

Restorative Dentistry 1 — Endodontics & Prosthodontics

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EXAM-DAY SUMMARY

everything on this page → detail in §§ overleaf

DIAGNOSIS → §1

- History = **SOCRATES**; assimilate history + tests + radiograph
- Reversible = short/settles · irreversible = spontaneous/lingering
- Chronic apical abscess = discharging sinus + radiolucency · condensing osteitis = radiopaque at apex

PULP TESTING → §1

- Test control tooth first; **cold = first-line** (vital + non-vital)
- EPT accurate vital, poor non-vital · cavity test = last resort
- False -ve: older/secondary dentine, heavily restored, recent trauma/ortho

REFERRAL (BES LEC) → §2

- Level 1 **GDP**: <30° negotiable, emergency, straightforward retreat
- Level 2 DwESE/SpE: 30–45°, >25 mm, opening 25–35 mm, post <8 mm
- Level 3 SpE/Consultant: >45°/S-shaped, anomalies, surgery, complex retreat

RCT PRINCIPLES → §3

- Straight-line access (reference = **CEJ outline**) · MAF to WL + tug-back
- Files: 6-8-10 glidepath · 15 → 35/40 WL · 50-60-70 flare
- NiTi enlarges not negotiates; glidepath first; EAL for length; single use

IRRIGANTS → §3

- NaOCl **0.5–5.25%** gold standard · EDTA 17% smear · CHX 2% (substantivity)
- 0.2% CHX mouthwash ✗ · saline ✗ (wash only)

OBTURATION & SUCCESS → §3

- Fill within **2 mm of radiographic apex** (aim apical constriction), no voids
- Single cone + bioceramic sealer · bulk CSC for open apex
- Good coronal seal as vital as apical fill

VITAL PULP THERAPY → §4

- Material = **CSC (MTA/Biodentine)**; CaOH acceptable if sealed
- 1-yr success: direct cap ~90% · partial 98% · full pulpotomy 99%
- Bismuth-oxide CSC discolours → avoid anterior

EMERGENCIES → §5

- Definitive treatment at visit; drugs adjunct · NSAID + paracetamol
- No antibiotics for irreversible pulpitis** — only spreading/systemic/immunocompromised
- Lower molar block fails → buccal articaine 4%

NAOCL ACCIDENT → §5

- Triad: sudden pain · canal bleeding · rapid swelling
- First step: irrigate with **saline/water** → CaOH dress + analgesia
- Prevent: side-vent needle, stopper 1–2 mm short, never lock needle

RETREATMENT → §6

- Failure: coronal leakage, **E. faecalis** biofilm, procedural errors
- Prognosis ~80% at 2–4 yr; outcomes favourable/uncertain/unfavourable
- 17% EDTA + crown-down; solvents Eucalyptol/Xylene (toxic)

FERRULE & RESTORABILITY → §7

- Restorability = ferrule: **2 mm height × 2 mm thickness · ≥2 walls** · no mobility
- No ferrule → gingivectomy/crown lengthening; biological width ≥2 mm
- >30% coronal volume + ≥2 mm dentine to restore

POSTS, CROWNS & BRIDGES → §7–8

- Post **retains core, not root**; leave 4–5 mm apical GP; fibre = monoblock
- Chamfer 0.3–0.5 · deep chamfer/shoulder 0.6–1 · shoulder 1–1.5 mm
- Fixed-fixed ≤4 units, 8–12 yr · RBB anterior 1st choice ~5 yr · fixed-movable for pier/tilted

§1 Endodontic diagnosis

History → examination → special tests → radiograph, assimilated together; never diagnose on one finding.

- **Pain history = SOCRATES:** Site · Onset (sudden/gradual) · Character (ache/stabbing) · Radiation · Associations · Time course (pattern) · Exacerbating/relieving · Severity (1–10)
- **Trauma history:** time/date/place · LOC or dizziness · tetanus status/meds/bleeding/allergy · emergency actions (re-implant, fragments) · prior treatment elsewhere
- **Extra-oral:** temperature · difficulty swallowing/breathing → airway spread → hospital · facial map · TMJ + nodes (referred peri-auricular pain → rule out TMJ)
- **Intra-oral:** mucosa map · 6-point perio chart · pocket >5.5 mm = ★**BPE 4** → full assessment · isolated pocket → suspect endo (fracture/perforation/sinus)
- **Coronal structure*:** assess restorability before starting → need ★**≥2 mm circumferential supra-gingival dentine + >30% original coronal tooth**

1.1 Pulpal & periapical diagnoses (AAE / BES Table 1.1)

Table 1 — Endodontic diagnoses: signs and radiographic features

	Symptoms / signs	Radiograph
Reversible pulpitis	Short sharp cold sensitivity · localised · settles fast	Normal apical tissues
Irreversible pulpitis	Spontaneous · lingering · poorly localised · radiates/refers	Normal ± early apical change if longstanding (widened PDL, ↓ lamina dura)
Pulp necrosis	None / vague intermittent that settles	Normal ± early apical change
Transient apical periodontitis	Percussion tender · occlusal/dental trauma	Intact lamina dura · widened PDL
Symptomatic apical periodontitis	Percussion + palpation tender · odd nigggle	Widened PDL · ↓ lamina dura
Asymptomatic apical periodontitis	None ± firm bony swelling	Apical radiolucency (rarefaction)
Chronic apical abscess	Little/no pain · discharging sinus	Apical radiolucency
Acute apical abscess	Severe pain + swelling · fluctuant → cellulitis	Often little/no change (unless acute-on-chronic)
Condensing osteitis	Variable · low-grade stimulus	Diffuse radiopaque lesion at apex

1.2 Special tests — pulp sensibility

- **Test control first:** contralateral tooth → patient's baseline; test on sound dry isolated enamel, away from restorations
- **Cold** (refrigerant spray, e.g. tetrafluoroethane ≈ -26 °C): ★**first-line** · **works vital AND non-vital**
- **Heat:** hot water under single-tooth dam · heated probe/GP stick
- **EPT:** electrical stimulus, digital reading vs contralateral → accurate for vital, ✗ poor for non-vital
- **Selective anaesthetic:** ID block → localises upper vs lower · infiltration/intraligamentary → isolates tooth in a quadrant
- **Cavity test:** outdated · non-conservative · last resort
- **Other:** cracked-cusp (transillumination/tooth sleuth) · percussion = perio/PDL health not pulp · record nature, duration, referral, lack of response



Fig. 1 — EPT on a dried, isolated crown; compare against the contralateral control.

Table 2 — Misleading pulp-test responses

False positive (non-vital reads vital)	False negative (vital reads non-vital)
Anxious / young · low pain threshold	High pain threshold · heavily restored / insulated
Recent trauma · partially vital	Older (secondary dentine) · recent trauma
Contact with gingiva or metal restoration	Recent orthodontics · sedatives / alcohol

★ EXAM PEARL

Reversible vs irreversible pulpitis is decided by **pain pattern, not trigger**: short/settles = reversible; spontaneous or lingering after the stimulus goes = irreversible.

§2 Case difficulty & when to refer

BES Levels of Endodontic Care (LEC): difficulty matched to operator skill. Prerequisite → stable environment: no active caries, restorable tooth.

Table 3 — BES complexity levels for endodontic treatment (Table 2.1)

Level	Operator	Representative cases
Level 1	GDP	Curvature <30° & negotiable · no obstruction/perforation · emergency extirpation or I&D · straightforward retreatment · anything not in Level 2/3
Level 2	DwESE · SpE	Curvature 30–45° · coronal-third negotiation difficulty · teeth >25 mm · incomplete root development · opening 25–35 mm · fractured post <8 mm
Level 3	SpE · Consultant	Curvature >45°, S-shaped/non-negotiable · anomalies (dens-in-dente, C-shaped, bifid apex) · severe trauma · iatrogenic damage/resorption · opening <25 mm · complex retreatment (posts >8 mm, silver points, separated files) · periradicular surgery

Abbreviations: GDP = general dental practitioner · DwESE = dentist with enhanced skills in endodontics · SpE = specialist endodontist.

§3 Root canal treatment

3.1 Principles & objectives

- **Access:** wide straight-line · deroof fully · remove all pulp horns · passive file entry to orifices
- **Working length:** master apical file to full WL with **tug-back** · check patency between files
- **Clean → shape → seal:** remove bacteria/pus/debris · shape for irrigant + filling ingress · achieve apical AND coronal seal · fill all space, no voids/missed canals
- **Biological objectives:** disinfect max of canal system · remove nutrient source · prevent recontamination
- **Mechanical objectives:** continuous **taper** · canal axis kept central · original foramen position maintained (not enlarged)
- **Isolation:** rubber dam mandatory · non-latex · single tooth
- **Laws of canal location:** floor darker than walls · orifices equidistant (except upper molars) · at wall–floor junction · at ends of developmental root-fusion lines

KEY POINTS

Straight-line access (reference = external outline at CEJ) → glidepath → crown-down shaping → chemo-mechanical debridement with NaOCl → obturate to apical constriction → coronal seal.

3.2 Instrumentation & file systems

Table 4 — Manual vs rotary preparation

	Manual stainless steel (step-back)	Rotary NiTi (crown-down)
Sequence	6-8-10 patency/glidepath · 15 → 35/40 to WL · 50-60-70 middle/coronal flare	Orifice opener (short, large taper) · WL files small → big taper & size · MAF = smooth full entry + tug-back
Direction	Apical enlargement then step back	Coronal → apical; bulk-removes infected material early

- **Glidepath:** small hand files (6/8/10) watch-winding → smooth path to terminus before NiTi
- **NiTi rules:** straight-line access done · NiTi enlarges **X** negotiates · glidepath first · always lubricate with irrigant · speed/torque motor · minimal apical pressure · single use
- **Length:** electronic apex locator (EAL — needs a patent canal) + radiograph → aim apical constriction
- **Patency:** small file (6/8/10) ★ ≤1 mm beyond foramen after each file → keeps apex debris-free

3.3 Irrigation

- **Roles:** antibacterial/tissue-dissolving · lubricates · improves cutting · cools · flushes debris · reaches walls files miss · removes smear layer

Table 5 — Endodontic irrigants

Irrigant	Conc.	Role
Sodium hypochlorite	★ 0.5–5.25%	Gold standard — antibacterial + dissolves organic tissue
EDTA	17%	Chelator — removes smear layer / inorganic
Chlorhexidine	2%	Antimicrobial + substantivity

- **Enhance:** dynamic agitation · ultrasonic activation · negative-pressure · heat

CAUTION

0.2% chlorhexidine mouthwash is **not** an endodontic irrigant (need 2%) · saline is **not** an irrigant — only rinses one active irrigant out before the next.

3.4 Obturation

- **Aim:** fluid-tight barrier protecting periradicular tissues → prevents coronal leakage · blocks periapical/periodontal fluid feeding microbes · entombs survivors
- **Techniques:** cold lateral condensation · warm vertical condensation · carrier-based GP · thermoplasticised injection · single cone + bioceramic (calcium-silicate) sealer · bulk calcium-silicate cement (immature/open apex)
- **Sealer families:** ZnO-eugenol · Ca(OH)₂ · glass-ionomer · resin · bioceramic (calcium silicate / phosphate)

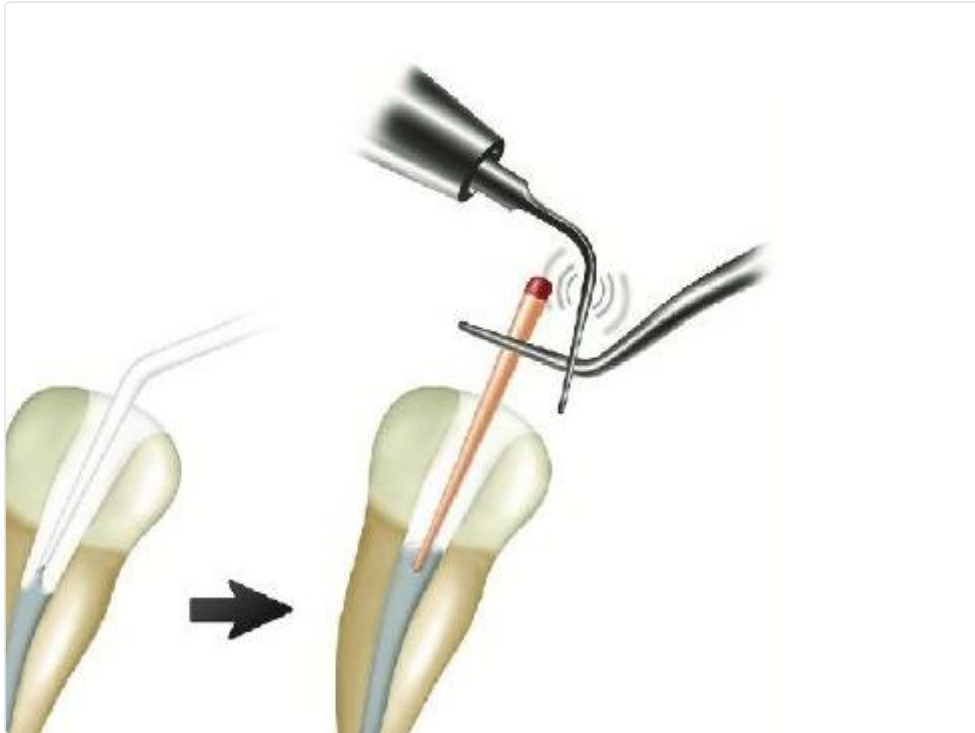


Fig. 2 — Single-cone technique with a calcium-silicate (bioceramic) sealer.

3.5 Success vs failure

Table 6 — Criteria for RCT success

Lecture criteria	BES: 4 factors improving outcome
All canals shaped/widened; fill just before radiographic apex (not over/under)	Pre-op absence of periapical radiolucency
Previous periapical radiolucency resolves; healthy bone + lamina dura	Root filling with no voids
Dense GP no voids; taper matches canal	★ Fill within 2 mm of radiographic apex
Good coronal seal, no defective restoration	Satisfactory coronal seal / restoration



Fig. 3 — Well-condensed fill to length with a sound coronal restoration.

★ EXAM PEARL

Lecture says "just before the radiographic apex"; the reference point that matters is the **apical constriction**. Short → retained necrotic tissue drives infection; long → apical irritation.

§4 Vital pulp therapy

Preserving vitality keeps defence + proprioception, allows continued root development, avoids fracture-prone RCT. Rubber dam + asepsis + selective caries removal in deep lesions.

Table 7 — Vital pulp therapy options (BES Ch 5)

Procedure	Situation	1-yr success
Indirect pulp cap	Dentine still over pulp	—
Direct pulp cap	Pinpoint exposure · bleeding controlled <5 min · mild symptoms	~90%
Partial pulpotomy	Inflamed superficial pulp / no haemostasis	★98%
Full pulpotomy	Coronal pulp removed to orifice level	★99%

- **Material of choice:** calcium-silicate cement (MTA / Biodentine) · Ca(OH)₂ acceptable if sealed with GIC/RMGIC
- **Disinfect / haemostasis:** NaOCl 0.5–5% on cotton pellet · bleeding not controlled in 5 min → escalate to next VPT step
- **Review:** history + exam at 6 months · periapical at 1 year · full-pulpotomy tooth is unresponsive to pulp testing

CAUTION

Bismuth-oxide-containing calcium-silicate cements **discolour teeth** — avoid on anterior / aesthetic teeth (e.g. use Biodentine, which is bismuth-free).

§5 Endodontic emergencies & sodium hypochlorite accident

5.1 Emergencies (BES Ch 4)

- **3D strategy:** diagnosis → definitive treatment at the emergency visit → drugs as adjunct only
- **Anaesthesia:** buccal + palatal infiltration (upper/lower anteriors) · lidocaine 2% + adr 1:80,000 or articaine 4% + adr 1:100,000 · lower posterior pulpitis high block-failure → **buccal articaine 4% after IAN lidocaine block** · supplement with intraligamentary / intraosseous
- **First operative step:** rubber dam → remove caries/cracks/restorations → confirm diagnosis + restorability
- **Analgesia:** NSAID + paracetamol · opioids not routine

★ EXAM PEARL

Antibiotics have no role in irreversible pulpitis or infection confined to periradicular tissues. Prescribe only for spreading/systemic infection or immunocompromise — antibiotic guardianship.

5.2 Sodium hypochlorite accident (BES Ch 9)

- **Cause:** NaOCl extruded beyond apex / under dam → chemical burn + inflammation
- **Triad:** sudden severe pain · bleeding from canal · rapid swelling (minutes–hours) · also ecchymosis, paraesthesia, trismus, sinus/ophthalmic signs · higher risk: female, maxillary posterior
- **Immediate management:** irrigate canal with ★saline (or water) to dilute · dress with calcium hydroxide + temporary · LA + analgesia (paracetamol 1 g QDS + ibuprofen) · swelling → NSAID, cold compress day 1 then warm · antibiotics only if infection risk (amoxicillin; metronidazole if penicillin-allergic)
- **Follow-up:** phone same day then regularly · most resolve ~2 weeks; severe 1–2 months · refer maxillofacial if concerned

CAUTION

Prevention: rubber dam · side-vented needle · stopper 1–2 mm short of WL · index finger not thumb · loose in-and-out motion (never lock the needle) · lower NaOCl concentration.

§6 Non-surgical retreatment

Aim → remove the cause of failure and achieve periapical healing. Judge outcome ≥1 year after treatment.

- **Causes of failure:** poor asepsis (no dam) · inadequate prep/obturation · coronal leakage · procedural errors (separated files, perforations) · resistant microbes (★*E. faecalis*, biofilm)

- **ESE outcomes:** favourable (normal) · uncertain (monitor to 4 yr) · unfavourable (persistent/enlarging radiolucency) → retreat / apical surgery / extract
- **Prognosis:** retreatment ≈ ★80% at 2–4 yr (lower than primary)
- **GP removal:** soften with ultrasonic/heat or solvent (Eucalyptol/Xylene — toxic, cautious) · avoid Gates-Glidden deflection · bulk crown-down with hand/NiTi + copious 17% EDTA
- **Prefer apical surgery when:** initial treatment already high quality · retreatment risks fracture/error (immovable post, sclerosed/ blocked canal)
- **Then:** chemo-mechanical prep + NaOCl → obturate → cuspal-coverage restoration (crack risk higher in retreatment)

§7 Restoring the endodontically treated tooth

Root-filled tooth is weaker: lost proprioception (less discriminative loading) + lost tooth volume. Commonest reason such teeth are extracted → **restorative (structural) failure**, not re-infection.

7.1 Restorability = the ferrule

- **Rule:** restorability = a question of ferrule · have/can obtain ferrule → restorable; if not → non-restorable
- **Ferrule:** band encircling sound residual tooth · ★2 mm height × 2 mm thickness · ≥2 walls (≥1 functional: B/L functional, M/D non-functional) · no mobility · measured with Iwanson caliper
- **BES ferrule guidance:** minimum height 1.5–2.5 mm · thickness ≥2 mm
- **Functions:** prevents wedging of extra-coronal restoration (↓ root stress) · resists lateral/lever loading
- **No ferrule?:** expose more tooth apically (gingivectomy or crown lengthening) → keep crown-root ratio + bone favourable
- **Gingivectomy vs crown lengthening:** per biological width (margin → crestal bone) → should be ★≥2 mm (biological width ≈ junctional epithelium 0.97 mm + connective-tissue attachment 1.07 mm)

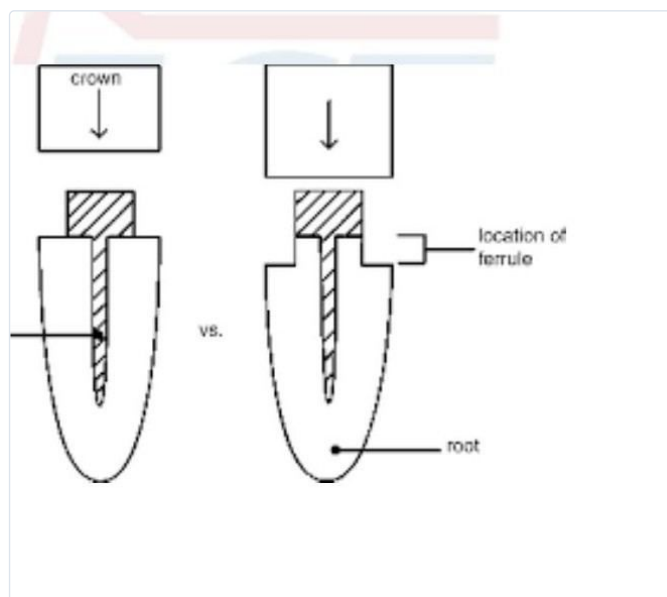


Fig. 4 — Crown margin on sound dentine (right) resists wedging a post alone (left) cannot.

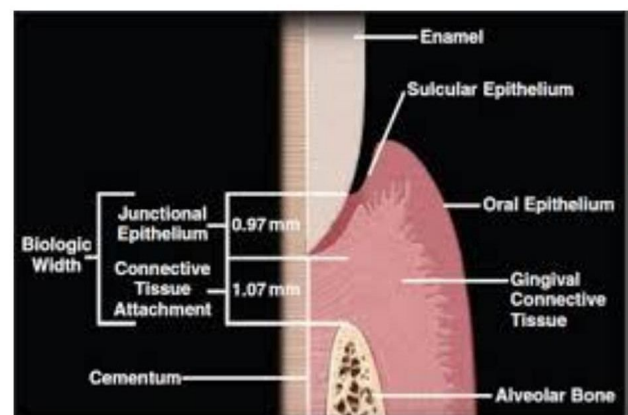


Fig. 5 — Biological width; a margin encroaching this zone causes chronic inflammation.

7.2 Structural decision — coverage & core

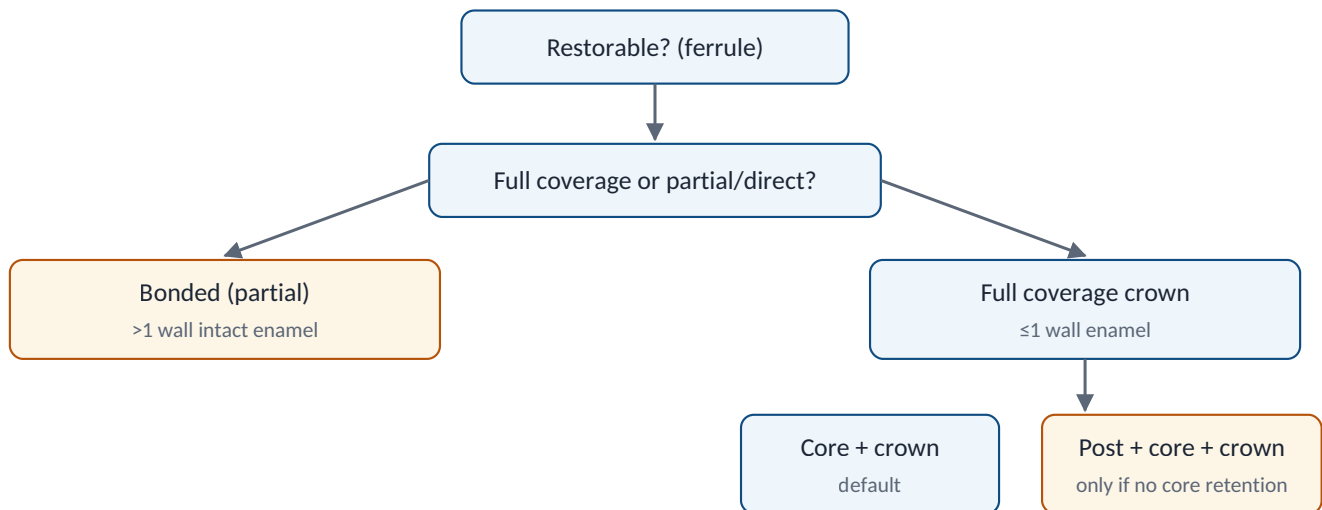


Diagram 1 — Restorative decision after RCT: ferrule → coverage → core, with a post only when core retention cannot be obtained otherwise.

- **Full vs partial coverage:** composite/partial ceramic = bonded → a question of **bonding ability** · >1 wall intact enamel (2+) → bonded; ≤1 wall → don't rely on bonding
- **Bonded restorations:** direct = composite · indirect = inlay / onlay / overlay / endocrown · semidirect = indirect composite (less shrinkage/time/cost)
- **Core vs post+core:** use a post **only** if core + crown cannot retain (multirooted badly broken · high demand · compromised ferrule) · always least intervention



Fig. 6 — Inlay → onlay → overlay: progressively more cuspal coverage as walls are lost.

7.3 Posts & cores

- **Post types:** prefabricated (colour-coded; tapered vs parallel; smooth/threaded/serrated) · custom-made · fibre · Nayyar (amalgam)
- **Function:** retains the core · does **not** reinforce the root · post material has no effect on tooth survival · stays passive
- **Dimensions:** diameter $\approx \frac{1}{3}$ root · length $\geq$ final crown · leave ★**4–5 mm apical GP** ($\approx \frac{1}{3}$ root length) for the seal
- **Placement:** distal canal (lower molars) · palatal canal (upper molars)

- **Fibre post:** only post that bonds (monoblock, chemical/dual-cure composite) · best bonding · better anterior aesthetics · low microleakage · immediate placement + same-visit core
- **Custom post:** mutilated teeth · canal drilled · anti-rotational grooves · inlay-wax pattern · elastomer impression
- **Nayyar core:** amalgam corono-radicular core in molars using pulp-chamber anatomy (≈ 4 mm coronal / 3 mm into canals)

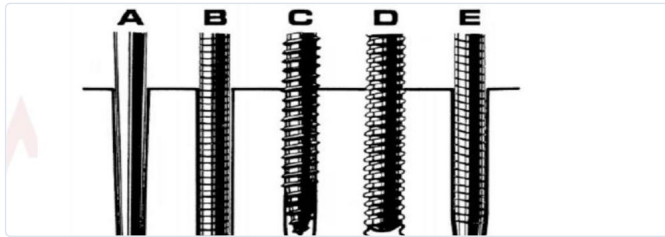


Fig. 7 — Prefabricated designs A-E: tapered/smooth through parallel/threaded.

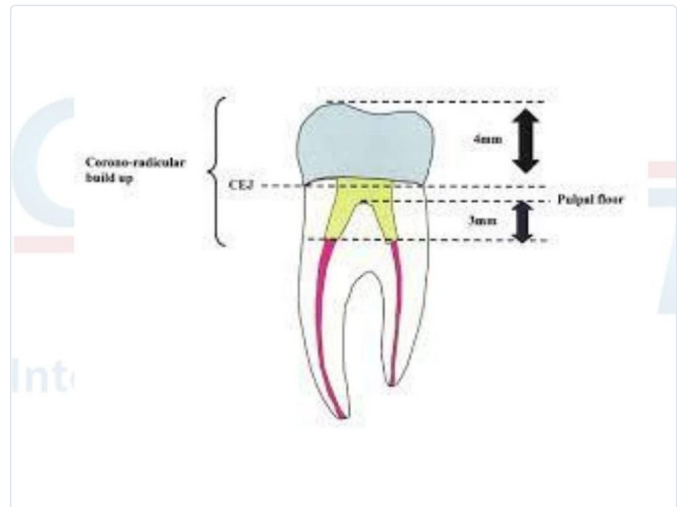


Fig. 8 — Nayyar core: amalgam engaging the coronal 3 mm of the canals.



Fig. 9 — Custom-made post & core for a mutilated tooth (canal pattern in inlay wax).

★ EXAM PEARL

Common misconception: a post does **not** strengthen the root — its sole job is core retention. Modern adhesive fibre posts stay passive and sacrifice no extra dentine.

7.4 Full-coverage crowns

Table 8 — Finish lines & reductions

Finish line	Reduction	Material
Chamfer	0.3–0.5 mm	All-metal (gold / St.St.); axial 1–1.5, occlusal 1.5
Deep / heavy / double chamfer	0.6–1 mm	All-ceramic (e.max), PFM, zirconia
Classic shoulder	1–1.5 mm	Ceramic margins
Round shoulder	0.6–1 mm	Ceramic margins
Veneer (knife/vertical edge)	0.3 mm margin · 0.5 axial · 1–1.5 occlusal	Ceramic partial coverage

KEY POINTS

BES Ch 8: confirm restorability before RCT (≥ 2 mm dentine, $>30\%$ coronal volume) · cuspal coverage when ≥ 1 proximal wall of a posterior tooth is lost · terminal / lone-standing teeth most at risk from occlusal overload.

§8 Replacement of tooth loss — bridges

- **Decision factors:** abutment teeth · number of teeth lost · position lost · tooth support · periodontal condition

Table 9 — Bridge designs

Type	Key points
Fixed-fixed	Rigid one-piece casting · splints teeth · ★ ≤ 4 units · ~25% RCT risk if abutments not aligned · lifespan 8–12 yr
Fixed-movable	Stress-breaker joint (limited movement) · tooth–tissue supported · best for pier & tilted abutments · more conservative · ✗ long span / perio abutments
Cantilever	Pontic one end · ✗ high occlusal load · limited lifespan
Spring cantilever	Maxilla only · palatal bar · replaces a central preserving a diastema
Resin-bonded (Maryland)	Metal/ceramic wing bonded with composite · anterior 1st choice · minimal/no prep · sound abutments · ~5 yr · debond risk
Rochette	Perforated metal retainer (mechanical retention through holes)

- **Perio-affected abutments:** treat perio first → fixed-fixed to splint
- **Pier abutment:** fixed-movable · implant · RPD
- **Tilted abutment:** ortho realign · fixed-movable · partial-veneer prep (pins/slots) · precision attachment (2-part screw + tube, joined after cementation)
- **Missing canine:** occlusion shifts canine-guided → group function · best order → **implant** → **minimally invasive RBB** → **cantilever** → **fixed-fixed**
- **RBB requirements:** space for pontic · sufficient enamel · pontic out of occlusion · good dam isolation · high debond risk with tooth wear/parafunction

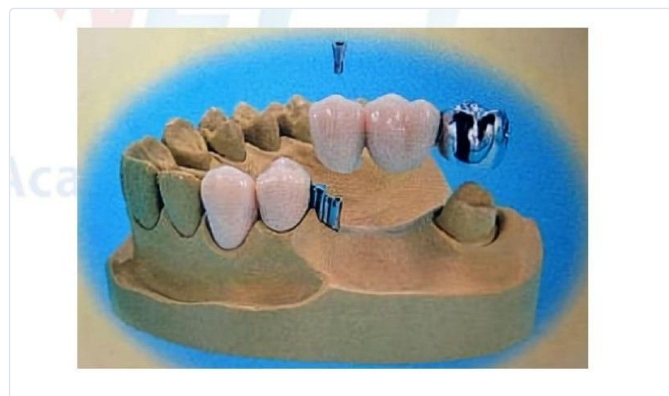


Fig. 10 — Fixed-movable bridge across a pier abutment; the keyway joint allows limited movement.



Fig. 11 — Resin-bonded (Maryland) bridge: metal wing bonded to a sound abutment.



Fig. 12 — Rochette bridge: retention through perforations in the metal retainer.