

Paediatric Dentistry 1 — development, eruption and dento-alveolar trauma

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EXAM-DAY SUMMARY

everything on this page → detail in §§ overleaf

PRIMARY VS PERMANENT

→ §1

- 20 vs 32 teeth; enamel **1 mm vs 2–3 mm**
- Primary: larger chamber, prominent pulp horns close to surface, ribbon/hourglass canals, high vascularity
- Accessory canals → **furcation** (primary) vs apical (permanent)

TWO GROWTH CLOCKS

→ §2

- Maxilla = skull base → **neural** curve, peak **0–5 y**, carried down and forward
- Mandible = body bone → **general** curve, peak 10–20 y
- Scammon: lymphoid · neural · general · genital
- Stages: pre-dentate 0–6 mo · deciduous 6 mo–5 y · mixed 6–13 y · permanent 13 y+ (Cl. 2 → Cl. 1 on catch-up)

ERUPTION NUMBERS

→ §3

- Primary A 6–10 mo (lower) → E 25–33 mo; order **A–B–D–C–E**
- Lower 6 first at 5.9–6.9 y; upper 3 last of the front teeth at 10.0–12.2 y; 8s 17–19 y
- Upper M1 calcifies **at birth**; root complete ~3 y after eruption

NORMAL DECIDUOUS & EARLY MIXED

→ §4, §7

- Deciduous normals: Cl. 2 skeletal · anterior open bite · deep bite **until the 6s erupt** · spacing between all teeth
- **Leeway** (c+d+e – 3+4+5): **maxilla 0.9–1.8 mm, mandible 1.7–2.5 mm per side**
- **Primate** ~1.5 mm/side: mesial to upper C, distal to lower C
- Ugly duckling = normal, self-corrects when 3s erupt

CLEFT LIP AND PALATE

→ §5

- UK prevalence **1 in 600–700**; males > females; hereditary + environmental
- Lip **3 months** — Millard
- Palate primary closure **9–12 months** — von Langenbeck
- Alveolar bone graft **8–11 years**

NATAL / NEONATAL TEETH

→ §6

- Natal = at birth · neonatal = within the 1st month
- **80–90% are true early primary teeth**, not supernumerary → keep them
- Site: lower anterior
- Remove only for aspiration risk (mobile) or injury to baby/mother; wait **10 days** — liver/coagulation maturity

ERUPTION DISTURBANCES

→ §8

- Eruption cyst = fluid/blood in the follicular space; **most rupture spontaneously** → observe; expose only for pain, bleeding or infection
- Failed/delayed: hereditary, or acquired — crowding after premature primary extraction, retained primary, supernumerary, dentigerous cyst, trauma, abnormal crypt position

TRAUMA — UNIVERSAL RULES

→ §9

- 1 parallel PA minimum; **+2 angulations + occlusal** for subluxation, all displacements, root/crown–root/alveolar fractures
- Sensibility = neural, not vascular; false negatives for months → never start RCT on that alone
- Splint passive + flexible; SS wire ≤ 0.4 mm (0.016"), nylon 0.13–0.25 mm
- Crown fracture + luxation → luxation regimen wins

PERMANENT LUXATIONS

→ §10

- Lateral + intrusive: immobile, **high metallic percussion**, no response
- Intrusion radiograph: PDL space lost, **CEJ more apical**
- Intrusion, closed apex: **<3 mm await · 3–7 mm surgical · >7 mm surgical**; pulp almost always necroses → RCT at 2 wk
- Intrusion, open apex: await re-eruption; ortho if none by **4 wk**

PERMANENT FRACTURES

→ §11

- Fragment reattachment: **rehydrate 20 min** in water/saline
- Dentin within 0.5 mm of pulp → Ca(OH)₂ then GI
- Pulp exposed → **partial pulpotomy** preferred, mature or immature
- Root + alveolar fracture: reposition, splint 4 wk (cervical root up to 4 months); **no endodontics at the emergency visit**; if a root fracture necroses, RCT of the coronal segment only

SPLINTS & REVIEWS

→ §11.4

- **2 wk**: subluxation (if needed), extrusion, replanted avulsion
- **4 wk**: lateral, intrusion (if repositioned), root fracture, alveolar fracture
- **4 months**: cervical-third root fracture only
- Displacements + root/crown–root/alveolar fractures → yearly ≥ 5 y; "6–8 wk" = **one** visit

AVULSION

→ §12

- 0.5–16% of injuries; hold by the crown; replant at the scene
- Media: **milk > HBSS > saliva > saline**
- Viability: ≤15 min · medium with dry time <60 min · dry >60 min (replant anyway)
- Splint 2 wk · amoxicillin/penicillin (no tetracycline <12 y) · tetanus · CHX 0.12% bd 2 wk
- Closed apex → RCT **within 2 wk**; open apex → await revascularisation

PRIMARY DENTITION TRAUMA

→ §13

- **Never replant a primary tooth**; observation is usually the right emergency answer
- Extrusion >3 mm or excessively mobile → extract
- Intrusion → spontaneous re-eruption **whatever the direction**; rapid referral within days; review at 6 y
- Root fracture treated only if displaced **and** mobile **and** interfering; every outcome list includes damage to the successor

§1 Primary versus permanent teeth

KEY POINTS

Every primary-tooth difference points the same way — **less hard tissue, more pulp, closer to the surface**: enamel 1 mm · large chamber · prominent pulp horns · furcal accessory canals · high vascularity → caries reaches the pulp fast, the pulp is easy to expose, and infection drains to the **furcation**, not the apex.

Table 1 — Primary vs permanent: chronology and crown form

	Primary	Permanent
In the mouth	6 months – 5.5 years	6 years – onward
Number	20 — per quadrant: 2 incisors, 1 canine, 2 molars	32 — per quadrant: 2 incisors, 1 canine, 2 premolars, 3 molars
Enamel	Thinner — ★ 1 mm	Thicker — 2–3 mm
Occlusal plane	Flatter, narrower	More curved contour, wider
Mamelons	Absent	Present

Table 2 — Primary vs permanent: pulp and root anatomy

	Primary	Permanent
Pulp chamber	Larger	Small
Pulp horns	More prominent, closer to the outer surface	Flattened, not close to the outer surface
Root canal	Ribbon-like — hourglass appearance	More defined
Accessory canals	★ More towards the furcation	More towards the apical portion
Vascularity	High	Low



Fig. 1 — Sectioned permanent vs primary ("milk") molar: enamel coat thinner · pulp chamber more extended · chewing (occlusal) surface narrower.

★ EXAM PEARL

Furcal accessory canals are the anatomical reason a non-vital primary molar shows a **furcation radiolucency** where a permanent molar would show a periapical one — a stock single-best-answer.

§2 Growth pattern and dental age

2.1 Scammon's curves — two clocks in one face

- **Four tissue curves:** lymphoid · neural · general · genital — each grows on its own timetable, plotted as % of adult size against age
- **Maxilla = part of the base of the skull:** growth controlled by growth of the brain (**neural curve**) → brain growth → gradual growth of skull → maxilla pushed **downward and forward**
 - peak of growth ★ **0–5 years**
- **Mandible = a separate bone of the body:** follows the **general growth pattern** — bones, muscles, hair and the rest of the body tissues
 - peak of growth ★ **10–20 years**

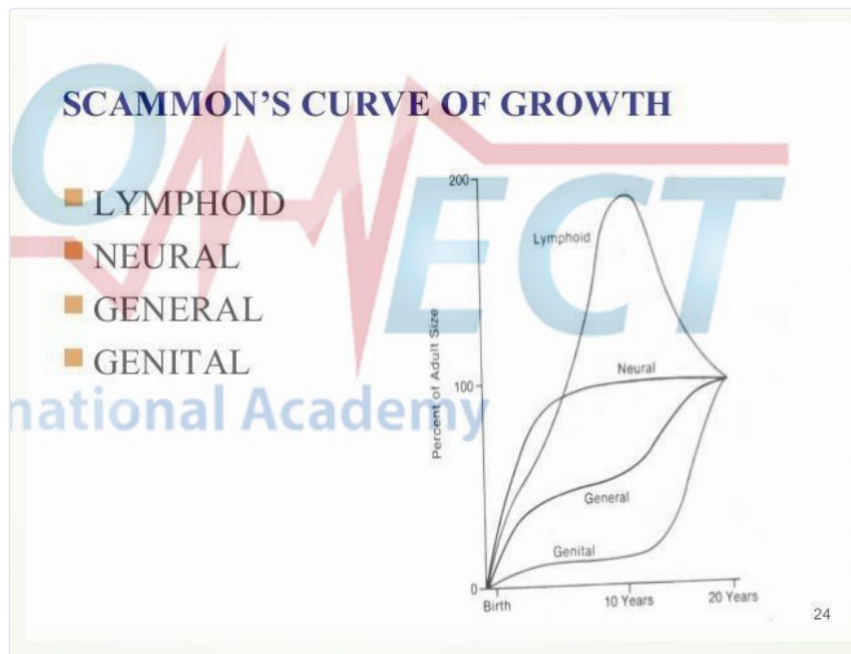


Fig. 2 — Scammon's curve of growth. Neural tissue (maxilla) is nearly complete early; the general curve (mandible) has its adolescent surge.

★ EXAM PEARL

The two clocks explain the whole paediatric occlusal story: the maxilla finishes first, so the **young child is skeletal Class II**; the mandible's late general-curve spurt is the "catch-up" that converts the face to Class I. Timing of functional appliances is built on this.

2.2 Dental age of the child

Table 3 — Dental stages, time limits and expected findings

Dental stage	Time limit	Findings
Pre-dentate	0–6 months	No teeth · Cl. 2 skeletal · open bite
Deciduous dentition	6 months – 5 years	All deciduous teeth erupt · Cl. 2 skeletal
Mixed dentition	6 years (eruption of the 1st permanent tooth) – 13 years (shedding of the last deciduous tooth)	Early mixed · late mixed · mandibular catch-up
Permanent dentition	13 years onward	Class 1 skeletal

§3 Chronology of eruption and development

Read Table 4 and Table 5 as ranges of eruption age; Table 6 adds what is happening inside the crypt before and after.

Table 4 — Chronology of eruption, permanent dentition (years). Welbury Paediatric Dentistry 4e, Table 2.1, p12

Tooth	Maxillary	Mandibular
1	6.7–8.1	6.0–6.9
2	7.0–8.8	6.8–8.1
3	10.0–12.2	9.2–11.4
4	9.6–10.9	9.6–11.5
5	10.2–11.4	10.1–12.1
6	6.1–6.7	5.9–6.9
7	11.9–12.8	11.2–12.2
8	17.0–19.0	17.0–19.0

Table 5 — Chronology of eruption, primary dentition (months). Welbury 4e, Table 2.2, p13

Tooth	Maxillary	Mandibular
A	8–12	6–10
B	9–13	10–16
C	16–22	17–23
D	13–19	14–18
E	25–33	23–31

- **Lower before upper:** mandibular A erupts first (6–10 months) → the whole primary sequence runs lower-first
- **D before C:** the primary sequence is **A – B – D – C – E**, i.e. the first molar beats the canine
 - full primary dentition complete by ~★**33 months** (upper E is last)

Table 6 — Chronology of the upper permanent dentition (calcification → root completion)

Tooth (upper)	First evidence of calcification	Crown completed	Eruption (mean age)	Root completed (years)
i1	3–4 mo	4–5 yr	7–8 yr	10
i2	10–12 mo	4–5 yr	8–9 yr	11
c	4–5 mo	6–7 yr	11–12 yr	13–15
P1	1½–1¾ yr	5–6 yr	10–11 yr	12–13
P2	2–2¼ yr	6–7 yr	10–12 yr	12–14
M1	★ At birth	2½–3 yr	6–7 yr	9–10
M2	2½–3 yr	7–8 yr	12–13 yr	14–16
M3	7–9 yr	12–16 yr	17–21 yr	18–25

- **Root completes ~3 years after eruption:** true across the arch → an 8-year-old's newly erupted incisor still has an open apex
 - clinical weight → trauma management, apexification vs apexogenesis, and the pulp prognosis of an immature tooth
- **First permanent molar starts calcifying at birth:** any systemic insult around birth is recorded in its enamel

★ **EXAM PEARL**

The deck's own chronology table heads two columns "(months)" while every value in them is in **years** — a typographic slip in the source, corrected in Table 6. Read crown completion and eruption as years.

§4 The deciduous dentition

4.1 Normal findings

- **Class 2 skeletal relationship:** the physiological state of the young face — mandible still awaiting its general-curve spurt
- **Anterior open bite:** expected in the infant / pre-dentate face
- **Vertical deep bite:** persists **until eruption of the 6s** → the first permanent molars establish posterior vertical height and open the bite

- **Spacing between all teeth:** generalised spacing is normal and desirable — a crowded primary arch predicts a crowded permanent one
- **Lower teeth erupt first:** mandible leads throughout
- **Order of eruption:** ★ As – Bs – Ds – Cs – Es

4.2 Abnormal findings

- **Cleft lip / palate:** → §5
- **Natal / neonatal teeth:** → §6

§5 Cleft lip and palate

- **Prevalence:** ★1 in every 600–700 children in the UK has cleft lip, cleft palate or a combination of both
- **Sex:** more common in males than females
- **Aetiology:** hereditary or environmental — **most commonly both** (multifactorial)

5.1 Timing of surgical repair

- **Cleft lip:** ★3 months of age — **Millard** operation (rotation–advancement)
- **Cleft hard and soft palate, primary closure:** ★9–12 months — **von Langenbeck** operation
- **Alveolar cleft closure (secondary bone grafting):** ★8–11 years of age



Diagram 1 — Cleft repair timeline as given in the lecture.

★ EXAM PEARL

Alveolar bone grafting at **8–11 years** is not an arbitrary window — it sits before eruption of the permanent canine into the cleft site, which is why the age is quoted rather than the operation name. Expect the question as "at what age...", not "by which technique".

§6 Natal and neonatal teeth

- **Natal:** teeth present at the time of birth
- **Neonatal:** teeth that erupt within the first month of life
- **Nature:** ★80–90% are early-erupting primary teeth, not supernumeraries → they should be **kept**, not removed, if possible
- **Site:** usually the lower anterior region



Fig. 3 — Natal / neonatal teeth in the lower anterior region, the characteristic site.

6.1 When to remove

- **Danger of aspiration or inhalation:** where the tooth is **mobile**
- **Injury or irritation:** to the baby or the mother during breastfeeding
- **Technique:** removable under LA — better done **after the first 10 days** of birth for bleeding control
 - rationale → maturation of the liver and the coagulation system

CAUTION

Removing a natal tooth usually means **extracting a genuine primary incisor** (80–90% of cases) — permanent loss of that tooth and its space. Removal is justified only by the two indications above, never by appearance.

★ EXAM PEARL

The deck's "injury or irritation to baby" is the classic named entity **Riga–Fede disease** — ulceration of the ventral tongue from the sharp incisal edge during suckling. Smoothing the edge or a composite overlay is tried before extraction. (*Named condition not in the deck; add it to the deck's indication.*)

§7 Early mixed dentition

7.1 Normal findings

- **Skeletal Class 2:** still, at this stage
- **Correction of deep bite and open bite:** both self-correct as the permanent molars and incisors establish
- **Dental Class 1 relationship:** the dental arch relationship normalises ahead of the skeletal one
- **Ugly duckling appearance:** flared, spaced, distally tipped upper incisors with a midline diastema
 - why → the unerupted canine crowns sit against the roots of the lateral incisors, tipping their crowns distally; the diastema closes as the canines erupt and the pressure moves incisally
- **Leeway space:** the difference in circumference between primary **c, d, e** and permanent **3, 4, 5**
 - maxilla ★ **0.9–1.8 mm per side** · mandible ★ **1.7–2.5 mm per side**
- **Primate space:** **mesial** to the maxillary canine · **distal** to the mandibular canine — ~1.5 mm per side

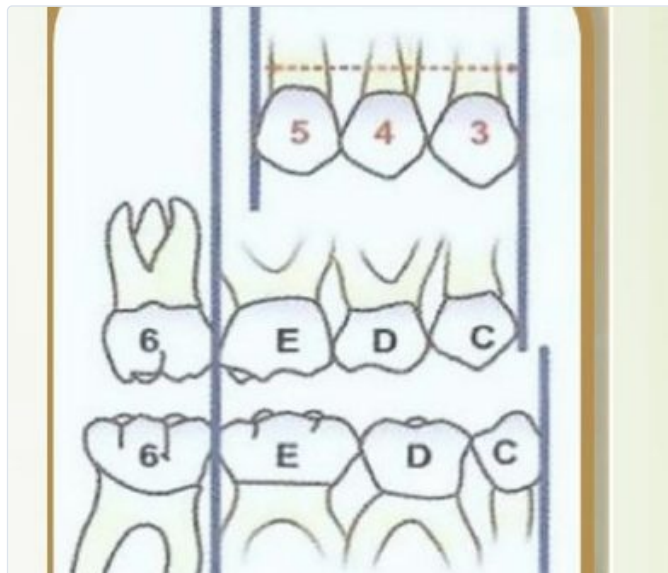


Fig. 4 — Leeway space: c+d+e wider than 3+4+5, the surplus absorbed by mesial drift of the 6s.

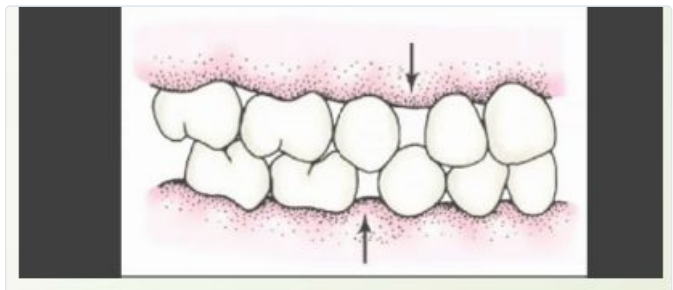


Fig. 5 — Primate spaces: mesial to the upper C, distal to the lower C.



Fig. 6 — Ugly duckling stage: spaced, distally tipped upper incisors with a midline diastema. A normal transient finding — not an indication to treat.

★ EXAM PEARL

Two spaces, two different things — **primate space is present from the moment the primary teeth erupt**, while **leeway space only appears as the Cs, Ds and Es are shed**. Leeway is the larger reservoir in the **mandible**; both are consumed by mesial drift of the 6s unless a space maintainer is placed.

7.2 Abnormal findings

- **Eruption cyst:** → §8.1
- **Failed or delayed eruption:** → §8.2

§8 Disturbances of eruption

8.1 Eruption cyst

- **Definition:** accumulation of **fluid or blood in the follicular space** overlying an erupting tooth
- **Natural history:** ★ **most rupture spontaneously**, allowing the tooth to erupt → observe
- **Intervention:** only if **pain, bleeding or infection** → surgical exposure of the tooth



Fig. 7 — Eruption cyst: bluish, fluctuant swelling of the alveolar mucosa over the erupting tooth.

8.2 Failed and delayed eruption

- **Hereditary:** familial / syndromic pattern
- **Acquired:**
 - **Crowding** due to premature extraction of primary teeth
 - **Retained primary teeth**
 - **Supernumerary teeth**
 - **Dentigerous cyst**
 - **Trauma**
 - **Abnormal crypt position** due to crowding → orthodontic treatment

★ EXAM PEARL

The commonest single cause of a failed upper central incisor in a 7–8-year-old is a **supernumerary** (mesiodens); the commonest cause of generalised delay is **crowding after premature primary extractions** — the deck's list, ranked the way examiners ask it.

§9 Appendix A — Dento-alveolar trauma: classification and common principles

The deck closes on a "Dento-alveolar trauma >>" divider with no content. §§9–14 supply that half from the **IADT 2020 guidelines** — Bourguignon *et al.* (fractures & luxations), Fouad *et al.* (avulsion), Day *et al.* (primary dentition), *Dental Traumatology* 2020.

9.1 Classification

Table 7 — IADT injury categories, permanent and primary

	Luxations (periodontal) · avulsion	Fractures (hard tissue)
Permanent	Concussion · subluxation · extrusive luxation · lateral luxation · intrusive luxation · avulsion	Enamel infraction · enamel fracture · enamel–dentin fracture · complicated crown fracture · crown–root fracture · root fracture · alveolar fracture
Primary	Concussion · subluxation · extrusive luxation · lateral luxation · intrusive luxation · avulsion	Enamel fracture · enamel–dentin fracture · complicated crown fracture · crown–root fracture (uncomplicated / complicated) · root fracture · alveolar fracture

- **Three papers, three categories:** fractures and luxations (paper 1) · avulsion (paper 2, **its own category**) · primary dentition (paper 3)
- **Luxation ≠ soft tissue injury:** luxations are injuries to the **periodontal / tooth-supporting tissues**; "soft tissue injuries" in the trauma literature means lacerations, contusions and abrasions of lip, gingiva and mucosa
- **Primary difference:** the primary guideline has **no enamel-infraction table**

9.2 Principles common to all permanent injuries

- **Radiographs — minimum:** one parallel periapical
 - concussion, enamel infraction, enamel and enamel–dentin fractures → one PA only, unless other injuries are suspected
- **Radiographs — extended set:** ★PA + 2 further periapicals at different vertical/horizontal angulations + an occlusal view for subluxation, extrusive, lateral and intrusive luxation, root fractures, crown–root fractures and alveolar fractures
- **CBCT:** when 2D imaging is insufficient to determine **location, extent and direction** of a fracture
- **Sensibility testing = neural activity, not blood supply:** a false negative is possible for **several months** after trauma → never start endodontic treatment on the basis of no response alone
- **Splints — passive, flexible, short-term:** stainless steel wire up to ★0.4 mm (0.016") in diameter; the avulsion guideline also permits nylon line 0.13–0.25 mm
 - keep composite off the gingiva and out of interproximal areas
- **Combined injuries:** where a crown fracture coexists with a luxation, the **luxation follow-up regimen prevails** (more frequent) and longer follow-up is needed
- **Antibiotics in luxation / fracture injuries:** limited evidence → at the clinician's discretion. *Avulsion is different* → §12
- **Photographic documentation:** strongly recommended at presentation and at every review

★ EXAM PEARL

The radiograph rule sorts cleanly: **anything that moved the tooth in its socket** (subluxation upwards) plus root, crown–root and alveolar fractures gets the four-view set; anything confined to the crown gets one periapical. Concussion is the outlier — the tooth did not move, so one film.

§10 Permanent dentition — luxation injuries

Table 8 — Permanent luxations: clinical and radiographic findings

Injury	Clinical examination	Radiographs
Concussion	Tender to percussion and touch · normal mobility, not displaced · likely to respond to sensibility testing · no sulcular bleeding	No abnormalities
Subluxation	Tender to touch / light tapping · increased mobility, not displaced · may NOT respond initially — transient pulp damage · bleeding from the gingival crevice may be present	Usually normal
Extrusive luxation	Tooth appears elongated incisally · increased mobility · not seated in its socket · likely no response to sensibility testing	Increased PDL space apically and laterally
Lateral luxation	Displaced, usually palatal/lingual or labial · usually an associated fracture of the alveolar bone · frequently immobile — apex locked in bone · high metallic (ankylosed) percussion sound · likely no response	Widened PDL space — best seen on a horizontal angle shift or the occlusal view
Intrusive luxation	Displaced axially into the alveolar bone · immobile · high metallic percussion sound · likely no response	PDL space may not be visible for all or part of the root · CEJ more apical than in adjacent non-injured teeth

10.1 Treatment

- **Concussion:** no treatment needed → monitor pulp condition for **at least 1 year**, preferably longer
- **Subluxation:** normally no treatment
 - passive flexible splint **up to 2 wk** only if there is excessive mobility or tenderness when biting · monitor pulp ≥ 1 year
- **Extrusive luxation:** reposition by gently pushing back into the socket under LA → passive flexible splint **2 wk**
 - breakdown / fracture of marginal bone → splint an **additional 4 wk**
 - monitor pulp; if necrotic and infected → RCT appropriate to the stage of root development
 - early endodontic treatment is typically advisable in **mature, severely extruded** teeth
- **Lateral luxation:** **disengage from the locked position** and reposition digitally under LA — finger over the apex, then push back into the socket → passive flexible splint **4 wk**, longer if marginal bone or socket wall is broken down
 - endodontic evaluation at about **2 wk** post-injury
 - **open apex** → spontaneous revascularisation may occur; if the pulp necroses with inflammatory resorption → RCT ASAP using immature-tooth techniques
 - **closed apex** → pulp will likely necrose; start RCT using a corticosteroid–antibiotic or Ca(OH)₂ intracanal medicament to prevent inflammatory external resorption
- **Intrusive luxation, open apex:** allow re-eruption **without intervention, independent of the degree of intrusion**
 - no re-eruption within **★4 wk** → initiate orthodontic repositioning
 - spontaneous revascularisation may occur; if necrosis / inflammatory resorption → RCT as soon as position allows, immature-tooth technique
- **Intrusive luxation, closed apex:** by depth —
 - **★ < 3 mm** → allow re-eruption; if none within **8 wk**, reposition surgically + splint 4 wk, or orthodontically before ankylosis
 - **★ 3–7 mm** → reposition surgically (preferred) or orthodontically
 - **★ > 7 mm** → reposition surgically
 - the pulp **almost always necroses** → start RCT at 2 wk or as soon as the tooth's position allows, using corticosteroid–antibiotic or Ca(OH)₂ to prevent inflammatory external resorption
 - parents must be told that follow-up visits are essential

10.2 Outcomes

- **Favourable — pulp:** asymptomatic; positive response to sensibility testing — *but a false negative is possible for months; do not start RCT on that basis alone*
- **Favourable — periodontal:** intact lamina dura; clinical and radiographic signs of a normal or healed periodontium; no marginal bone loss; marginal bone height corresponding to that seen after repositioning (lateral luxation); tooth in place or re-erupting (intrusion)
- **Favourable — root:** continued root development in immature teeth; no external or internal resorption

- **Unfavourable — pulp:** symptomatic; pulp necrosis and infection → requires RCT
- **Unfavourable — periodontal:** apical periodontitis; breakdown of marginal bone; **ankylosis** — metallic percussion tone, tooth locked in place
- **Unfavourable — root:** external **inflammatory** (infection-related) resorption; external **replacement** resorption; no further root development in immature teeth

CAUTION

External inflammatory resorption → start RCT immediately with Ca(OH)_2 as intracanal medicament: placed for **3 wk**, replaced every **3 months** until the resorptive radiolucencies resolve; obturate when bone repair is visible. Alternatively a corticosteroid/antibiotic medicament initially, followed by Ca(OH)_2 .

§11 Permanent dentition — fractures

Table 9 — Permanent fractures: clinical and radiographic findings

Injury	Clinical examination	Radiographs
Enamel infraction	Incomplete crack / crazing of enamel, no loss of tooth structure · normal mobility · no percussion or palpation sensitivity · sensibility usually positive	No abnormalities · one parallel PA
Enamel fracture	Loss of enamel, no visible exposed dentin · normal mobility · sensibility usually positive · evaluate for associated luxation or root fracture, especially if tender	Enamel ($\pm$ dentin) loss visible · one PA · account for missing fragments — if a fragment is missing with soft tissue injury, radiograph lip and/or cheek
Enamel–dentin fracture	Fracture in enamel and dentin, pulp not exposed · normal mobility · sensibility usually positive · no percussion/palpation sensitivity	As for enamel fracture · one PA, additional views as indicated
Complicated crown fracture	Pulp exposed and sensitive to stimuli (air, cold, sweet) · normal mobility · no percussion sensitivity · evaluate for associated luxation or root fracture	PA + 2 angulations + occlusal · apical extension usually not visible · CBCT for fracture path, extent, relation to marginal bone, crown–root ratio
Crown–root fracture	Coronal (or mesial/distal) fragment present and mobile · tender to percussion · sensibility usually positive · determine whether the extent is supra- or sub-alveolar	PA + 2 angulations + occlusal · fracture may be at any root level, often undetected without extra views · CBCT for location, extent, direction
Root fracture	Coronal segment may be mobile and displaced · tender to percussion · bleeding from the gingival sulcus · sensibility may be negative initially (transient or permanent neural damage)	PA + 2 angulations + occlusal · fracture lines at any level from marginal bone to apex · panoramic and/or CBCT if 2D is insufficient
Alveolar fracture	Complete fracture buccal → palatal (maxilla) / buccal → lingual (mandible) · several teeth move together · occlusal disturbance · teeth in the segment may not respond to sensibility testing	PA + 2 angulations + occlusal · panoramic and/or CBCT as needed

11.1 Treatment

- **Enamel infraction: severe** infractions → etch and seal with bonding resin, preventing discoloration and bacterial contamination; otherwise no treatment
- **Enamel fracture:** bond the fragment back on if available, or smooth the edges / place a composite restoration
- **Enamel–dentin fracture:** bond the fragment back on if available and intact — ★ **rehydrate in water or saline for 20 min first**
 - cover exposed dentin with glass-ionomer, or bonding agent + composite
 - dentin **within 0.5 mm of the pulp** (pink, no bleeding) → Ca(OH)_2 lining then glass-ionomer
- **Complicated crown fracture: immature / open apex** — preserving the pulp is paramount → **partial pulpotomy** or pulp capping to allow continued root development
 - conservative pulp treatment (partial pulpotomy) is **also preferred in mature teeth**
 - non-setting calcium hydroxide or a non-staining calcium silicate cement on the pulp wound
 - if a post is required for crown retention in a mature tooth → RCT is the preferred treatment
 - bond the fragment back on after the pulp is treated; otherwise cover dentin with GI or bonding + composite
- **Crown–root fracture — emergency:** temporarily **stabilise the loose fragment** to adjacent teeth or to the non-mobile fragment until a definitive plan is made
 - no pulp exposure → consider removing the coronal/mobile fragment and restoring; cover dentin with GI or bonding + composite

- pulp exposed, **immature** → partial pulpotomy to preserve the pulp (rubber dam is challenging but should be tried)
- pulp exposed, **mature** → pulp removal usually indicated
- later options → orthodontic extrusion of the apical fragment (± periodontal recontouring), surgical extrusion, RCT + restoration, root submergence, intentional replantation, extraction, autotransplantation
- **Root fracture:** reposition the displaced coronal fragment **as soon as possible** and check radiographically → passive flexible splint **4 wk**, up to ★ **4 months if the fracture is cervical**
 - cervical fractures **can heal** — do not remove the coronal fragment at the emergency visit, especially if it is not mobile
 - **no endodontic treatment at the emergency visit;** monitor healing and pulp status for at least 1 year
 - necrosis is usually in the **coronal fragment only** → RCT of the coronal segment only; oblique fracture lines make length determination difficult and an apexification approach may be needed; the apical segment rarely needs treatment
 - mature tooth, cervical fracture **above the alveolar crest** with a very mobile coronal fragment → remove the fragment, RCT and post-retained crown; ± orthodontic extrusion, crown lengthening, surgical extrusion or extraction
- **Alveolar fracture:** reposition any displaced segment → passive flexible splint **4 wk** → suture gingival lacerations
 - **RCT is contraindicated at the emergency visit**
 - monitor the pulp condition of **all teeth in the segment**, initially and at every review, to decide if and when endodontic treatment becomes necessary

11.2 Outcomes

- **Favourable — pulp:** asymptomatic; positive response to sensibility testing (false negative possible for months after trauma)
- **Favourable — periodontal / bone:** intact PDL and lamina dura; fractured segments fixed together after splinting; physiological (or slightly more than physiological) mobility of the coronal fragment; signs of repair between root-fracture segments; soft tissue healing and radiographic signs of bone repair; slight tenderness of bone to palpation may persist for months
- **Favourable — root / restoration:** continued root development in immature teeth; good quality restoration
- **Unfavourable — pulp:** symptomatic; discoloration; pulp necrosis and infection — all require RCT
- **Unfavourable — periodontal / bone:** apical periodontitis; failure of fixation on splint removal; marginal bone loss and periodontal inflammation; radiolucency at the fracture line; extrusion or excessive mobility of the coronal segment; non-healing of the bone fracture; inadequate soft tissue healing
- **Unfavourable — root / restoration:** lack of further root development in immature teeth; external inflammatory (infection-related) resorption; loss or breakdown of the restoration

11.3 Splint times and follow-up — the whole permanent set

Table 10 — Splinting and review schedules, permanent dentition. S+ = splint removal; S++ = splint removal for cervical-third root fractures

Injury	Splint	Follow-up
Concussion	None	4 wk · 1 y
Subluxation	Up to 2 wk, only if needed	2 wk S+ · 12 wk · 6 mo · 1 y
Extrusive luxation	2 wk (+4 wk if marginal bone broken down)	2 wk S+ · 4 wk · 8 wk · 12 wk · 6 mo · 1 y · then yearly ≥ 5 y
Lateral luxation	4 wk	2 wk · 4 wk S+ · 8 wk · 12 wk · 6 mo · 1 y · then yearly ≥ 5 y
Intrusive luxation	4 wk if surgically repositioned	2 wk · 4 wk S+ · 8 wk · 12 wk · 6 mo · 1 y · then yearly ≥ 5 y
Enamel infraction	None	None if certain it is an infraction only; an associated luxation regimen prevails
Enamel fracture	None	6–8 wk · 1 y
Enamel–dentin fracture	None	6–8 wk · 1 y
Complicated crown fracture	None	6–8 wk · 3 mo · 6 mo · 1 y
Crown–root fracture	Temporary stabilisation at emergency	1 wk · 6–8 wk · 3 mo · 6 mo · 1 y · then yearly ≥ 5 y
Root fracture	4 wk; up to 4 months if cervical	4 wk S+ · 6–8 wk · 4 mo S++ · 6 mo · 1 y · then yearly ≥ 5 y
Alveolar fracture	4 wk	4 wk S+ · 6–8 wk · 4 mo · 6 mo · 1 y · then yearly ≥ 5 y

★ EXAM PEARL

IADT writes each review as a single bullet, so **"6–8 wk" is one appointment scheduled within that window** — not a 6-week visit followed by an 8-week one. Splint durations reduce to a three-number rule: **2 wk** (subluxation, extrusion, replanted avulsion) · **4 wk** (lateral, intrusion, root fracture, alveolar fracture) · **4 months** (cervical root fracture only).

§12 Avulsion of permanent teeth

- **Prevalence:** ★0.5–16% of all dental injuries
- **Default is to replant:** not replanting is an **irreversible** decision
- **Replantation not indicated** — judged case by case: severe caries or periodontal disease · uncooperative patient · severe cognitive impairment requiring sedation · severe medical conditions such as immunosuppression · severe cardiac conditions

12.1 First aid at the site of the accident

1. Keep the patient calm.
2. Find the tooth and **pick it up by the crown** — avoid touching the root.
3. If dirty, rinse gently in **milk, saline or the patient's saliva** and replant in its original position.
4. Encourage the patient / parent / teacher to **replant immediately at the site**.
5. Once repositioned, have the patient bite on gauze, a handkerchief or a napkin to hold it in place.
6. If replantation is not possible, place the tooth immediately in a storage medium — ★milk > HBSS > saliva > saline (water is a poor medium, but better than letting it air-dry).
7. Bring tooth and patient to the dental clinic immediately. **Primary teeth are never replanted.**

Table 11 — PDL cell viability groups (these guide *prognosis*, not treatment — the emergency management is the same)

Group	Definition
Likely viable	Replanted immediately, or within about 15 min at the site
Viable but compromised	Kept in a storage medium (milk, HBSS, saliva, saline) with total extra-oral dry time < 60 min
Likely non-viable	Total extra-oral dry time > 60 min , regardless of whether the tooth was subsequently stored in a medium

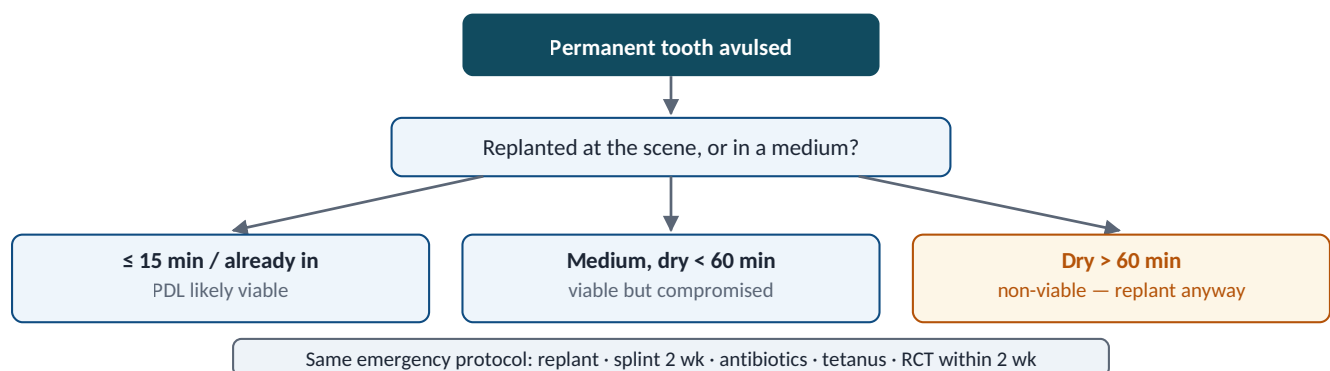


Diagram 2 — Viability groups set the prognosis conversation, not the emergency treatment.

12.2 Management at the dental office

- **Tooth already replanted:** clean the area with water, saline or chlorhexidine → verify position clinically and radiographically → leave the tooth in place, correcting malposition with slight digital pressure
 - replanted into the wrong socket or rotated → consider repositioning **up to 48 h** after the injury
- **Tooth in a storage medium:** rinse visible contamination off the root with a stream of saline or balanced medium; remove debris by gently agitating in the storage medium → leave the tooth in the medium while taking the history, examining and preparing the patient
 - irrigate the socket with sterile saline · examine the socket, remove the coagulum if necessary, reposition a fractured socket wall with a suitable instrument
 - **replant slowly with slight digital pressure — never force the tooth back**

- **Dry time > 60 min: same protocol — replant anyway.** The PDL is necrotic and will not regenerate; expect ankylosis-related (replacement) resorption
 - goal → restore aesthetics and function at least temporarily while maintaining alveolar bone contour, width and height, and keep future options open
 - inform parents that **decoronation or autotransplantation** may be needed later
- **Common to all:** LA if necessary, **preferably without a vasoconstrictor** · passive flexible splint ★ **2 wk** — wire ≤ 0.016"/0.4 mm or nylon 0.13–0.25 mm, bonded labially · suture gingival lacerations · check tetanus · post-op instructions · arrange follow-up
 - short immature teeth may need longer splinting; with an associated alveolar or jaw fracture use a **more rigid splint for about 4 wk**

12.3 Systemic antibiotics, tetanus and instructions

- **Antibiotics:** recommended after avulsion and replantation in **all** protocols, to reduce infection-related reactions and inflammatory root resorption; dose for age and weight
 - **amoxicillin or penicillin** first choice; alternatives in penicillin allergy
 - doxycycline has antimicrobial, anti-inflammatory and anti-resorptive effects, but tetracyclines are generally **not recommended under 12 years** (tooth discoloration)
- **Tetanus:** refer to a physician to evaluate the need for a booster — **do not assume** immunisation is up to date
- **Patient instructions:** avoid contact sports · soft diet up to 2 wk as tolerated · brush with a soft toothbrush after every meal · ★ **chlorhexidine 0.12% rinse twice daily for 2 wk**

12.4 Endodontics and follow-up

- **Closed apex:** start RCT ★ **within 2 wk of replantation** — i.e. at or before splint removal, not after — under dental dam, clamping neighbouring uninjured teeth
 - either Ca(OH)_2 for up to **1 month** then root filling; or a corticosteroid, or corticosteroid/antibiotic, mixture placed immediately or shortly after replantation and left **at least 6 wk**, then root filling
 - keep medicaments **out of the crown** — several cause discoloration
- **Open apex:** spontaneous pulp revascularisation may occur → **avoid RCT** unless there is clinical or radiographic evidence of pulp necrosis and infection
 - weigh the risk of infection-related resorption (**very rapid in children**) against the chance of revascularisation; if necrosis is confirmed → apexification, revitalisation/revascularisation or RCT
- **Follow-up, closed apex:** 2 wk (splint removal) · 4 wk · 3 mo · 6 mo · 1 y · then yearly for at least 5 y
- **Follow-up, open apex** (more frequent — revascularisation carries a risk of rapid infection-related resorption): 2 wk (splint removal) · 1 mo · 2 mo · 3 mo · 6 mo · 1 y · then yearly for at least 5 y

§13 Primary dentition trauma

KEY POINTS

Every primary luxation and avulsion table — and the alveolar fracture table — lists **disturbance to the development and/or eruption of the permanent successor** among its outcomes. Treatment choice is driven by the child's maturity and ability to tolerate the procedure and by whether a child-oriented team is available; **observation is often the most appropriate emergency option**, and Day *et al.* state that avoiding extractions where possible is a reasonable strategy.

- **Radiographs:** beyond the scheduled ones — 1 y after pulpotomy or RCT for complicated crown and crown–root fractures, and 4 wk + 1 y for alveolar fractures — radiographic follow-up is indicated **only where clinical findings suggest pathosis**
- **Avulsed primary teeth are never replanted:** → risk to the permanent germ

Table 12 — Primary dentition: fractures

Injury	Treatment	Follow-up
Enamel fracture	Smooth any sharp edges. No radiographs recommended.	None — no clinical or radiographic follow-up recommended
Enamel-dentin fracture	Cover all exposed dentin with glass-ionomer or composite; lost tooth structure restored with composite immediately or later.	Clinical examination at 6–8 wk
Complicated crown fracture	Preserve the pulp — partial pulpotomy under LA with non-setting $\text{Ca}(\text{OH})_2$ over the pulp, then composite; cervical pulpotomy for large exposures. Evidence for calcium silicate biomaterials is emerging — select on the case, not the material.	1 wk · 6–8 wk · 1 y; radiographic review at 1 y if pulpotomy or RCT was done
Crown-root fracture	Often no treatment is the most appropriate emergency option — but only where rapid referral (within several days) to a child-oriented team is possible. If treating: LA, remove the loose fragment, decide whether the crown can be restored. Restorable + pulp not exposed → cover dentin with GI. Restorable + pulp exposed → pulpotomy, or RCT depending on root development and fracture level. Unrestorable → extract all loose fragments without damaging the successor; a firm root fragment may be left in situ, or extract the whole tooth.	Where the tooth is retained: 1 wk · 6–8 wk · 1 y; radiographic review at 1 y following pulpotomy or RCT
Root fracture	Coronal fragment not displaced → no treatment. Displaced but not excessively mobile → leave to reposition spontaneously, even with some occlusal interference . Only when displaced AND excessively mobile AND interfering with occlusion (both under LA): A — extract only the loose coronal fragment, leaving the apical fragment to resorb; B — gently reposition, and if unstable splint to adjacent uninjured teeth for 4 wk.	Not displaced: 1 wk · 6–8 wk · 1 y. Repositioned + splinted: 1 wk · 4 wk S+ · 8 wk · 1 y. Coronal fragment extracted: 1 y. Continue yearly clinical review until eruption of the permanent tooth where an unfavourable outcome is likely.
Alveolar fracture	Reposition the displaced segment under LA; stabilise with a flexible splint to adjacent uninjured teeth for 4 wk . Best performed by a child-oriented team.	1 wk · 4 wk S+ · 8 wk · 1 y · and at 6 years of age to monitor eruption of the permanent teeth. Radiographs at 4 wk and 1 y to assess impact on the primary tooth and the permanent germs in the fracture line — may show that more frequent review is needed.

Table 13 — Primary dentition: luxations and avulsion

Injury	Treatment	Follow-up
Concussion	No treatment — observation. No baseline radiograph recommended.	1 wk · 6–8 wk (clinical)
Subluxation	No treatment — observation.	1 wk · 6–8 wk (clinical)
Extrusive luxation	Decided on degree of displacement, mobility, occlusal interference, root formation and the child's ability to cope. Not interfering with occlusion → let it reposition spontaneously. Excessively mobile, or extruded > 3 mm → extract under LA.	1 wk · 6–8 wk · 1 y
Lateral luxation	Minimal or no occlusal interference → allow spontaneous repositioning, usually within 6 months . Severe displacement: A — extraction where there is a risk of ingestion or aspiration; B — gently reposition, and if unstable splint 4 wk to adjacent uninjured teeth.	1 wk · 6–8 wk · 6 mo · 1 y. If repositioned + splinted: 1 wk · 4 wk S+ · 8 wk · 6 mo · 1 y
Intrusive luxation	Allow spontaneous repositioning irrespective of the direction of displacement — the old labial-plate vs tooth-germ rule was dropped in 2020. Improvement usually within 6 months, sometimes up to 1 year. Arrange rapid referral (within a couple of days) to a child-oriented team — up front, not only if re-eruption fails.	1 wk · 6–8 wk · 6 mo · 1 y. Plus review at 6 years of age for severe intrusion, to monitor eruption of the permanent tooth.
Avulsion	Not replanted . Account for the missing tooth — explore its location during history and examination, especially if the accident was unwitnessed or there was loss of consciousness. Rule out intrusion (radiograph) and embedding in lip, cheek, tongue or nose, or ingestion/aspiration. If not found → refer to an emergency room for medical evaluation, especially where there are respiratory symptoms.	Clinical examination at 6–8 wk. Plus review at 6 years of age to monitor eruption of the permanent tooth.

- **Parent / patient education — identical for every primary injury:** care when eating so as not to further traumatise the injured tooth, while encouraging a return to normal function as soon as possible
 - clean the area with a soft brush or cotton swab plus **alcohol-free 0.1–0.2% chlorhexidine gluconate** topically twice a day for 1 week

- warn parents which unfavourable outcomes to watch for → **sinus tract · gingival swelling · abscess · increased mobility · persistent dark grey discoloration** → return promptly

★ EXAM PEARL

Primary trauma answers almost always resolve to "**observe**", and the three exceptions are memorable: extrusion > 3 mm or excessively mobile · lateral luxation with aspiration risk · an unrestorable crown–root fracture. Everything else is left to reposition itself — including an intruded tooth, whatever direction it went.

§14 Where older summary sheets differ

Points on which pre-2020 revision sheets — including the earlier version of this one — no longer match the guideline.

Table 14 — Corrections against IADT 2020

Item	Older summaries said	IADT 2020 says
Avulsion — RCT timing	Start RCT after 2 weeks of stabilisation	Initiate RCT within 2 weeks of replantation
Avulsion — PDL group 2	Dry time < 30 min and extra-oral < 1 h	Storage medium with total extra-oral dry time < 60 min
Avulsion — antibiotics	Not mentioned	Systemic antibiotics in every replantation protocol; amoxicillin/penicillin first choice
Permanent intrusion	No endodontic guidance	Closed apex: pulp almost always necroses → RCT at 2 wk with corticosteroid–antibiotic or Ca(OH) ₂ . Open apex: orthodontic repositioning if no re-eruption at 4 wk
"6 wk – 8 wk"	Two separate review visits	One bullet — a single review appointment within the 6–8 wk window
Enamel infraction	Absent	A distinct injury with its own table — etch and seal severe infractions; no follow-up if isolated
Luxation follow-up	Ends at 1 year	Extrusion, lateral and intrusive luxation: then yearly for at least 5 years
Subluxation — pulp	"Slight increased pulp response"	May not respond initially — transient pulp damage
Emergency "don'ts"	Not stated	RCT contraindicated at the emergency visit (alveolar fracture); no endodontics at the emergency visit and do not remove a cervical coronal fragment (root fracture); temporarily stabilise the loose fragment (crown–root fracture)
Primary enamel fracture	6–8 wk follow-up	No follow-up recommended (6–8 wk applies to enamel–dentin)
Primary root fracture	Occlusal interference or excessive mobility → treat	Displaced and excessively mobile and interfering; displaced-but-stable is left alone even with some interference
Primary intrusion	Refer only if re-eruption fails	Rapid referral within a couple of days; spontaneous repositioning irrespective of direction; review at 6 y of age for severe intrusion
Primary alveolar fracture	No follow-up given	1 wk · 4 wk S+ · 8 wk · 1 y · and at 6 y of age
Primary outcomes	Absent	Every primary luxation/avulsion table, plus alveolar fracture, includes disturbance to development/eruption of the permanent successor as an outcome
Terminology	"Soft tissue" vs "hard tissue"	Organised as fractures and luxations, avulsion (a separate paper and category), and primary dentition; luxations are periodontal/supporting-tissue injuries

Sources: Bourguignon C *et al.* IADT guidelines: 1. Fractures and luxations. *Dent Traumatol* 2020 · Fouad AF *et al.* IADT guidelines: 2. Avulsion of permanent teeth. *Dent Traumatol* 2020 · Day PF *et al.* IADT guidelines: 3. Injuries in the primary dentition. *Dent Traumatol* 2020. Guidelines inform clinical judgement; they do not replace it.