

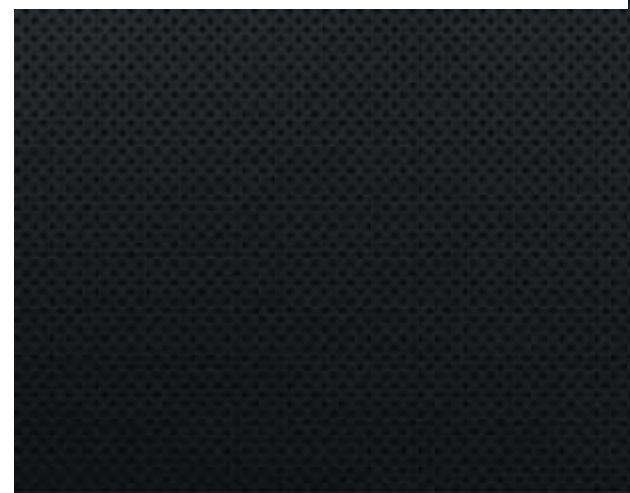
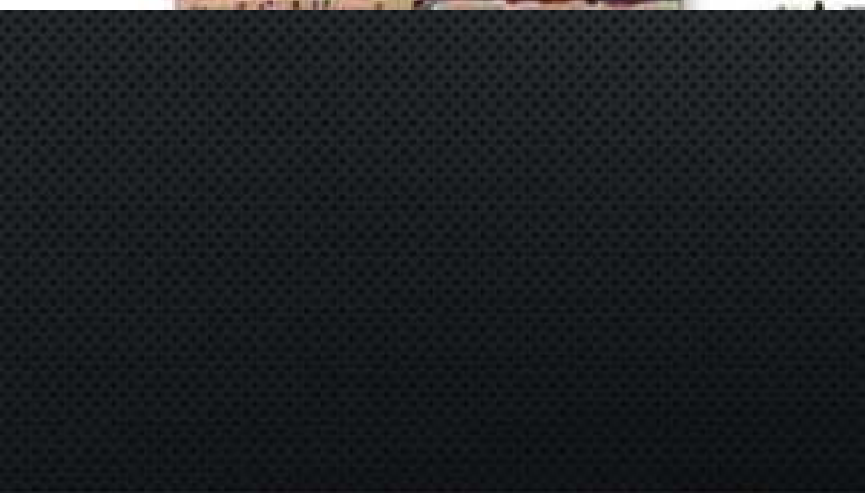
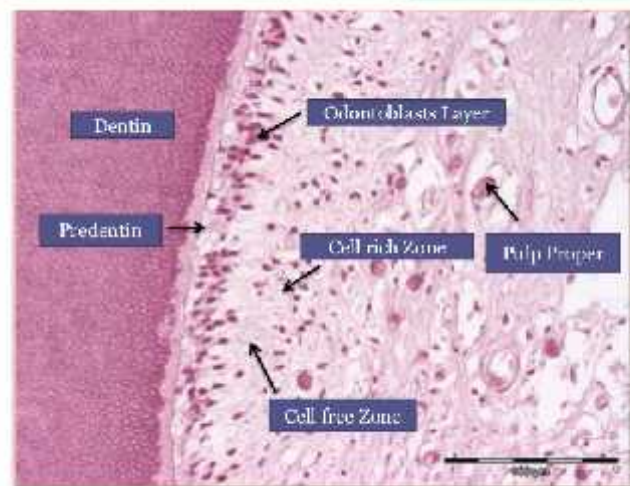
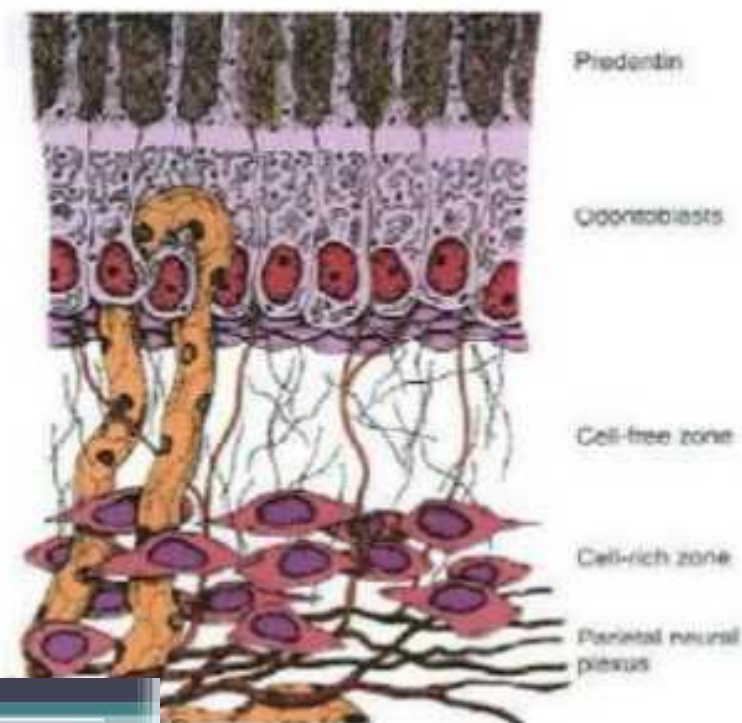
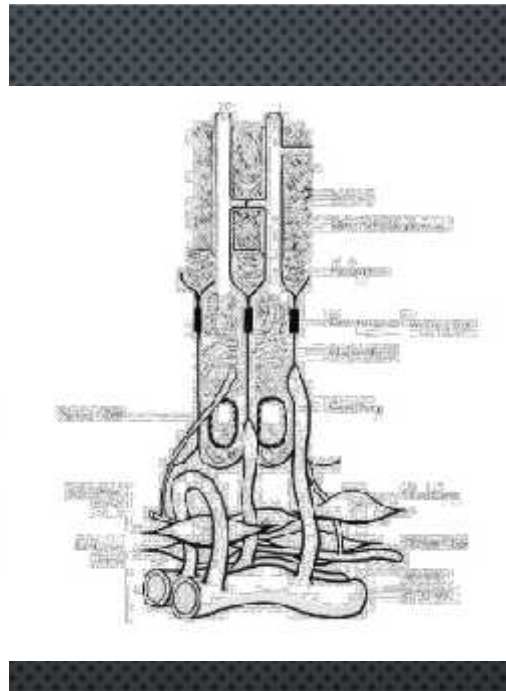
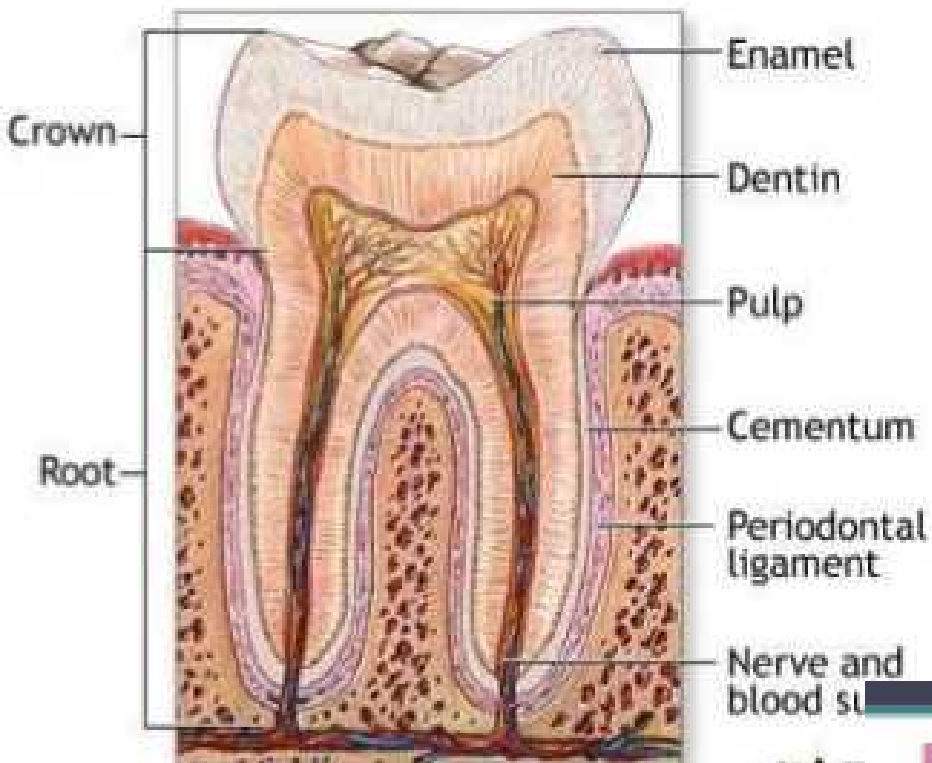
VİTAL PULPA TEDAVİLERİ

- **PROF.DR.HIKMET AYDEMİR**
- **ONDOKUZ MAYIS ÜNİVERSİTESİ DIŞ HEKİMLİĞİ FAKÜLTESİ**
- **ENDODONTİ ANABİLİM DALI**



KAYNAKLAR

1. Tronstad L. Clinical Endodontics, A Textbook, Second Revised Edition, ISBN 3-13-768102-2GTV, 2002 , Oslo
2. Bergenholtz G, Bindslev PH, Reit C. Textbook of Endodontology, ISBN 8-7161-2185-6, 2003, Oxford/UK
3. Alaçam T. Endodonti. ISBN 978-975-96479-0-2, 2012 ANKARA



PULPAL HASTALIKLARIN NEDENLERİ

ÇÜRÜK

FİZİKSEL/KİMYASAL/TERMAL

PULPAL İRRİTASYON

ENFLAMASYON

REVERSİBL (GERİ DÖNÜŞÜMLÜ) PULPİTİS

İREVERSİBL (GERİ DÖNÜŞÜMLÜ) PULPİTİS

VİTAL PULPA TEDAVİLERİ

NEKROZ

TAMİR

KANAL TEDAVİ

DİŞLERE GÖRE PULPA TEDAVİ ENDİKASYONLARI

SÜT DİŞLERİ

İNDİREKT KUAFAJ (INDIRECT PULP CAPPING)

DİREKT KUAFAJ (DIRECT PULP CAPPING)

AMPUTASYON (PULPATOMY)

KANAL TEDAVİ (PULPECTOMY)

GENÇ DAİMİ DİŞLER

İNDİREKT KUAFAJ (INDIRECT PULP CAPPING)

DİREKT KUAFAJ (DIRECT PULP CAPPING)

AMPUTASYON (PULPATOMY)/**APEKSOGENEZİS**

APEKSİFİKASYON

PULPAL TEDAVİLERİN SINIFLANDIRILMASI

VİTAL PULPA TEDAVİLERİ

İNDİREKT KUAFAJ (INDIRECT PULP CAPPING)

DİREKT KUAFAJ (DIRECT PULP CAPPING)

AMPUTASYON (PULPATOMY)/ **APEKSOGENEZİS**

KANAL TEDAVİ (VITAL PULPECTOMY)

NON VİTAL PULPA TEDAVİLERİ

KANAL TEDAVİ (NON VITAL PULPECTOMY)

APEKSİFİKASYON

Case selection in young patients

Reversible pulpitis



Vital pulp therapy



Pulp capping or pulpotomy

Irreversible pulpitis/
necrotic pulp



Closed apex



Root canal therapy

Open apex



Root-end closure
&
obturation

HISTORY



1756,
Pfaff



1826,
Koecker



1921,
Dätwyler



1930,
Hermann

VİTAL PULPAL TEDAVİLERİNİN TEMEL HEDEFİ

DENTİN KÖPRÜSÜNÜN OLUŞMASININ SAĞLANMASI

KÖK GELİŞİMİNİN DEVAMI

REPARATİF MATERYALLER İLE SİTİMÜLASYON

DİFFERANSİYE OLMAYAN MEZENKİMAL HÜCRELER

ODONTOBLASTLAR

ODONTOBLASTLARA BENZEYEN HÜCRELER

REPARATİF DENTİN

REAKSİYONER DENTİN

TERSİYER DENTİN

DENTİNAL KÖPRÜ

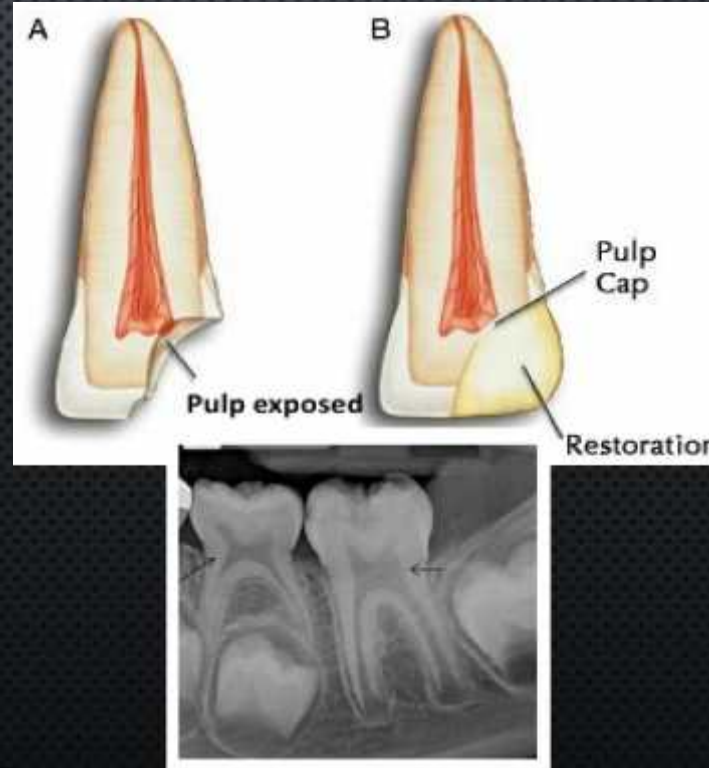
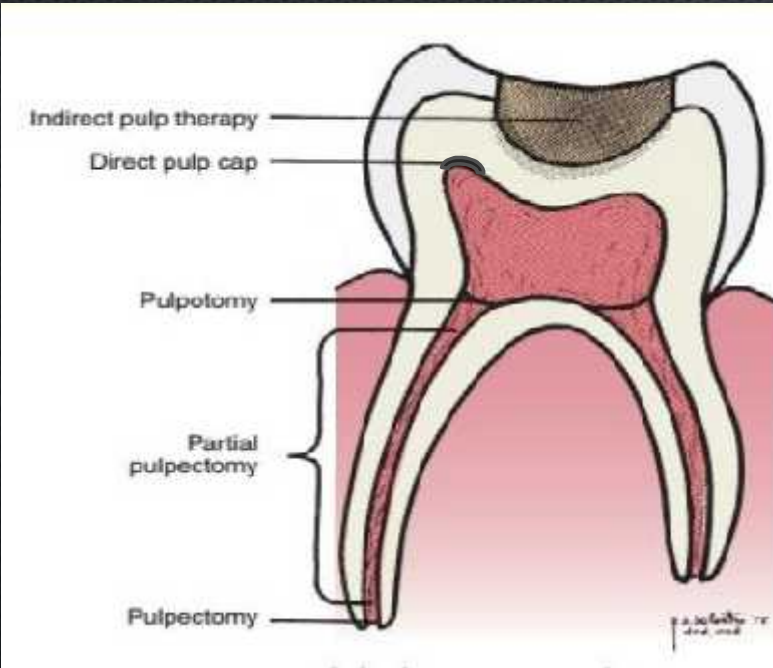
KALAN DENTİN KALINLIĞINA GÖRE KUAFAJ TEDAVİLERİ

KALAN DENTİN KALINLIĞI (0,25-2 mm)

İNDİREKT KUAFAJ (INDIRECT PULP CAPPING)

KALAN DENTİN KALINLIĞI (0-0,25 mm)

DİREKT KUAFAJ (DIRECT PULP CAPPING)



•Little or no bleeding at the exposure site



Maruz kalma bölgesinde çok az miktarda veya hiç kanama yok

PULP CAPPING TECHNIQUES

DIRECT PULP CAPPING



INDIRECT PULP CAPPING



Direct Pulp Capping

✦ Technique



DİREKT KUAFAJIN BAŞARISINI ETKİLEYEN FAKTÖRLER

ÖNEMLİ DEĞİL	ÖNEMLİ
YAŞ	BAKTERİYAL KONTAMİNASYON
CİNSİYET	EKPOZE NEDENİ/LOKALİZASYONU
DİŞİN LOKALİZASYONU	EKPOZE TİPİ-BÜYÜKLÜĞÜ-KANAMA
DİŞİN POZİSYONU	KUAFAJ MATERYALİ
	SIZINTI/RESTORASYON TİPİ-SINIFI

EKPOZE LOKALİZASYONU

- PERFORASYONUN PULPA BOYNUZUNDA OLMASI < KOLE BÖLGESİNDE OLU ANLARA KIYASLA DAHA AZ DOKU HASARINA YOL AÇABİLMEKTEDİR
- YAPILAN ÇALI MALARDA EN BA ARILI BÖLGE OKLUZAL VE OKLUZO-MESIAL İKEN,
- PALATINAL VE DISTAL BÖLGELER EN BA ARISIZ KUAF AJ BÖLGELERİ OLARAK BİLDİRİLMİ TİR

PULPANIN KONTAMINASYONU

- ENFEKSİYON OLU MADİ İNDA PULPANIN REJENERASYON KAPASİTESİ OLDUKÇA YÜKSEKTİR
- BAKTERİYEL KONTAMINASYON ÇÜRÜKLE OLABİLDİĞİ GİBİ PULPANIN TÜKRÜKLE VEYA PLAKLA TEMAS ETMESİ SONUCUNDA OLUŞABİLİR

KANAMA KONTROLÜ

- **PULPADAKI KANAMANIN KISA SÜREDE DURDURULABİLMESİ, RENGİNİN ENFEKSIYON DURUMLARINDA GÖRÜLEN KANAMALARDAKI GIBI KOYU RENKLİ OLMAMASI DIKKATE ALINMALIDIR**
- **3-5 DAKIKADAN UZUN SÜREN BİR KANAMA IRREVERSİBL PULPİTİSİN GÖSTERGESİ OLABİLECEĞİ İÇİN BÖYLE DURUMLARDA PROGNOZ KÖTÜ OLACAKTIR**

ÇÜRÜK DEFEKTİNİN DERİNLİĞİ

- **YUMUŞAK DENTİNİN PULPAYA DOĞRUDAN ULAŞTIĞI VE KAVİTENİN TEMİZLENMESİ ESNASINDA PULPANIN HEMEN AÇILDIĞI DURUMLARDA PULPADA İLTIHABI VE DEJENERATİF DEĞİŞİMLİKLER BAŞLAMIŞTIR**

BU DURUMDA KUAFAJ TEDAVİSİ BAŞARISIZ OLUR

İYATROJENİK FAKTÖRLER

- **ISI**
- **BASINÇ**
- **KUAFAJ MATERYALİNİN SEÇİMİ**
- **MIKROSIZINTI OLUŞMASI**

DİĞER FAKTÖRLER

- **HASTANIN YA İ KONUSUNDA FARKLI GÖRÜŞLER VARDIR**

PROGNOZDA HASTANIN KRONOLOJİK YAŞINDAN ÇOK DIŞIN DURUMUNUN DAHA ETKİLİ OLDUĞU SÖYLENEBİLİR

History

Sharp, penetrating pain persisting after withdrawing stimulus

Prolonged spontaneous pain, particularly at night



Indirect Pulp Capping

- ❖ Indications
 - ❖ Minimal pulp inflammation
 - ❖ Complete removal could cause exposure
- ❖ Contraindications
 - ❖ Teeth with history of pain
 - ❖ Teeth with inflamed pulp or periapical disease



III-Contraindications

•Systematic diseases: diabetes, cancer...



X •NO PULP VITALITY



Clinical examination

Non responsiveness to pulp testing techniques

Excessive tooth mobility

Soft leathery dentin covering a very large area of the cavity, in a non restorable tooth

Tooth discoloration

Parulis in the gingiva approximat the roots of the tooth



•Large pulp exposures

•Uncontrolled bleeding

•No pulp calcification



•primary teeth → root resorption



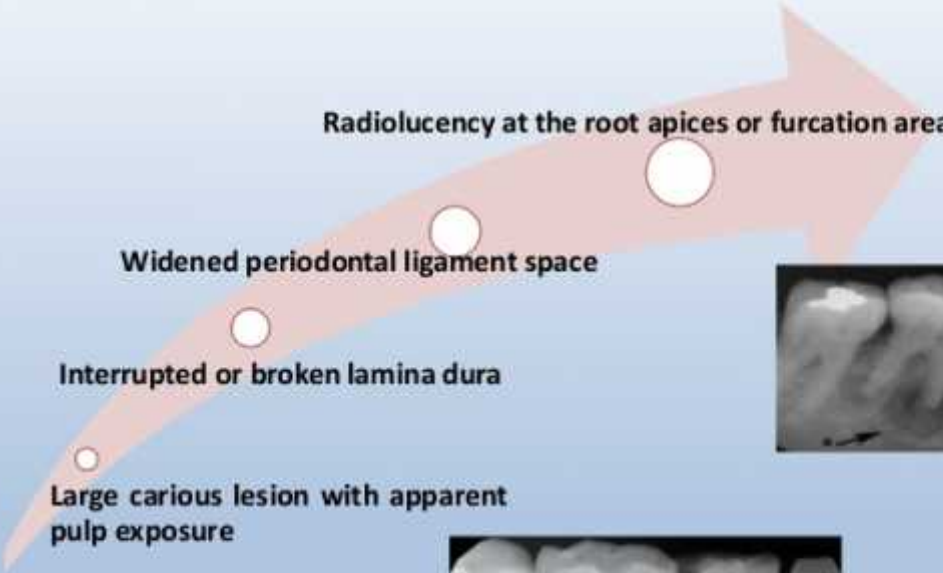
•Inflammatory signs/ symptoms

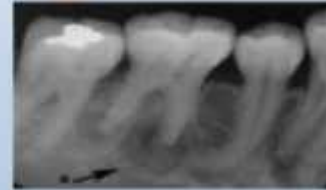
Radiographic examination

- ▶ Large carious lesion in close proximity to the pulp
- ▶ Normal lamina dura
- ▶ Normal periodontal ligament space
- ▶ No interradicular or periapical radiolucency



Radiographic examination

- 
- ▶ Large carious lesion with apparent pulp exposure
 - ▶ Interrupted or broken lamina dura
 - ▶ Widened periodontal ligament space
 - ▶ Radiolucency at the root apices or furcation areas



ENDİKASYONLAR

- PULPA VITAL VE AĞIZ ORTAMINA AÇILMAMIŞ OLMALI
- PULPA SEMPTOMSUZ VEYA REVERSİBL(GERİ DÖNEBİLEN) PULPİTİS SAFHASINDA OLMALI
- PROVOKE AĞRI OLMALI(SOĞUK, TATLI VEYA EKŞİ UYARANLAR İLE KISA SÜRELİ AĞRI)
- PERKÜSYONDA DUYARLILIK OLMAMALI
- RADYOGRAFİK MUAYENEDE PERİRADİKÜLER DOKULAR SAĞLIKLI GÖRÜNMEİ, LAMINA DURADA GENİŞLEME VEYA PERIAPİKALDE RADYOLÜSENSİ BULUNMAMALIDIR
- DIŞTEKİ MADDE KAYBI RESTORE EDİLEBİLİR DÜZEYDE OLMALIDIR

KONTRENDİKASYONLAR

- **NEKROZE PULPA**
- **AÇIK (PERFORE) PULPA**
- **SPONTAN AĞRI**
- **SICAHTA AĞRI**
- **PERKÜSYONDA HASSASİYET**
- **İRREVERSİBL(GERİ DÖNEMEYEN) PULPİTİS**
- **EKPOZE VAKALARDA PULPADA HIÇ KANAMA OLMAMASI VEYA KANAMANIN 5 DAKİKADAN FAZLA SÜRMESİ**

İNDİREKT/DİREKT KUAFAJ

1- ANESTEZİ



2- İZALASYON (RUBBER-DAM)-PREPARASYON

- YUMUŞAK DENTİN ÇELİK ROND FREZ VEYA EKSKAVATÖRLERLE UZAKLAŞTIRILIR
- PULPANIN AÇILMA RISKİ OLAN KISIMLARI İSE EN SON UZAKLAŞTIRILIR
- PULPAYA YAKLAŞTIKÇA DENTİN KANALLARININ SAYISININ ARTTIĞI GÖZ ÖNÜNDE BULUNDURULMALIDIR
- FREZLER SÜRTÜNME KUVVETİNİ AZALTMAK AMACI İLE DÜŞÜK DEVİRDE VE BASINÇSIZ KULLANILMALIDIR
- ÇÜRÜK DENTİNİN KALDIRILMASI İŞLEMİ ENFEKTE, RENKLEŞMİŞ VE YUMUŞAK DENTİNİN UZAKLAŞTIRILARAK SERT DOKUYA ULAŞILMASI İLE TAMAMLANIR



Çürük tek bir a amada temizlenebildi i gibi, iki a amalı (En erken 8-10 HAFTA) olarak da uzakla tırılabilir

İNDİREKT/DİREKT KUAFAJ

3- Klorheksidin Ağız Gargarası



4- Steril Salin Solusyon veya Anestezik ile durulanır



İNDİREKT/DİREKT KUAFAJ

5- STERİL PAMUK PELET İLE

**KANAMA MEVCUT İSE KONTROL EDİLİR (PULPADA OLUŞAN
KANAMA 3-5 DAKIKADAN FAZLA SÜRMEMELİ**

**PERFORE PULPANIN ÜZERİNE KANAMAYI KONTROL ETMEK İÇİN
PAMUK PELETE EMDİRİLMİŞ (%0.5-%6) NAOCl UYGULANIR**

**KAVİTE HAZIRLANDIKTAN SONRA BASINÇSIZ SU İLE YIKANARAK
HAVA SPREYİ İLE HAFİFÇE KURUTULUR**

A İRİ KURUTMADAN KAÇINILMALIDIR

6- KUAFAJ MATERYALİ KARIŞTIRILIR



İNDİREKT/DİREKT KUAFAJ

7- YARA YÜZEYİ/EKPOZE ALANA KARIŞTIRILAN KUAFAJ MATERYALİ YERLEŞTİRİLİR

PULPA KUAFAJ MATERYALİ, **KAN PIHTISI** OLUŞMADAN ÖNCE UYGULANMALIDIR. AKSI TAKDİRDE PROGNOZU OLUMSUZ YÖNDE ETKİLER

UZUN SÜREN **İNATÇI KANAMA** PULPANIN ENFLAME OLDUĞUNUN İŞARETİDİR VE BU DURUMDA KÖK KANAL TEDAVİSİ YAPILMALIDIR



8- DAHA SONRA KAİDE MATERYALİ (RESİN MODİFİYE CAMİYONOMER SIMAN) VE KALICI RESTORASYON

MATERYALİ (KOMPOZİT) YERLEŞTİRİLİR.

(EKPOZE ALAN REKONTAMINASYONU ENGELLENMİŞ OLUR)



Pulpotomy

✦ Indications

- ✦ Young permanent teeth (Immature apex)
- ✦ Deciduous teeth (with coronal pulp inflammation)
- ✦ Emergency treatment for permanent teeth (Not definitive treatment)



Pulpotomy

Criteria for Selection

- ✦ Pulp exposed
- ✦ Vital pulp
- ✦ No pain on percussion
- ✦ Absence of periapical lesion
- ✦ Controllable hemorrhage (3-4 min)



Pulpotomy



- ✦ Contra-indications

- ✦ Clinically:

- ✦ Spontaneous pain
 - ✦ Swelling or fistula
 - ✦ Uncontrollable hemorrhage
 - ✦ Purulent exudate
 - ✦ Non-restorable tooth

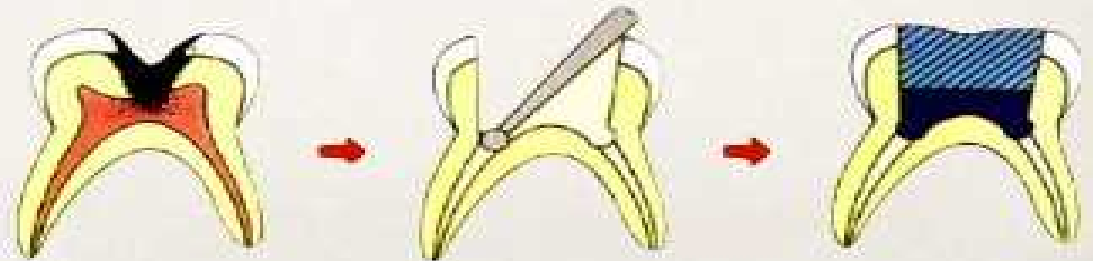
- ✦ Radiographically:

- ✦ Periapical lesion
 - ✦ Incase of deciduous (no bone separating successor & roots resorbed)

Pulpotomy

CLASSIFICATION

- ❖ According to level of pulp amputation
- ❖ Shallow (Cvek pulpotomy)
- ❖ Deep pulpotomy



Pulpotomy

CLASSIFICATION

- ❖ According to type of dentition
 - ❖ Deciduous teeth
 - ❖ Young permanent teeth (open apex)
 - ❖ Permanent teeth (emergency)



Pulpotomy

CLASSIFICATION

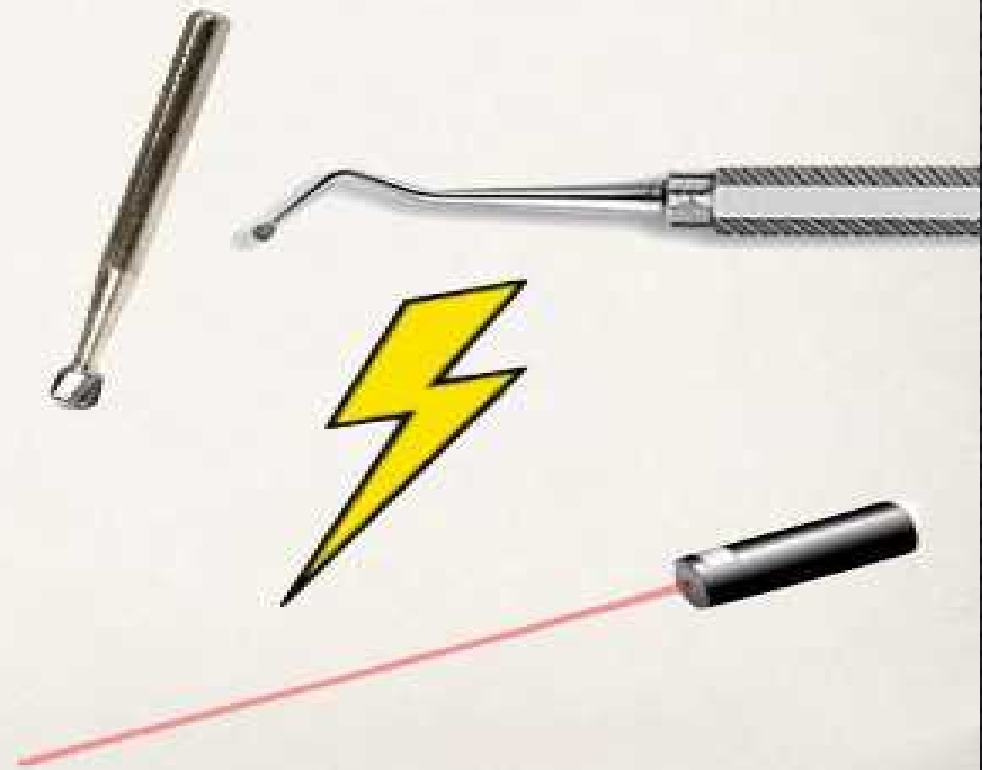
- ❖ According to capping material used
- ❖ $\text{Ca}(\text{OH})_2$
- ❖ MTA
- ❖ Formocresol
- ❖ Glutaraldehyde



Pulpotomy

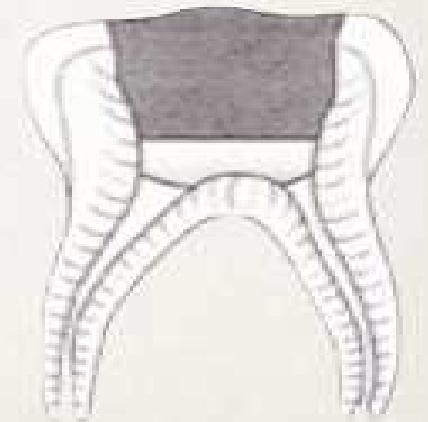
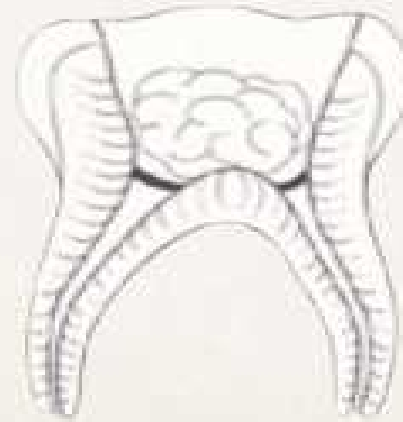
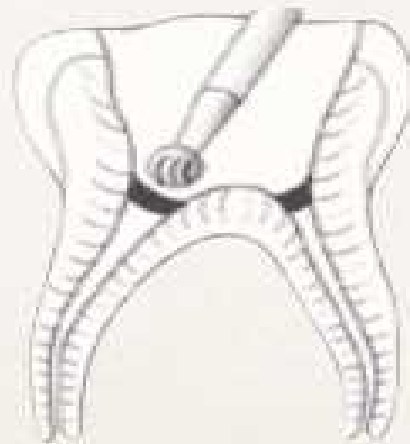
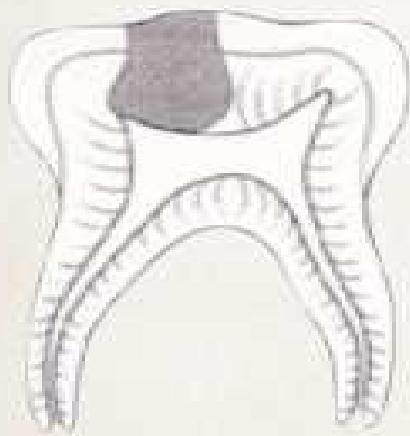
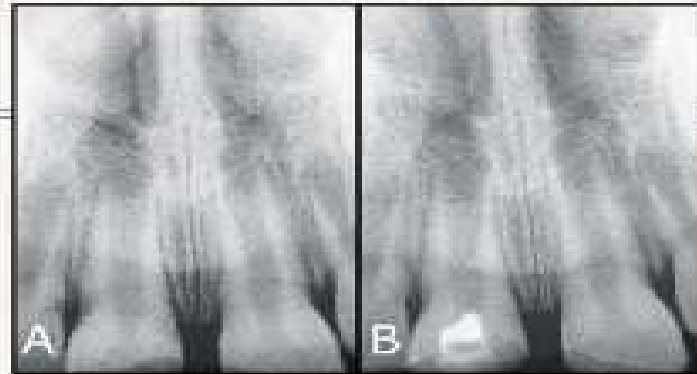
CLASSIFICATION

- ❖ According to method of pulp amputation
- ❖ A bur
- ❖ Spoon excavator
- ❖ Electro-surgery
- ❖ Laser



Pulpotomy

✦ Technique



Pulpotomy

Criteria for Failure

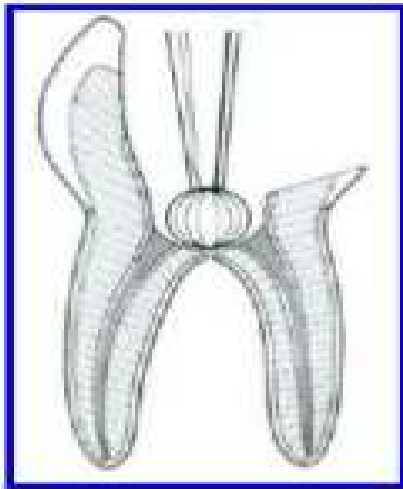
✦ Clinically:

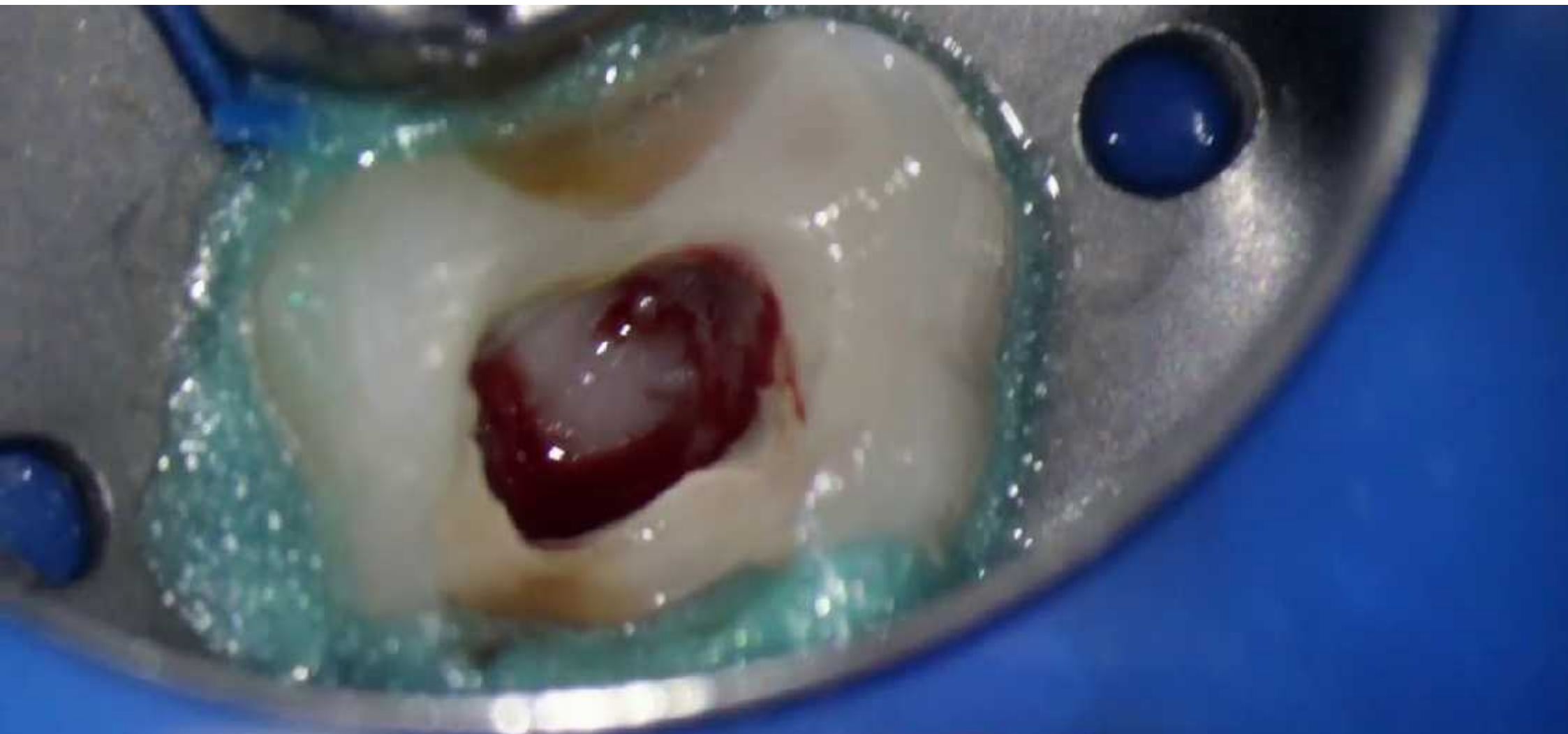
- ✦ Spontaneous pain
- ✦ Swelling
- ✦ Discoloration



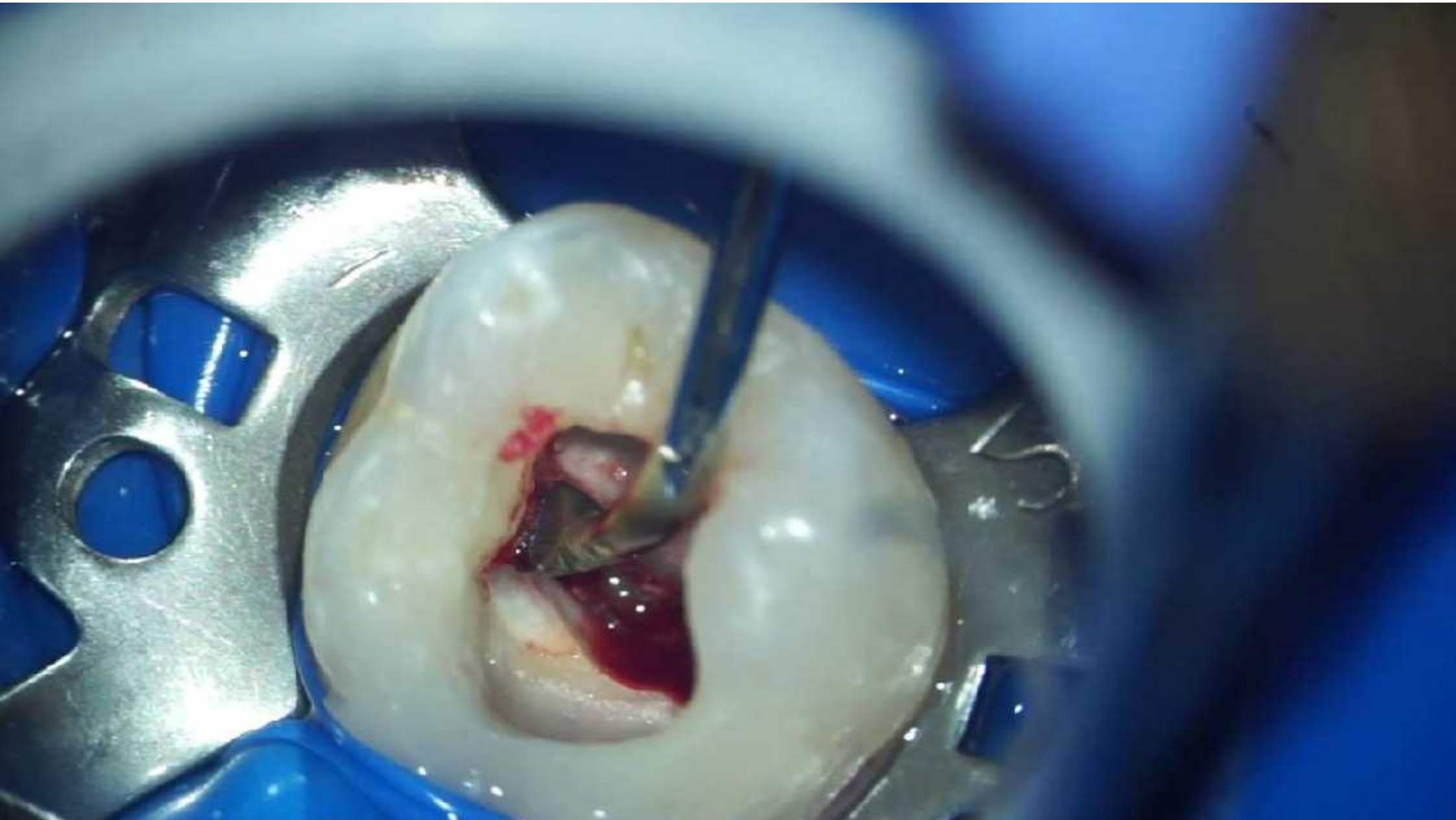
✦ Radiographically:

- ✦ Periapical lesion
- ✦ Internal resorption
- ✦ Calcification



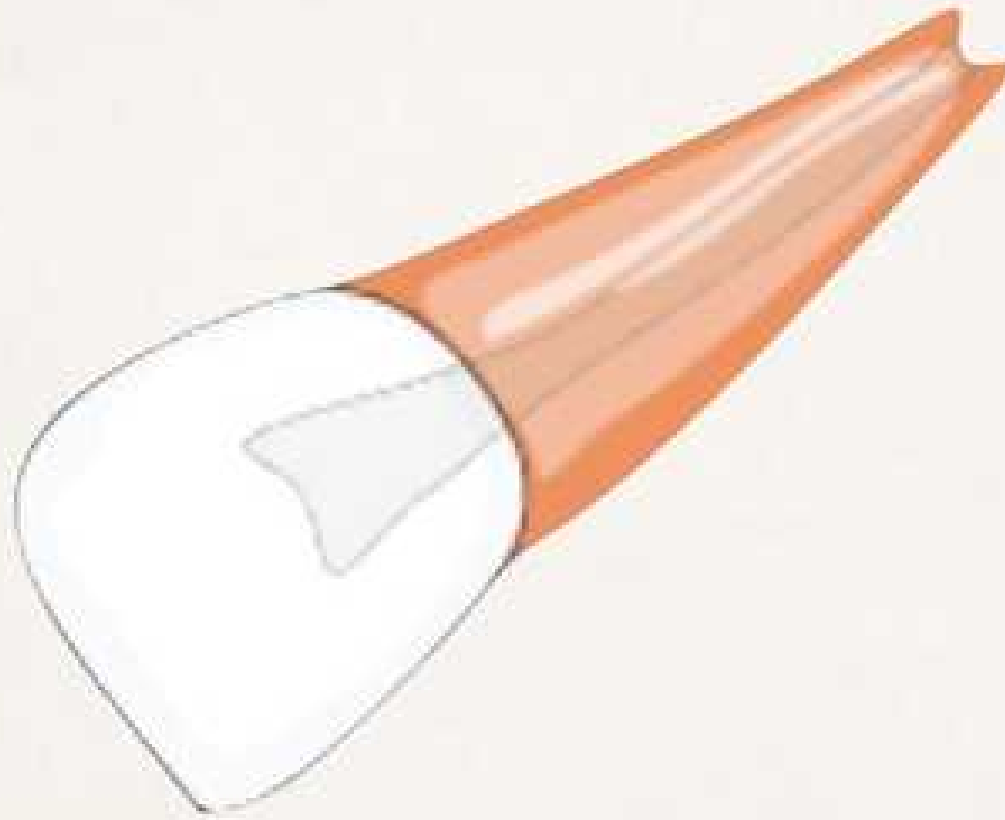


Amputation of coronal pulp tissue



OPEN APEX CASES





Management of Teeth with Open Apices

Apexogenesis (Vital)

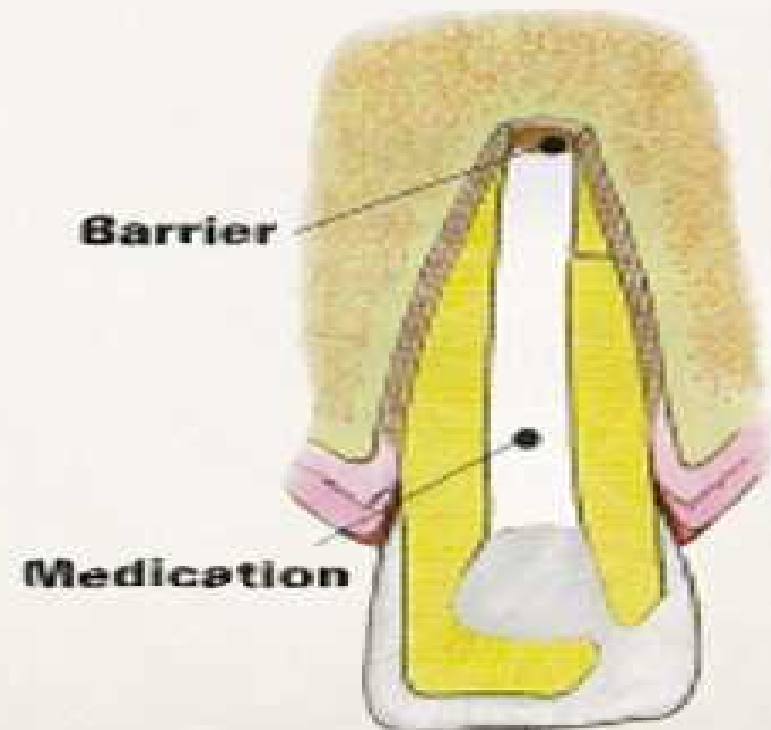


Apexification (Non-Vital)

Apexification

❖ Definition

“It is the procedure by which apical closure is induced at the apex of an immature tooth”

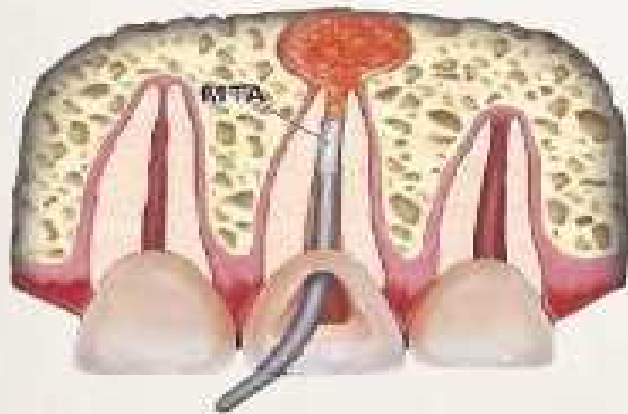


Apexification

✦ Technique

$\text{Ca}(\text{OH})_2$

MTA



Apexification



www.shutterstock.com - 84049345

Periodic Recall (Every 3 months)

- ✦ Apical closure between 6-24 months
- ✦ Success is judged radiographically
- ✦ Clinical testing could perforate the barrier (done with care)
- ✦ If no closure re-application of Ca(OH)_2
- ✦ With MTA re-entry not required



VITAL PULPA TEDAVİLERİ DEĞERLENDİRME KRİTERLERİ

- SEMPTOMLAR
- KLİNİK BULGULAR
- KORONAL ÖRTÜCÜLÜK
- RADYOGRAFİK BULGULAR

SEMPTOMLAR

EĐER TEDAVİ BAŐARILI İSE

PULPİTİS

VEYA

PERİRADİKÜLER PERİODONTİTİSE

AİT HERHANGİ BİR

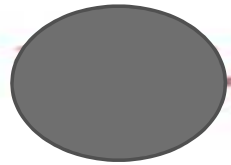
SEMPTOM YOKTUR

KLİNİK BULGULAR

- DİŞ VİTALİTE TESTİNE **POZİTİF YANIT** VERMELİ
- DİŞTE **PERKÜSYONA VE PALPASYONA** KARŞI HASSASİYET OLMAMALI
- **RENKLEŞME** OLMAMALI,
- PERKÜSYONDA DUYARLILIK OLMASI İSE TEDAVİNİN **BAŞARISIZ** OLDUĞUNU GÖSTERİR
- DİŞTE **MOBİLİTE** OLMAMALI
- ENDODONTİK ORJİNLİ BİR **FİSTÜL** BULUNMAMALI
- KUAFAJ UYGULAMALARINI TAKİBEN HİÇBİR **SEMPATOM GÖRÜLMEDİĞİ** GİBİ, DİŞTE BİR **DUYARLILIK** DA OLUŞABİLMEKTEDİR
- DİŞTE BİRKAÇ GÜN **HAFİF AĞRI** VE **SOĞUKTA DUYARLILIK** OLUŞMASI NORMAL KABUL EDİLİR
- **BAŞARILI VAKALARDA** BU DUYARLILIK İLERLEYEN SÜREÇTE AZALARAK KAYBOLMAKTADIR
- **SPONTAN, GİTTİKÇE ARTAN ŞEKİLDE VE ZONKLAYICI TARZDA AĞRILAR** **BAŞARISIZLIK GÖSTERGESİDİR**

RADYOGRAFİK BULGULAR

- PERIODONTAL LİGAMENTTE GENİŞLEME
- PERİRADİKÜLER RADYOLÜSENSİ
İZLENMEMELİ
- BU DIŞLER DÜZENLİ OLARAK (3-6 AY İLE
1YILA KADAR) TAKİP EDİLMELİDİR



- Prognosis of direct pulp capping:

Success rates range from **13% to 98%** in one to 10 years retrospective studies:

- Armstrong and Hoffman: **97.8%** success rate after 1.5 years.
- Fitzgerald and Heys: **79%** success rate after one year.
- Haskell and colleagues: success rate of **87.2%** after five years.
- Barthel and colleagues: success rate of **37%** after five years and **13%** after 10 years for 123 pulp-capping procedures performed by dental students.
- Baume and Holz: The operator's skill seems to be one factor that influences the outcome of pulp-capping procedures

VITAL PULPA TEDAVISI PROGNOZU

- HASTANIN YAŞI
- PULPAL DURUMUN TEŞHİSİ BAKTERİYAL KONTAMINASYON
- OLGU SEÇİMİ
- PULPA ODASININ HASARIN BÜYÜKLÜĞÜ
- İZALASYON
- KULLANILAN PULPA KAPLAMA MATERYALI
- RESTORASYON KALİTESİ



Mekanik Nedenle Pulpal Açılım (Expose) Başarı Oranı > Çürük Nedeniyle Pulpal Açılım Başarı Oranı

Kuafaj materyalleri ve kaide sonrası kronel sızıntısız daimi dolgu başarıda önemli faktördür

Non Significant Factors

Age of patient

Sex of patient

Tooth location

Tooth position

Outcome of pulp capping (%) in relation to patients' age group.*

AGE (YEARS)†	OUTCOME‡	TOTAL‡
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Outcome of pulp capping (%) in relation to patients' sex.*

SEX	OUTCOME‡	TOTAL‡
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Outcome of pulp capping (%) in relation to the tooth location (maxillary versus mandibular).*

TOOTH LOCATION	OUTCOME‡	TOTAL‡
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Outcome of pulp capping (%) in relation to the tooth position (anterior versus posterior).*

TOOTH POSITION	OUTCOME‡		TOTAL‡
	Success	Failure	
Anterior	12 (57.1)	9 (42.9)	21 (10.3)
Posterior	109 (59.6)	74 (40.4)	183 (89.7)
TOTAL†	121 (59.3)	83 (40.7)	204 (100.0)

* $\chi^2 = 0.05; df = 1; P = .83.$

† Percentage distribution (%) within each tooth position group.

‡ Percentage distribution (%) within the total number of teeth that underwent pulp capping.

Significant Factors

1. Type of Exposure:

Mechanical exposure: Direct pulp capping + permanent restoration to conserve the vital pulp.

Carious exposure: Avoid Pulp capping & opt for endodontic therapy.

Outcome of pulp capping (%) in relation to the type of pulp exposure.*

PULP EXPOSURE	OUTCOME†		TOTAL‡
	Success	Failure	
Carious	38 (33.3)	76 (66.7)	114 (55.9)
Mechanical	83 (92.2)	7 (7.8)	90 (44.1)
TOTAL‡	121 (59.3)	83 (40.7)	204 (100.0)

* $\chi^2 = 72.3; df = 1; P < .001.$

† Percentage distribution (%) within each type of pulp exposure.

‡ Percentage distribution (%) within the total number of teeth that underwent pulp capping.

Significant Factors

2. Type of Restoration:

An **hermetic seal** against bacterial infiltration is a must to guarantee the success of the pulp treatment.

Outcome of pulp capping (%) in relation to the type of restoration placed immediately after pulp capping.*

TYPE OF RESTORATION	OUTCOME†		TOTAL‡
	Success	Failure	
Temporary	62 (47.3)	69 (52.7)	131 (64.2)
Permanent	59 (80.8)	14 (19.2)	73 (35.8)
TOTAL‡	121 (59.3)	83 (40.7)	204 (100.0)

* $\chi^2 = 72.3$; $df = 1$; $P < .001$.

† Percentage distribution (%) within each type of restoration.

‡ Percentage distribution (%) within the total number of teeth that underwent pulp capping.

Significant Factors

3. Class of Restoration:

The prevention or reduction in the microleakage reflects the higher success rate of pulp capping in Class I restorations relative to that in the Class II, III, IV and V and MOD restorations

Outcome of pulp capping (%) in relation to the class of restoration placed immediately after pulp capping.*

RESTORATION CLASS	OUTCOME†		TOTAL‡
	Success	Failure	
Class I	31 (83.8)	6 (16.2)	37 (18.1)
Class II	74 (56.1)	58 (43.9)	132 (64.7)
Class III	10 (58.8)	7 (41.2)	17 (8.3)
Class IV	1 (50.0)	1 (50.0)	2 (1.0)
Class V	1 (50.0)	1 (50.0)	2 (1.0)
Mesial-Occlusal-Distal	4 (28.6)	10 (71.4)	14 (6.9)
TOTAL‡	121 (59.3)	83 (40.7)	204 (100.0)

* $\chi^2 = 15.4$; $df = 5$; $P = .009$.

† Percentage distribution (%) within each class of restoration.

‡ Percentage distribution (%) within the total number of teeth that underwent pulp capping.

To Remember

Success Rates

1. Type of Exposure	92.2% Mechanical
	33.3% Carious
2. Type of Restoration	80.8% Permanent
	47.3% Temporary
3. Class of Restoration	83.8% CI I O
	28.6% CI II MOD

New perspectives and future trends:

- **Other innovative technical advances** include the use of:
 - Lasers
 - Ozone technology
 - Bioactive agentsthat induce and stimulate pulpal defenses
- **Gene-enhanced Tissue Engineering**
- **Dental Pulp Stem Cell Therapy:**
 - Potential to improve on conventional pulp-capping with calcium hydroxide or other artificial materials.
 - Ex vivo cell therapy may have an advantage and might result in copious amounts of reparative dentin formation.
 - Skin fibroblasts transduced with BMP7-adenovirus induce reparative dentin formation (Rutherford, 2001)
 - Techniques have to be established and optimized before cell therapy with BMP2 can become a clinical reality for caries and endodontic therapy.

VİTAL PULPA TEDAVİLERİNDE KULLANILAN MATERYALLER

CALCIUM HYDROXIDE - Ca(OH)_2

MINERAL TRIOXIDE AGGREGATE (MTA)

TRI-CALCIUM PHOSPHATE

BIO-AGGREGATE

BIODENTINE

BONDING SYSTEMS

Yaygın
Olarak
Kullanılırlar

VARIOUS PULP CAPPING AGENT



Calcium hydroxide

Thera Cal

Zinc oxide eugenol cement

Castor oil bean cement

Corticosteroids and antibiotics

Endo sequence root repair material

Polycarboxylate cement

Odontogenic ameloblast associated protein

Isobutyl cyanoacrylate and tri calcium phosphate ceramic

Growth factors

Collagen

MTA 1-Calcium

Bonding Agents

Lasers

Calcium phosphate

GIC/RMGIC

Hydroxyapatite

Mineral trioxide aggregate

CALCIUM HYDROXIDE - Ca(OH)₂

- En yaygın olarak kullanılan kuafaj materyalidir
- Pulpa yüzeyinde dezenfektan ve antibakteriyal etkilidir.
- Yüksek pH a sahiptir (12,5)
- Saf kalsiyum hidroksit, hızlı sertleşen kalsiyum hidroksit macunlarından (Dycal, Kerr Life) daha yakıcıdır, ancak aynı tip iyileşmeyi başlattığı gösterilmiştir.

CALCIUM HYDROXIDE PULPA ÜZERİNE ETKİSİ

- Yüzeysel pulpada likeifikasyon nekrozu
- Derin tabakalarda toksisitenin nötralizasyonu
- Kuagülasyon nekrozu ve bitişik pulpa dokusunun irritasyonu
- Minör enflamasyon ve sert doku bariyeri oluşumu



Pure Calcium hydroxide



ADVANTAGES

- ✓ Reparative dentin formation
- ✓ Antibacterial action
- ✓ Pulp protection
- ✓ The tissue-dissolving property
- ✓ Newer preparation shows Improved strength, essentially no solubility in acid, and minimal solubility in water and control the over working time

DISADVANTAGES

- Pulp obliteration
- Internal resorption
- Lack of adhesion to hard tissues
- Microleakage
- Short working time of self cured preparation

COMPOSITION

Base paste –

Glycol salicylate-40%-reacts with calcium hydroxide and ZnO
Titanium dioxide-Inert fillers
Calcium tungstate - Fillers
Barium sulphate-provide radioopacity

Catalyst paste

Calcium hydroxide-50%-principal reactive ingredient
Zinc oxide-10%
Zinc stearate-0.55%-accelerator
Sulphonamide-39.5%-oily compound acts as carrier.



•AVAILABLE AS

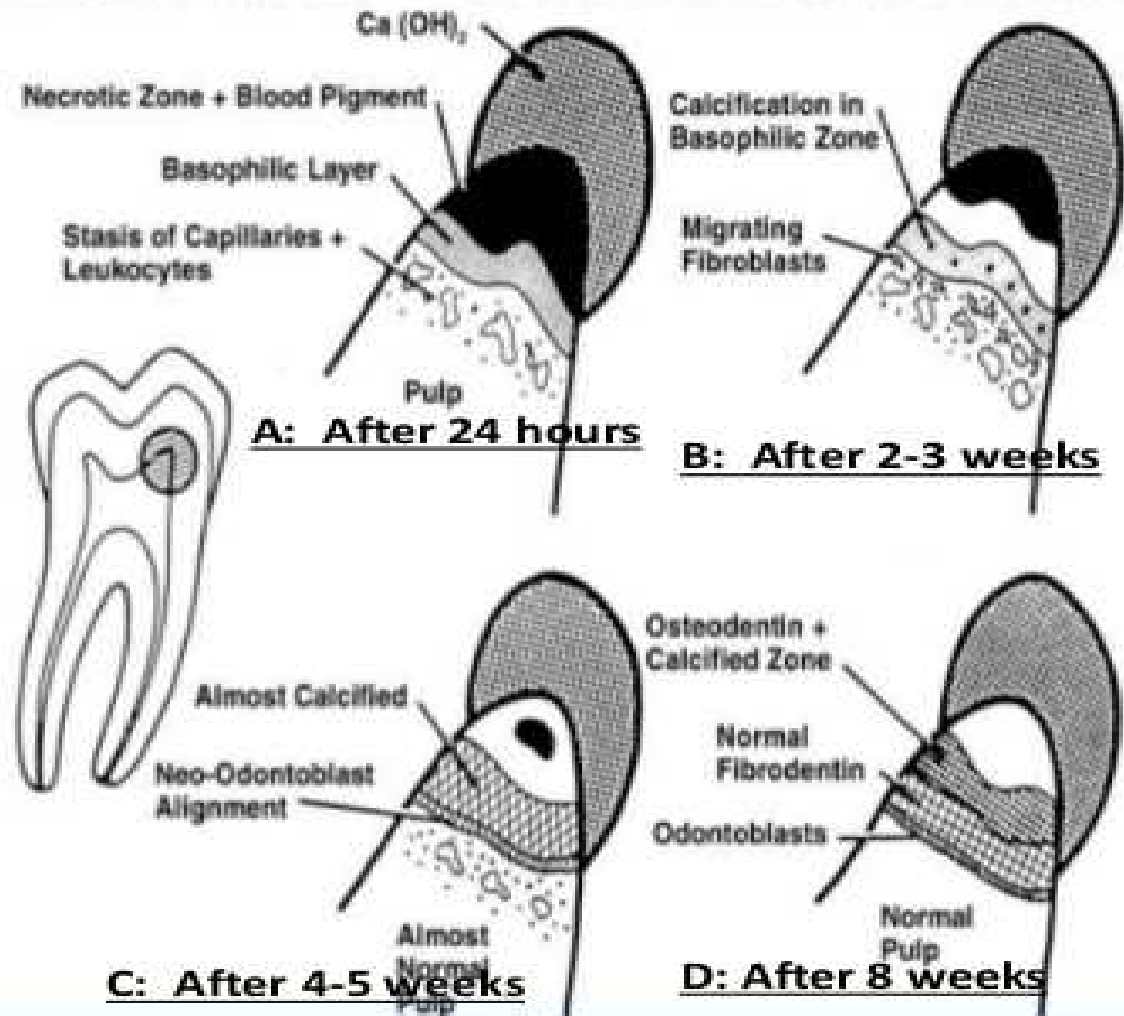
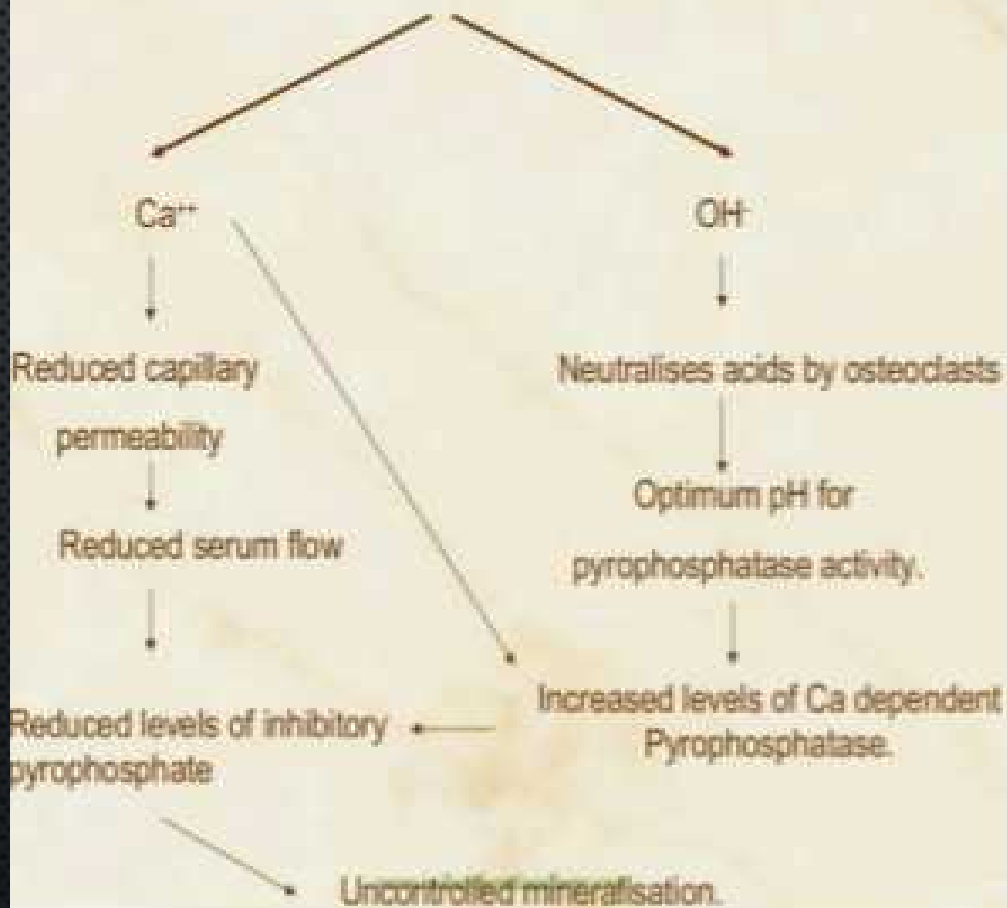
a)Pulpdent

b)Hydrex : two paste system

c)Dycal.

MECHANISM OF ACTION

Calcium Hydroxide



HISTOLOGY OF HEALING AFTER PULP CAPPING WITH Ca(OH)₂

Three distinct zone can be visualised:

- I. Zone of obliteration (early changes: area of superficial debris)
- II. Zone of coagulation necrosis (Schroeder's layer of "firm necrosis", Stanley's "mummified zone")
- III. Line of demarcation

Zone of obliteration

- ❖ Early changes: area of superficial debris
- ❖ Drug's caustic effect
- ❖ Tissue in immediate contact becomes deranged and distorted.
- ❖ This Zone consists of-
 - i. Debris
 - ii. Dentinal fragments
 - iii. Blood clot
 - iv. Blood pigment
 - v. Calcium hydroxide particles

Zone of coagulation necrosis

- ❖ Weaker chemical reaction from 1st zone reaches the subjacent, more apical tissues & results in this zone of coagulation & necrosis.
- ❖ Thickness- 0.3-0.7 mm (**Acc. to Craig: 1mm thick**)
- ❖ Represents devitalised tissue without complete obliteration of its structural architecture
- ❖ Cellular details-greatly diminished
- ❖ Capillaries outlines, nerve bundles & pyknotic nuclei can be recognized.
- ❖ Stimulates subjacent vital pulp
- ❖ Vascular changes occur

Line of demarcation

Develops between Zone of coagulation necrosis and vital tissues
This zone results from reaction of Calcium hydroxide with the tissue protein to form proteinate globules.

MINERAL TRIOXIDE AGGREGATE (MTA)

Son zamanlarda vital pulpa tedavileri, perforasyon tamiri ve kök kanal tedavi başta olmak üzere tüm pulpa tedavilerinde kullanılabilecek materyal olarak tanımlanmıştır.

İçeriği

Trikalsiyum silikat

Trikalsiyum alimunat

Trikalsiyum oksit

Silikat oksit

1/3 oranında steril su ile karıştırılarak kullanılır ve 5 dk 'da sertleşir.



Dr. M. Torabinejad



MINERAL TRIOXIDE AGGREGATE (MTA)

- Hiç veya düşük eriyebilirlik
- Antibakteriyal etkili
- Başlangıç pH 10,2 olup, karıştırıldıktan ve 3 saat sonra pH 12,5 'a ulaşır.
- Pulpal hücrelerin proliferasyonunu indükler
- Mineralize sert doku sitümülasyonunu sağlar

MINERAL TRIOXIDE AGGREGATE (MTA) PULPA ÜZERİNE ETKİSİ

- Etki mekanizması tam olarak bilinmez
- Trikalsiyum oksit + Doku sıvısı = Kalsiyum hidroksit → Sert doku formasyonu



Application of MTA

PROPERTIES OF MTA

• Mixing MTA:

Powder: Water = 3: 1

Glass SLAB or paper slab used

• SETTING TIME:

Hydration of MTA powder results in a colloidal gel that solidifies to a hard structure in 3~ 4 hrs which has a long setting time with less shrinkage.

• pH=12.5

INDICATION

- To preserve pulp vitality
- Prevent pathological changes in the periradicular tissues
- Mechanical pulp exposures
- Carious pulp exposures with immature apices.

CONTRAINDICTION

Irreversible pulpitis

ADVANTAGES

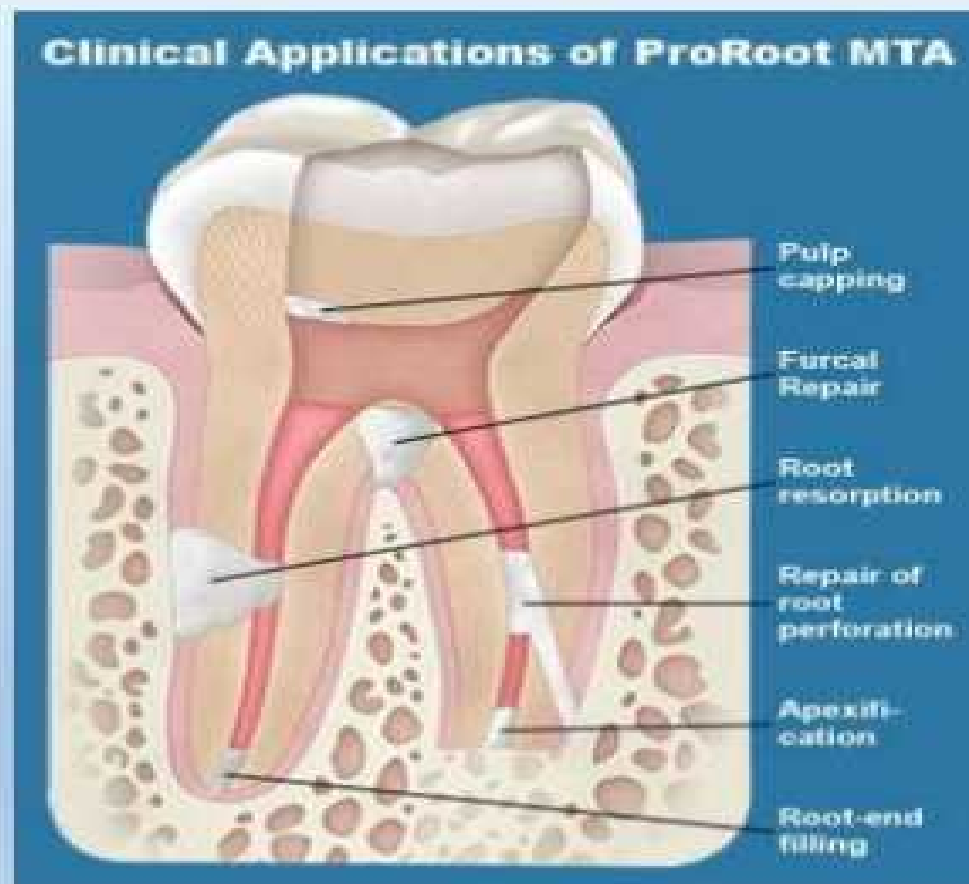
- Antimicrobial Activity
- Prevents MicroLeakage over vital pulp
- Cementoconductive
- Non toxic and Non-mutagenic
- Cell adherence & growth
- Alkaline phosphatase/ osteocalcin
- Interleukin production
- Periodontal ligament attachment to cementum growth
- Dentinal bridge formation

DISADVANTAGES

- More difficult to manipulate
- Longer setting time

CLINICAL APPLICATION OF MTA

- Direct Pulp Capping
- Apical plug
- Root End Filling
- Perforation Repair
- Furcation involvement
- Resorptive Defects
- Immature apices
(apexogenesis/ Apexification)



	<u>Ca(OH)₂</u>	<u>MTA</u>
Hard tissue formation	Not much	Root end induction
Calcific bridge	Not continuous	Continuous with dentin
Biocompatibility	Low	High
Degree of Inflammation	Low	High
Sets	Not Hard	Hard
pH	High	High
Solubility	Partially dissolve	Less soluble
	Permeable to fluids	Non permeable
Viscosity	Poor	Good
Application	Not easy to apply in RC	Easy
Resorption	Rate vary with density	Non-resorbable
Appical barrier formation	Change rate/ initial narrow appical width	Less/wide
Patient follow up	More	Less
Treatment	Delay	shortens

MTA

- **Abedi et al. (1996)** MTA: less inflammation
- **Pitt Ford et al. (1996)**: dentine bridge formation in all pulps capped with MTA and no inflammation except in one sample
- **MTA: excellent sealing ability (Torabinejad et al. 1993, 1994, Bates et al. 1996, Fischer et al. 1998, Wu et al. 1998)**
- **Excellent biocompatibility (Kettering & Torabinejad 1995, Torabinejad et al. 1997, 1998, Holland et al. 1999, Mitchell et al. 1999, Keiser et al. 2000)**. Supposedly due to CH and Hydroxyapatite formation

BIO-AGGREGATE

Nano partiküllü bioseramik içerikli Bio-aggregate kök kanal tamir materyali olarak sunulmuştur.

- Perforasyon tamiri
- Rezorpsiyon tedavisi
- Apeksifikasyon
- Pulpa kuafaj materyali olarak kullanılabileceği belirtilmiştir.

İçeriği

Toz

Trikalsiyum silikat (ana kor materyal)
Dikalsiyum silikat (ikincil kor materyal)
Kalsiyum karbonat ve okside foldurucular
Zirkonyum oksit radyoopafisier

Likid

Kalsiyum klorit akseleratör
Suda çözünen su indirgeyici ajan



Mta Ve Biyolojik Agrega ile bazı farklılıklar ile birlikte benzer kimyasal kompozisyon gösterir



Tantalum oxide

VS



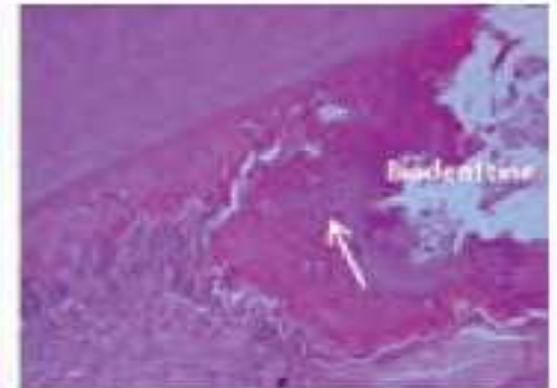
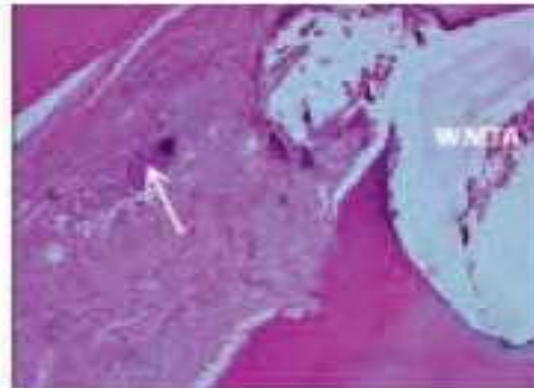
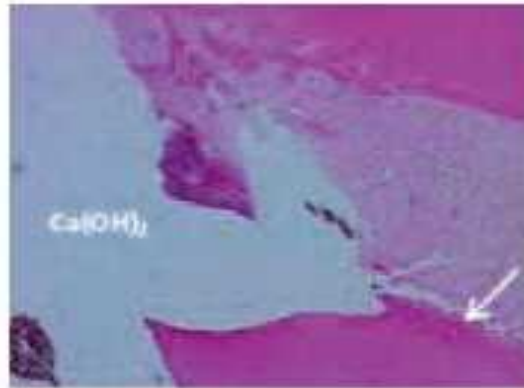
Bismuth oxide

Calcium hydroxyde

WMTA

Biodentine™

1 week
Inflammation



2/10 Calcification

7/10 Calcification

9/10 Calcification

4 weeks
Inflammation-
Tissu regeneration
transition

7/10 Important calcification

10/10 Important calcification

10/10 Important calcification

5/10 Partial calcification

12 weeks
Complete healing

10/10 Important calcification

10/10 Important calcification

9/10 Important calcification

ZINC OXIDE-EUGENOL



- ▶ Germicidal agent
- ▶ Used in **indirect pulp capping** due to its
 - ▶ Palliative affect
 - ▶ Excellent initial seal
 - ▶ Kills bacteria present in carious lesions
 - ▶ So arrests the caries process
- ▶ This gives the pulp the chance for healing & regeneration
- ▶ **Direct contact** → chronic inflammation, abscess formation and liquefaction necrosis.
- ▶ After 24Hr of capping → a mass of red blood cells & PNLs. Demarcated from the underlying tissue by zone of fibrin and inflammatory cells.
- ▶ After 2W of capping → pulp degeneration & chronic inflammation extends deep to the apex.

LASER



- Different studies were led on laser energy to overcome the histological deficits of electrosurgery.
- Used in Direct pulp capping & pulpotomy.
- Co2 Laser , Argon Laser, Diode Laser, Erbium:Yttrium-Aluminum Garnet (Er:YAG).
- Laser radiation has been proposed for pulp treatment based on its **haemostatic, coagulative and sterilizing** effects.
- **Laser** irradiation creates a superficial zone of coagulation necrosis that remains compatible with the underlying tissue and isolate pulp from effects of the subbase. Mortiz et al., reported that the thermal effects of laser radiation caused sterilization and scar formation in the irradiated area, which in turn preserves the pulp from bacterial invasion.

Adhesive Liners

- There were suggested as direct pulp capping and pulpotomy agents with the introduction of adhesive dentistry in both primary and permanent dentition.
- Adhesive material forms:
 - A complete marginal seal
 - Prevents bacterial intrusion
 - Allowed pulp repair, characterized by a new odontoblast cell layer underlying the dentin bridge formation.
- Many studies have indicated that composite & resin-modified glass-ionomer are compatible with pulp tissue.

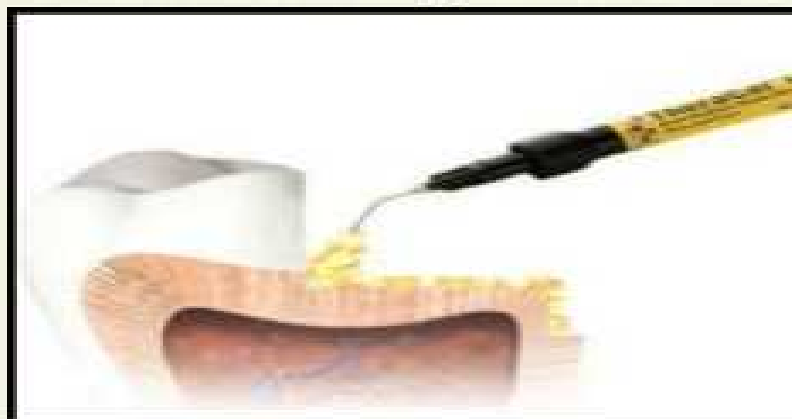
Propolis



- ▶ Propolis, a resinous material collected by honey bees, has been used as a traditional anti-inflammatory and anti-bacterial medicine for many centuries.
- ▶ Used as indirect pulp capping paste when mixed with ZnO powder and this showed similar effect of ZnO and Eugenol as secondary dentin formation.
- ▶ In direct capping with this paste showed no pulp degeneration and formation of protective layer.

THERACAL

It is a light cured, resin modified calcium silicate filled liner insulating and protecting dentin-pulp complex. It can be used in direct and indirect pulp capping, as a protective base/liner under composites, amalgams, cements, and other base materials. When this material was compared with ProRoot MTA and Dycal, it was found that calcium release was higher and solubility was low.



OTHER MATERIALS USED AS PULP CAPPING AGENT....

PULP CAPPING AGENT	ADVANTAGES	DISADVANTAGES
Zinc oxide eugenol cement.	<ol style="list-style-type: none"> 1) Reduces inflammation. 	<ol style="list-style-type: none"> 1) Lack of calcific bridge formation. 2) Releases eugenol in high concentration which is cytotoxic. 3) Demonstrates interfacial leakage.
Corticosteroids and antibiotics.	<ol style="list-style-type: none"> 1) Reduces pulp inflammation. 2) Vanomycin and calcium hydroxide stimulated a more regular reparative dentin. 	<ol style="list-style-type: none"> 1) Should not be used in patients with risk from bacteremia.
Polycarboxylate cement.	<ol style="list-style-type: none"> 1) Chemically bond to tooth structure. 	<ol style="list-style-type: none"> 1) Lack of antibacterial effect. 2) Fail to stimulate calcific bridge formation.
Inert materials(Isobutyl cyanoacrylate and tri calcium phosphate ceramic)	<ol style="list-style-type: none"> 1) Reduces pulp inflammation. 2) Stimulate dentin bridge formation. 	<ol style="list-style-type: none"> 1) NONE of these materials have been promoted in dentist profession as a viable technique
Collagen	<ol style="list-style-type: none"> 1) Less irritating than calcium hydroxide and promotes mineralization. 	<ol style="list-style-type: none"> 1) Does not help in thick dentin bridge formation.
Bonding Agents	<ol style="list-style-type: none"> 1) Superior adhesion to hard tissues. 2) Effective seal against micro leakage. 	<ol style="list-style-type: none"> 1) Has cytotoxic effect. 2) Absence of calcific bridge formation.

PULP CAPPING AGENT	ADVANTAGES	DISADVANTAGES.
Calcium phosphate.	<ol style="list-style-type: none"> 1) Helps in bridge formation with no superficial tissue necrosis. 2) Significant absence of pulp inflammation. 3) Good physical properties. 	<ol style="list-style-type: none"> 1) Clinical trials are necessary to evaluate this material.
Hydroxyapatite.	<ol style="list-style-type: none"> 1) Biocompatible. 2) Act as a scaffold for the newly formed mineralized tissue. 	<ol style="list-style-type: none"> 1) Mild inflammation with superficial necrosis of pulp.
Carbon dioxide lasers	<ol style="list-style-type: none"> 1) Formation of secondary dentin. 2) Bactericidal effects. 	<ol style="list-style-type: none"> 1) Technique sensitive. 2) Causes thermal damage to pulp at high doses.
Glass ionomer/ Resin modified glass ionomer.	<ol style="list-style-type: none"> 1) Excellent bacterial seal. 2) Fluoride release, coefficient of thermal expansion and modulus of elasticity similar to dentin. 3) Good biocompatibility. 	<ol style="list-style-type: none"> 1) Cause chronic inflammation. 2) Lack of dentin bridge formation. 3) Cytotoxic when in direct cell contact. 4) High solubility and slow setting rate.
MTA 1-Calcium	<ol style="list-style-type: none"> 1) Helps in dentin bridge formation without formation of necrotic layer. 2) Shear bond strength is higher than conventional GIC and similar to RMGIC. 	<ol style="list-style-type: none"> 1) Presence of 10% calcium hydroxide interferes with complete curing of the material, residual monomers causes cytotoxicity.
Growth factors.	<ol style="list-style-type: none"> 1) Formation of osteodentin and tubular dentin. 2) Formation of more homogenous reparative dentin 3) Superior to calcium hydroxide in the mineralization inducing properties. 	<ol style="list-style-type: none"> 1) High concentration is required. 2) Half life is less. 3) Appropriate dose response is required to avoid uncontrolled obliteration of pulp chamber.

PULP CAPPING AGENT	ADVANTAGES.	DISADVANTAGES.
Odontogenic ameloblast associated protein.	<ol style="list-style-type: none"> 1) Biocompatible. 2) Accelerates reactionary dentin formation. 3) Normal pulp tissue appearance without excessive tertiary dentin formation and obliteration of the pulp cavity compared to MTA 	<ol style="list-style-type: none"> 1) Till now only invitro studies were conducted. 2) Further studies regarding this material is required.
Endo sequence root repair material	<ol style="list-style-type: none"> 1) Antibacterial property. 2) Less cytotoxic than MTA, Dycal and light cure calcium hydroxide. 	<ol style="list-style-type: none"> 1) Bioactivity of the cells were decreased gradually when exposed to this material.
Castor oil bean cement.	<ol style="list-style-type: none"> 1) Good antibacterial property. 2) Less cytotoxic. 3) Good mechanical properties. 4) Facilitates tissue healing. 5) Better sealing ability than MTA and GIC. 6) Less cost. 	<ol style="list-style-type: none"> 1) Bio inert rather than bioactive. 2) More clinical trials are required.
Thera Cal.	<ol style="list-style-type: none"> 1) Act as protectant of the dental pulp complex. 2) Has strong physical properties, no solubility, high radiopacity. 3) TheraCal exhibited higher calcium 	<ol style="list-style-type: none"> 1) It is opaque and whitish in color and it should be kept thin so as not to show through composite material that are very translucent affecting final