprocal systems is having a single filefor root canal shaping. So the procedure is easy, time saving, prevents cross-contamination and has minimum risk of file fracture. Besides these advantages, the studies shows that they are effective to shape such as rotary systems and these benefits may indicate that they will take an important role in future endodontics.

However the reciprocal systems are quite new and many in vivo and in vitro studies are necessary to evaluate them. Besides it is known that the use of irrigation solutions in root canal cleaning and shaping procedure have a very important role for disinfection. In standard root canal therapies performed either with rotary and hand-files, 2 ml of root canal irrigant was used between each file which is essential for antimicrobial effect and soft tissue dissolution. Thus the need for a new irrigation procedure for one filed reciprocating systems will be a new subject in endodontics in order to obtain successful root canal therapies.

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Research Article should be presented in the order of Introduction, Methods, Results, and Discussion sections. The main text of manuscripts submitted as Research Articles should have a limit of 3000 words.

Case Report should be consisted of a short introduction, case report, discussion and conclusion sections.

Letter To The Editor should have a limit of 600 words and written nonstructured format.

Review Invited or non-invited reviews will be published.

Conflict of interest: Please disclose whether any authors received any financial support for the conduct of the research or any commercial affiliations that could be considered to pose a conflict of interest regarding the submitted manuscript. If so, briefly describe the role of the sponsor(s).

Acknowledgements: If applicable, acknowledgements should be grouped in a paragraph at the end of the text and before the references. Permission and approval of the wording must be obtained from the person thanked.

Tables and Figures: A maximum of seven figures and four tables should be submitted. Tables and figures must be numbered consecutively. Ensure that each table and figure is cited in the text.
A short descriptive title should appear above each table. Do not draw vertical rules in tables. Figures should be submitted separately in TIFF, JPEG or EPS format in grayscale. Figures should have a caption. If the patient is clearly identified in the article, his/her written permission must be obtained.

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...as reported by Saito et al.[2]
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Several studies[3–6, 11, 15] have shown that primary stability in dental implants.

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Internet pages and online resources may be included within the text and should state as a full URL and date of access. For example:
http://www.tdkterim.gov.tr/bts/ (12.10.2014)

Example for thesis references:
Efthimiadou D. (2006) Evaluation of Dental and Skeletal Changes Due To Surgically Assisted Rapid Maxillary Expansion. PhD Thesis, Istanbul, Marmara University, Institute of Medical Sciences.

**CHECKLIST**

**Only complete manuscript submissions will be considered for publication. Complete submission must include:**

1. Cover letter for manuscript submission
2. Signed copyright transfer statement by corresponding author
3. Letter of approval from review committee for the use of human samples in research and human experiments (if necessary)
4. Letter of approval from relevant authority for the use of animals in experiments (if necessary)
5. Signed consent to publish from human subjects who can be identified in your manuscript (if necessary)

**In the actual article, ensure that the following information is provided:**

Title page (double spaced)

- Article title
- Name(s) and affiliation(s) of author(s)
- Running title not exceeding 50 characters
- Corresponding author's contact details (name, e-mail, mailing address, telephone and fax numbers)

Abstract max 250 words and 3-10 key words (double spaced)
Main text with appropriate section headings (double spaced)
References (double spaced), on a new page
Tables (double spaced), each on a new page
Figures and/or illustrations should be JPG/TIFF format and separate files