Güncel Endodonti Çalışmaları XI

Editör

Oğuz YOLDAŞ

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Bölüm 1

ENDODONTİDE DEZENFEKSİYON PARADİGMASININ EVRİMİ: GENTLEWAVE SİSTEMİ

Mertkan KUMRU[1]
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GİRİŞ

Kök kanal tedavisinin amacı, pulpal ve/veya periradiküler patolojilerle mücadele etmek amacıyla kök kanal sistemi içerisindeki enfekte veya inflame pulpa dokusunun uzaklaştırılmasıdır.(1) Kök kanal şekillendirme ve irrigasyonundaki gelişmeler klinik sonuçları iyileştirmiş olsa da, geleneksel yaklaşımlar; istmuslar, lateral kanallar ve apikal dallanmalar gibi kök kanal sisteminin karmaşık mikroanatomisini yeterli düzeyde hedeflemede sıklıkla yetersiz kalmaktadır.(2) Bu anatomik karmaşıklıklar, tedavinin genel başarısını olumsuz yönde etkileyebilen rezidüel biyofilm ve doku artıkları için uygun bir barınak oluşturmaları nedeniyle önemli bir zorluk teşkil etmektedir.(3) Artan çok sayıda kanıt, endodontik döner eğe sistemlerinin kök kanal sisteminin önemli bir bölümüne ulaşamadığını ve temizleme ile dezenfeksiyonun belirli bir kısmının irrigasyon solüsyonlarına bağımlı olduğunu göstermektedir.(4)

Bu zorlukların üstesinden gelmek amacıyla, kök kanal sistemi içerisindeki sıvı dinamiklerini optimize etmek ve kimyasal ajanların penetrasyonunu artırmak üzere tasarlanmış çoklu sonik irrigasyon cihazı olan GentleWave (GW) sistemi (Sonendo, Laguna Hills, CA, ABD) geliştirilmiştir.(5) Geleneksel irrigasyon yöntemlerinin büyük ölçüde mekanik ajitasyon ve ultrasonik aktivasyona(6) dayandığı dikkate alındığında, bu yaklaşım irrigant akışını ve kavitasyon

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bildirmiştir. Ayrıca, GW'nin kırık enstrümanların uzaklaştırılmasına da yardımcı olabildiği gösterilmiştir.(56) Yapılan bir çalışmada GW sisteminin, yan delikli iğne (%16) ve EndoVac (%9) gruplarına kıyasla daha fazla rezidüel obturasyon materyali uzaklaştırdığı (%26) belirlenmiştir; ancak GW ile diğer iki grup arasındaki farklar istatistiksel olarak anlamlı bulunmamıştır.(57) Başka bir çalışmada GW sistemi, tüm kanal boyunca kalan dolgu materyalinin yaklaşık %10'unu uzaklaştırabilmişken, PUI %18 oranında uzaklaştırma sağlayarak daha iyi bir performans göstermiştir. Kök kanalının farklı üçlüleri değerlendirildiğinde, orta ve apikal üçlülerde PUI'nin, GW'ye kıyasla daha fazla dolgu materyali uzaklaştırdığı belirlenmiştir. Koronal üçlüde ise test edilen gruplar arasında istatistiksel olarak anlamlı bir fark saptanmamıştır. Bu çalışmanın sonuçlarında, her iki tekniğin de kök kanal sisteminde kalan dolgu materyalinin uzaklaştırılmasını artırdığını, ancak tam bir uzaklaştırma sağlayamadığını göstermiştir. PUI (%18) ile GW (%10) kullanımıyla uzaklaştırılan dolgu materyali miktarları arasında istatistiksel olarak anlamlı bir fark saptanmış olsa da, bu farkın klinik açıdan anlamlı bir karşılık oluşturup oluşturmadığı belirsizliğini korumaktadır.(58)

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Bölüm 2

KÖK KANAL TEDAVİSİNDE BİYOSERAMİK PATLARIN ANTİBAKTERİYEL PERFORMANSI: İN VİTRODAN KLİNİĞE

Nursel MAHAN[1]

GİRİŞ

Endodontik tedavinin temel ve nihai amacı; pulpal hastalıklar veya nekroz sonucunda kök kanal sistemini enfekte eden mikroorganizmaların, bu mikroorganizmalara ait toksinlerin ve biyolojik yan ürünlerin elimine edilerek steril bir ortamın sağlanması ve kanal sisteminin üç boyutlu olarak sızdırmaz bir şekilde doldurulmasıdır (1). Günümüz modern diş hekimliğinde gelişmiş nikel-titanyum döner alet sistemleri ve sodyum hipoklorit, etilendiamintetraasetik asit (EDTA) veya klorheksidin (CHX) gibi antimikrobiyal irrigasyon solüsyonlarının yoğun kullanımına rağmen, kök kanal sisteminin tam anlamıyla sterilize edilmesi neredeyse imkansızdır (2).

Bu durumun temel nedeni, kanal sisteminin düz bir boru şeklinde olmaması; aksine istmuslar, lateral kanallar, apikal dallanmalar ve mikroskobik dentin tübülleri içeren son derece karmaşık ve düzensiz bir anatomik ağdan oluşmasıdır. Bu anatomik "kör noktalar", mikroorganizmalar için mekanik aletlerin ulaşamadığı ve irrigasyon solüsyonlarının yüzey gerilimi nedeniyle tam olarak nüfuz edemediği güvenli sığınaklar yaratmaktadır. Bu mikrobiyal kalıcılık, zamanla rezidüel bakterilerin çoğalmasına ve post-operatif apikal periodontitis gibi başarısızlık tablolarına yol açmaktadır (3). Endodontik başarısızlıkların yaklaşık %58.6'sının kök kanal sisteminin eksik veya yetersiz doldurulmasına bağlandığı göz önüne alındığında, kanal dolgu patlarının taşıdığı kritik rol çok daha net anlaşılmaktadır (4).

Bu klinik gerçeklik, endodontik kanal dolgu patlarının yalnızca inert materyaller olmaktan çıkıp, aktif birer biyolojik ajan olarak işlev görmesi gerektiği

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başa çıkma becerisi ve kemo-mekanik dezenfeksiyonun kalitesi olduğudur.

SONUÇ

Kök kanal tedavisinde mutlak mikrobiyal eradikasyon, endodontik materyal biliminin henüz tam anlamıyla ulaşılamamış nihai hedefi olmaya devam etmektedir. Kalsiyum silikat esaslı hidrolik biyoseramik patların endodonti sahnesine çıkışı, diş hekimliğini salt boşluk dolduran (inert) materyallerden; aktif olarak dentinle etkileşime giren, pH modülasyonu sağlayan ve güçlü hücresel yıkım dinamikleri sunan "akıllı" biyomateryallere doğru taşıyan tartışılmaz bir evrimdir.

Detaylı *in vitro* çalışmaların ışığında, biyoseramik patların sertleşme reaksiyonları esnasında ortaya çıkardıkları alkali fırtınanın, bakteriyel hücresel bileşenleri (yağ asitleri, proteinler ve DNA) tahrip etme kapasitesi son derece güçlüdür. Özellikle *Enterococcus faecalis* gibi persistan patojenleri elimine etme potansiyelleri laboratuvar ortamında net bir şekilde kanıtlanmıştır. Ancak, insan kök kanal dentininin sahip olduğu güçlü iyon tamponlama kapasitesi, karmaşık çoklu-tür biyofilmlerinin ekolojik sığınak dinamikleri ve kök kanal anatomisinin ulaşılamaz ramifikasyonları; laboratuvardaki steril başarıların doğrudan klinik başarıya aktarılmasını engelleyen majör doğal bariyerlerdir.

Klinik verilerin ve meta-analizlerin açıkça ortaya koyduğu üzere, biyoseramikler tek başına sihirli bir dezenfektan değildir; antibakteriyel etkinlikleri ancak güçlü kök kanal irrigasyon protokolleri (NaOCl, EDTA, ultrasonik aktivasyon) ile desteklendiğinde ve ideal kanal kurutma (*blot-drying*) teknikleriyle el ele çalıştığında maksimize olmaktadır. Son tahlilde, klinisyenler için kanal dolgu patı seçimi; yeni nesil bir biyomateryalin sunduğu antibakteriyel kapasiteye körü körüne güvenerek temel kemo-mekanik dezenfeksiyon disiplininden taviz vermek şeklinde yorumlanmamalıdır. Aksine biyoseramik patlar; mekanik olarak titizlikle şekillendirilmiş ve kimyasal olarak yoğun şekilde dezenfekte edilmiş bir kanal sisteminin apikal üçlüsünde, doku iyileşmesini indükleyen ve geride kalan son mikrobiyal kalıntıları alkali bir biyo-mineral mezarına (*entombment*) gömen üstün biyolojik araçlar olarak konumlandırılmalıdır.

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Bölüm 3

İNTERNAL REZORPSİYONUN YÖNETİMİNDE GÜNCEL KANITLAR: TANIDAN TEDAVİYE

Hamdi Alperen YALÇIN[1]

1. GİRİŞ

İç kök rezorpsiyonu olarak da adlandırılan internal rezorpsiyon; pulpa boşluğundaki klastik hücre aktivitesi sonucu intraradiküler dentin kaybıyla karakterize, nadir görülen patolojik bir durumdur. Bu süreç genellikle kronik pulpa iltihabı ile ilişkilidir ve uzun süre boyunca semptomsuz kalabilir; genellikle rutin radyografik muayene sırasında tesadüfen tespit edilir (1). Bununla birlikte, aktif inflamasyon varlığında spontan ağrı, kron hassasiyeti veya klasik "Mummery'nin pembe dişi" (pink tooth of Mummery) görünümü gibi bulgular ortaya çıkabilmektedir (2). Tedavi edilmezse, rezorpsiyon süreci ilerleyebilir, bu da diş yapısının zayıflamasına, kök perforasyonuna ve sonunda diş kaybına yol açabilir.

Kesin etiyolojisi henüz tam olarak aydınlatılamamış olmakla birlikte, travma, pulpal enfeksiyon ve geçirilmiş restoratif veya endodontik girişimlerin predispozan faktörler arasında yer aldığı bildirilmiştir. Olumlu bir prognoz için erken teşhis büyük önem taşımaktadır; bununla birlikte, internal rezorpsiyonun doğru tanımlanması, özellikle erken evrelerde oldukça güç olabilmektedir (3). Geleneksel radyografik yöntemler, yalnızca iki boyutlu görüntü sağlamaları nedeniyle internal ve eksternal rezorpsiyon lezyonlarının ayırıcı tanısında yetersiz kalabilmektedir. Bu doğrultuda, konik ışınlı bilgisayarlı tomografi (KIBT) lezyonun boyut ve kapsamının üç boyutlu görüntülenmesine imkân tanıyarak tanı doğruluğunu belirgin şekilde artırdığı bildirilmiştir (4).

İnternal rezorpsiyonun görülme sıklığı oldukça düşüktür ve Haapasalo, inflamatuvar nedenlere bağlı internal rezorpsiyon için %0,01-%1 arasında bir prevalans öne sürmüştür (5). KIBT tabanlı yakın tarihli bir çalışmada;

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Bölüm 4

YAPAY ZEKANIN ENDODONTİDEKİ KULLANIM ALANLARI

Gamze AKDUMAN[1]
Hatice BÜYÜKÖZER ÖZKAN[2]

GİRİŞ

Yapay zekâ (YZ), son yıllarda sağlık bilimlerinde olduğu gibi endodonti alanında da tanı, tedavi planlaması ve klinik karar verme süreçlerini dönüştüren önemli bir teknolojik araç hâline gelmiştir. Özellikle makine öğrenmesi (ML) ve derin öğrenme temelli algoritmalar, dental görüntüleme verilerinin analizinde yüksek doğruluk oranları sunarak periapikal lezyonların tespiti, kök kanal morfolojisinin değerlendirilmesi ve kök kırıklarının belirlenmesinde geleneksel yöntemlere göre daha tutarlı sonuçlar sağlamaktadır. Konik ışınlı bilgisayarlı tomografi (CBCT) ve dijital periapikal radyografilerden elde edilen büyük veri setlerinin YZ ile analiz edilmesi, endodontik tanının daha erken ve objektif biçimde konulmasına olanak tanımaktadır.

Bunun yanı sıra, YZ tabanlı sistemler doğru çalışma boyu tespiti, kanal konfigürasyonunun öngörülmesi ve tedavi prognozunun değerlendirilmesi gibi klinik uygulamalarda destekleyici bir rol üstlenmektedir. Eğitim alanında ise simülasyon ve karar destek sistemleri aracılığıyla diş hekimliği öğrencilerinin klinik öncesi becerilerinin geliştirilmesine katkı sağlamaktadır. Ancak veri güvenliği, algoritmik şeffaflık ve klinik doğrulama gereksinimleri gibi etik ve metodolojik sınırlılıklar, YZ'nin endodontide rutin kullanımı önünde dikkate alınması gereken önemli faktörlerdir. Bu bağlamda, etik ilkelere dayalı düzenleyici çerçevelerin oluşturulması ve YZ uygulamalarının klinik olarak valide edilmesi, endodontide yapay zekânın güvenli ve sürdürülebilir biçimde entegrasyonu için temel bir gereklilik olarak değerlendirilmektedir. Gelecekte, standartlaştırılmış

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tabanları veya uzman kişiler tercih edilmelidir.

6.GELECEKTEKİ YAPAY ZEKA YAZILIMLARINDAN BEKLENTİLER

YZ, günümüzde hızla büyüyüp gelişmektedir. Bu durumun gelecekte diş hekimliğinde ve endodontide de çeşitli gelişmeleri sağlaması beklenmektedir. Gelecekte YZ uygulamaları nedeniyle daha doğru ve hızlı tanı konulması beklenmektedir. Araştırmalar, YZ tabanlı görüntüleme analizlerinin belirli dental bulguları uzmana benzer veya daha yüksek doğrulukla tespit edebildiğini göstermiştir (Wang et al., 2025). Ayrıca, YZ kişiselleşmiş tedavi planlaması sağlayabilir. Bu, hastanın yaşı, geçmiş tedavileri, genetik risk faktörleri ve yaşam tarzı gibi verilerin analizini içerir. Örneğin ortodontide diş hareketleri için kişiye özel tahmin modelleri, implant yerleştirilmesi öncesi kişisel simülasyonlar oluşturulabilir. Ancak tüm bu gelişmelerin diş hekimlerinin yerini tamamen almayacağı ve YZ'nin insan uzmanlığını tamamlayıcı bir araç olduğu düşünülmektedir. Ayrıca YZ'nin etik, veri güvenliği ve regülasyon gibi önemli zorlukları da mevcuttur (Dua et al., 2025).

SONUÇ

Sonuç olarak, YZ teknolojilerinin endodonti ve genel diş hekimliği alanlarındaki kullanımının geleceği, klinik uygulamalarda devrim yaratma potansiyeline sahiptir. YZ, tanı doğruluğunu artırarak, özellikle görüntüleme teknikleriyle diş çürükleri, kanal enfeksiyonları gibi karmaşık durumları hızlı ve etkili bir şekilde belirlemenin yanı sıra, tedavi süreçlerini bireyselleştirerek her hastaya özel çözüm sunma imkânı tanıyacaktır. Ayrıca, yapay zekâ destekli sistemler, diş hekimlerine klinik kararlar ve hasta bakımında daha bilinçli seçimler yapmalarını sağlayarak, tedavi başarısını yükseltecek ve sağlık hizmetlerinin kalitesini artıracaktır. Bu gelişmeler, diş hekimliğini sadece daha doğru ve verimli hale getirmekle kalmayıp, aynı zamanda hastaların tedavi süreçlerini daha güvenli ve hızlı bir şekilde tamamlamalarına da olanak tanıyacaktır.

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Bölüm 5

APİKAL PERİODONTİTİSLİ DİŞLERDE KÖK KANAL TEDAVİSİ YENİLEME STRATEJİLERİ

Mert ÖZÇELİK[1]
Mine BÜKER[2]

GİRİŞ

Kök kanal tedavisinin amacı, kanal sistemindeki enfeksiyonu ortadan kaldırıp periapikal iyileşmeyi sağlayarak dişi işlevsel biçimde korumaktır. Ancak tedavi her zaman başarılı olmaz; kanalda kalan persistan veya sekonder intraradiküler enfeksiyon ya da koronal sızıntı, tedavi sonrası apikal periodontitise yol açabilir (1). Bu olgularda dişi korumaya yönelik en konservatif seçenek, kök kanal dolgusunun uzaklaştırılıp kanalın yeniden dezenfekte edildiği cerrahi olmayan yenileme tedavisidir. Uygun olmayan durumlarda ise periradiküler cerrahi alternatif oluşturur (1). Bu bölümde, apikal periodontitisli dişlerde kök kanal tedavisi yenileme stratejileri; başarısızlık nedenleri, tedavi kararını etkileyen etkenler ve dolgu uzaklaştırmadan dezenfeksiyona uzanan klinik basamaklar ele alınmaktadır.

KÖK KANAL YENİLEME TEDAVİSİ NEDİR?

Kök kanal tedavisi yenilemesi, daha önce endodontik tedavi görmüş bir dişte mevcut kanal dolgu materyalinin uzaklaştırılması, kanal sisteminin yeniden temizlenmesi, şekillendirilmesi ve doldurulması esasına dayanan cerrahi olmayan bir tedavi yaklaşımıdır (2). Bu prosedürün temel amacı, başarısız primer tedavi sonrası devam eden periapikal hastalığın kontrol altına alınması, kök kanal sistemindeki persistan enfeksiyonun azaltılması ve doğal dişin çekimden korunarak ağızda fonksiyonunu sürdürmesini sağlamaktır (2). Cerrahi olmayan

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uygulanamadığı veya başarısız kaldığı olgularda, mikrocerrahi teknikler ve büyütme sistemleriyle desteklenen apikal cerrahi güvenilir bir tedavi alternatifi sunabilir. Sonuç olarak, tedavi başarısı; titiz bir vaka seçimini, kanıta dayalı klinik protokolleri ve gerektiğinde cerrahi yaklaşımla desteklenmiş bütüncül bir tedavi planlamasını kapsayan, vaka bazlı bir klinik stratejinin izlenmesine bağlıdır.

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Bölüm 6

ENDODONTİDE YAPAY ZEKA KULLANIMI VE GELECEĞE YÖNELİK PERSPEKTİF

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YAPAY ZEKA TARİHSEL GELİŞİMİ VE TEMEL KAVRAMLAR

Yapay zeka terimi ilk kez John McCarthy tarafından kullanılmış ve başlangıçta akıllı makineler geliştirmeye yönelik bir bilim ve mühendislik dalı olarak tanımlanmıştır. McCarthy ve çalışma arkadaşları 1955 yılında, öğrenme sürecinin ve zekânın herhangi bir bileşeninin ilke olarak yeterince açık biçimde tarif edilip bir makineye simüle ettirilebileceği fikrinden yola çıkarak, iki ay sürecek ve on kişinin katılacağı bir araştırma önerisi sunmuşlardır (1). Bu dönüm noktası niteliğindeki proje hızla gelişti ve günümüzde hayatımızın birçok yönünü etkilemeye devam ediyor. Bugün yapay zeka, karmaşık problemlerin çözümünde başvurulan etkili bir teknoloji haline gelmiştir. Sağlık alanına da hızla dahil olmuş tıp, diş hekimliği gibi birçok alanda kullanılmaya başlanmıştır (2).

Yapay zekayı anlayabilmek için, öncelikle sıklıkla kullanılan temel kavramları ve bu kavramların birbirleriyle olan ilişkilerinin bilinmesi gerekmektedir.

Yapay Zeka: Yapay zeka, görüntüyü yorumlama, sesi tanıma, karar alma ve doğal dili anlama gibi normalde insan zekâsı gerektiren görevleri yerine getirebilen makinelerin tasarlanmasıyla ilgilenen bir bilgisayar bilimi ve mühendislik dalıdır (3).

Makine Öğrenmesi: Makine öğrenmesi, veriler içerisindeki yapıları ve örüntüleri belirlemek amacıyla algoritmalardan ve istatistiksel modellerden yararlanan bilgisayar sistemlerinin geliştirilmesini ifade eder. Bu algoritmalar, yeni veriler sisteme dahil edildikçe öğrenebilir ve kendilerini uyarlayabilir; böylece

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iyi görüntülenmesini sağlayabilir. Kanser teşhisi alanında halihazırda geliştirilmiş olan benzer yapay zeka entegreli mikroskopi sistemleri (53, 54) bu tür sistemlerin endodontideki uygulama potansiyelini ortaya koymaktadır. Tıbbi ortamlarda prosedürler sırasında görüntüleme verilerinin gerçek zamanlı analizi için yapay zekadan yararlanılmasına benzer şekilde (55), yapay zeka destekli görüntü analizi de gerçek zamanlı veri akışlarını işleyerek çürükleri, diş çatlaklarını, pulpa taşlarını, kanal ağızlarını ve diğer klinik açıdan değerli bilgileri vurgulayıp işlemlere rehberlik edebilir. Bu durum, ergonomiyi ve iş akışını iyileştirebilir. Bununla birlikte, yapay zeka yeteneklerinin mikroskoplara sorunsuz bir şekilde entegre edilebilmesi için çok modlu görüntü işleme ve akıllı kontrol alanlarında önemli yeniliklere hala ihtiyaç duyulmaktadır (37).

Yapay zeka, diş hekimliği uygulamalarının yönetimini geliştirmek amacıyla çeşitli şekillerde kullanılabilir. Örneğin, endodontik vaka seçimi ve sevk süreçlerine yön vermek, yapay zekanın potansiyel bir uygulama alanıdır. Radyografik görüntüler ile tıbbi geçmiş, kaygı düzeyi ve ağız açıklığı gibi hastaya özgü diğer faktörlere dayanarak belirli bir vakanın karmaşıklığını değerlendiren ve daha zorlu vakaların endodonti uzmanlarına sevk edilmesini öneren derin öğrenme modelleri geliştirilebilir. Ayrıca yapay zeka ve makine öğrenimi; sağlık hizmeti sunucusunun üzerindeki yükü azaltmak, hasta memnuniyetini artırmak ve hastaya daha özel bir bakım sunmak amacıyla hasta randevu planlamasını optimize edebilir (56).

6) SONUÇ

Sonuç olarak yapay zeka endodonti biliminde henüz tam olarak adapte olmasa da birçok alanda gelişime açıktır. Endodonti alanında irrigasyon yöntemlerini optimize etmek, rejeneratif prosedürlerde kullanmak, dental materyallerin biyouyumluluklarını artırmak gibi birçok alanda kullanılması beklenmektedir. Hala bu konuyla ilgili daha fazla araştırma ve çalışmaya ihtiyaç vardır (37).

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Bölüm 7

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Burcu REVİ ATMACA[1]

GİRİŞ

Endodontik tedavinin temel amacı, kök kanal sisteminde etkin bir dezenfeksiyon sağlayarak bakteriyel yükü en aza indirmektir.(1) Bu amaca ulaşılabilmesi için, etkili bir kemomekanik preparasyonun uygulanmasının yanı sıra kök kanal sisteminin uygun tekniklerle hermetik olarak doldurulması gerekmektedir.(2)

Kök kanal sisteminin kompleks anatomisi, kemomekanik preparasyona rağmen kanal sisteminin tüm uzantılarında tam bir temizlik sağlanmasını güçleştirmektedir.(3) Kök kanal sisteminin temizliği, lateral kanallar, istmuslar ve aksesuar kanallar gibi anatomik oluşumlarının etkin biçimde debride edilmesini ifade etmekte olup, bu sürecin başarısı büyük ölçüde debris ve smear tabakasının etkili bir şekilde uzaklaştırılmasına bağlıdır. Preparasyon sonrasında oluşan smear tabakası; dentin debrisleri, mikroorganizmalar ve nekrotik doku kalıntıları gibi organik ve inorganik bileşenlerden meydana gelmektedir.(4, 5) Smear tabakasının varlığı, kök kanal irriganlarının ve kanal içi medikamentlerin dentin tübüllerine yeterli düzeyde penetre olmasını engelleyerek dezenfeksiyon etkinliğini azaltabilmektedir.(6, 7)

İrrigasyon solüsyonları, kök kanal tedavisinin başarısında kritik bir rol oynamakla birlikte, kökü çevreleyen dokular üzerinde zararlı etki oluşturmamaları, hasta ve klinisyen açısından güvenli olmaları ve dişin fonksiyonel iyileşmesine katkı sağlamaları gerekmektedir.(8) Farklı konsantrasyonlarda (%0,5–6) kullanılabilen ve spesifik olmayan proteolitik bir ajan olan sodyum hipoklorit (NaOCl), güçlü doku çözücü etkisinin yanı sıra antimikrobiyal ve antibiyofilm özellikleri nedeniyle endodontik irrigasyonda yaygın olarak tercih edilmektedir. (9, 10) Bununla birlikte NaOCl, smear tabakasını uzaklaştırmada yetersiz kalmakta ve sert doku debrislerinin birikimini önleyememektedir.(11) Dentin

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Bölüm 8

KALSİFİYE KÖK KANALLARININ YÖNETİMİNDE REHBERLİ ENDODONTİ: STATİK REHBERLERDEN DİNAMİK NAVİGASYONA

Medine ÇİÇEK[1]

GİRİŞ

Pulpa kanal obliterasyonu (PKO), pulpa boşluğunda sekonder veya tersiyer dentin ve benzeri kalsifiye dokuların birikmesi sonucunda kök kanal sisteminin daralması ya da radyografik olarak izlenemez hâle gelmesiyle karakterize bir süreçtir (1,2). Travmatik diş yaralanmaları, yaşlanmaya bağlı fizyolojik değişiklikler, çürük, restoratif işlemler, vital pulpa tedavileri, rejeneratif endodontik uygulamalar, ortodontik hareketler ve okluzal travma bu durumun gelişmesinde rol oynamaktadır (3-5).

Özellikle lüksasyon yaralanmaları sonrasında gelişebilen PKO, klinik olarak kuronda sarımsı renk değişikliği ve pulpa duyarlılık testlerine verilen yanıtların azalması veya kaybolmasıyla fark edilebilir (3,5,6). Ancak pulpa duyarlılık testine negatif yanıt alınsa da, pulpa-dentin kompleksi içindeki kalsifiye doku birikimi canlı sert doku oluşturan hücreler tarafından sağlanmaktadır. Bu nedenle PKO, tek başına pulpa nekrozunun göstergesi olarak değerlendirilmemeli; çeşitli irritatif veya travmatik uyaranlara karşı gelişebilen pulpal bir yanıt olarak ele alınmalıdır (3). Ayrıca, bu olgularda duyarlılık testlerinin güvenilirliği sınırlıdır (6). Literatürde travma sonrası PKO bulunan dişlerin %1-27'sinde pulpa nekrozu ve apikal periodontitis gelişebildiği bildirilmiştir (3). PKO tek başına kök kanal tedavisi endikasyonu oluşturmadığından, tedavi kararı klinik semptomlar ve apikal periodontitisi düşündüren radyografik bulgular birlikte değerlendirilerek verilmelidir (3,6,7).

İleri derecede kalsifikasyon bulunan dişlerde kanal ağızlarının ve kanal yolunun belirlenmesi zorlaşmakta ve bu durum tedavinin karmaşıklığını

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Kalsifiye kanallar dışındaki diğer uygulamalar

Kalsifiye kanalların lokalizasyonu dışında, statik rehberli endodonti ve dinamik navigasyon sistemlerinin anatomik anomalilere sahip dişlerde erişim sağlanması, fiber postların uzaklaştırılması, kök kanal tedavisinin yenilenmesi, önceki erişim girişimine bağlı sapma veya perforasyon bulunan olgularda kanalın yeniden lokalize edilmesi ve endodontik mikrocerrahi gibi işlemlerde kullanımı bildirilmiştir (7,9,13). Statik rehberlerden ayrıca diş ototransplantasyonunda alıcı soketin hazırlanması ve donör dişin planlanan konuma yerleştirilmesi amacıyla yararlanılmıştır (7). Bu uygulamalar rehberli endodontinin kalsifiye kanallar dışındaki kullanım alanlarını göstermekle birlikte, bu bölümün kapsamı nedeniyle ayrıntılı olarak ele alınmamıştır.

Mevcut yayınlar rehberli endodontinin farklı klinik işlemlerde uygulanabileceğini göstermekle birlikte, özellikle dinamik navigasyona ilişkin klinik kanıtlar sınırlıdır. Martinho ve ark.'nın kapsam derlemesine dâhil edilen yayınlar arasında randomize klinik çalışma bulunmadığı ve statik ile dinamik sistemlerin klinik sonuçlarını doğrudan karşılaştıran daha fazla çalışmaya ihtiyaç duyulduğu bildirilmiştir (13).

6. SONUÇ

Statik rehberli endodonti ve dinamik navigasyon, ileri derecede kalsifiye kanallara erişimin dijital olarak planlanmasına olanak sağlayan bilgisayar destekli yöntemlerdir. Statik rehberli yaklaşımın erişim doğruluğunu ve kanal lokalizasyon başarısını artırabildiği; dinamik navigasyonun ise gerçek zamanlı yönlendirme sağlayarak erişim doğruluğunu artırabildiği ve diş dokusu kaybını azaltabildiği bildirilmiştir (2,5,6,10,11). Bununla birlikte, statik ve dinamik yöntemler kanal lokalizasyonunu bütün olgularda garanti etmemekte ve kendilerine özgü teknik sınırlılıklar taşımaktadır (3,6,8,9). Özellikle dinamik navigasyona ilişkin klinik kanıtların sınırlı olması nedeniyle statik ve dinamik sistemlerin klinik etkinliğini değerlendiren kontrollü ve doğrudan karşılaştırmalı araştırmalara ihtiyaç bulunmaktadır (10-12).

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Bölüm 9

ENDODONTİDE İRRİGASYON AKTİVASYONU: KLASİK TEKNİKLERDEN GÜNCEL SİSTEMLERE

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GİRİŞ

Günümüzde kök kanal şekillendirmesi, ağırlıklı olarak apikal anatomiye irrigasyon solüsyonlarının ulaşmasını sağlayan bir araç olarak görülmekte ve dezenfeksiyonun büyük kısmını bu solüsyonların gerçekleştirmesi beklenmektedir [1]. Kök kanal enfeksiyonlarına dentin yüzeylerine tutunan mikrobiyal biyofilmler neden olmaktadır ve bu durum irrigasyonun etkinliğini kısıtlayan temel unsurdur [2]. Biyofilm, mikroorganizmaların kendi salgıladıkları ekstrasellüler polimerik matriks (EPS) içerisinde çok katmanlı bir yapı oluşturmasıyla meydana gelir [3]. Bu matriks, antimikrobiyallerin difüzyonunu engelleyip onları nötralize ederek koruyucu bir bariyer işlevi görmektedir [4].

Kök kanal sisteminin anatomik karmaşıklığı da biyofilm eliminasyonunu zorlaştıran kritik bir faktördür. Biyofilm; istmuslar, aksesuar kanallar ve apikal dallanmalar gibi ana kanal dışındaki alanlara yerleşebileceği gibi, şekillendirme sırasında biriken dentin talaşları da bakteriler için koruyucu bir tabaka oluşturmaktadır [5]. Dahası, dentin tübüllerinin derinliklerine invaze olan ve dezenfeksiyondan kaçmayı başaran mikroorganizmalar hem birincil kanal tedavilerinin hem de retreatment işlemlerinin başarısızlığındaki ana neden olarak öne çıkmaktadır [6].Bu nedenle, kök kanalının mekanik olarak temizlenemeyen bu bölgelerinde kimyasal irrigasyonun etkinliği irrigasyon aktivasyon teknikleriyle artırılmaktadır. Bu tekniklerin klinik değeri yalnızca dezenfeksiyonla sınırlı kalmayıp; kanal dolgu materyalinin dentin tübüllerine penetrasyonunu ve buna bağlı olarak bağlantı dayanımını da artırabilir [7].

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dalgaları, standart PIPS protokolünde kullanılan tek atımlı Er:YAG lazer enerjisine kıyasla çok daha güçlüdür [81].

İlk buhar kabarcığı sönümlenmeye başladığı esnada, irrigasyon solüsyonu içerisine ikinci bir lazer atımı iletilerek yeni bir buhar kabarcığı tetiklenmektedir. Meydana gelen bu ikinci kabarcık, ilk kabarcığın çökme sürecini güçlendirip ivmelendirerek güçlü bir şok dalgası üretmektedir. Buna ek olarak, kök kanal duvarlarına yakın alanlarda meydana gelen ve çöken ikincil kabarcıkları da ilave şok dalgaları yayarak, kanal yüzeylerine tutunmuş olan debrisin yerinden sökülerek uzaklaştırılmasına katkı sağlamaktadır [82].

SONUÇ

Kök kanal irrigasyon aktivasyon sistemlerine ilişkin mevcut literatür, konvansiyonel şırınga irrigasyonunun kanal anatomisinin karmaşık bölgelerine ulaşmakta yetersiz kaldığını ve bu sınırlılığın aşılması amacıyla geliştirilen sonik, ultrasonik, negatif basınçlı, multisonik ve lazer destekli sistemlerin farklı düzeylerde klinik fayda sunduğunu ortaya koymaktadır. Bu yöntemler arasında PUI ve EDDY gibi teknikler nispeten güçlü bir kanıt tabanına sahipken, GentleWave ve PIPS/SWEEPS gibi yeni nesil sistemlere ilişkin bulgular büyük ölçüde in vitro çalışmalarla sınırlı kalmakta ve klinik üstünlükleri henüz kesin olarak kanıtlanamamıştır. Hiçbir yöntem tüm anatomik zorluklara karşı evrensel bir çözüm sunmadığından, aktivasyon tekniğinin seçimi kanal anatomisi, maliyet ve mevcut kanıt düzeyi göz önünde bulundurularak vaka bazında yapılmalıdır. Bu alandaki bilgi birikiminin klinik pratiğe daha güvenilir biçimde aktarılabilmesi için, standardize edilmiş protokoller kullanan uzun dönemli klinik çalışmalara ihtiyaç duyulmaktadır.

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Bölüm 10

KALSİYUM SİLİKATLARLA ORTOGRAD OBTÜRASYON

Ekin Deniz ÇATMABACAK[1]

GİRİŞ

Kök kanal obtürasyonunun amacı hazırlanmış ve dezenfekte edilmiş kanal sistemini koronal ve apikal yeniden kontaminasyona karşı üç boyutlu olarak doldurmak, mikroorganizmalar ile besin kaynaklarının hareketini sınırlamak ve periapikal iyileşme için stabil bir ortam oluşturmaktır. Geleneksel yaklaşımda gutta-perka hacmin büyük bölümünü oluşturur, sealer ise gutta-perka ile dentin arasındaki düzensizlikleri dolduran ince bir ara tabaka olarak kullanılır. Kalsiyum silikat esaslı sealerların gelişmesiyle "sealer mümkün olduğunca az olmalı" ilkesi yeniden tartışılmış; tek, konik uyumlu gutta-perka konunun daha fazla hidrolik sealerla birlikte kullanıldığı sealer-temelli obtürasyon yaygınlaşmıştır (1-3).

Bu materyaller suyla hidratasyon, alkalin pH, kalsiyum iyonu salımı, apatit benzeri çökelti ve genel olarak elverişli biyouyumluluk gibi özellikleri nedeniyle 'biyoseramik' olarak pazarlanır. Ancak aynı sınıftaki ürünlerin bileşimi, su kaynağı, reolojisi, sertleşme süresi, çözünürlüğü ve ısıya yanıtı önemli ölçüde değişir. Dolayısıyla kalsiyum silikatlarla obtürasyon tek bir materyal veya teknik değildir. Bu bölüm, materyal kimyasını klinik protokolle ilişkilendirmekte; soğuk hidrolik kondensasyon, sıcak teknikler, apikal taşkınlık, uzun dönem klinik sonuçlar ve retreatability üzerinden kanıtı değerlendirmektedir (1-6,16,21).

MATERYAL SINIFLAMASI VE SERTLEŞME REAKSİYONU

Kalsiyum silikat esaslı sealerlar, trikalsiyum silikat ve/veya dikalsiyum silikat içeren hidrolik bağlayıcılar üzerine kuruludur. Radyopaklaştırıcı olarak zirkonyum oksit, tantal oksit, bizmut oksit veya kalsiyum tungstat; akış ve stabiliteyi düzenlemek için doldurucular ve polimerik katkılar kullanılabilir. Toz-sıvı sistemler suyu

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SONUÇ

Kalsiyum silikat esaslı sealerlar, gutta-perkayla birlikte kullanıldığında ortograd obtürasyon için klinik olarak geçerli bir seçenektir. Güncel sistematik derlemeler ve dört-beş yıllık klinik çalışmalar, sealer-temelli tek kon tekniğinin seçilmiş olgularda geleneksel sıcak tekniklere benzer iyileşme sağlayabildiğini göstermektedir (7-15,23). Bununla birlikte ürünler arasında fizikokimyasal davranış, ısı toleransı, çözünürlük ve retreatability bakımından önemli farklar vardır (1-6,16-19,21,22,24,25). Biyouyumluluk apikal taşkınlığı meşrulaştırmaz; bioactivity laboratuvar bulgusunun daha iyi prognoz anlamına geldiği varsayılmamalıdır (26,27). Gutta-perka halen boy kontrolü, hacimsel stabilite ve yeniden tedavi edilebilirlik için temel çekirdektir. Başarı; materyal etiketinden çok etkili dezenfeksiyon, uygun anatomi seçimi, kontrollü sealer hacmi, koronal sızdırmazlık ve uzun dönem izlemin birlikte sağlanmasına bağlıdır (20,21).

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Bölüm 11

ENDODONTİK TEDAVİNİN GÖRÜNMEYEN SONLANIMI: OBTÜRASYON ANINDAKİ REZİDÜEL BAKTERİYEL YÜK PROGNOZU BELİRLİYOR MU?

Ekin Deniz ÇATMABACAK[1]

GİRİŞ

Apikal periodontitis mikrobiyal kökenli inflamatuvar bir hastalıktır. Kök kanal tedavisi bu nedenle yalnız biçimlendirme ve dolum işlemi değil, enfekte bir anatomik sistemde mikroorganizma yükünü konak savunmasının kontrol edebileceği düzeye indirme girişimidir. Güncel mikrobiyoloji, kanal içi bakterilerin çoğunlukla dentin yüzeyine tutunmuş çok türlü biyofilmler halinde bulunduğunu; mantar, arkea ve virüsler saptanabilse de hastalığın baskın etiyolojik unsurunun bakteriler olduğunu göstermektedir (1). Obtürasyon radyografide görülebilir, fakat o anda kanalda kalan mikrobiyal yük rutin klinik muayenede görünmez. Bu nedenle tedavinin teknik sonlanımı ile biyolojik sonlanımı aynı olmayabilir.

Tedavi sonucunu başlangıç lezyonunun büyüklüğü, apikal anatomi, primer tedavi veya retreatment yapılması, dezenfeksiyonun etkinliği, kök dolgusunun apikal seviyesi ve koronal restorasyon gibi birbirine bağlı değişkenler belirler. Güncel sonuç modeli, tedaviyi konak ile enfeksiyon arasındaki dengeyi değiştiren aktif bir müdahale; kök dolgusu ve restorasyonu ise bu yeni dengeyi yeniden kontaminasyona karşı koruyan pasif bir bariyer olarak ele alır (2). Rezidüel bakteriyel yük bu modelin merkezindedir, ancak tek başına mutlak bir başarı veya başarısızlık göstergesi değildir. Bu bölüm, obtürasyon anındaki mikrobiyal durumun prognozla ilişkisini, ölçüm yöntemlerini, anatomik ve istatistiksel sınırlılıkları ve klinik karar vermeye olası katkısını değerlendirmektedir.

REZİDÜEL BAKTERİYEL YÜKÜN ANLAMI

Rezidüel bakteriyel yük, kemomekanik preparasyon ve varsa kanal içi

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SONUÇ

Obtürasyon anındaki rezidüel bakteriyel yük prognozu etkiler, ancak prognozu tek başına belirlemez. Klasik kültür çalışması, qPCR temelli retreatment araştırması ve 2026 prospektif kohortu; daha yüksek kalan yükün daha düşük periapikal iyileşme olasılığıyla ilişkili olduğunu tutarlı biçimde göstermektedir. Buna karşın pozitif örnekli birçok diş iyileşir, negatif örnek bütün kanal sisteminin steril olduğunu kanıtlamaz ve ölçülen sinyalin canlılığı yönteme göre değişir. Klinik hedef, mutlak sterilite iddiası yerine başlangıç yükünü mümkün olan en düşük düzeye indirmek, apikal ekolojiyi iyi bir kök dolgusu ve koronal restorasyonla konak lehine korumak ve lezyon şiddetine uygun izlem yapmaktır. Rezidüel yük bugün rutin bir koltuk başı karar testi değil, güçlü bir biyolojik risk göstergesidir.

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Bölüm 12

MODERN ENDODONTİDE KANAL İÇİ MEDİKAMANLAR

Deniz KARAASLAN BAYAZIT[1]
Melikşah GÜNDÜZ[2]

GİRİŞ

Pulpal ve periapikal inflamasyon, insan vücudunun bakteriyel uyarılara karşı geliştirdiği immünolojik bir savunma reaksiyonudur. Bu nedenle endodontik tedavi stratejileri, bakterilerin ve oluşturdukları yan ürünlerin kök kanal sisteminden uzaklaştırılmasını amaçlar. Kök kanal tedavisi aynı zamanda, bakterilerin ağız boşluğundan yeniden kök kanal sistemine invazyonunu engellemek için dezenfeksiyon sonrası kök kanal sisteminin ağız boşluğuyla bağlantısını kesmeyi amaçlar (1).

Kök kanal sisteminin anatomik karmaşıklığı ve kök kanal enfeksiyonlarının çeşitliliği, mekanik enstrümantasyon ve irrigasyon gibi çeşitli stratejilerin etkinliğini sınırlamaktadır (2). Kök kanal sisteminin bu anatomik faktörleri ve enstrümantasyonun sınırlılıkları, kök kanal içindeki enfeksiyonun giderilmesinin engellenmesine sebep olmaktadır (3).

Mekanik preparasyon, kanalı huni şeklinde şekillendirmede ve irrigasyon ile dolguya zemin hazırlamada temel bir adım olsa da kanal temizliği ve debridmanında yetersizdir. Bu nedenle kimyasal temizlik ve dezenfeksiyon üzerine daha fazla çaba harcanmıştır. Kök kanal irrigasyonu ve kanal içi ilaç uygulamaları, mekanik preparasyondan sonra kalan mikroorganizmaları (özellikle kök kanal duvarında, lateral aksesuar kanallarda, isthmus ve apikal deltada) inhibe etmek veya öldürmek için kullanılmaktadır. Kliniklerde çeşitli irrigantlar ve yöntemler uygulanmış olsa dahi tek bir irrigantın tüm gereklilikleri güvenli ve yan etkisiz

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eden yüzey alanı artmaktadır (91). Biyoaktif camın intrakanal medikament olarak etki mekanizmasını açıklayan çalışmalar bulunmaktadır. Kabul edilen mekanizma, materyalin oluşturduğu ozmotik basınç ve çevresel pH değişiklikleri ile iğne benzeri keskin partikülleri hücre hasarına yol açmakta ve antimikrobiyal bileşenlerin bakteri sitoplazmasına daha kolay penetre olmasını sağlamasıdır (95).

SONUÇ

Endodonti alanında son yıllarda kaydedilen önemli teknolojik ve klinik ilerlemelere rağmen, bakterilerin ve oluşturdukları yan ürünlerin kök kanal sisteminden tam anlamıyla uzaklaştırılamaması günümüzde hala klinik uygulamalarda karşılaşılan önemli bir sorun olarak görülmektedir. Kalsiyum hidroksit kanal içi medikamentler içinde hala altın standart olarak kabul edilmektedir (86). Ancak bugüne kadar ne kalsiyum hidroksit ne de diğer kanal içi medikamentler ideal kanal içi medikament kriterlerinin tamamını karşılayamamıştır. Bu yüzden hastaya koyulan teşhislere ve hastaya ait faktörlere göre farklı kanal içi medikamentler kullanılabilmelidir (6). Ayrıca nanopartiküllerin ve antimikrobiyal peptitlerin kanal içi medikaman olarak kullanımı umut vericidir ve bu alanda daha fazla araştırma yapılması teşvik edilmelidir.

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Bölüm 13

ENDODONTİK TEDAVİDE İYATROJENİK KOMPLİKASYONLAR: ÖNLEME, TANI VE YÖNETİM

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GİRİŞ

Endodontik tedaviler, karmaşık kök kanal anatomisi içerisinde gerçekleştirilen ve yüksek düzeyde teknik hassasiyet gerektiren girişimlerdir. Uygun koşullarda yüksek başarı oranlarına sahip olmalarına karşın; tanı, giriş kavitesi hazırlığı, kök kanal sisteminin temizlenmesi ve şekillendirilmesi, irrigasyon ve obturasyon gibi farklı tedavi aşamalarında istenmeyen komplikasyonlar meydana gelebilmektedir. Bu komplikasyonların bir kısmı anatomik güçlüklerden kaynaklansa da önemli bir bölümü tedavi ilkelerinin yeterince anlaşılmaması, uygun olmayan tekniklerin uygulanması veya kullanılan aletlerin kontrolündeki yetersizliklerle ilişkilidir(1-3).

İyatrojenez, genel anlamıyla bir sağlık girişimi sonucunda hastada ortaya çıkan zarar veya istenmeyen etkiyi ifade etmektedir. Terim, Yunancada hekim veya iyileştirici anlamına gelen "iatros" ile oluşum veya köken anlamındaki "genesis" sözcüklerinden türemiştir. Diş hekimliğinde iyatrojenik komplikasyonlar; tanı, tedavi, koruma veya rehabilitasyon süreçlerinde meydana gelen ve hastanın sağlığını ya da uygulanan tedavinin prognozunu olumsuz etkileyebilen durumları kapsamaktadır(4, 5). Endodontik tedavi sırasında karşılaşılan başlıca iyatrojenik komplikasyonlar arasında giriş kavitesinin hatalı hazırlanması, kök kanallarının gözden kaçırılması, kanal tıkanıklığı, basamak oluşumu, kanal transportasyonu, apikal bölgenin yapısının bozulması, kök veya furkasyon perforasyonları, endodontik aletlerin kırılması, aşırı enstrümantasyon ve kök kanal dolgu materyalinin yetersiz ya da taşkın uygulanması yer almaktadır(4, 6). Bu komplikasyonlar tedavinin farklı aşamalarında tek başına ortaya çıkabileceği

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Bölüm 14

ENDODONTİK YENİDEN TEDAVİDE SOLVENTLERİN YERİ: GELENEKSEL VE GÜNCEL YAKLAŞIMLAR

Sine GÜNGÖR US [1]

GİRİŞ

Kök kanal tedavisinin temel amacı, kök kanal sistemindeki mikroorganizmaların ve enfekte dokuların uzaklaştırılması, yeniden kontaminasyonun önlenmesi ve kanal boşluğunun üç boyutlu olarak doldurulmasıdır (1, 2). Bununla birlikte, kök kanal sisteminin karmaşık anatomisi, yetersiz kemomekanik preparasyon, uygun olmayan obturasyon veya koronal sızıntı, tedavinin başarısızlığına neden olabilir (3, 4). Başarısızlığın başlıca nedenleri arasında, kök kanal sistemi içerisinde varlığını sürdüren veya sisteme sonradan ulaşan mikroorganizmalar yer almaktadır (5, 6).

Primer kök kanal tedavisinin başarısız olduğu durumlarda cerrahi olmayan endodontik yeniden tedavi, enfeksiyonun kontrol altına alınmasını ve periapikal dokuların iyileşmesini amaçlayan konservatif bir tedavi seçeneğidir (7-9). Yeniden tedavi başarısının önemli bir belirleyicisi, özellikle kalıntıların mikroorganizmaları barındırabileceği ve yeniden obturasyonu tehlikeye atabileceği karmaşık anatomik alanlardan mevcut kök kanalı dolgu malzemelerinin tamamen çıkarılmasıdır (7, 10). Dolgu materyallerinin uzaklaştırılmasında mekanik, kimyasal ve ultrasonik yöntemlerden tek başına veya birlikte yararlanılmaktadır (11). Ancak istmuslar, dallanmalar ve oval kök kanal konfigürasyonları gibi anatomik karmaşıklıklar, dolgu materyalinin tamamen uzaklaştırılmasını güçleştirmektedir (12). Bu nedenle mekanik uzaklaştırma yöntemlerini destekleyen yardımcı yaklaşımlardan yararlanılmaktadır.

Solventler, gutta perka ve kanal patlarını kimyasal özelliklerine bağlı olarak çözündürmek veya yumuşatmak amacıyla kullanılan ajanlardır (12). Endodontik yeniden tedavide mekanik yöntemlerle birlikte kullanılarak aletlerin dolgu

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Bölüm 15

ENDODONTİDE LAZER UYGULAMALARI: KANITLAR VE SINIRLILIKLAR

Hasan UYANIK[1]

1. GİRİŞ

Çağdaş endodontik tedavinin başarısı, kök kanalının mekanik olarak şekillendirilmesi ile kimyasal dezenfeksiyonun birlikte ve etkin bir şekilde yürütülmesine bağlıdır. Ancak bu geleneksel yaklaşım hem tanı hem de tedavi süreçlerinde bazı önemli sınırlılıklar barındırmaktadır. Tanı aşamasında pulpal durumun değerlendirilmesi büyük ölçüde klinik bulgulara ve hastanın yanıtına dayanan sensibilite testleriyle gerçekleştirilmektedir (1). Ayrıca iki boyutlu radyografiler, kök kanal anatomisinin üç boyutlu yapısını ve erken dönemdeki periapikal değişiklikleri her zaman yeterince ortaya koyamamaktadır (2,3). Bu sınırlılıklar, pulpal dolaşımı doğrudan değerlendirmeye yönelik objektif yöntemlerin geliştirilmesine olan ilgiyi artırmıştır.

Tedavi açısından karşılaşılan önemli güçlüklerden biri, mikroorganizmaların kök kanal sisteminin anatomik olarak korunaklı bölgelerinde yerleşebilmesidir (4). Enfeksiyon etkenleri bu bölgelerde bulunarak konvansiyonel dezenfeksiyon yöntemlerinin etkisinden kaçabilir (5). Özellikle isthmus, lateral kanallar ve apikal ramifikasyonlar gibi karmaşık anatomik alanlara geleneksel iğne irrigasyonu yeterince ulaşamadığından, buralarda yerleşen mikroorganizmaların tamamen uzaklaştırılması güçleşmektedir (4,6). Ayrıca biyofilm oluşturan patojenler doğrudan lazer uygulamasına maruz kaldıklarında dahi direnç gösterebilmekte ve biyofilmin tek bir yöntem kullanılarak tamamen ortadan kaldırılması günümüzde mümkün görünmemektedir (5,6). Kök kanal anatomisinin karmaşıklığı ile biyofilmin dirençli yapısının bir arada bulunması, kimyasal irrigasyon ajanlarının etkinliğini sınırlayan başlıca etkenlerdir.

Konvansiyonel yöntemlerin bu sınırlılıkları, lazer destekli yaklaşımların

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rutin klinik kullanımı destekleyecek düzeyde olgunlaşmamıştır (6,8). Ayrıca belirli Nd:YAG protokollerinde 1,5 W ve üzerindeki güç düzeylerinde kalıcı pulpa hasarı bildirilmiş olması, lazer uygulamalarında uygun parametre seçiminin ve termal güvenliğin kritik önemini açıkça ortaya koymaktadır (10).

Mevcut kanıtlar ışığında en dengeli yaklaşım, endodontik lazerlerin özellikle Er:YAG temelli lazerle aktive irrigasyon, bazı fotobiyomodülasyon uygulamaları ve fotodinamik terapi gibi alanlarda umut verici yardımcı teknolojiler olarak değerlendirilmesidir (8,28). Klinik etkinliklerinin büyüklüğü ve rutin endodontik tedaviye sağladıkları ek katkı ise henüz tüm endikasyonlar için kesin olarak ortaya konulmuş değildir (28). Dolayısıyla güncel kanıtlar lazerleri, kemomekanik hazırlığın alternatifi olarak değil, uygun endikasyon ve kontrollü parametrelerle tedavinin belirli aşamalarına ek değer sağlayabilecek yardımcı teknolojiler olarak konumlandırmaktadır. Bu potansiyelin güvenli ve etkili biçimde kullanılabilmesi ise klinisyenin lazer fiziği, doku–lazer etkileşimi ve histopatolojik güvenlik sınırları konusunda yeterli bilgi ve klinik yetkinliğe sahip olmasını gerektirmektedir.

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Bölüm 16

KÖK KANALI OBTURASYON TEKNİKLERİ: GÜNCEL YAKLAŞIMLAR VE KLİNİK UYGULAMALAR

Hasan UYANIK[1]

1. GİRİŞ

1.1. Obturasyonun Tanımı ve Amacı

Obturasyon terimi Latince *obturare* (tıkamak, kapatmak) kökünden gelir ve temizlenip şekillendirilmiş kök kanal sisteminin tümünün, çalışma boyunda doku dostu bir materyalle doldurulması işlemini tanımlar. (3)

İşlemin amacı kanal sistemi içinde bakteri ve sıvı geçirmeyen bir ortam oluşturmaktır. Bundan beklenen üç işlev vardır: ağız ortamından kaynaklanan yeniden kontaminasyonun engellenmesi, periapikal doku sıvılarının kanala sızmasının önlenmesi ve temizleme-şekillendirme sonrasında kaçınılmaz olarak kalan mikroorganizmaların hapsedilerek besin kaynaklarından yoksun bırakılması. Bu sonuncusu obturasyonun biyolojik gerekçesinin özüdür: Kanal sistemi tümüyle steril hâle getirilemediğine göre, dolgunun görevi kalan mikroorganizmalar için yaşam ortamını ortadan kaldırmaktır. (3)

1.2. Üç Boyutlu Sızdırmazlık Kavramı ve Sınırları

Kanal sistemi apikal, lateral ve koronal yönde sızdırmaz hâle getirilmelidir; literatürde bu üç boyutlu sızdırmazlık olarak adlandırılır. Mekanik enstrümantasyon kanal duvarlarının yalnızca bir bölümüne ulaşır; kök kanal sisteminin %35–53'ü enstrümente edilmeden kalır. İstmus, lateral kanal ve apikal delta içindeki mikroorganizmalara irrigasyonla da güçlükle ulaşılır; sızdırmazlığın işlevi bu alanlardaki rezidüel organizmaların ve toksinlerinin periapikal dokuya erişimini kesmektir. (3,17,19)

Burada gerçekçi bir sınır çizilmelidir. Hedef sızdırmazlıktır; sıvı ve bakteri geçişinin tümüyle önlenmesi ise erişilemeyen bir idealdir: Dentinin poröz tübüler

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Sonuç olarak teknik seçimi; kanal anatomisi ve kavis derecesi, apikal açıklık, anatomik özel durumlar, retreatment ve post gereksinimi, materyal özellikleri, hekimin deneyimi ve mevcut ekipman birlikte değerlendirilerek yapılmalıdır. Mevcut kanıtlar, tüm klinik koşullarda diğerlerinden üstün tek bir obturasyon tekniğini desteklememektedir. (2,4)

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Bölüm 17

ENDODONTİDE KRİYOTERAPİ: FİZYOLOJİK MEKANİZMALAR, KLİNİK UYGULAMALAR VE POSTOPERATİF AĞRI YÖNETİMİ

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GİRİŞ

Kriyoterapi terimi, etimolojik olarak Grekçe "soğuk" anlamına gelen cryos ve "tedavi/iyileştirme" anlamına gelen therapeia kelimelerinin birleşiminden türetilmektedir. Genel tanımı ile kriyoterapi, terapötik amaçlarla doku sıcaklığının düşürülmesini ifade eden non-farmakolojik bir tedavi yaklaşımıdır (1).

Biyofiziksel prensipler açısından bakıldığında bu süreç, doğrudan hedef dokunun soğutulması olmaktan çok, daha yüksek sıcaklıktaki dokudan daha düşük sıcaklıktaki bir nesneye veya ortama ısı çekilmesi (termal enerji transferi) esasına dayanmaktadır (2).

Tıbbi uygulamalarda soğuk kullanımının tarihsel kökeni Antik Çağ'a kadar uzanır. MÖ 3000 yıllarında eski Mısırlılar, yaralanmaları tedavi etmek, doku iyileşmesini desteklemek ve iltihabi reaksiyonları azaltmak amacıyla soğuk uygulamalarından faydalanan ilk uygarlık olarak kabul görmektedir (1,3).

Tıp literatüründe kriyoterapinin sistemik ve bilimsel bir dondurma tedavisi olarak rapor edilmesi ise 19. yüzyılın ortalarını bulmaktadır.

James Arnott, 1851 yılında tuz ve buz karışımından faydalanarak malign (kötü huylu) hastalıkların tedavisinde dondurma terapisinin etkinliğini ilk kez göstermekte ve klinik olarak raporlamaktadır (1,3).

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- **Standart Protokol İhtiyacı:** Yıkama solüsyonunun ideal hacmi (5–20 mL), uygulama süresi (1–5 dk), ideal sıcaklık aralığı (1.5-4°C) ve negatif/pozitif basınçlı irigasyon sistemlerinin karşılaştırmalı etkinliği gibi klinik parametrelerin uluslararası düzeyde standardize edilmesi gerekir (1,4,32,33).
- **Uzun Dönem Biyomekanik Takip:** Kriyoterapinin dentin mikroyapısı ve vertikal kırılma direnci üzerindeki etkilerini inceleyen in vitro kaygılar göz önüne alındığında (14,40), soğuk uygulamasının kök kanal tedavili dişlerin uzun dönemli klinik sağkalımı üzerindeki olası etkilerini değerlendiren prospektif klinik araştırmalara ihtiyaç duyulmaktadır (14,40).
- **Kanıt Kesinliğinin Yükseltilmesi:** Mevcut meta-analizlerde GRADE kanıt kesinliğinin "düşük" veya "çok düşük" düzeyde kalması (4,32,33); hastaların pulpal/periapikal tanılarının tam olarak ayrıştırıldığı, çift körleme standartlarının korunduğu, yüksek örneklem boyutuna sahip randomize kontrollü klinik çalışmaların (RKKÇ) yapılması gerekliliğini ortaya koymaktadır (4,32,33).

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Bölüm 18

MİNİMAL İNVAZİV ENDODONTİ: KAVİTE TASARIMINDAN KANAL PREPARASYONUNA

Ecem ÇİFTCİ ŞAHİN[1]

GİRİŞ

Minimal invaziv endodonti (MİE), kök kanal tedavisinin biyolojik ve biyomekanik hedeflerinden ödün vermeden mümkün olduğunca fazla sağlıklı diş dokusunun korunmasını amaçlayan bir tedavi felsefesidir (1,2).

Bu yaklaşımın merkezinde, kron-kök birleşim bölgesinde, kemik krestinin yaklaşık 4 mm koronalinden 4 mm apikaline kadar uzanan perisevikal dentin (PCD) kavramı yer alır; bu bölgedeki dentin kalınlığının korunması, oklüzal kuvvetlerin kök yapısına aktarımını düzenleyerek endodontik tedavi görmüş dişlerin kırılma direncini doğrudan etkiler (1,2).

Geleneksel erişim kavitesi tasarımı ve yüksek konikiteli kanal preparasyon protokolleri, yeterli görüş ve enstrümantasyon kolaylığı sağlarken önemli miktarda koronal ve radiküler dentinin kaybına yol açabilmektedir (1); bu durum, özellikle endodontik tedavi sonrası restoratif başarısızlığın ve kök kırığının önde gelen nedenlerinden biri olarak tanımlanmaktadır. Son yirmi yılda büyütme sistemlerindeki, görüntüleme teknolojilerindeki ve alet metalürjisindeki gelişmeler, erişim kavitesi tasarımından kanal preparasyonuna kadar tedavinin her aşamasında daha muhafazakâr protokollerin geliştirilmesine olanak sağlamıştır (2).

Bu bölümün amacı, minimal invaziv endodontinin temel ilkelerini; kavite tasarımındaki güncel yaklaşımları, rehberli endodonti ve dijital planlama uygulamalarını, kanal preparasyonunda dentin korunumuna yönelik stratejileri ve bu yaklaşımların klinik karar verme sürecindeki yerini güncel literatür ışığında ele almaktır.

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büyütme/aydınlatma imkânlarına erişimi gibi çok sayıda faktöre bağlı olarak bireyselleştirilmelidir (6,7). Sevin ve arkadaşlarının fayda-risk analizi, minimal invaziv kavitelerin yalnızca başarı olasılığının yüksek, teknik güçlüğün düşük olduğu ve yeterli ekipmanın mevcut olduğu olgularda tercih edilmesi gerektiğini; aksi hâlde geleneksel veya konservatif tasarımların daha güvenilir bir seçenek olabileceğini önermektedir (7).

Bu çerçevede minimal invaziv endodonti, her olguya kayıtsız şartsız uygulanması gereken katı bir dogma değil; dentin korunumu ile yeterli temizlik, şekillendirme ve dezenfeksiyon hedefleri arasında olgu bazında kurulması gereken bir denge olarak ele alınmalıdır.

SONUÇ

Minimal invaziv endodonti, kavite tasarımından kanal preparasyonuna uzanan geniş bir yelpazede, perisevikal dentinin korunmasını merkeze alan bir tedavi felsefesidir (1,2). Güncel kanıtlar, konservatif ve truss tipi kavite tasarımlarının ve düşük konikiteli enstrümantasyonun, uygun olgu seçimiyle birlikte kırılma direncine katkı sağlayabileceğini göstermektedir; ancak bu yaklaşımların dezenfeksiyon etkinliği, alet güvenliği ve klinik uygulanabilirlik açısından bazı ödünleşimler içerdiği de açıktır (5,6,7,12).

Rehberli endodonti ve dinamik navigasyon gibi dijital teknolojiler, minimal invaziv hedeflerin daha öngörülebilir biçimde gerçekleştirilmesine katkı sunmakla birlikte, maliyet ve öğrenme eğrisi nedeniyle henüz rutin uygulamanın bir parçası hâline gelmemiştir (9,10,11). Sonuç olarak minimal invaziv endodontinin başarısı; doğru vaka seçimi, dengeli bir dentin koruma-dezenfeksiyon stratejisi ve kalan diş yapısının restoratif planlamayla bütünleştirilmesine bağlıdır (17,18).

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Bölüm 19

ENDODONTİDE TARAMALI ELEKTRON MİKROSKOBU VE ENERJİ DAĞILIMLI X-IŞINI SPEKTROSKOPİSİNİN YERİ

Zehra Nur DEMİR[1]

Mikroskop, patolojilerin tanımlanması, mikroorganizmaların tanımlanması, çalışma alanının büyütülerek daha ayrıntılı değerlendirilmesi ve endodontik araştırmaların yürütülmesine katkı sağlaması nedeniyle endodontide önemli bir araç olarak kullanılmaktadır. [1]

Son yıllarda cerrahi ve cerrahi olmayan endodontide yaşanan teknolojik gelişmeler arasında operasyon mikroskobunun yaygın kullanıma girmesi önemli bir dönüm noktası olmuştur [2] . Mikroskopik yöntem aynı zamanda pulpa ve periapikal dokuların hücresel yapısının incelenmesi, endodontik biyomateryallerin biyouyumluluğunun değerlendirilmesi, periapikal patolojilerin araştırılması ve pulpa kök hücrelerine yönelik çalışmaları da kapsamaktadır.[1]

Diş hekimliğinde farklı araştırma ve tanı amaçlarına yönelik çeşitli mikroskobik görüntüleme yöntemleri kullanılmaktadır. Faz kontrast mikroskobu, floresan mikroskobu, konfokal lazer taramalı mikroskopi (CLSM), atomik kuvvet mikroskobu (AFM) ve taramalı elektron mikroskobu (SEM) bu yöntemlerden bazılarıdır. [3]

CLSM, dental materyallerin yüzey pürüzlülüğünün ve dental erozyonun değerlendirilmesi, mikrogerilim bağlanma dayanımının incelenmesi ve sert diş dokularının yüzey topografisinin analiz edilmesi amacıyla yaygın olarak kullanılmaktadır.[3] SEM, yüzey topografisini yüksek çözünürlükte ve yüksek büyütme altında ayrıntılı olarak görüntüleyebilme yeteneği sayesinde mikroyapısal analizlerde yaygın olarak kullanılan önemli bir görüntüleme yöntemidir.[4]

Bu üstün görüntüleme kapasitesi sayesinde SEM, endodontik araştırmalarda kök kanal duvarının mikromorfolojik özelliklerinin değerlendirilmesinde yaygın olarak kullanılmaktadır. Smear tabakası ve debrisin varlığının belirlenmesi,

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7. SONUÇ

SEM, dental sert dokuların yüzey ve morfolojik özelliklerinin yüksek çözünürlükte incelenmesine olanak sağlayan önemli bir görüntüleme yöntemidir.[11] SEM-EDX analizi ise kök dentininin elementel kompozisyonunun ve Ca/P oranının değerlendirilmesinde kullanılmaktadır.[25] Bu yöntemler, endodontik araştırmalarda dental dokuların morfolojik ve elementel özelliklerinin değerlendirilmesine katkı sağlamaktadır.

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Bölüm 20

DAİMİ VE SÜT DİŞLERDE PULPİTİS YÖNETİMİNDE GÜNCEL YAKLAŞIMLAR

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Pulpitis, pulpa dokusunun mikrobiyal invazyon, travma ve çeşitli irritanlara karşı verdiği inflamatuvar yanıtı ifade eden patolojik bir tablodur (1). Klinik olarak çoğunlukla ağrı ile ilişkilidir ve termal uyaranlara karşı hassasiyet, istirahat sırasında veya yatma pozisyonunda şiddetlenen ağrı atakları şeklinde ortaya çıkabilir (2). Pulpitisin tedavisine yönelik yaklaşımlar tarihsel süreçte önemli değişimler göstermiştir. İlk dönemlerde ağrının kontrolü amacıyla diş çekimi veya pulpayı devitalize etmeye yönelik kimyasal ajanlar kullanılırken, endodonti biliminin gelişmesiyle birlikte enfekte pulpanın yönetiminde daha biyolojik ve bilimsel temelli stratejiler benimsenmiştir.(3). Bu süreçte kök kanal tedavisi, uzun yıllar boyunca özellikle geri dönüşümsüz pulpitis olgularında standart tedavi yaklaşımı olarak kabul edilmiş; mumifikasyon ve rezinifikasyon gibi erken dönem uygulamalar ise öngörülebilir klinik sonuçlar sunamamaları nedeniyle terk edilmiştir (4–6).

Son yıllarda pulpa biyolojisine ilişkin bilgi birikiminin artması ve biyouyumlu materyallerin geliştirilmesi, pulpitis yönetimine yönelik geleneksel yaklaşımların yeniden değerlendirilmesine yol açmıştır. Güncel araştırmalar, dental pulpanın belirgin bir savunma ve iyileşme kapasitesine sahip olduğunu ve minimal invaziv girişimlerle desteklendiğinde bu potansiyelin korunabileceğini göstermektedir (7–9). Geçmişte pulpal inflamasyonun ilerleyici ve kaçınılmaz olarak nekrozla sonuçlanan bir süreç olduğu düşünülürken, günümüzde inflamasyonun uygun koşullar altında onarım ve rejenerasyonu destekleyebilen karmaşık bir biyolojik yanıt olduğu kabul edilmektedir (10). Bu süreçte immün hücrelerin aktivasyonu,

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