WO-03 To close or not to close: sutures, delayed primary closure and healing by secondary intention

HEALING after the FALL, research library, WO-03

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

How to read this report

The real question is when skin may be sewn at all, not how to sew it. A stitch turns an open wound, which drains, into a closed space, which does not. Three terms recur. Primary closure means closing at the first treatment. Delayed primary closure (DPC) means cleaning and excising the wound, leaving it open, and closing it days later if it looks healthy. Secondary intention means never closing it and letting it fill in and contract. This report builds on the wilderness, humanitarian and bleeding reports (THRIVING library, FO-09, FO-11, WO-01). The related reports WO-02, WO-12 to WO-15 and MA-04 were not yet in the library, so irrigation, dressings and antibiotics appear here only as far as the closure decision needs them.

1. Why closure is dangerous

Every traumatic wound is contaminated. The Wilderness Medical Society (WMS) guideline states that infection is unlikely below about 10^5 bacteria per gram of tissue, and that an early animal model passed that count within about 5 hours of injury, which became the "golden period" (Quinn RH 2014). Its usual origin is Friedrich's 1898 guinea-pig experiments, in which contaminated wounds excised after about 6 hours proved fatal (Morgenstern, First10EM, secondary).

A stitch is itself a foreign body. In human volunteers, Elek and Conen (1957) found that fewer than about a million staphylococci injected into skin produced no pus, but that a suture in the tissue lowered the dose needed by several orders of magnitude (Elek 1957, read via secondary summaries). Popular accounts say the suture was silk. My notes from the summaries say cotton [VERIFY]. Braided thread is worse than smooth. Katz, Izhar and Mirelman (1981) found that braided sutures bound five to eight times more bacteria than nylon monofilament, and infection in mice tracked that adherence (Katz 1981, secondary). Silk, linen and cotton are all braided or twisted. Horsehair and fishing line are monofilaments.

Closure traps what an open wound would drain. The ICRC war-surgery manual states that the deep anaerobic conditions in which gas-gangrene clostridia thrive are "seen particularly in wounds sutured closed without debridement", with soil, tight plasters, long tourniquet times and compartment syndrome adding risk. Incubation is usually under three days and mostly under 24 hours, and can be as short as 6 hours (Giannou 2009).

Leaving a wound open is not free. It heals slowly, needs dressings and scars more. In a UK cohort, open surgical wounds took a median of about three months to heal (Chetter 2019). After the Fall, though, the treatments for a closed infection (theatre drainage, intravenous antibiotics, amputation under anaesthesia) are the hardest to obtain, so the balance tips towards leaving open.

2. The war record: what delayed primary closure changed

2.1 Before 1914

John Jones advised against early closure of gunshot wounds during the American Revolutionary War (Manring 2009). Hospital mortality among the wounded was about 16.7 per cent in the Crimea and 14.1 per cent in the American Civil War (THRIVING library, FO-11). Joseph Lister's 1867 paper reported eleven compound fractures treated with carbolic dressings: nine recovered, one was amputated and one died (Lister 1867, secondary). Lister closed over a chemically treated wound, a different philosophy from excision and delay. Carbolic acid is a dangerous substance and its preparation is not given here.

2.2 The First World War

The Western Front combined high-energy wounds with manured farm soil.

- Gas gangrene affected about 5 per cent of wounds in the American forces, with about 28 per cent mortality (Manring 2009). Secondary summaries give 5 to 6 per cent of wounds in 1915 falling to just over 1 per cent by 1918 [VERIFY]. At the Scottish Women's Hospital at Royaumont Abbey, Frances Ivens reported 107 cases among 1,694 wounded (6.3 per cent), of whom 25 (23.4 per cent) died, and achieved clean closure in 75 per cent of wounds initially contaminated with clostridia, after meticulous excision and serial anaerobic cultures (KUMC essay).
- Antoine Depage held that dead tissue caused the infection and taught wide excision. After poor results from early primary closure, wounds were left open 24 to 48 hours and closed if bacterial counts were low (Manring 2009). Depage advised against plaster and tight bandages over fresh wounds (KUMC).
- Alexis Carrel and Georges Dehelly (1915) combined excision with Carrel-Dakin hypochlorite irrigation and closed wounds once counts fell, usually within 20 days (Manring 2009).
- H. M. W. Gray, with Milligan, published on wound excision in June 1915 and later wrote the British standard text (Gray 1919), which I could not read.
- At a Fourth Army casualty clearing station run by Captain Forbes Fraser, reported by G. E. Gask, primary suture after excision succeeded in 102 of 123 cases (82.9 per cent), and delayed primary suture "compares very favourably" (Gask 1918, search summary only). Wallace reported 625 primary sutures, 444 healing by first intention and 69 suppurating (Wallace 1918, search summary only).

The record does not show a single moment when "closure at four to five days" was proved. The war taught three things together: excise dead tissue, do not close a dirty wound at once, and close later when it looks or cultures clean. Selected primary suture after excision worked for experienced surgeons with laboratories (Gask 1918). The brief's premise is right in spirit, but the four-to-five-day standard was fixed in the Second World War.

2.3 Spain and the Second World War

Josep Trueta in Barcelona excised wounds, left them open and immobilised the limb in closed plaster. Of 1,073 open fractures, 6 died and 4 were amputated, among more than 20,000 wounded treated this way (Manring 2009). The Americans relearned DPC. At Pearl Harbor, Hardaway's team closed after about three days, having seen early-closed amputation stumps become infected. In North Italy in 1944, Churchill reported about 25,000 soft-tissue wounds closed on their appearance, with about 5 per cent failure. Cleveland and Grove reviewed 2,293 delayed closures, of which 93 per cent healed. A 1945 summary for the US Surgeon General set closure at or after day 4 (Manring 2009).

2.4 Korea, Vietnam and the punji stake

In Korea, gas gangrene fell to 0.08 per cent of 4,900 wounds, and inadequate debridement caused most infections that did occur. In Vietnam, wounds were packed open and closed at about day 7, and Hardaway's 1966 to 1967 series of 17,726 patients had 3.9 per cent infection (Manring 2009). For punji-stake punctures, the WMS cites Shepard,

Rich and Dimond for 2 per cent infection with DPC against nearly universal infection without it (Quinn RH 2014), and the library repeats 2 per cent (THRIVING library, FO-09). Manring gives 10 per cent (Manring 2009). I could not read Shepard, so the figure should be carried as 2 to 10 per cent.

2.5 The modern humanitarian standard

The ICRC defines DPC as closure 4 to 7 days after debridement, in the fibroblastic phase, with 4 to 5 days as its standard. After about 8 days, fibrosis usually prevents direct closure. "No wound should be closed if there is persistent contamination or infection" (Giannou 2009). The library flagged this timing as single-source (THRIVING library, FO-11). It now has independent support, with differing windows: day 4 or later in 1945 (Manring 2009), about 48 hours in a WHO disaster document (WHO, wound infection, search summary), about day 7 in Vietnam (Manring 2009), days 3 to 5 in abdominal trials (Siribumrungwong 2014), and 3 to 5 days in family-medicine guidance (Forsch 2008). Four to five days is the safe middle.

3. Which wounds may be closed at once

3.1 No fixed golden period

- Jaman and colleagues (2021) reviewed nine studies and concluded that no time frame for safe primary closure could be established. In Quinn's study, infection was 2.9 per cent (64 of 2,176) before 12 hours and 1.4 per cent (1 of 72) after. Baker and Lanuti found 1.2 against 1.6 per cent across 6 hours. The outlier was Morgan's small hand and forearm study: 6.6 per cent before 12 hours against 31.5 per cent (6 of 19) after, relative risk 4.8. Berk's series found healing in 92.1 per cent before 19 hours against 77.4 per cent after, with 45 per cent lost to follow-up (Jaman 2021, Berk 1988).
- Quinn, Polevoi and Kohn (2014) followed 2,663 patients. Infection was 2.6 per cent overall, and 3.7 against 3.0 per cent before and after 6 hours. Risk factors were diabetes (relative risk 2.7), the lower limb (4.1, with 7.6 per cent infected), contamination (2.0) and length over 5 cm (2.9) (Quinn JV 2014, abstract and summaries).
- Hollander and colleagues (2001) studied 5,521 patients with 3.5 per cent infected. Adjusted odds ratios were 6.7 for diabetes, 2.6 for a foreign body, 1.05 per millimetre of width, and 0.28 for head and neck (Hollander 2001, abstract).
- Zehtabchi and colleagues (2012) pooled four studies of 3,724 patients without a consistent effect of wound age (Zehtabchi 2012, secondary).
- The Cochrane review of primary against delayed closure of non-bite wounds found no randomised trials (Eliya-Masamba 2013).

The guidelines differ:

Source	Body and limbs	Face and scalp
Hesperian	Over 12 hours: leave open	Not given separately
WMS text (Quinn RH 2014)	Up to 6 hours (grade 1C)	Up to 10 hours
WMS table (Quinn RH 2014)	Over 8 to 12 hours: treat as contaminated	Over 24 hours
MSD Manual	6 to 8 hours, "no definitive limit"	12 to 24 hours
AFP (Forsch 2017)	Up to 18 hours if clean (SORT B)	Up to 24 hours
Jaman 2021	No limit can be set	No limit can be set

The WMS text and table disagree with each other. The higher limits come from emergency departments with sterile materials, follow-up and a hospital behind them. My inference for after the Fall [VERIFY]: 6 hours for body and limbs, 12 hours for face and scalp, and none at all if risk factors are present.

3.2 Risk factors that override the clock

Dirt or foreign material, crushing (the WMS treats all stellate compression wounds as dirty), the lower limb, the hand, the armpit and groin (dirty in the WMS matrix), length over 5 cm, diabetes and old age (Quinn JV 2014, Hollander 2001, Quinn RH 2014, Jaman 2021). The face and scalp tolerate later closure because of their blood supply. The ICRC allows immediate closure of head, neck, scalp and genital wounds after excision unless severely contaminated, and always closes the mouth's lining (Giannou 2009).

3.3 Small wounds may need no closure

Quinn and colleagues randomised 91 patients with 95 uncomplicated hand lacerations under 2 cm to sutures or to conservative care (tap-water irrigation, pressure, ointment, gauze for 48 hours). Cosmetic scores at three months were 83 against 80 mm on a 100 mm scale (difference 3, 95 per cent confidence interval minus 1 to 8). One sutured wound became infected, none of the others. Treatment took 19 against 5 minutes (Quinn J 2002). Hesperian likewise says small wounds need no stitches (Hesperian). This is the most useful trial for a village.

3.4 Cleaning before any closure

Drinking water is as good as sterile saline (grade A in Forsch 2017, 1A in Quinn RH 2014). The AFP gives 50 to 100 mL per centimetre of wound at 5 to 8 psi, for instance from a 35 mL syringe with a 19-gauge needle (Forsch 2017). The WMS gives 6 to 15 psi (Quinn RH 2014), which the library summarised as 6 to 12 psi and at least 1 L (THRIVING library, FO-09). About one third of foreign bodies are missed on examination. Clean non-sterile gloves did as well as sterile ones in trials of 493 and 816 patients, but instruments and suture must be sterile (Forsch 2017).

4. The wounds that must wait or stay open

4.1 Bites

The AFP gives infection rates of up to 19 per cent for bites overall, 47 to 58 per cent for cat bites, 8 to 14 per cent for dog bites and 7 to 9 per cent for human bites (Forsch 2017). The trials are more nuanced than "never close a bite".

- Paschos and colleagues randomised 168 dog-bite patients: infection 9.7 per cent sutured against 6.9 per cent open, not significant, with better appearance after suturing (Paschos 2014, secondary). A summary reports 4.5 per cent infection when closed within 8 hours and 22.2 per cent later [VERIFY].
- Maimaris and Quinton found sutured dog bites of the hand infected in 5 of 30 (16 per cent) against 4 of 45 (8 per cent) left open (Maimaris 1988, secondary).
- Chen and colleagues closed 145 mammalian bites (88 dog, 45 cat, 12 human) with 5.5 per cent infected (Chen 2000, via AFP 2018).
- Cochrane found only dog-bite trials: risk ratio for remaining free of infection 1.01 (0.97 to 1.05), 782 participants, very low certainty (Bhaumik 2019, abstract).

The MSD Manual's rule: close only fresh, minimally damaged, cleanable bites. Leave open human bites, punctures, wounds of the hand, foot, perineum and genitals, wounds involving deeper structures, swollen wounds and wounds more than several hours old. Delayed closure gives comparable results, so little is lost by waiting (MSD Manual, bites). Dog bites of the face may be closed, and cat bites do better left open (Forsch 2017). A cut over the knuckle from punching a mouth must be examined with the fist clenched, because the tendon wound slides away when the fingers straighten (MSD Manual, bites). It is never closed.

4.2 Possible rabies

The WMS advises irrigation, preferably with a virucidal agent, and closure delayed for 4 days (grade 1C) (Quinn RH 2014). The WHO's 2018 position calls for washing and flushing for about 15 minutes with soap and water, then an iodine preparation, and allows loose suturing only after rabies immunoglobulin has been infiltrated (WHO 2018). The WHO Rabies Bulletin Europe advises avoiding or delaying suturing, and Irish guidance warns that suturing may push virus into nerves (WHO Rabies Bulletin Europe, HPSC, summaries). After the Fall there will be no immunoglobulin, so the WMS rule applies: wash 15 minutes, do not close, reconsider at day 4 only for disfiguring wounds.

4.3 Punctures, contaminated and crushed wounds

Punctures cannot be irrigated or inspected to their depth, and the MSD Manual lists them, with high-velocity missile wounds, among those not to suture (MSD Manual, sutures). The WMS matrix is the simplest rule: clean wounds close primarily, dirty wounds get high-pressure irrigation and may close primarily, and contaminated wounds get high-pressure, high-volume irrigation and DPC. Between two categories, choose the dirtier. Bites anywhere but the face count as contaminated (Quinn RH 2014). For war wounds, the ICRC uses excision and DPC. Machete wounds under 6 hours old may be closed after debridement with a drain, and older ones get DPC at 2 to 4 days. Small, superficial, low-energy fragment wounds get soap, water, disinfectant and a dry dressing and heal by secondary intention (Giannou 2009).

4.4 Old and neglected wounds

At the ICRC hospital at Lokichokio in northern Kenya, 84 per cent of 12,264 wounded registered between 1991 and 2006 arrived more than 72 hours after injury. The ICRC states that most neglected wounds are unsuitable for DPC and need grafting, flaps or healing by granulation, with honey, sugar or hypertonic salt dressings as adjuncts, not replacements for surgery (Giannou 2009).

4.5 Disasters

A WHO wound-infection document, read only through a search summary, advises leaving contaminated wounds and clean wounds over 6 hours old open and closing them at 48 hours, and warns that "injudicious closure of a contaminated wound will promote infection" [VERIFY]. A disaster-wound consensus drawing on 62 studies advised against primary closure in disasters (Wuthisuthimethawee 2014, summary). Among tsunami casualties evacuated to Germany in 2004, 88 per cent of wounds were on the lower limbs and Gram-negative infection was common (Maegele 2005, summary).

4.6 Deep structures

The ICRC closes the dura, pleura (with a chest drain), peritoneum and joint capsule, covers vessels with muscle, and leaves the skin open over them. Hand wounds get conservative excision and DPC at 2 to 4 days with tendons and nerves covered, though small hand wounds may be closed primarily (Giannou 2009). The AFP refers any tendon or muscle injury of the hand, nerve injury, open fracture or eyelid wound (Forsch 2017).

5. Delayed primary closure: how it is done

First operation. Clean the wound and remove dead tissue and foreign material. The ICRC lays in bulky fluffed gauze, loosely, without petroleum-jelly gauze, and forbids tight circumferential bandages, which act as tourniquets (Giannou 2009). The WMS packs grossly contaminated wounds with wet-to-dry dressings (Quinn RH 2014). Both leave the wound open.

Waiting. The ICRC does not change the dressing before closure unless something is wrong. Its test: "The wound is doing quite well if the patient is smiling, eating, and sitting comfortably in bed." Take the dressing down early for bleeding, fever, toxicity, excessive pain, warmth, redness (a shiny surface on dark skin), swelling or an offensive wet dressing. Tetanus prophylaxis is given to all, and the ICRC gives penicillin for five days to soldiers with excised wounds (Giannou 2009). Antibiotic history, dose and harms belong to MA-04.

Reading the wound at day 4 to 5 (Giannou 2009):

- Ready: dressing dry and greenish-black, an ammoniacal "good-bad smell", muscle sticking to the gauze that contracts and bleeds slightly when freed, surface bright red and oozing.
- Infected: dressing slides off on pus, surface dull or greyish-red, no bleeding, a foul "bad-bad smell". Clean again and leave open.

Churchill's 25,000 wounds in Italy were closed on this kind of visual judgement with about 5 per cent failure (Manring 2009). This test is the core skill of the report.

Closure. Direct suture, minimal undermining, no tension. Small wounds may be closed with adhesive tape. Absorbable sutures for deep structures only, fascia and fat need not be sutured. Avoid drains or remove them within 24 hours. Leave dry gauze on until the stitches come out. If infection develops, reopen in theatre, not on the ward (Giannou 2009).

What trials add. DPC has been randomised only in abdominal surgery. In appendicitis, surgical site infection was 23 per cent (55 of 234) after primary closure against 26 per cent (45 of 182) after DPC, risk ratio 0.89 (0.46 to 1.73), and DPC added about two hospital days (Siribumrungwong 2014). Bhangu's pooling of eight trials (623 patients) of contaminated or dirty incisions found an odds ratio of 0.65 (0.40 to 0.93) favouring DPC, with high risk of bias and no significance on random effects (Bhangu 2013, summary). With modern antibiotics, DPC is at best modestly better in the abdomen. That does not transfer to a soil-filled limb wound, for which the war record is the evidence.

6. Healing by secondary intention

The ICRC washes open wounds and changes dressings every 4 to 5 days, because "every dressing is a trauma", and uses sugar and honey (Giannou 2009). Hesperian dresses infected wounds daily with honey (Hesperian). Honey and sugar dressings are covered in WO-12.

Timescales. A York survey found 0.41 open surgical wounds per 1,000 people, 48 per cent planned and 41 per cent broken-down closures (Chetter 2017, summary). In a cohort of 393 patients, 81.4 per cent healed during follow-up, with a median time to healing of 86 days. Infection, wound area and contamination predicted delay (Chetter 2019, abstract). Scar strength rises fast to about week 6, peaks around three months, and reaches only about 80 per cent of uninjured skin (Levenson 1965, secondary [VERIFY]). A contraction rate of about 1 mm a day appears only in study aids [VERIFY]. My inference [VERIFY]: a wound of a few centimetres heals in two to four weeks, a large one in two to four months, and one not shrinking after two weeks of good dressings has a reason (dead tissue, a foreign body, infection, poor circulation, diabetes).

Scarring. Primary closure gives the best scar where it succeeds (Paschos 2014). Secondary intention leaves a broader scar that can contract across joints, the neck and the hand, which is why the ICRC closes or covers hand and face early (Giannou 2009).

7. Materials

7.1 Modern evidence

Absorbable and non-absorbable sutures perform alike for skin across 19 studies, and monofilament and braided alike in trauma. The AFP recommends 5-0 or 6-0 on the face, 4-0 for most of the body, and 3-0 on back, scalp, palms and

soles (Forsch 2017). These trials assume sterile commercial thread. After the Fall the question is which material can be made and sterilised without becoming a source of infection.

7.2 Catgut

History. Lister in 1869 tied a calf's carotid artery with carbolised catgut and found it absorbed without suppuration (Lister 1869, secondary). He later introduced chromic catgut, tanned to slow absorption. Kocher in 1890 found catgut treated with juniper oil and mercuric chloride still caused infections and turned to silk (secondary). Reliable catgut sterilisation took about forty years after Lister (secondary).

Harm. Gut comes from intestine, full of spore-forming bacteria. In the 1920s at the Royal Infirmary of Edinburgh, catgut had been used in all eleven cases of post-operative tetanus. T. J. Mackie found contaminated supplies made by methods thirty years out of date, which led to batch testing (King's College London archive, summary). A 1936 Ministry of Health memorandum described nine post-operative tetanus cases, five fatal, in three groups, pointing to "home-cured" catgut (Dalrymple-Champneys 1936, summary). Britain's Therapeutic Substances Act of 1925 and its 1930 to 1931 regulations brought catgut under control (secondary). Moist heat destroys catgut, so heat sterilisation requires it dry (secondary).

Modern status. Commercial catgut is collagen from sheep, cattle or goat intestine. Plain gut holds for days. Chromic gut holds about 7 to 20 days and is absorbed in about 90 (manufacturer data, secondary), and the AFP gives a 50 per cent loss of strength in 10 to 14 days (Forsch 2017). France banned catgut by an order of 31 August 2001 (Ecolex), after BSE. The tanning and sterilisation steps involve dangerous substances and are not given here.

Feasibility. A village can make gut string but cannot make it safe inside the body without reliable sterilisation and a sterility test. For skin stitches, which come out anyway, catgut offers nothing. Grade B under controlled manufacture, X for home-cured catgut buried in tissue.

7.3 Silk

Silk (Bombyx mori) is ancient. William Halsted used fine silk at Johns Hopkins from 1889 with gentle handling and low tension, and Hopkins used black silk until about 1960 (secondary). It is braided and holds bacteria (Katz 1981). Boiling weakened silk in Scarff's 1927 tests, autoclaving did not (Scarff 1927, abstract). Silk is the best salvageable thread for skin stitches if steam- or dry-heat sterilised and removed on time. Grade B.

7.4 Linen and cotton

Linen (flax, Linum usitatissimum) is the oldest wound material on record. The Edwin Smith Papyrus, about 1600 BC, describes linen strips drawing wound edges together, and cotton (Gossypium species) thread was used into the nineteenth century (Atıcı 2010). Both are twisted multifilaments and should share silk's bacterial adherence [VERIFY: inference]. Strips laid on the skin bury nothing, which may make the Egyptian method safer than thread through skin [VERIFY: inference]. Grade C.

7.5 Horsehair

Horsehair (tail of Equus caballus) was used in the nineteenth century and by Confederate surgeons when supplies were cut off, boiled to soften it, with reported low infection but no data (Atıcı 2010, secondary). As a monofilament it should hold fewer bacteria [VERIFY: inference]. It is weak, so only fine stitches under no tension suit it. Grade D.

7.6 Fishing line and floss

Nylon fishing line resembles nylon suture but was not made for implantation and its additives are unknown [VERIFY: inference]. A veterinary study found that ethylene-oxide sterilisation weakened three of four brands (Thieme

veterinary study, summary). In a knot-tying study with large nylon line, more than 70 per cent of knots slipped [VERIFY: summary of PeerJ 14106]. I found no human data on fishing line or floss. Grade D, skin only.

7.7 Salvaged sutures

Sealed commercial sutures will be precious salvage. The library notes that suture perishes in storage [VERIFY] (THRIVING library, FO-11), and I found no data on loss of strength after expiry. A Community Eye Health guideline advises resterilising only monofilament sutures, by a 10-minute soak in 10 per cent povidone-iodine, and discarding braided silk (Community Eye Health 2004, summary [VERIFY]). Grade A for intact in-date stock, D for resterilised.

7.8 Ant heads

Tradition. Living ants bite across the wound, their bodies are snapped off, and the heads stay as clips.

Record. The best account is second-hand. In 1896 R. Morton Middleton told the Linnean Society that Miltiades Issigonis of Smyrna had, about six years earlier, cut his forehead about an inch in a fall from his horse, and that a Greek barber applied at least ten living ants with forceps and severed their bodies. The heads stayed about three days, by which time the cut had healed. The ant was dark brown, about three-eighths of an inch long, nearest to a large-headed Camponotus. Middleton cited one earlier report: Émile Mocquerys wrote in 1844 that Indigenous Brazilians closed wounds with seven or eight heads of Atta cephalotes. Middleton noted that Bates and Wallace, who knew that ant, never mentioned it (Middleton 1896). Gudger collected further claims in 1925, including Hindu sources (Gudger 1925, secondary). Secondary sources say the Sushruta Samhita uses ant heads for intestinal wounds [VERIFY: verse not located]. The entomologist Daniel Kronauer has heard of East African use of Dorylus and South American use of Eciton army ants but has never seen it (Kronauer, Vice).

Science infers. Soldier-ant jaws can hold small edges for a few days. No infection data exist, and the head is an unsterile foreign body on cuts that would heal under a strip anyway. The brief's warning holds: repeated far more than observed. Grade D.

7.9 Thorns and pins

I found no primary ethnographic source for thorns used to pin wound edges. Reports of acacia thorns as needles in southern Africa could not be confirmed [VERIFY]. The nearest documented technique is the nineteenth-century "twisted suture" for harelip, in which pins crossing the wound were wound with thread in a figure of eight. I found titles of the period (Cooper 1862) but could not read the text [VERIFY]. A thorn combines a puncture with a foreign body [VERIFY: inference]. Grade D, not recommended.

7.10 Plants

No plant is central to closure. Flax and cotton supply thread, and no lookalikes apply. I found no source on plant gums or resins as wound glues. Sealing is the danger, so they should not be used [VERIFY: inference].

8. Sterilising needles and thread

Two sources agree on dry heat. The CDC gives 170°C for 60 minutes, 160°C for 120 minutes or 150°C for 150 minutes (CDC). Hesperian tells lay readers to bake needle, thread and pliers at 170°C for 1 hour or 150°C for 2.5 hours (Hesperian). Kitchen thermostats may be off by 10 to 20 degrees [VERIFY], so an oven thermometer helps.

Steam is the hospital standard. The ICRC uses 134°C at 2.1 bar for 18 minutes, and the CDC gives 121°C for 30 minutes for wrapped loads. A domestic pressure cooker at about 1.1 bar reaches about 121°C, and a blocked valve can explode it (THRIVING library, FO-11). Steam suits steel and silk (Scarff 1927) but ruins catgut.

Boiling disinfects but does not reliably kill spores, including those of tetanus and gas gangrene (Sondhi 2022, summary, and THRIVING library, FO-11). The sanitation report gives at least 10 minutes of boiling for instruments [VERIFY] (THRIVING library, SY-03). Boiling is better than nothing for a needle used on a removable skin stitch, but it is not sterilisation.

9. Needles, knots and patterns

Hesperian suggests silk or nylon thread, a curved needle or a sharpened sewing needle, and pliers (Hesperian). The simple interrupted stitch is the one pattern a lay healer should learn (MSD Manual, sutures, Hesperian):

- Enter at 90 degrees, pass to equal depth on both sides, exit at 90 degrees. Make the stitch deeper than wide so the edges turn slightly outward.
- Bite 2 to 5 mm from the edge (training guides, summaries), with spacing about equal to the bite (MSD Manual).
- Place the first stitch in the middle, then halve the gaps.
- Instrument tie: two wraps for the first throw, then single throws in alternating directions, about four square throws, tails about 1 cm, just tight enough to bring the edges together (MSD Manual). Hesperian says one knot then three more.
- A review of knot security gives 3 to 5 throws, more for monofilament than multifilament (em-consulte 2024, abstract). Slippery line needs extra throws.

Running stitches dehisce less in surgical wounds (Forsch 2017), but one break opens the whole line, so interrupted stitches are safer for beginners [VERIFY: inference].

Local anaesthetic. The AFP gives maximum lidocaine doses of 3 to 5 mg per kg plain and 7 mg per kg with adrenaline (Forsch 2008). I found only this one source, and did not research overdose signs, so this fails the two-source rule. Lidocaine belongs to the anaesthesia report and should not be used by a lay healer without it.

10. Tape, glue, hair and bandaging

Adhesive strips. Tape has the lowest tensile strength and highest dehiscence of any closure, but in low-tension wounds matches glue. It must be applied without shearing the skin, and skin adhesives under it can blister (Quinn RH 2014). The ICRC closes small wounds at DPC with tape (Giannou 2009). Tape puts nothing in the wound and can be lifted to let pus out [VERIFY: inference]. I found no trial of home-cut butterfly strips [VERIFY].

Tissue glue. A Cochrane review of 13 trials found equal cosmesis to sutures, slightly more dehiscence (number needed to harm 40, 95 per cent confidence interval 20 to 1,168), less redness, less pain and about 5 minutes saved (Farion 2002, abstract). The AFP gives a number needed to harm of 25 for dehiscence (Forsch 2017). The difference is unexplained [VERIFY]. Glue suits wounds under 12 hours old that are linear, not across joints, not in hair, not contaminated and not bites (Forsch 2017). Apply three or four layers 30 seconds apart, overlapping 5 mm, and it falls away in 5 to 10 days (Forsch 2008). Hesperian gives three layers 30 seconds apart and warns against use near eyes and mouth and on hands and joints (Hesperian). Household superglue was not studied here [VERIFY].

Hair apposition. Strands on each side of a scalp cut are twisted together and fixed with a drop of glue. In the Singapore HAT trial of 189 scalp lacerations under 10 cm, complications were 7.4 against 21.5 per cent for sutures (number needed to treat 7) and the procedure took 5 against 15 minutes (Ong 2002, secondary). The AFP calls it cheapest with highest satisfaction for wounds under 10 cm with hair over 3 cm (Forsch 2017, Forsch 2008). The WMS confirms it, noting it closes only the surface and controls little bleeding (Quinn RH 2014). I found no data for knotted hair without glue [VERIFY]. Grade A with glue.

Bandaging. A clean protective dressing helps in austere settings (WMS 2C), and a moist environment promotes healing (WMS 1C) (Quinn RH 2014). No tight circumferential bandage or plaster over a fresh wound (Giannou

2009, KUMC).

11. Removal times and signs of failure

Site	AFP (Forsch 2017, 2008)	MSD Manual	Hesperian
Face	3 to 5 days	3 to 5 days, alternate stitches out at day 3	About 1 week overall
Scalp	7 to 10	6 to 10	About 1 week
Arms	7 to 10	10 to 14	About 1 week
Trunk	10 to 14	6 to 10	About 1 week
Legs	10 to 14	10 to 14	About 10 days
Hands and feet	10 to 14	Not given	About 1 week
Over joints	Not given	14	About 10 days
Palms and soles	14 to 21	Not given	Not given

The sources differ most for the trunk and arms. Early removal reduces stitch marks, late removal reduces dehiscence. With braided home-made thread, the earlier end of each range is safer for infection [VERIFY: inference]. A practical compromise: face 5 days, scalp 7, arms and trunk 10, legs, hands and feet 12, joints, palms and soles 14. The MSD Manual advises a wound check at 2 days.

Signs of failure: pain increasing after the first day, spreading redness (a shiny or darker surface on dark skin), warmth, swelling, pus, foul discharge, stitches cutting through, fever, a patient who stops eating (Giannou 2009, Hesperian). Gas gangrene (Giannou 2009): sudden severe pain, swelling, thin watery or blood-stained discharge, a pulse high for a temperature rarely above 38°C, anxiety or odd euphoria, tense pale marbled cold skin turning bronze, dark blisters, crepitus, a sweetish smell.

What to do. Hesperian: remove the stitches, open the wound, wash it with plenty of water, dress with honey and change daily (Hesperian). Gas gangrene needs excision to healthy, contracting, bleeding muscle, or amputation, at district level (Giannou 2009).

Evidence grades

Practice	Tradition says	Record shows	Science infers	Grade
DPC of contaminated wounds at day 4 to 5	Wait, then close (Jones onward)	WWII: 25,000 wounds about 5 per cent failure, 2,293 closures 93 per cent healed	Abdominal RCTs show little gain with antibiotics, no trauma RCTs	B
Excision before closure	Depage, Gray, Trueta	Gas gangrene fell to about 1 per cent by 1918 [VERIFY]	Dead tissue feeds anaerobes	B
Immediate closure of contaminated wounds	Nineteenth-century practice	WWI gas gangrene, Pearl Harbor stumps	Closed space, dead tissue, bacteria	X
Primary closure of clean, fresh, simple lacerations	Universal	Infection 2.6 to 3.5 per cent in large cohorts	No fixed time limit found	A

Practice	Tradition says	Record shows	Science infers	Grade
A fixed 6-hour golden period	Friedrich 1898	Not reproduced in humans	Risk factors dominate	X as rule, B as caution
Leaving clean hand cuts under 2 cm unsutured	Common sense	Equal cosmesis, RCT of 91	Stitches add pain and time	A
Primary closure of dog bites (not hand)	Never close bites	About 7 per cent infection either way	Very low certainty	B
Closing human, cat, hand or foot bites, punctures	Rarely advised	Hand dog bites 16 against 8 per cent	High risk	X
Closing rabies-prone bites without immunoglobulin	None	WMS: wait 4 days	Virus into nerves	X
Secondary intention	Universal	Median 86 days for open surgical wounds	Safe, slow	B
Tissue glue, low-tension wounds	Modern	13 trials, equal cosmesis	Dehiscence NNH 25 to 40	A
Hair apposition, scalp	Modern	RCT of 189	Cheap, fast	A
Adhesive strips	Egyptian linen strips	Matches glue in low tension	Nothing buried	A (WMS 1A, adhesives group)
Silk	Antiquity, Halsted	Standard to about 1960	Braided	B
Linen, cotton thread	Egypt, Europe	Long use, no data	Braided	C
Horsehair	Nineteenth century	Anecdote	Weak monofilament	D
Fishing line	Survival lore	No human data	Unknown additives	D
Home-made catgut in tissue	Long use	Fatal tetanus, Edinburgh 1920s, Britain 1936	Spores	X
Ant-head clips	Smyrna, Brazil, India (reported)	Two second-hand reports	Unsterile foreign body	D
Thorn pins	Not found	Not found	Puncture plus foreign body	D
Dry heat 170°C 1 h	Hospital practice	CDC and Hesperian agree	Kills spores	A as standard
Boiling instruments	Common	Spores survive	Disinfection only	B for skin needles, X for implants
ICRC smell and colour test before DPC	ICRC teaching	Visual closure in WWII, 5 per cent failure	Not formally validated	B

Means ledger

Rung	What can be done	What it changes
Hands and knowledge	The decision rule. Pressure for bleeding. Washing with the cleanest water. Leaving open under clean cloth. Reading a wound at day 4 to 5.	Most deaths from closure are prevented by not closing.
Hearth	Boiled water for irrigation. Boiled needle and silk or cotton for fresh face and scalp cuts. Cloth-strip closures. Honey or sugar dressings (WO-12). Oven dry heat at 170°C for 1 hour if the temperature holds.	Simple clean cuts closed. Dirty wounds left open and dressed.
Garden and still	Pressure cooker at about 121°C for needles, silk and linen. Forge-made curved needles [VERIFY]. Soap, ethanol. Horsehair and linen thread dry-sterilised.	True sterilisation, which makes DPC safe.
Village dispensary (300)	Salvaged sutures, needle holder, forceps, scissors. Planned DPC with written day-4 review. Wound register. Tape and glue from stock. Tetanus vaccine while it lasts.	Larger wounds excised and closed late. Infection rates measured.
District infirmary (3,000)	Excision under anaesthesia, reopening in a clean room, skin grafts, amputation for gas gangrene, Gram stains to guide closure as Depage and Carrel did.	Neglected and crushed wounds survivable, gas gangrene sometimes treatable.
Hospital before the Fall	Imaging, antibiotics, rabies immunoglobulin and vaccine, hand surgery, negative-pressure dressings, flaps.	About 3 per cent infection after primary closure. Tendons and nerves repaired.

Harm test

The closed abscess and trapped infection. Closing a wound holding pus, dead tissue or soil seals bacteria in a space with no exit, and clostridia can produce gas gangrene within hours (Giannou 2009). The harmful errors are closing a wound past the time limits, a crush or puncture, a farm or war wound, any wound with dirt left in it, or an abscess cavity after drainage [VERIFY: inference for the abscess], and putting tight bandages or plaster over a fresh wound (Giannou 2009). Those most at risk have diabetes (odds ratio 6.7), are old, or have leg wounds (relative risk 4.1) (Hollander 2001, Quinn JV 2014). Signs and treatment are in section 11. Historical cases: the early closures of 1914 to 1915 (Manring 2009) and the infected early-closed stumps at Pearl Harbor (Manring 2009).

The sutured bite. Mouth bacteria are carried deep. Sutured hand bites were infected twice as often as open ones (16 against 8 per cent) (Maimaris 1988). Suturing may push rabies virus into nerves (HPSC, summary). The error is closing human, cat, hand, foot, puncture or old bites, or a possible rabies bite before day 4. Remove the stitches, open, wash and leave open.

The missed or stitched tendon or nerve. About 30 per cent of flexor tendon injuries are reported missed on explo-

ration outside theatre, and combined emergency and hand-surgeon accuracy in one study of 101 patients was 68.2 per cent (EP Monthly) [VERIFY: secondary summaries]. Closing skin over a cut tendon hides it, and a deep stitch can catch a nerve or tendon [VERIFY: inference]. Before closing any hand or wrist wound, test bending of each finger joint against light resistance and feeling on both sides of each fingertip. If anything is lost, close skin only or leave open, and send to the district (Forsch 2017 refers all such injuries).

Infection from the material. Home-made catgut caused fatal tetanus (Dalrymple-Champneys 1936). Braided thread carries five to eight times more bacteria (Katz 1981). Boiled thread may carry spores (Sondhi 2022). Bury nothing home-made.

Tension and dehiscence. Glue and tape fail more under tension (Quinn RH 2014, Farion 2002). If the edges do not meet easily, do not close.

Other harms. Lidocaine above 3 to 5 mg per kg plain (Forsch 2008), with overdose signs outside this report. Pressure-cooker explosion from a blocked valve (THRIVING library, FO-11). Ant heads and thorns put unsterile matter in skin.

Special groups. No closure method is contraindicated in pregnancy. In small children, glue, tape or hair apposition avoid the pain and struggle of stitching (Farion 2002 included children, inference [VERIFY]), and lidocaine limits per kilogram are far lower.

Red flags

- Signs of gas gangrene (section 11). Death can follow within hours. Remove all stitches and dressings, open widely, carry the patient at once to whoever can excise or amputate.
- Spreading redness or red streaks with fever, confusion, cold skin, fast breathing or no urine (sepsis). Open the wound, give fluids by mouth if conscious, send.
- Jaw stiffness or spasms days after a wound (tetanus). Nothing in the village cures it. Quiet, darkness, fluids and comfort.
- A bite from a possibly rabid animal with no vaccine. Wash 15 minutes at once (WHO 2018). Once symptoms begin, rabies is almost always fatal, and comfort and sedation are what can be offered.
- Lost finger movement or feeling after a hand cut, or a knuckle cut from a punch. Splint in the position of function and send.
- Exposed bone, joint, chest or abdomen. Cover with clean damp cloth and send.
- A large leg wound in someone with diabetes or poor circulation. Leave open, elevate, watch daily.

Honest comfort: a slow open wound with a wide scar is a success. Tell the patient that leaving it open is the safe choice, not neglect.

The case against

The strongest case against this report's caution comes from emergency medicine. Cochrane found no randomised evidence that delayed closure beats primary closure for traumatic wounds (Eliya-Masamba 2013). Large cohorts found 2.6 to 3.5 per cent infection with no effect of the clock (Quinn JV 2014, Hollander 2001), and Jaman concluded no time limit can be set (Jaman 2021). The WMS states that primary closure has not raised infection in several high-risk wounds, including mammalian bites, landmine amputation stumps, open fractures and complicated appendicitis (Quinn RH 2014). Dog-bite trials show no benefit from leaving open (Bhaumik 2019), and abdominal DPC trials show no clear gain (Siribumrungwong 2014). By this argument, leaving wounds open condemns patients to slow healing and ugly scars for nothing. Its leading voices are J. V. Quinn, J. E. Hollander and the WMS panel led by R. H. Quinn.

My answer is that these studies used sterile commercial materials, thorough irrigation, follow-up, antibiotics and a

hospital behind them. The only evidence from settings like the world after the Fall is the war record, and it favours excision and delay for contaminated wounds. A wrong closure costs a limb or a life, a wrong delay costs a slower scar.

Delay has its own costs: dressings, the healer's time, wounds never closed, and worse scars on the face and hand, where the ICRC itself closes early (Giannou 2009). Lister's chemical antisepsis saved most of his closed compound fractures (Lister 1867).

Against the romance of tradition: ant heads rest on two hearsay reports, thorns on none, and home-cured catgut on a record of fatal tetanus. Against the romance of the hospital: sutures, glue and antibiotics will run out, and the most effective act in this report, deciding not to close, needs none of them.

10-line summary

1. Closing a contaminated wound seals bacteria in, and a stitch itself lowers the infecting dose.
2. The First World War taught excision and delay, and by 1945 DPC at about day 4 failed in about 5 per cent of 25,000 wounds.
3. The ICRC standard is DPC at 4 to 5 days (range 4 to 7, not after 8), never over persistent contamination.
4. No fixed golden period has been proved: dirt, crushing, the leg, the hand, size over 5 cm and diabetes matter more than hours.
5. Clean, fresh, simple wounds close safely, with about 3 per cent infection in hospital cohorts, and the face and scalp tolerate later closure.
6. Clean hand cuts under 2 cm heal as well without stitches.
7. Never close human, cat, hand or foot bites, punctures, crushed wounds or possible rabies bites at once.
8. Glue, tape and hair apposition match stitches in low-tension wounds and bury nothing.
9. Dry heat at 170°C for 1 hour sterilises needles and thread, boiling only disinfects.
10. Remove stitches at about 5 days on the face and 7 to 14 elsewhere, and all of them at the first sign of infection.

Open questions

- No randomised trial compares primary and delayed closure of contaminated traumatic wounds.
- The original WWI series (Gask, Wallace, Gray) were read only through summaries, and the 1917 to 1918 closure interval is unconfirmed.
- Punji infection with DPC: 2 or 10 per cent.
- Glue dehiscence: number needed to harm 25 or 40.
- Removal times differ by up to 4 days for trunk and arms.
- How long sealed sutures stay safe after expiry.
- Whether dry-sterilised linen, cotton or horsehair stitches infect more than silk.
- Ant and thorn closures lack any first-hand observation with outcomes.
- The contraction rate of open wounds lacks a primary source I could read.

Sources to read in full

1. Giannou and Baldan, War Surgery volume 1 (ICRC 2009), chapters 10 to 13.
2. Manring and colleagues, Treatment of war wounds: a historical review (2009).
3. Quinn RH and colleagues, WMS wound guideline (2014).
4. Forsch, Little and Williams, Laceration repair: a practical approach (2017).
5. Hesperian, New Where There Is No Doctor, Wounds.
6. Jaman and colleagues, golden-period systematic review (2021).
7. Bhaumik and colleagues, Cochrane review of bite closure (2019).
8. Quinn J and colleagues, hand-laceration trial (2002).

9. Middleton (1896), the ant-suture account.
10. Gray (1919), The early treatment of war wounds, if access can be had.

At the bedside after the Fall

Household. Minimum version: the decision rule on a card. Close only clean, fresh, simple cuts, within 12 hours on face and scalp and 6 hours elsewhere. Wash every wound with large volumes of boiled water. Leave small hand cuts unstitched. Use hair apposition on the scalp and cloth strips for small low-tension cuts. Leave bites and punctures open. Needs: boiled-and-dried cotton cloth, a lidded tin, sharp needles, silk if any, a hot oven or pressure cooker, honey or sugar, soap. First failure to expect: someone stitches a dirty garden-tool cut or a dog bite to the hand because it looks neat, and it festers within two or three days. Remove every stitch and open it.

Village of 300. Minimum version: one or two trained lay healers who can remove obvious dead tissue, irrigate, perform DPC with a day-4 to day-5 review by the ICRC test, and place interrupted stitches, plus a register of every wound with date, type, treatment and outcome. Needs: a pressure cooker kept for instruments, needle holder or pliers, toothed forceps, scissors, scalpel, salvaged sutures reserved for face and hand, silk or linen for the rest, tape, any glue, dressings, and practice on animal skin [VERIFY]. First failure to expect: closing too much, too early, because patients want stitches. The register will show it if kept.

District of 3,000. Minimum version: an infirmary with a clean room for excision under anaesthesia, reopening of failed closures, skin grafts and amputation for gas gangrene, with a bench for Gram stains. It holds the reserve sutures and glue. Needs: a surgically trained nurse or doctor, pressure steriliser and dry-heat oven, local anaesthetic and its report, graft knives or razors, splints, tetanus vaccine while it lasts, and a teaching programme. First failure to expect: wounds days old, as at Lokichokio (84 per cent over 72 hours), most unsuitable for DPC. Secondary-intention care and grafting matter more than suturing.

Protocols

Protocol 1: Deciding whether to close

1. Stop bleeding first (WO-01).
2. Note the hours since injury.
3. Bite, puncture, crush, gunshot, blast, soil-contaminated farm tool: leave open (Protocol 3).
4. Diabetes, poor circulation or age over 75: prefer leaving open.
5. Time limits: face and scalp about 12 hours, elsewhere 6 hours. Hand, foot, leg, armpit, groin: be stricter. Older: leave open.
6. Hand or arm wound: test bending of each finger joint and feeling on both sides of each fingertip. Any loss: do not close deep layers, send.
7. Clean (Protocol 2). Any dirt left: leave open.
8. Edges must meet without pulling, or leave open.
9. Clean hand cut under 2 cm: dress, do not stitch.
10. Otherwise choose the least invasive method that holds: hair apposition, tape, glue, then stitches.

Tolerance: when unsure, leave open.

Protocol 2: Cleaning

1. Wash hands with soap. Clean gloves if available.
2. Drinking water or boiled water cooled to body warmth.
3. 50 to 100 mL per centimetre of wound, at least 1 L for a sizeable wound.
4. A firm jet, about 5 to 8 psi: a 35 mL syringe with a 19-gauge needle, or a squeeze bottle with a small hole.
5. Pick out visible dirt with sterilised forceps. Do not dig for hidden objects.

6. Trim obviously dead tissue only if safe. Clip hair, do not shave (Quinn RH 2014).

Protocol 3: Leaving open and delayed primary closure

1. Clean (Protocol 2).
2. Lay sterilised gauze or boiled-dried cloth loosely into the wound. Do not pack tight.
3. Bulky dressing, loose bandage, never tight around a limb. Raise the limb.
4. Leave 4 to 5 days unless fever, worsening pain, a wet or foul dressing, or bleeding.
5. Day 4 or 5, lift the dressing gently:
    - Ready (dry greenish-black dressing, ammonia smell, red wound that bleeds slightly): go to step 6.
    - Not ready (pus, dull grey, no bleeding, foul smell): clean again, re-dress, look again in 2 to 3 days.
6. Close only if edges meet without tension, by tape for small wounds or interrupted stitches.
7. If they do not meet, or after day 8, let it heal by secondary intention (Protocol 6).

Protocol 4: Sterilising

1. Wash items with soap and water, dry them.
2. Wrap in cloth or place in a lidded metal tin.
3. Dry heat: 170°C for 1 hour or 150°C for 2.5 hours, timed from reaching temperature. If the oven runs cool, add time.
4. Or pressure cooker at full pressure for 30 minutes, valve checked each time.
5. If neither is possible, boil at least 10 minutes [VERIFY], for removable skin stitches only.
6. Never heat or boil catgut or synthetic absorbable sutures.
7. Keep sealed until use.

Protocol 5: Simple interrupted stitches

1. Clean, wash hands, lay out sterilised kit.
2. Finest strong thread, curved needle if possible, held two-thirds back from the point.
3. Enter at a right angle 3 to 4 mm from the edge (tolerance 2 to 5 mm).
4. Equal depth both sides, exit at a right angle the same distance out, deeper than wide.
5. Tie: two wraps, then three more single throws alternating, four in all. Add one or two for slippery thread.
6. Tighten until edges just touch, not puckered or white.
7. Cut tails about 1 cm.
8. First stitch in the middle, then halve the gaps, spacing equal to bite width.
9. Skin only. Never on hand or wrist without Protocol 1 step 6.
10. Dry dressing. Check at 2 days.

Protocol 6: Secondary intention

1. Clean, then cover with clean moist or honey dressing (WO-12).
2. Dry clean dressing: change every 4 to 5 days. Wet or smelly: daily.
3. Wash gently at each change.
4. Measure weekly and record.
5. Splint wounds across joints in the position of function [VERIFY].
6. Not shrinking at 2 weeks: look for dead tissue, a foreign body, infection, diabetes.

Protocol 7: Removing stitches

1. Wash hands, clean the wound line.

2. Lift each knot, cut close to the skin on one side, pull towards the wound so no outside thread passes through skin.
3. Timing: face 3 to 5 days (alternate stitches at day 3), scalp 7 to 10, arms 7 to 10, trunk 10 to 14, legs, hands and feet 10 to 14, joints 14, palms and soles 14 to 21. With braided home-made thread, prefer the earlier end [VERIFY].
4. Support with tape strips for a further week if available.

Protocol 8: A closed wound going wrong

1. Look daily for 3 days.
2. Worsening pain, spreading redness, swelling, pus, foul smell or fever: remove all stitches at once, open fully, wash, leave open, dress.
3. Sudden severe pain, swelling, thin brown discharge, crackling under the skin, bronze or marbled skin: remove everything, open widely, send at once.

Numbers to carry

1. 4 to 5 days: delayed closure of contaminated wounds, never after 8 (Giannou 2009).
2. 6 and 12 hours: limits for primary closure on body and on face and scalp after the Fall (Quinn RH 2014, MSD Manual, inference [VERIFY]).
3. 2 cm: clean hand cuts shorter than this need no stitches (Quinn J 2002).
4. 3 per cent: infection after primary closure of clean lacerations in hospital (Quinn JV 2014, Hollander 2001).
5. 5 per cent: failure of visually judged DPC in 25,000 WWII wounds (Manring 2009).
6. 170°C for 1 hour: dry-heat sterilisation (CDC, Hesperian).
7. 15 minutes: soap-and-water washing of any possible rabies bite (WHO 2018).
8. 4 throws: per stitch knot, more for slippery thread (MSD Manual, Hesperian).
9. 5, 10 to 14 and 14 days: stitch removal on face, body and joints (Forsch 2017, MSD Manual).
10. 6 hours: shortest reported onset of gas gangrene (Giannou 2009).

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