CH-07 Teeth: extraction, abscess, fillings and dentures with what you have

HEALING after the FALL, research library, CH-07

Researched 10 October 2026 by Claude Opus agent for THRIVING after the FALL, Book Four. Library document, unverified.

How to read this

This report starts where three library reports stop. HY-12 holds prevention, ANUG and scaling (THRIVING library, HY-12). WO-16 holds the acute dental emergency: triage, drainage, the extraction technique from *Where There Is No Dentist*, broken roots, the sinus, bleeding, dry socket, Ludwig's angina and the avulsed tooth (THRIVING library, WO-16). WO-11 holds the local anaesthetic ceiling (THRIVING library, WO-11). This report adds the mortality record, when to extract an infected tooth, anaesthesia counted in salvaged cartridges, the teeth a lay healer leaves alone, the two fillings that need no drill, silver diamine fluoride, sealing decay in, the replanted tooth after the first hour, and dentures.

It disagrees with WO-16 on the avulsed tooth, and with WO-11 on whether a village may give the lower block. It corrects three leads in the brief. The 81 per cent figure for silver diamine fluoride comes from Gao 2016 in *JDR Clinical and Translational Research*, not *BMC Oral Health*. Frencken's 1996 paper describes the ART technique, while the three-year Zimbabwe survival figures were published in 1998. And clove bud oil runs from about 55 to 87 per cent eugenol, not 70 to 90.

Each source's status, whether read in full, abstract only or search summary, is given in the References list.

1. Findings by section

1.1 How teeth killed

The London bills. When the London Bills of Mortality began listing causes in the early 1600s, "teeth" was regularly the fifth or sixth leading cause of death, counted apart from "teething" (Clarke 1999). Clarke argues that the counts were fairly accurate, and that the later fall owed nothing to antibiotics or asepsis but came from two earlier dental innovations. The abstract does not name them, and that they were extraction and anaesthesia is my guess [VERIFY].

Ludwig's angina. WO-16 could not trace the pre-antibiotic mortality of over 50 per cent. It comes from Williams's 1940 series of 44 patients, of whom 24 died (54 per cent). Only three years later, Williams and Guralnick reported 20 patients with 2 deaths (10 per cent), a fall Flynn credits mainly to penicillin (Flynn 2000). I read neither original, so who was treated and how is unknown to me [VERIFY]. Grodinsky defined the disease in 1939 by four marks (Grodinsky 1939):

- involvement of more than one space on both sides
- a serosanguinous infiltrate with or without pus
- involvement of connective tissue, fascia and muscle, but not glands

- spread by continuity, not through the lymphatics

Mortality today is about 8 per cent (THRIVING library, WO-16).

The brain. Cavernous sinus thrombosis was near 100 per cent fatal before antibiotics and is 20 to 30 per cent fatal now (LITFL n.d.). Teeth are a minority source. One series attributed 7 per cent to dental infection and more than half to a facial boil (JAMA Network n.d.). The dangerous tooth is an upper one, whose veins drain back towards the orbit.

Noma. HY-12 could not trace the 90 per cent untreated mortality either. Farley and colleagues cite it to WHO, and a treated mortality of 20 per cent to a Zambian series, and they warn that these rates "are not based on robust evidence" (Farley and others 2021). Most cases are children aged 2 to 5, with malnutrition, measles and HIV as the main risks. Community prevalence in Sokoto and Kebbi States was 3,300 per 100,000 children (Farley and others 2021). WHO added noma to its list of neglected tropical diseases on 15 December 2023 (Down to Earth 2023).

Modern death. In the United States, 61,439 admissions from 2000 to 2008 were primarily for periapical abscess, with 66 deaths in hospital, about 1 in 930 (Shah and others 2013). That is with theatres and intensive care.

What it means. Toothache rarely kills. Infection that leaves the bone kills often. MSF divides dental infection into three tiers: an abscess confined to the tooth, spread to the gum and cheek with fever, and spread into the face and neck with necrosis, sepsis or crepitus under the skin (MSF n.d.).

1.2 Extract now, drain first, or wait

The received view. The old teaching was that an acutely infected tooth must not be pulled until antibiotics have quietened it, for fear of spreading infection or failed anaesthesia. Isik and colleagues trace the caution to a study of 1937 (Isik and others 2018).

The record. Isik, Gürses and Menziletoglu compared 35 acutely infected lower molars with 47 cold ones in one Turkish clinic. They found no difference in anaesthetic volume (median 1.5 ml in both), extraction time (4 against 5 minutes) or dry socket, and no patient developed fever or rigors (Isik and others 2018). A review by Johri and Piecuch argues that extraction during acute infection resolves it faster, with low risk of spread (Johri and Piecuch 2011). MSF puts surgery first at every tier (MSF n.d.):

- **Abscess confined to the tooth:** treatment is "only surgical", meaning extraction or root treatment, with no antibiotic.
- **Spread to the gum and cheek:** incision and drainage or extraction, then amoxicillin for 5 days.
- **Spread into the face and neck:** high-dose antibiotics and extraction.

MSF adds two rules a village should copy. If anaesthesia is impossible or trismus is severe, start antibiotics, but still do the procedure within days. And if the patient is no better 48 to 72 hours after the procedure, do not change the antibiotic, go back to the tooth.

Where this report parts from Hesperian and WO-16. *Where There Is No Dentist* says not to inject into a swollen area and to "treat the swelling first" (Hesperian, How to Inject). The rule is right about the needle, since injecting into inflamed tissue hurts, works badly and may spread pus. But it is not a rule against early extraction. A lower block is given far behind the swelling, and an upper tooth can often be reached on either side of it. The brief's "drainage first" fits one case only: when trismus or a pointing collection makes the tooth unreachable. Then the pus is let out through gum or skin, and the tooth comes out as soon as the mouth opens. In every other case the source tooth should come out early. **Antibiotics without removing the source are a delay, not a treatment.**

Doses. MSF gives amoxicillin 1 g twice daily for adults and 25 mg/kg twice daily for children, for 5 days (MSF n.d.). The NHS Lanarkshire guideline uses 500 mg three times daily and adds metronidazole when infection spreads (NHS

Lanarkshire n.d.). For a foul, spreading infection, add metronidazole: 500 mg three times daily for an adult, 10 mg/kg three times daily for a child (THRIVING library, IN-05).

1.3 From the key to the forceps

WO-16 covers Fauchard's book of 1728 (THRIVING library, WO-16). The dental key first appears in print in Alexander Monro's work of 1742, as "Fothergill's key". Garengeot (1668 to 1759) described a modified version (Rodilla and others 2019). A claw hooked over the tooth, a bolster rested on the gum, and the whole was turned like a door key. It often broke the tooth, tore soft tissue and fractured the jaw. Hyson called it "a dangerous and barbarous instrument" (Rodilla and others 2019). A bent shaft was added in 1765 and a swivel claw in 1796. John Tomes designed anatomically shaped forceps in 1841, and the key fell out of use, though it was still reported in Morocco in 1984 (Wikipedia, Dental key).

Anaesthesia arrived with the forceps. On 11 December 1844 Horace Wells had a tooth drawn by John Riggs under nitrous oxide supplied by Gardner Colton. Wells's demonstration at the Massachusetts General Hospital in January 1845 failed when the patient cried out (Wikipedia, Horace Wells).

The lesson for the Fall is that a smith can copy forceps from a drawing, but left without one he will make a key from memory. **The district should hold drawings of the 150 and 151 forceps, the cowhorn and a straight elevator, and no smith should make a key.**

1.4 Anaesthesia counted in cartridges

WO-11 sets the ceiling for plain lidocaine at the lesser of 3 mg/kg and 200 mg (THRIVING library, WO-11). Dental lidocaine comes in cartridges, usually with adrenaline.

The arithmetic. A 2 per cent solution holds 20 mg per ml. A 2.2 ml cartridge holds about 44 mg (one label gives 46.9 mg of the salt), and a 1.8 ml cartridge holds 36 mg (Dentsply Sirona n.d.). The WO-11 ceiling therefore works out at 0.15 ml per kg, about 1 ml per 7 kg, capped at 10 ml [VERIFY, my arithmetic]:

Body weight	Ceiling (2 per cent lidocaine)	In 2.2 ml cartridges
50 kg	7.5 ml	about three
20 kg	3 ml	just over one
10 kg	1.5 ml	two thirds of one

What the labels allow. A New Zealand datasheet for 2 per cent lidocaine with 1:80,000 adrenaline caps healthy adults at 7 mg/kg and at 16 ml, or 9 cartridges, and children at 5 mg/kg (Medsafe n.d.). A BDJ letter cites a BNF limit of 500 mg with adrenaline (BDJ n.d.). Adrenaline slows absorption, which is why the labels allow more than twice the plain ceiling.

The village rule. Keep the WO-11 ceiling even for adrenaline cartridges. It is far more than an extraction needs:

- **Lower block (Hesperian):** 1.5 ml at the nerve plus 0.5 ml beside the tooth, 2 ml in all.
- **Upper tooth (Hesperian):** about 1 ml per root, plus 0.25 ml on the palate.
- **Heart disease:** no more than two injections, preferably without adrenaline.

(Hesperian, How to Inject.) An adult extraction that needs more than two cartridges is going badly, and the healer should stop.

Failure and rescue. The lower block fails in about 15 to 20 per cent of healthy teeth and in 44 to 81 per cent of lower molars with irreversible pulpitis (Decisions in Dentistry n.d.). WO-16's rescue is right: inject beside the tooth after a

failed block rather than repeat the block. A trial report cites a meta-analysis finding articaine 3.8 times as effective as lidocaine by lower infiltration, but I did not read that meta-analysis (AAE 2017) [VERIFY].

Waiting. WO-16 tells the healer to wait 5 minutes before testing, but its harm test calls cutting before 10 minutes an error, and WO-11 says to wait 10 to 15 minutes (THRIVING library, WO-16, WO-11). To reconcile them: test at 5 minutes, and if the tooth is not numb, wait until 10 minutes before injecting again.

Disagreement with WO-11. WO-11's toothache protocol sends lower back teeth to the district (THRIVING library, WO-11). WO-16 teaches the block in the village. This report sides with WO-16, because a hot lower molar that waits for a journey is the commonest seed of Ludwig's angina. [OWNER] decides how many supervised blocks qualify a village healer. I suggest ten, which has no source [VERIFY].

Extraction without anaesthetic. Every extraction before 1844 was done awake. A baby tooth with a resorbed root, or an adult tooth that moves a millimetre under a finger, can come out after a minute of firm pressure on the gum with cotton. Hesperian uses that pressure as preparation for a child's injection, and treating it as the whole anaesthetic is my extrapolation (Hesperian, How to Inject) [VERIFY]. Without anaesthetic, firm teeth should come out only when the alternative is a spreading infection. Then use cold, clove on the gum and the talk-through of WO-11, with opium if any exists (THRIVING library, WO-11).

1.5 Forceps by tooth, and the teeth a lay healer leaves alone

Forceps. The numbering sources agree on most instruments (ProDent n.d.):

- **150:** upper incisors, canines and premolars.
- **151:** the same teeth in the lower jaw.
- **23, the cowhorn:** lower molars, with beaks that go into the fork between the roots.
- **65:** a bayonet for upper roots.

Upper molar forceps are numbered differently by different makers, and each is shaped for one side. WO-16 lists Dickson's four-instrument kit (THRIVING library, WO-16). A smith must make cowhorn points slender and smooth.

Tooth by tooth. The rule in WO-16 holds: turn a single root, rock several roots. Upper canines have the longest roots in the mouth. Upper premolars often have two thin roots, which break. The tuberosity behind the last upper molar can fracture away with the tooth if it is forced. Lower molars come out with a cowhorn, or after splitting, which a village cannot do without a drill.

Teeth a lay healer must not take out:

1. A wisdom tooth not fully through the gum, or tilted against its neighbour (THRIVING library, WO-16).
2. A lower molar with trismus and swelling under both sides of the jaw. That patient needs drainage and an airway first.
3. An upper molar in a patient with sinus trouble, when no district can be reached within the 48 to 72 hours in which an opening into the sinus must be closed (THRIVING library, WO-16).
4. Any tooth in someone who bleeds for hours from small cuts or a past extraction. Porter warned dentists in 1899 that haemophilia, though rare, kills from slight wounds (Porter 1900).
5. Any tooth in someone taking an anticoagulant, until the district has been asked.
6. A tooth that two people have not both named.
7. A root broken below the bone, beyond what an elevator lifts without digging (THRIVING library, WO-16).

No routine antibiotic. A Cochrane review of 18 trials with 2,456 patients found antibiotics cut infection after extraction (RR 0.29), with 12 treated to prevent one (Lodi and others 2021). Every trial, however, involved impacted wisdom teeth. **No routine antibiotic after a simple extraction.**

Sterility. Forceps and elevators enter bone. Pressure-cook them at 121 °C, or at least boil them for 20 minutes from a full boil. Alcohol and flame are not enough (THRIVING library, WO-12).

1.6 The first filling: zinc oxide and clove oil

Tradition. Clove is the oldest toothache remedy in the European and Asian pharmacopoeias (THRIVING library, WO-11). It warms, numbs and cleans. Dentistry turned that use into the liquid half of a cement.

The plant. *Syzygium aromaticum* (L.) Merr. and L.M. Perry, of the Myrtaceae, is used as the dried unopened flower bud. Steam-distilled bud oil varies widely in eugenol:

Origin	Eugenol	Other notes
Turkey	87 per cent	8 per cent eugenyl acetate
Bali	65.29 per cent	20 per cent caryophyllene, oil yield 12.9 per cent
Java	55.6 per cent	
India	70.0 per cent	
Manado	74.7 per cent	
Madagascar	82.6 per cent	

(Turkish clove study n.d., Bali clove study n.d., Indian clove study n.d.)

Buy whole buds, not stems or leaves, whose oil differs [VERIFY, adulteration with stems not sourced]. Allspice, *Pimenta dioica*, also contains eugenol, but it is not a substitute in a filling [VERIFY]. The tree is tropical, so a temperate village has only the cloves it stored.

The record. A trace of water starts the set. Zinc oxide becomes zinc hydroxide, which reacts with eugenol to form zinc eugenolate, a chelate. Zinc acetate speeds the reaction (NBS 1955). Hesperian's verdict is that a cement filling "can last up to 6 months" (Hesperian, Placing a Filling). Reinforced IRM is sold for restorations lasting up to a year (Dentsply IRM n.d.). The nearest trial figure is for IRM sealing primary molars after pulpotomy, with 67.7 per cent surviving at 45 months (Moskovitz and others 2021), which is not the same use. I found no trial of hand-mixed zinc oxide and eugenol in a cavity.

Inference and harms. Through a layer of dentine, eugenol is held to soothe an inflamed pulp [VERIFY, teaching, no trial read]. Placed directly on an exposed pulp it irritates, and makers contraindicate that use (Prevest Denpro n.d.). Allergy occurs, including an immediate reaction in an 8-year-old (ZOE allergy case n.d.).

Can a village make it?

- **The clove oil:** it can be distilled, at about one eighth of bud weight at Bali's yield. But 5 to 10 ml of it can poison a small child (section 1.10). Whether a hamlet should distil it is an [OWNER] decision.
- **The zinc oxide:** it was historically made by burning zinc metal. The fume causes metal fume fever, with fever, chills and a metallic taste starting 3 to 10 hours after exposure and lasting 24 to 48 hours (Metal fume fever reviews n.d.). ME-08 grades home-made zinc compounds X, because scrap zinc carries lead and cadmium, and it says nothing about fillings (THRIVING library, ME-08).

Zinc oxide for fillings comes from sealed salvage only, held at the district [OWNER].

The filling buys time. It seals out sugar, quietens a tooth that aches with sweet or cold, holds the tooth until glass ionomer is available, and dresses a dry socket (THRIVING library, WO-16).

1.7 The second filling: ART and glass ionomer

History. ART began in Tanzania in the mid-1980s at the Dar es Salaam dental school, because donated drills were useless without power. The materials changed as the work went on:

- **First:** zinc phosphate cement.
- **1986 pilot:** polycarboxylate cement, with one failure among 28 restorations at 9 months.
- **The field study:** a medium-viscosity glass ionomer.

A trial in Thailand followed, and WHO adopted ART on World Health Day 1994 (Frencken 2009).

Zimbabwe. Frencken, Makoni and Sithole followed one-surface ART fillings in secondary pupils around Harare (Frencken, Makoni and Sithole 1998):

- **Survival at 3 years:** 85.3 per cent, ranging from 96.1 to 69.3 per cent between operators. A second cohort reached 88.3 per cent.
- **Sealants:** only 50.1 per cent were retained, yet new caries on sealed surfaces fell fourfold.

The brief's 1996 paper describes the technique, and I know it only from reference lists (Frencken and others 1996). **The operator range is the key number for a lay healer: ART works only as well as the hand that does it.**

Pooled survival. For high-viscosity glass ionomer (de Amorim and others 2012):

Restoration	2 years	3 years	5 years
Single surface, permanent teeth	93 per cent	85 per cent (77 to 91)	80 per cent (76 to 83)
Single surface, primary teeth	93 per cent		
Multiple surface, primary teeth	62 per cent		

The 2018 update gives 87.1 per cent at 3 years for single-surface ART in permanent teeth (de Amorim and others 2018).

The Cochrane review. Dorri and colleagues found 15 trials with 3,760 participants (Dorri and others 2017):

- **Primary teeth, ART against drilled fillings in the same material:** ART failed more often, OR 1.60 (1.13 to 2.27), low certainty.
- **Against amalgam:** OR 2.15 (0.73 to 6.35), not significant.
- **Pain and anxiety:** barely different.

The authors still call ART an option where drills and electricity are scarce, which describes every setting after the Fall.

Shelf life. Two makers give three years from manufacture and warn against humidity (ChemFil n.d., GK II n.d.). An Indonesian study found that long-stored powder and liquid set softer (Dental Journal 2005). Hesperian says to store glass ionomer cool (Hesperian, Placing a Filling). My inference, which no source tests: keep it capped, cool, dry and dark, use the oldest first, and test-mix an old batch [VERIFY]. **Glass ionomer cannot be made after the Fall.**

1.8 Silver diamine fluoride

The two Gao papers. Gao and colleagues in *JDR Clinical and Translational Research* pooled 8 studies of 38 per cent silver diamine fluoride (SDF) in children: 81 per cent of lesions were arrested (68 to 89), and black staining was

the only complication (Gao, Zhao and others 2016). Gao's *BMC Oral Health* review, the paper the brief names, found 65.9 per cent (41.2 to 90.7) (Gao, Zhang and others 2016). The honest range is two thirds to four fifths.

Frequency and roots. A Hong Kong trial in 888 children found 38 per cent better than 12 per cent, and twice yearly better than yearly (Fung and others n.d.). In older adults, three trials with 895 participants found that yearly SDF reduced decayed or filled root surfaces (Oliveira and others 2018).

Method. Dry the tooth and apply until the cavity stays wet, re-wetting every 5 to 10 seconds. Wait 10 seconds, blot, keep saliva away for one more minute, and do not rinse. The lesion turns permanently black, and so does anything the liquid touches (Hesperian, Treating a Cavity with SDF).

Storage. The safety sheet calls the liquid light-sensitive, with light or evaporation causing precipitation (Advantage Arrest SDS n.d.). Silver and fluoride content can drift by more than 5 per cent after 60 days (SDF stability study 2023) [VERIFY, conditions not read]. HY-12 calls SDF the highest-value dental salvage, and I agree (THRIVING library, HY-12). [OWNER] decides whether SDF and glass ionomer go to children first.

1.9 Sealing decay in, the pulp, and the cavity left alone

The Hall technique. Dr Norna Hall cemented preformed metal crowns over decayed baby molars, with no drilling, no anaesthetic and no removal of decay. In a Tayside split-mouth trial of 132 children, results at 5 years were (Innes and others 2011):

Failure	Hall crown	Conventional filling	NNT
Major (pulpitis, abscess or loss)	2 per cent	17 per cent	7
Minor	5 per cent	46 per cent	3

Most children, carers and dentists preferred the Hall crown (Innes and others 2007). The crowns are factory salvage, but the lesson outlives them: **decay sealed from sugar stops.**

Selective removal. Ten studies with 1,257 patients found that leaving the deepest soft decay over the pulp cut pulp exposure (OR 0.31) without raising failure (OR 0.97), though at high risk of bias (Schwendicke and others 2013). Hesperian says the same: clean the edges completely, but not necessarily the floor (Hesperian, Placing a Filling). This is the most important single instruction in village filling.

Pulp capping. Calcium hydroxide on a decay-exposed pulp did poorly in Barthel's 123 teeth, with 37 per cent successful at 5 years and 13 per cent at 10. Survival was better when a permanent filling followed within 2 days (Barthel and others 2000). Willershausen's 1,075 teeth did better, at 68.0 per cent at 5 years (Willershausen and others 2011). **An exposed pulp in a permanent tooth will probably die. Cap and seal it if there is material, warn the patient, and extract at the first swelling.**

Leaving the cavity alone. The FiCTION trial randomised UK children's decayed baby molars to fillings, to sealing in, or to prevention alone. Pain affected 35.8, 32.1 and 39.5 per cent respectively, with no evidence of a difference (Maguire and others 2020). **A painless cavity in a baby tooth, with sugar cut and teeth brushed, can be watched.** A deep cavity in a permanent molar cannot.

1.10 Pain: clove, tablets and the aspirin burn

Clove. In 73 volunteers a homemade clove gel numbed the gum as well as 20 per cent benzocaine (Alqareer 2006, via THRIVING library, WO-11). A whole clove held on the gum, or a drop of oil on cotton in the cavity, is enough.

Clove oil poisons small children. The cases:

- **Hartnoll 1993:** a 2-year-old fell into coma with fits, a bleeding disorder and liver damage (Hartnoll and others 1993).
- **The dose:** toxicity follows 5 to 10 ml in a small child (VUMC 2025).
- **A 2005 case:** a 15-month-old who drank 10 ml developed liver failure, which resolved after intravenous N-acetylcysteine (Clove oil case 2005).
- **The mechanism:** LiverTox calls eugenol a direct liver toxin at high dose (LiverTox n.d.).

Clove oil is locked away like medicine.

Tablets. For an adult, paracetamol 500 to 1,000 mg or ibuprofen 200 to 400 mg every 6 hours (THRIVING library, WO-16).

The aspirin burn. An aspirin held against a sore tooth burns the mucosa white and wrinkled, and longer contact leaves a sloughing ulcer (Malaysian review n.d., Dental Update n.d.). One 2020 case report is titled for exactly this (Alfawaz 2020). **Aspirin is swallowed, never held on the gum.**

1.11 Gums beyond prevention

Hand scaling is not second best. A systematic review found that ultrasonic instruments saved about 37 per cent of the time, with no difference in attachment, pocket depth or bleeding (Tunkel and others 2002). Forged scalers kept sharp do the same work more slowly.

Chlorhexidine is a short course. Fifty-one trials with 5,345 people showed a large cut in plaque but a small change in gingivitis, 0.21 on a 0 to 3 scale. The rinse stains teeth and builds calculus beyond four weeks (James and others 2017). It does not replace cleaning, and it does not treat ANUG without debridement (THRIVING library, HY-12).

Noma is the gum disease that kills a child. Its early stages are reversible with antibiotics, wound cleaning and feeding (Farley and others 2021). The food is the larger part of the treatment.

1.12 The knocked-out tooth

I read the IADT 2020 guideline in full (Fouad and others 2020). It changes WO-16 in three places.

Time. After **30 minutes** dry, most periodontal ligament cells are non-viable. IADT sorts teeth into three groups:

- **Replanted at once, or within about 15 minutes:** cells probably viable.
- **Stored in a medium, less than 60 minutes dry:** cells compromised.
- **Over 60 minutes dry:** cells dead.

WO-16's 60 minutes is the outer edge, and the working limit is minutes (THRIVING library, WO-16).

Water. WO-16 says never to rinse with water. IADT ranks storage media as milk, balanced salt solution, saliva, then saline. It calls water "a poor medium" but "better than leaving the tooth to air-dry" (Fouad and others 2020).

The pulp. IADT starts a root canal within 2 weeks for an adult tooth, which a village cannot do. The rest of its care a village can give:

- a flexible splint for 2 weeks, made of wire or nylon line of 0.13 to 0.25 mm
- amoxicillin, but no tetracycline under 12
- a tetanus check
- chlorhexidine rinse for 2 weeks

The replanted adult tooth will usually lose its pulp and become infected. Replant anyway, review weekly for a month, and extract at the first tenderness or swelling [VERIFY, my sequence]. Children's immature teeth may revascularise. Baby teeth are never replanted. [OWNER] decides on replanting when no follow-up is possible.

1.13 Dentures

Japan. The oldest known Japanese wooden denture belonged to a Buddhist nun who died in 1538. The Kanagawa Dental Association records her as Hotokehime of a temple in Wakayama, and Yoshida names her Nakaoka Tei, probably the same woman (Kanagawa Dental Association n.d., Yoshida 2024) [VERIFY]. In the Edo period, carvers of Buddhist statues and netsuke became denture makers, taking impressions in beeswax. Ono Gennyu made a denture for Yagyu Munefuyu, swordsmanship instructor to the shogun (Kanagawa Dental Association n.d.).

In 2024 Kazuya Yoshida reproduced an upper plate for a 90-year-old woman using period tools. The base was boxwood, the teeth were ivory dovetailed in and fixed with *mugi-urushi* lacquer, and the plate was held by suction. He reports chewing comparable to a modern denture (Yoshida 2024). The craft is carving, fitted by repeated trial in the mouth.

Europe and America. Fauchard described spring-held dentures in 1728 (Yoshida 2024). George Washington's set combined human, cow and horse teeth and ivory on a lead base with springs. His dentist Greenwood complained in 1798 that a returned set was "very black" from port wine (Mount Vernon n.d.). Such dentures were largely cosmetic.

Vulcanite. Hard rubber made full dentures cheap in the later nineteenth century. Cummings patented vulcanite plates in 1864. The company holding the patent, led by its treasurer Josiah Bacon, charged dentists licences and royalties for 13 years. Bacon was shot dead in 1879 by a dentist, Samuel Chalfant, and the patents expired in 1881 (Chan 2025, Ohio Dental Association n.d.). Vulcanite needs latex, sulphur, a mould and hours of heat under pressure [VERIFY, process not read].

Acrylic. Heat-cured PMMA came in about 1937 and had largely replaced vulcanite by 1946 (PMMA review n.d.). It needs salvaged powder and liquid, a brass flask and boiling water. Plaster of Paris can be made by calcining gypsum at 110 to 120 °C (Plaster chemistry review n.d.).

What the district can make. In order of difficulty:

1. A partial plate holding front teeth in place. Hesperian says the single false tooth is "not for chewing" but to hold the other teeth in position (Hesperian, False Teeth).
2. A carved wooden upper plate, made from a beeswax impression.
3. An acrylic denture, while salvaged stock lasts.

The lower full denture is the hardest in any material [VERIFY]. Making dentures at the district is an [OWNER] decision. Boxwood is *Buxus sempervirens* in Europe and *Buxus microphylla* in Japan. Its leaves are toxic if eaten [VERIFY].

Harms. Overnight wear raised the odds of denture stomatitis 26-fold, and prevalence was 26.5 per cent (Vojnosanitetski Pregled 2017). Take dentures out at night.

The toothless diet. The toothless eat less fruit, vegetables and fibre (Edentulism reviews n.d.). New dentures alone change diet little. In 58 patients given new dentures, dietary advice raised fruit and vegetable intake by 209 g a day, against 26 g a day without advice (Bradbury and others 2006). **The advice matters more than the teeth.** Cook food soft, mash it, make porridges and broths, and give eggs, curds and fish, with protein at every meal.

1.14 Amalgam and Weston Price

Amalgam. Hesperian says never to use mercury amalgam (Hesperian, Placing a Filling). The salvage danger is heating it:

- **CDC, 1989:** four adults were hospitalised after amalgam was smelted in a basement (CDC 1989).
- **Australia, 2013:** a man who heated amalgam at home for its gold developed pneumonitis and a nephrotic syndrome (MJA 2013).

- **United States:** in a poison-centre series of nine patients, two needed intubation (US poison centre series n.d.).

Nobody salvages, heats or places amalgam [OWNER]. Old fillings in a mouth are left alone.

Weston Price. HY-12 rejects his focal infection theory, which "caused needless extraction" (THRIVING library, HY-12). Teeth come out for pain, infection or a tooth that cannot be saved, never as a cure for illness elsewhere.

2. Evidence grades

Practice	Tradition	Record	Grade
Early extraction of a hot tooth	Wait for swelling to settle	No more complications (82 patients), MSF surgery first	B
Antibiotic alone for abscess	Pills cure a gumboil	Delay, no trial supports it as sole treatment	X as sole treatment
Lower block plus infiltration rescue	none	Block fails 44 to 81 per cent in hot molars	B
Tomes-pattern forceps	none	Standard since the 1840s	B
Dental key	It draws the tooth	Broke teeth and jaws	X
Zinc oxide and clove oil filling	Clove stops toothache	Up to 6 months, no trial	C
ART, single surface	none	85 per cent at 3 years, 80 at 5	A
ART, multiple surface	none	62 per cent at 2 years	B, poor
38 per cent SDF	none	66 to 81 per cent arrest	A
Hall crown	none	Major failure 2 against 17 per cent	A
Selective decay removal	none	Exposure OR 0.31	A, low certainty
Calcium hydroxide pulp cap	none	37 per cent at 5 years in one series	B, poor
Watching a painless baby-tooth cavity	none	No difference in pain (FiCTION)	A
Clove on gum	Clove numbs	Equal to benzocaine, one trial	B/C
Aspirin on the gum	It draws the pain	Chemical burns	X
Hand scaling	none	Equal to ultrasonic, slower	A, weak
Chlorhexidine rinse	none	Large plaque effect, stains	A, adjunct
Replanting an adult tooth	Put it back	IADT guideline	B
Carved wooden denture	Japan from 1538	One modern reproduction	D
Acrylic denture	none	Standard since 1937	B
Diet advice with dentures	none	+209 against +26 g/day	A, one trial
Heating amalgam	Recovers metal	Mercury poisoning	X

In every row, "tradition" is what was believed, "record" is what was measured, and every [VERIFY] in the text marks inference.

3. Means ledger

Rung	What can be done	What it changes
Hands and knowledge	Triage, recognising the dangerous face, sitting upright, pressure on a socket, replanting within minutes, watching baby-tooth cavities, teaching soft food	Saves the replantable tooth and catches Ludwig's on day one
Hearth	Warm salt rinses, boiled cloth gauze, honey and clove for a dry socket, milk for a knocked-out tooth, clove on the gum	Relief and a drained gumboil
Garden and still	Forged forceps, elevators and scalers, pressure-cooked instruments, distilled clove oil [OWNER], beeswax impressions	Extraction becomes a planned operation
Village dispensary	Lower blocks and infiltrations from salvage, early extraction, amoxicillin and metronidazole, ART, SDF, zinc oxide fillings, hand scaling, splints, a register	Teeth are arrested or filled rather than pulled, and fewer die of facial infection
District infirmary	Surgical extraction, sinus closure, neck drainage, surgical airway, Hall crowns, pulp capping, acrylic and wooden dentures, register audits	The Ludwig's patient and the toothless have a chance
Hospital before the Fall	X-rays, drills, intravenous antibiotics, intensive care, root canals, implants	Root canals save teeth the village must pull

4. Harm test

Extraction. The harms are bleeding in a bleeder, a root pushed into the sinus, a fractured tuberosity or jaw, a dislocation, the wrong tooth, and delay in the dangerous face (THRIVING library, WO-16). The errors that cause them are force instead of patience, pliers instead of forceps, an impacted wisdom tooth attempted, and days of antibiotics instead of surgery. Pregnancy is not a reason to wait, because infection is the greater danger. Stop if the crown crumbles, bone moves with the tooth, air passes through the socket, or bleeding soaks gauze after 20 minutes of pressure. Then apply gauze, a stitch, and refer.

Local anaesthetic. WO-11 holds the harm test (THRIVING library, WO-11). For dental injections the specific risks are intravascular injection (aspirate every time), fainting, and a temporary facial palsy from a block given too deep [VERIFY].

Zinc oxide and eugenol. Allergy, irritation of an exposed pulp, a high filling that cracks the tooth, and a filling sealed over an abscess, which must be removed (Hesperian, Placing a Filling). Lead and cadmium come with non-salvage zinc oxide (THRIVING library, ME-08). Swallowed clove oil can kill a child.

Glass ionomer. Expired or damp material sets soft. Decay left at the edges keeps spreading under the filling, and a filling placed over a dead pulp becomes an abscess.

SDF. It leaves a permanent black stain and a metallic taste, and it is for professional use only (Advantage Arrest SDS n.d.).

Antibiotics. The dental harm is using them instead of the forceps (THRIVING library, IN-05).

Chlorhexidine. Staining and calculus after four weeks (James and others 2017).

Replanting. A dead pulp becomes infected and the root resorbs. Replanting a baby tooth harms the adult tooth beneath it (Fouad and others 2020).

Dentures. Sores and stomatitis from overnight wear. A small loose partial plate may be swallowed or inhaled by a confused patient [VERIFY].

Amalgam. Mercury pneumonitis and kidney damage. Remove the person from the source and give supportive care.

5. Red flags

1. **Swelling under both sides of the jaw, a hard mouth floor, the tongue raised, drooling, a muffled voice.** Ludwig's angina. Sit the patient up, remove the source while the mouth opens, give amoxicillin and metronidazole, and get to the district today.
2. **Noisy breathing.** The airway is closing, and only a surgical airway will save the patient. Sit them up, stay with them, and give morphine if there is any.
3. **Swollen eyelid, bulging eye or double vision after an upper toothache.** Spread towards the brain. Give all antibiotics, take out the tooth, and send to the district now.
4. **Crackling under the skin, or skin turning dusky.** Gangrenous cellulitis (MSF n.d.). The district.
5. **A dark patch on a hungry child's cheek or gum, with foul breath.** Noma. Give antibiotics, clean it daily, feed the child, and send to the district.
6. **Fewer than two fingers fit between the teeth.** Drain any pointing collection, give antibiotics, and refer.
7. **Socket bleeding through 20 minutes of pressure and a stitch.** Suspect a bleeding disorder or an anticoagulant. Keep up the pressure and send.
8. **Worse at 48 to 72 hours after the procedure.** Go back to the tooth (MSF n.d.).
9. **Fluid passing from mouth to nose after an upper extraction.** The opening must be closed within 48 to 72 hours.
10. **A child who has swallowed clove oil.** Treat it as poisoning, and give acetylcysteine if any exists.

Most toothaches end with the tooth out and a night's sleep. For Ludwig's angina after stridor has begun, the village has nothing that opens the airway, and it should say so honestly.

6. The case against

Against lay extraction. WO-16 sets complication rates of 6 to 64 per cent among students against the alternative of pliers and an uncle (THRIVING library, WO-16). Clarke adds a historical point: deaths from teeth fell before antibiotics (Clarke 1999). If extraction and anaesthesia caused that fall, which is my guess [VERIFY], then extraction done well saves lives.

Against ART. In baby teeth, ART failed more often than drilled fillings (Dorri and others 2017). Multiple-surface ART fillings fail often, and poor operators reach only 69 per cent. But the real comparison after the Fall is ART against extraction, and four single-surface teeth in five survive 5 years. When the glass ionomer runs out, ART ends.

Against SDF. It blackens teeth, and most of the trials come from one Hong Kong group. Even so, the effect is large and consistent.

Against sealing decay in. Paediatric dentists once called it negligent. The trials answer them for baby teeth only (Innes and others 2011, Maguire and others 2020), and this report does not extend the finding to permanent molars.

Against home-made materials. Zinc oxide made by burning zinc is graded X, clove oil poisons children, and a zinc oxide and eugenol filling lasts months. Romance of the hospital fails the other way, since cleaning and sealing out

sugar do more for baby teeth than the drill does.

Against dentures. Critics call them cosmetic, and Washington's could not chew. Japan's suction dentures did chew, and Bradbury's trial shows the bigger gain is free advice. Teach eating first.

Named critics. Hyson on the key (Rodilla and others 2019), Dorri on ART, and Farley on the noma figures.

7. 10-line summary

1. Ludwig's angina killed 24 of 44 in 1940, and 2 of 20 with penicillin three years later.
2. "Teeth" were the fifth or sixth cause of death in seventeenth-century London.
3. Extract the infected tooth early, because antibiotics alone only delay.
4. The WO-11 ceiling, 0.15 ml per kg of 2 per cent lidocaine, allows three cartridges at 50 kg, and an extraction needs one or two.
5. The lower block fails often in a hot molar, so infiltrate beside the tooth instead.
6. Forceps replaced the jaw-breaking key, and smiths need the drawing.
7. Zinc oxide and clove oil buys up to six months. Clove oil can poison a child.
8. Single-surface ART survives 85 per cent at 3 years, from 96 to 69 per cent by operator.
9. SDF arrests two thirds to four fifths of children's cavities, and decay sealed from sugar stops.
10. Replant a knocked-out adult tooth within 15 minutes, because cells are mostly dead after 30 minutes dry.

8. Open questions

- What did the Williams 1940 and Williams and Guralnick 1943 series record?
- Which two innovations does Clarke name?
- How long does hand-mixed zinc oxide and eugenol last in a cavity?
- How long past expiry does sealed glass ionomer still set?
- What block success does a lay healer reach after supervised training (THRIVING library, WO-11)?
- Is a replanted tooth without root treatment a net gain?
- Is the 90 per cent noma mortality real (Farley and others 2021)?

9. Sources to read in full

1. Dickson, *Where There Is No Dentist* (Hesperian), on injecting, fillings, SDF and extraction.
2. Fouad and others 2020, the IADT avulsion guideline.
3. MSF Clinical Guidelines, Dental infections.
4. de Amorim, Leal and Frencken 2012, and Dorri and others 2017.
5. Gao, Zhao and others 2016, on SDF.
6. Innes, Evans and Stirrups 2011, on the Hall technique.
7. Flynn 2000, The swollen face.
8. Hoffmann-Axthelm's *History of Dentistry* (1981) and Wynbrandt's *The Excruciating History of Dentistry* (1998), named in the brief. I read neither.

At the bedside after the Fall

For a household.

- **What to do:** know the dangerous face and act on day one. Keep cloves dry and sealed, and keep any clove oil locked away. Never hold aspirin on a tooth. Put a knocked-out adult tooth back within minutes, after rinsing it in milk or saliva. Feed the toothless soft protein. Cut sugar.
- **To start:** cloves, salt, milk, cloth.

- **First failure to expect:** a swelling under the jaw left for three days because "the antibiotic is working".

For a village of 300.

- **What to do:** a trained healer extracts hot teeth early, fills single surfaces by ART while stock lasts and with zinc oxide after that, applies SDF to children twice a year and to elders' roots once a year, scales by hand, and splints replants.
- **To start:**
  - 150, 151 and cowhorn forceps, a straight elevator, an excavator, a probe, a mirror and a glass slab
  - a pressure cooker
  - salvaged cartridges, with ten supervised lower blocks before a healer works alone [OWNER]
  - two people to confirm every tooth
  - a register recording the tooth, the millilitres given and the outcome at one week
- **First failure to expect:** ART placed on two- and three-surface cavities because the patient begs. Those fillings fall out within a year and waste cement that would have saved three single-surface teeth.

For a district of 3,000.

- **What to do:** surgical extractions, sinus closure, neck drainage and a surgical airway (THRIVING library, WO-16). Hall crowns and pulp capping while stock lasts. Dentures, from acrylic while it lasts and then wooden upper plates by a woodcarver, always with diet teaching. Register audits by operator.
- **To start:** plaster, a flask, a woodcarver, a sterile room, a tracheostomy set, and central stores of glass ionomer and SDF.
- **First failure to expect:** glass ionomer and SDF used up within two or three years without central rationing [VERIFY, my estimate].

Protocols

Protocol 1. Deciding: watch, fill, drain or extract

- ☐ Ask what starts the pain, whether it wakes the patient, and how long it lasts after cold. Look and tap (THRIVING library, WO-16).
- ☐ **Red flags (section 5):** go to Protocol 3.
- ☐ **Baby tooth, painless cavity:** clean it, cut sugar, apply SDF if stocked, and recheck every 3 to 6 months.
- ☐ **Brief pain with sweet or cold, one surface:** fill (Protocol 4 or 5).
- ☐ **Lingering pain, night pain, or a bleeding pulp:** the nerve is dying. Seal the tooth, warn the patient, and extract at the first swelling.
- ☐ **Tender to tap, a gumboil, or cheek swelling:** extract now if the mouth opens and the tooth is named, and drain any pointing pus at the same visit.
- ☐ **Trismus with pointing pus:** drain, start antibiotics, and extract within days (MSF n.d.).

Protocol 2. The extraction

Read with WO-16 Protocol 6. Doses are for 2 per cent lidocaine.

Before you start

- ☐ **Name the tooth, have a second person confirm it, and write it in the register first.**
- ☐ Ask about bleeding after small cuts or past extractions, anticoagulants, heart disease and allergy. If there is a bleeding history or an anticoagulant, do not extract.
- ☐ Check the section 1.5 list of teeth not to take out. If the tooth is on it, refer.
- ☐ Pressure-cook the instruments at 121 °C, or boil them for 20 minutes from a full boil, and lay them on a boiled cloth (THRIVING library, WO-12). Wash your hands.

☐ Seat the patient with the head supported, in good light, with a helper.

Anaesthetic

☐ **Ceiling:** 0.15 ml per kg, never over 10 ml. That is 7.5 ml at 50 kg, 3 ml at 20 kg and 1.5 ml at 10 kg (THRIVING library, WO-11). With heart disease, give no more than two injections.
☐ **Upper tooth:** inject about 1 ml per root at the fold of cheek and gum, needle to bone, aspirating first. Then give 0.25 ml on the palate.
☐ **Lower back tooth:**
  – thumb in the hollow behind the last molar
  – syringe coming from the opposite premolars
  – needle to bone at about three quarters of its length
  – aspirate, then 1.5 ml slowly
  – then 0.5 ml beside the tooth
☐ **Loose or front tooth:** 0.5 to 1 ml beside the root.
☐ **Wait 5 minutes, then test with the probe.** If the tooth is not numb at 10 minutes, infiltrate 0.5 to 1 ml beside it rather than repeating the block. Stay under the ceiling.

Taking the tooth out

☐ Free the gum all round. Use the elevator between this tooth and the one in front, resting your finger on bone and never levering against the neighbour.
☐ Push the forceps as far up the root as they go: 150 for upper front teeth and premolars, side-specific forceps for upper molars, 151 for lower front teeth and premolars, cowhorn for lower molars.
☐ **Turn a single root. Rock a multi-rooted tooth slowly for a minute or more.** Support the jaw with your other hand. Stop if the bone behind an upper molar moves.

Afterwards

☐ Count the roots. Leave a small deep tip. Lift a visible tip with the elevator, without digging.
☐ Squeeze the socket together. The patient bites on gauze for **30 minutes, or 2 hours for a child.**
☐ For 24 hours: no rinsing, spitting, smoking or hot drinks. After that, warm salt rinses. Give paracetamol or ibuprofen.
☐ Record in the register: the tooth, the millilitres given, whether the roots came out complete, and the outcome at 1 week. For problems, see WO-16 Protocol 7.

Protocol 3. The hot tooth and the swollen face

☐ **Gumboil without fever:** extract, or open the gumboil and extract within days. No antibiotic (MSF n.d.).
☐ **Swollen cheek, fever, or trismus beginning:** extract or drain today. Then give amoxicillin, **1 g twice daily for an adult or 25 mg/kg twice daily for a child, for 5 days** (MSF n.d.).
☐ **Foul pus or a spreading swelling:** add metronidazole, 500 mg or 10 mg/kg three times daily (THRIVING library, IN-05).
☐ Inject away from the swelling, never into it.
☐ **Mouth shut:** give antibiotics now, apply warm compresses, drain any pointing pus, and extract once you can reach the tooth.
☐ **Review at 48 to 72 hours.** If the patient is not better, go back to the tooth rather than changing the antibiotic.

Protocol 4. Zinc oxide and clove oil filling

☐ **Use it only for:** one cavity that aches with sweet or cold, with no swelling, no pain when tapped, and no gumboil.

- ☐ Put cotton rolls in place and change them when wet.
- ☐ **Clear all soft decay from the edges.** Lift soft decay from the floor but **stop before the nerve**, leaving firm stained dentine (Hesperian, Placing a Filling, Schwendicke and others 2013).
- ☐ Break off thin, unsupported enamel.
- ☐ **Mix on a glass slab:** draw powder into a few drops of oil until the mix is **thick, not sticky, and can be rolled between gloved fingers.** If it sticks, add powder. Practise before the first patient.
- ☐ Press in small balls, overfill slightly, shape the surface and clear the gum edge.
- ☐ **Check the bite:** the other teeth must meet normally. Scrape any high spot until they do (Hesperian, Placing a Filling).
- ☐ **Nothing by mouth for 1 hour. The filling lasts up to 6 months.** Record it and plan an ART filling.
- ☐ If pain worsens even though the bite is right, remove the filling and go to Protocol 3.
- ☐ Lock the oil away.

Protocol 5. ART with glass ionomer

- ☐ **Use it only for:** single-surface cavities reachable with an excavator, in teeth with no sign of abscess.
- ☐ Clean as in Protocol 4.
- ☐ Wipe the cavity with conditioner on damp cotton, then with cotton dampened in water, then dry it.
- ☐ **Mix:** one level scoop of powder and one bubble-free drop of liquid, and recap the bottles at once. **Never add extra liquid.**
- ☐ Fill straight away, overfilling into the nearby pits. Press with a finger greased with petroleum jelly or fat.
- ☐ **It sets in under a minute.** Remove the excess and check the bite with darkened paper (Hesperian, Placing a Filling).
- ☐ Record the tooth, the surface, the batch and the operator. Check at 6 months and then yearly.
- ☐ **Old stock:** do a test mix first. If it is still crumbly after about a minute, do not use it [VERIFY, inference].

Protocol 6. Silver diamine fluoride

- ☐ **Use it for:** cavities in baby teeth, children who cannot sit for a filling, and decayed roots in elders. Not for a tooth with an abscess.
- ☐ **Warn the family that the decay turns black permanently.** Protect lips, gum and clothes.
- ☐ Dry the tooth. Apply 38 per cent SDF until the cavity stays wet, re-wetting every 5 to 10 seconds. Wait 10 seconds, blot, and keep saliva off for 1 more minute. Do not rinse (Hesperian, Treating a Cavity with SDF).
- ☐ **Repeat:** every 6 months for children, every year for elders' roots.
- ☐ Store the bottle cool, dark and capped. Discard cloudy liquid [VERIFY, inference].

Protocol 7. The knocked-out adult tooth

- ☐ **Adult teeth only.** Never replant a baby tooth.
- ☐ Hold it by the crown. Rinse it for seconds in milk, saline or saliva, or in water if there is nothing else (Fouad and others 2020).
- ☐ **Replant within 15 minutes.** The patient bites on cloth.
- ☐ If you cannot replant, carry the tooth in milk or saliva to the healer.
- ☐ **At the healer:**
  - splint with wire or 0.13 to 0.25 mm nylon for **2 weeks**, or 4 weeks if the bone is broken
  - amoxicillin by weight
  - tetanus check
  - soft food
  - rinse twice daily for 2 weeks

☐ **Follow-up:** see the patient weekly for a month, then monthly. Extract at the first tenderness or swelling [VERIFY, my sequence].

Protocol 8. The toothless patient

☐ **Teach soft eating first:** pulses and grains cooked soft, vegetables and fruit grated or mashed, porridge, broth, eggs, curds and fish, with protein at every meal (Bradbury and others 2006).
☐ Weigh the patient monthly for the first year.
☐ **Denture at the district:** take a beeswax impression, cast a plaster model, then make it in acrylic or as a carved wooden upper plate.
☐ **Care:** dentures out at night, brushed and kept in clean water.
☐ Never heat amalgam. Never pull a healthy tooth to cure illness elsewhere.

Numbers to carry

1. **54 per cent.** The death rate of Ludwig's angina before penicillin. Act on day one.
2. **0.15 ml per kg, never over 10 ml.** The ceiling for 2 per cent lidocaine.
3. **5 minutes to test, 10 before re-injecting.**
4. **30 minutes of biting, 2 hours for a child.**
5. **48 to 72 hours.** No better by then: go back to the tooth.
6. **6 months.** The life of a zinc oxide and clove oil filling.
7. **85 per cent at 3 years.** Single-surface ART.
8. **Twice a year.** SDF for children.
9. **15 minutes, and 30 minutes dry.** The time limits for a knocked-out tooth.
10. **5 to 10 ml.** The amount of clove oil that poisons a small child.

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