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A Potpourri of Wound Care Issues

Alexander J Rogers, MD
Children's Emergency Services
12/3/10

Introduction

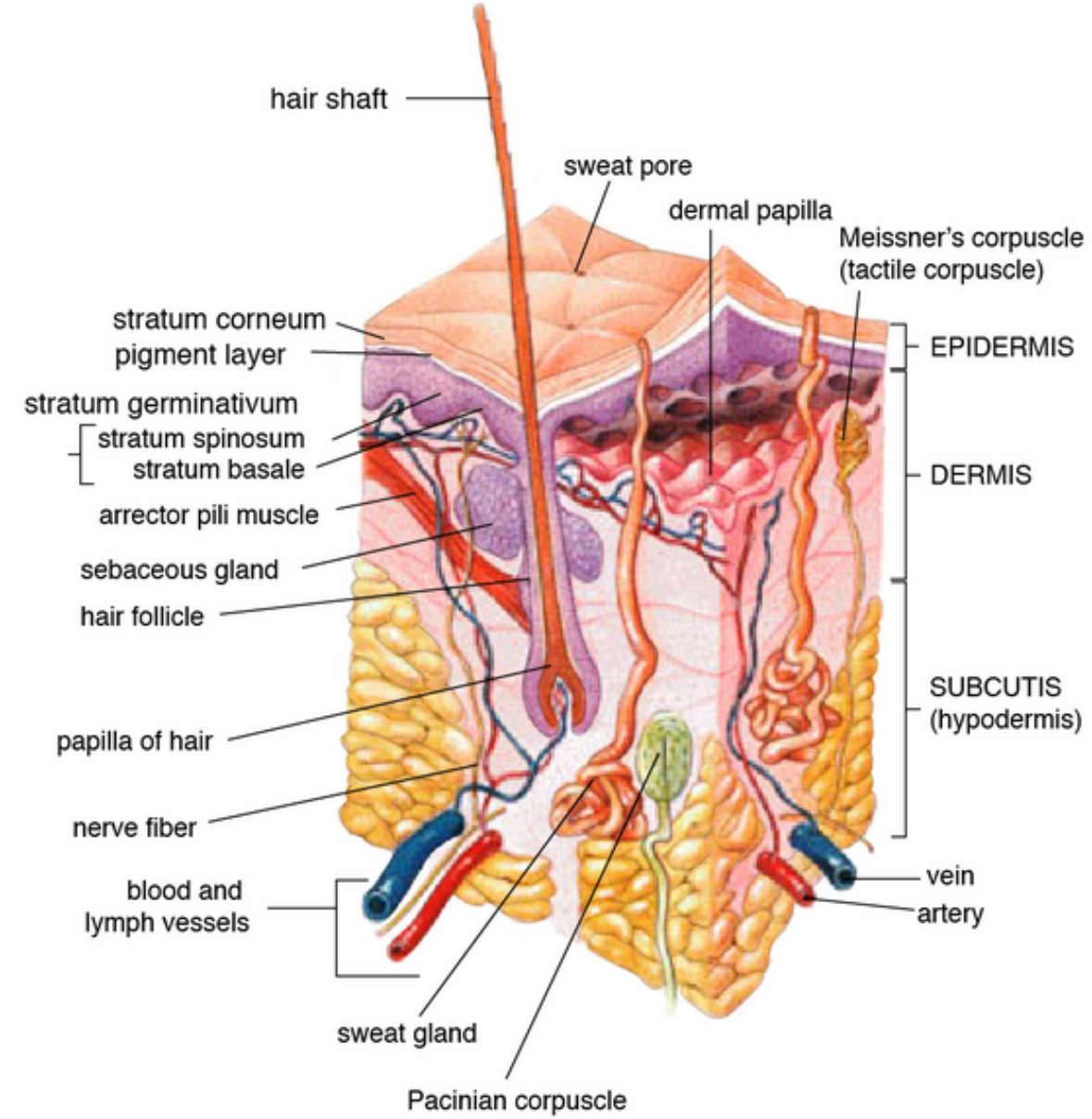
- Wounds, soft tissue infections and lacerations are common problems in the pediatric ED
- Wound care and minor surgical procedures are important part of Pediatric EM practice
  - Part of our niche

This talk

- Some wound care studies
- General abscess management
  - A touch of MRSA
- Specific situations
  - Perianal
  - Pilonidal
  - Paranychia
  - Felon
  - Plantar Puncture Wounds

The problem…

- Despite being an ancient issue, good studies of wound management are relatively rare
- Paucity of randomized, controlled trials



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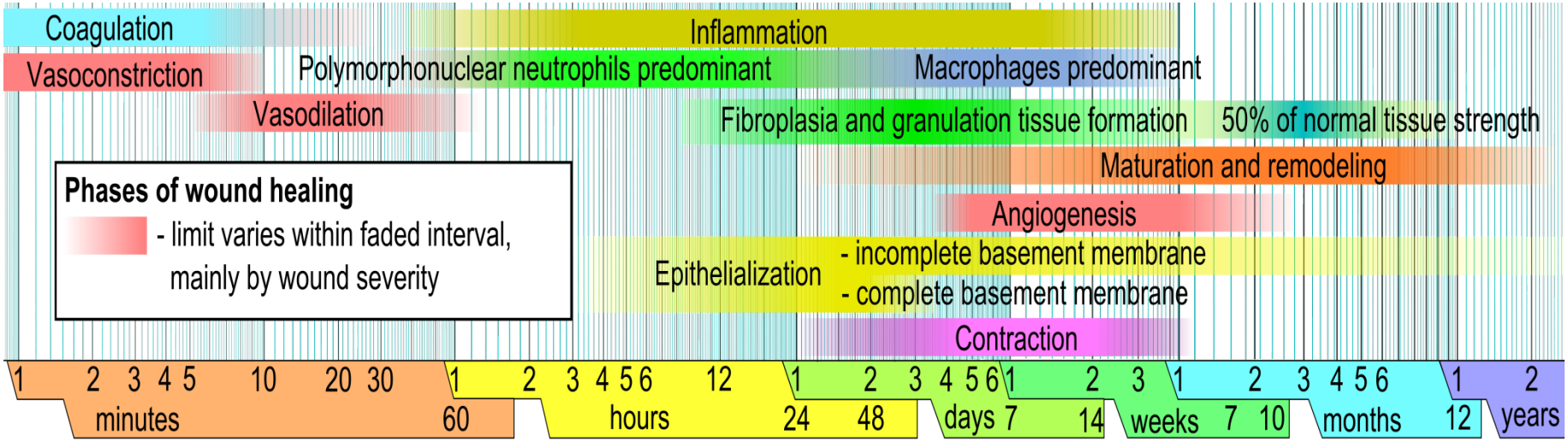
Physics of Wounding

- Shear is caused by a small total energy applied symmetrically to a very small volume of tissue, e.g. a scalpel wound. Shear-type wounds have a low potential for infection
- Compression involves energy distributed over a greater volume of tissue and requires the absorption of a far greater total energy in order to produce tissue failure. There is, therefore, much greater tissue injury, and a much higher potential for infection
  - stellate laceration caused by a blunt object striking the skin at 90 degrees
- Tension type wounds are intermediate between shear and compression in terms of the energy required to produce tissue failure and the degree of tissue damage. The entirety of tissue damage caused by a tension injury is often not immediately evident

Biology of Wound Healing

- 4 classic stages of wound healing
  - Hemostasis – platelet activation, fibrin clot
  - Inflammatory – PMN infiltration
  - Proliferative – fibroblast migration, collagen formation, angiogenesis
  - Remodeling – collagen maturation



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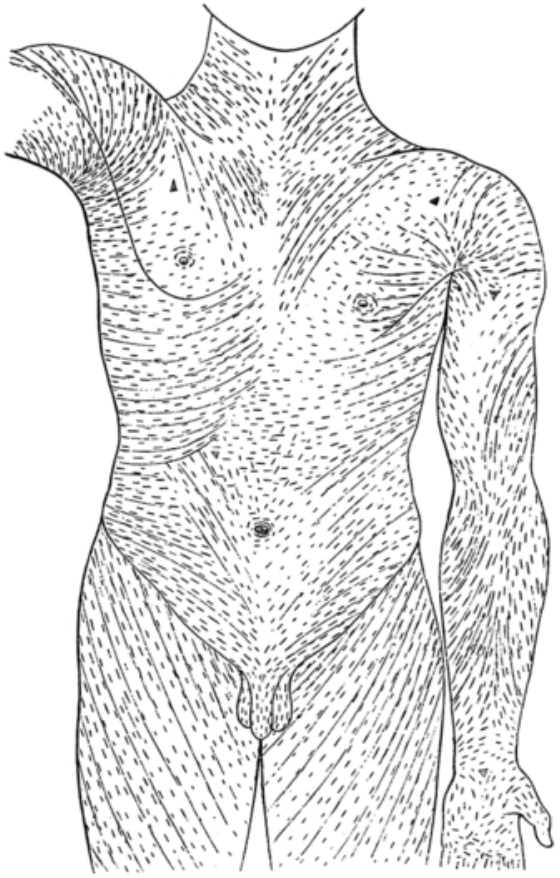
Biology

- Re-epithelialization begins to occur within hours after wound
  - Fibroblasts migrate to edges, create granulation tissue
  - Neovascularization occurs
  - Wound contraction begins at 2 weeks
- Tensile strength
  - 1 week – about 5-10% of original
  - 6-7 weeks, tensile strength plateaus at 70-80% of unwounded skin

Wound Healing

- Skin tension lines
- Skin tension can be estimated by the degree of wound gaping at rest/motion
- Wounds which cross tension lines generally have more pronounced scarring



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Wound Preparation

- Studies have not demonstrated effect of:
  - Cap, gown, mask or sterile gloves…however sterile technique is advisable
- Shaving increased infection rate vs. clipping, but probably don't have to do either (Seropian et al)

Cleaning

- Disinfection of the wound without contacting the wound itself
  - Most antiseptics inhibit natural defenses and should not be introduced into the wound

Wound Preparation

- Hemostasis
  - Pressure, epinephrine, electrocautery, ligature
- Debridement/removal of clots
- Irrigation
  - Efficacy is directly proportional to pressure at which fluid is delivered
  - High pressure irrigation with large syringe and splatter shield
  - Normal saline – good and cheap, tap water is cheaper (Bansal, AJEM 2002)
  - 50 -100 ml per cm of wound (no evidence)

Wound Preparation

- Observational ED study compared infection rates and cosmesis at one week with irrigated vs. nonirrigated facial lacs
  - Infection rate
    - Irrigated 0.9%
    - Non-irrigated 1.4%
  - Optimal Cosmetic outcome
    - Irrigated 76%
    - Non-irrigated 82%
      - Hollender et. Al. Ann Emerg Med. 1998

Anesthesia

- Local
  - Hurts, distorts, but reliable and easy
- Topical
  - Less reliable
  - Time consuming
  - End arteriolar issues
- Regional
  - Less reliable
  - Technically difficult
  - Specific locations

How to make anesthesia…less painful

- Application of topical anesthesia at triage is feasible and effective in reducing pain of injection, and saves time (Singer and Stark, AEM, 1999)
- There is at least some evidence for:
  - Buffered Lidocaine
  - Warm solution
  - Infiltrate within wound
  - Slow infiltration
  - Subcutaneous (vs. intradermal)

Nerve Blocks…A different talk

- BUT
- MCP vs. block along digit (standard digital)
  - In study of 30 volunteers (ouch)
    - MCP block less reliable (23% vs. 3% failure) and slower (6.35 vs. 2.82 minutes)
      - Knoop and Trott, Annals Emergency Medicine, 1994

Toxic Doses

Drug	Adult max dose	Peds max dose
Lidocaine	300 mg	4 mg/kg
Lidocaine with epi	500 mg	7 mg/kg
Bupivicaine	175 mg	1.5 mg/kg
Bupivicaine with epi	225	3 mg/kg

Alternative Anesthetic Agents

- For those with ‘caine’ allergies
- Diphenhydramine
  - more painful, but works about as well as lidocaine
- Benzyl alcohol
  - found as preservative in multidose saline
  - not very painful to inject
  - Short acting – can mix with epi
  - Add 0.2 ml epi 1:1000 to 20 mL vial of normal saline with 0.9% benyzl alcohol

What about epi in the finger?

- Finger Injection with High-Dose (1:1,000) Epinephrine: Does it Cause Finger Necrosis and Should it be Treated?
  - Colleen Fitzcharles-Bowe & Keith Denkler & Don Lalonde
  - Documented 59 cases of accidental epi injection with NO cases of tissue necrosis
  - High dose epi led to about 10 weeks of neuropraxia
- *"One of the authors of this paper (DL) had three of his own fingers injected with epinephrine on July 21, 2005, to carefully and accurately document the outcome."*

So to treat or not to treat?

- For high dose (1:1000) epi (epi-pen) use of phentolamine did decrease the length of time to reperfusion
- Unclear (but possible) if treatment could prevent neuropraxia
- Again, no cases of tissue necrosis

Wound Closure

- A little history
  - Ancient Egyptians used form of tape to close eyebrow wounds in 2500 BC
  - Oldest known sutures – 1100 BC – on mummy
  - Ancient Hindus used ant mandibles to close wounds
  - In middle ages – pus was believed necessary for healing

Classifications of closures

- Primary closure (primary intention) – clean, minimally contaminated wounds
  - This is most of what we do
- Secondary closure (secondary intention) – not closed and allowed to heal gradually
- Tertiary closure (delayed primary closure) – initially cleaned, and then closed after 4 or 5 days – consider for highly contaminated wounds

Wound Closure Techniques

- Tissue Adhesives
- Sutures
- Tapes
- Staple
- Other mechanisms
- Important to know when to use each one!

Tissue Adhesives

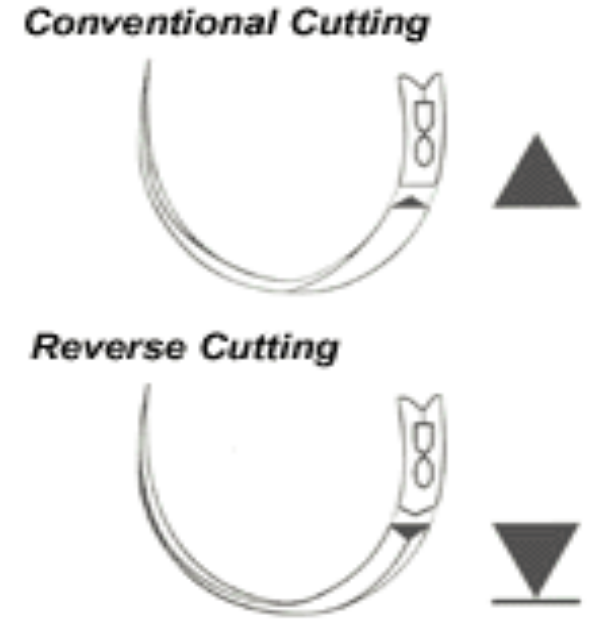
	Octylcyanoacrylate (Dermabond)	Butylcyanoacrylate (Indermil)
Carbon side chains	8	4
Breaking strength	Moderate	Low
Flexibility	Great	Poor
Microbial Barrier	Yes	Some

Sutures - Absorbable

Suture Type	50% Strength Retention	Reactivity	Use	Filament
Plain Gut	5-7 days	Moderate	Intraoral*	Mono
Chronic Gut	10-14 days	Moderate	Intraoral	Mono
Vicryl	3 weeks	Minimal	Deep sutures	Braided
Vicryl Rapide	5 days	Minimal	Skin approximation	Braided
Monocryl	1.5 weeks	Minimal	Deep sutures	Mono
Fast Gut	<5-7 days		Percutanious	Mono
Prolene	___	Least	Skin Approximation	Mono

Needle Selection

- Size
- Common types
  - Conventional cutting
  - Reverse cutting
- Ethicon Needles
  - FS (for skin) – lower quality
  - PS (for plastic skin)
  - P (for precision point)
  - PC (for precision cosmetic)



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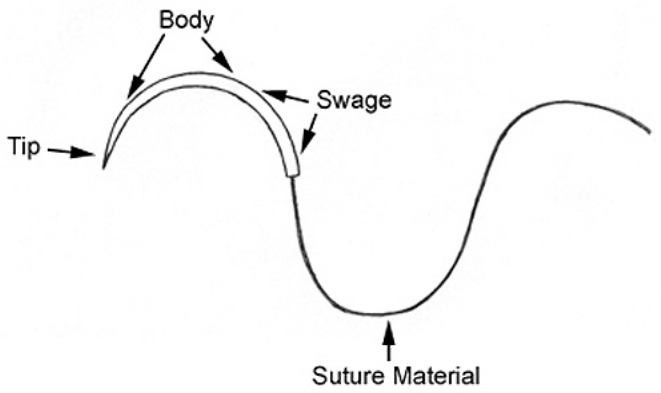

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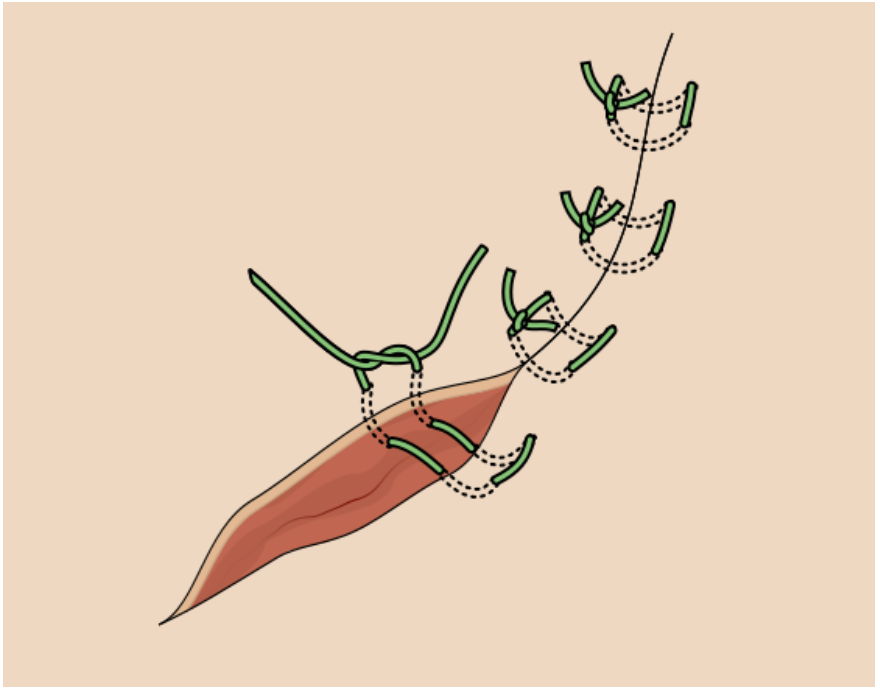
Types of Sutures

- Simple Interrupted
  - Most common suture
  - Versatile, easy to place, good tensile strength
  - Allow adjustments to closure
  - Slow, and risk of crosshatched marks if left long

Types of Sutures

- Horizontal Mattress
  - Good for tension and eversion
  - High propensity to scar
  - Can be temporary to bring wound together for other suture techniques



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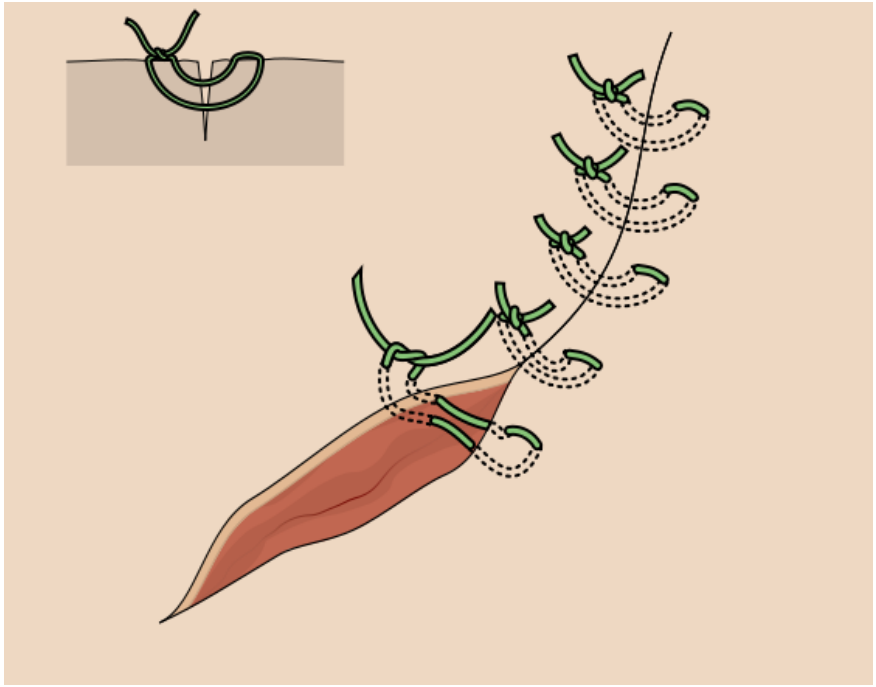
Types of Sutures

- Vertical mattress
  - Maximizes eversion, minimizes dead space
  - Good with high tension wounds
  - High risk of scarring if left long
  - Can strangulate tissue



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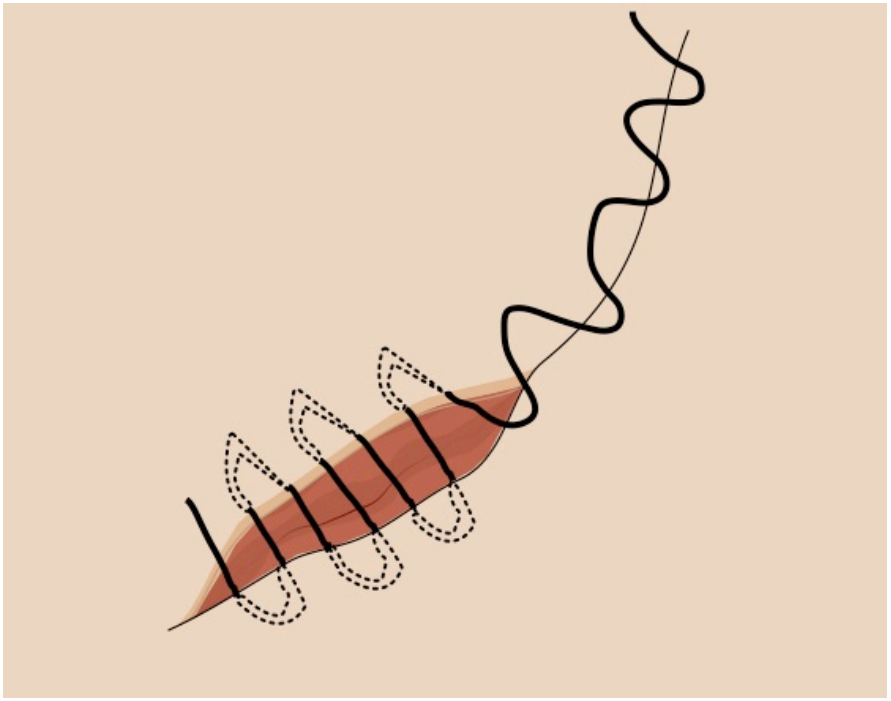
Types of Sutures

- Running subcuticular suture closure
  - Good for very low tension areas when want to approximate skin
  - No external marks, but not very strong
  - Can use absorbable suture



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To absorb or not to absorb…

- A Randomized, Controlled Trial Comparing Long-tern Cosmetic Outcomes of Traumatic Pediatric Lacerations Repaired with Absorbable Plain Gut Vs. Nonabsorbable Nylon Suture (Karounis et al. AEM 2003)
- Randomized trial of patients 1-18 years old with lacerations presenting to Peds ED
  - Excluded bites, crush, gross contaminated, crossing joints, diabetes, tendon/nerve/cartilage, scalp
  - Re-evaluated in 10 days by research nurse, and 4-5 months by plastic surgeon

Plain Gut vs. Nylon

- 147 eligible, 95 enrolled
- At 10 days, optimal score (no significant difference)
  - 63% for absorbable
  - 49% for non-absorbable
- No difference in dehiscence or infection
- At 4 month follow up
  - No significant difference (trend towards better results with absorbable)

Fast gut vs. Adhesive vs. Nylon

- Cosmetic outcomes of facial lacerations repaired with tissue-adhesive, absorbable, and nonabsorbable sutures (Holger, AJEM 04)
  - Enrolled 145 patients, followed up 84 in 9-12 mo
  - Wounds followed by two experienced evaluators
  - No clinically important difference in any closure type

Predictors of poor outcome

- **Singer et al. Determinants of Poor Outcome after Laceration and Surgical Incision Repair. Plastic and Reconstructive Surgery, Aug 2002.**
- 814 patients (924 wounds)
- Examined characteristics associated with poor cosmetic outcome
- No effect with type of closure device or use of deep sutures

TABLE I

Univariate Predictors of Wound Infection

Predictor Variable	No. of Wounds in which Predictor Variable Is Present or Absent (present/absent)	Infection Rate (%) when Variable Present	Infection Rate (%) when Variable Absent	Relative Risk (95% CI)†	*p* Value
Gender* (male)	427/457	2.1	0.7	3.2 (0.9–11.8)	0.08
Treatment (OCA)	438/446	2.1	0.7	3.1 (0.8–11.2)	0.09
Deep sutures (deep sutures)	499/385	1.0	1.8	0.6 (0.2–1.7)	0.38
Wound type					
Lacerations	357/527	2.2	0.8	2.9 (0.9–9.7)	0.08
Excisions	219/652	20.5	16.4	1.3 (0.9–1.7)	0.16
Body location†					
Head/neck	404/480	1.5	1.3	1.2 (0.4–3.7)	0.79
Trunk	301/583	0.7	1.7	0.4 (0.1–1.8)	0.36
Extremities	179/705	2.2	1.1	2.0 (0.6–6.5)	0.28
Decontamination	827/55	1.2	3.6	0.3 (0.1–1.5)	0.17
Use of local anesthetic	669/215	0.9	2.8	0.3 (0.1–1.0)	0.08
Hemostasis method†					
Direct pressure	548/336	0.7	2.4	0.3 (0.1–1.0)	0.07
Electrocautery	152/732	1.3	1.4	1.0 (0.2–4.4)	1.00
Sponge/epinephrine	61/823	4.9	1.1	4.5 (1.3–16.2)	0.04
Other	39/845	5.1	1.2	4.3 (1.0–19.1)	0.10
Associated tissue trauma	23/859	8.7	1.2	7.5 (1.7–32.2)	0.04
Use of additional securing devices	48/836	2.1	1.3	1.6 (0.2–12.0)	0.49
Incomplete wound edge apposition	121/763	6.6	0.5	12.5 (3.9–41.7)	<0.001
Wound dehiscence (5–10 days)	11/873	9.1	1.3	7.2 (1.0–51.2)	0.14
Scar tissue (5–10 days)	38/841	13.2	0.8	15.8 (5.3–47.5)	<0.001

	No. of Wounds with and without Infection (with/without)	Noninfected Wounds [mean (SD)]	Infected Wounds [mean (SD)]	Group Difference (95% CI)	*p* Value
Age‡ (years)	12/872	32.0 (20.2)	28.2 (26.8)	–3.8 (–15.4–7.7)	0.52
Wound length (cm)	12/872	2.2 (2.0)	2.8 (1.9)	0.7 (–0.4–1.8)	0.24
Wound width (mm)	12/851	3.5 (3.8)	7.2 (6.1)	3.7 (1.5–5.9)	0.001
Wound depth (mm)	12/852	6.2 (8.5)	4.9 (5.0)	–1.3 (–6.1–3.6)	0.61
Time for closure (min)	12/867	4.0 (5.1)	6.6 (6.5)	2.6 (–0.3–5.5)	0.08

* Gender is multiply-counted for patients with >1 wound.

† Relative risks for variables with >2 groups are calculated individually for each value against all other values combined, and are therefore not independent estimates.

‡ Age is multiply-counted for patients with >1 wound.

TABLE II

Univariate Predictors of Suboptimal Cosmetic Appearance

Predictor Variable	No. Present/Absent	Suboptimal Wounds in Presence of Risk Factor (%)	Suboptimal Wounds in Absence of Risk Factor (%)	Difference	Relative Risk (95% CI)†	*p* Value
Gender* (male)	423/448	21.5	13.6	7.9	1.6 (1.2–2.1)	0.002
Treatment (OCA)	439/432	18.0	16.9	1.1	1.1 (0.8–1.4)	0.72
Deep sutures	492/379	15.4	20.1	–4.7	0.8 (0.6–1.0)	0.09
Wound type (lacerations)	349/522	24.9	12.5	12.4	2.0 (1.5–2.7)	<0.001
Body location†						
Head/neck	396/475	17.9	17.1	0.8	1.1 (0.8–1.4)	0.79
Trunk	298/573	9.7	21.5	–11.8	0.5 (0.3–0.7)	<0.001
Extremities	177/694	29.4	14.4	15.0	2.0 (1.5–2.7)	<0.001
Decontamination	816/53	16.5	30.2	–13.7	0.5 (0.4–0.8)	0.02
Use of local anesthetic	658/213	15.8	22.5	–6.7	0.7 (0.5–1.0)	0.03
Hemostasis method†						
Direct pressure	547/324	15.9	20.1	–4.2	0.8 (0.6–1.1)	0.14
Electrocautery	150/721	26.0	15.7	10.3	1.7 (1.2–2.3)	0.004
Sponge/epinephrine	56/815	19.6	17.3	2.3	1.1 (0.7–2.0)	0.72
Other	37/834	29.7	16.9	12.8	1.8 (1.0–3.0)	0.07
Associated tissue trauma	25/845	52.0	16.4	35.6	3.2 (2.1–4.7)	<0.001
Use of additional securing devices	50/821	24.0	17.1	6.9	1.4 (0.8–2.4)	0.25
Incomplete edge apposition (5–10 days)	135/736	36.3	14.0	22.3	2.6 (1.9–3.4)	<0.001
Wound dehiscence (5–10 days)	10/840	30	17.3	12.7	1.7 (0.7–4.5)	0.39
Presence of scar (5–10 days)	36/809	47.2	16.2	31.0	2.9 (2.0–4.3)	<0.001
Wound infection (5–10 days)	11/839	54.5	16.9	37.6	3.2 (1.8–5.6)	0.005

	No. of Patients with/without Optimal Cosmesis	Suboptimal Wounds‡ [mean (SD)]	Optimal Wounds‡ [mean (SD)]	Group Difference (95% CI)	*p* Value
Age, years*	719/152	24.9 (18.6)	33.7 (20.3)	–8.9 (–12.4 to –5.4)	<0.001
Wound length, cm	719/152	2.2 (2.3)	2.1 (1.8)	0.11 (0.23–0.44)	0.54
Wound width, mm	706/145	5.3 (4.2)	3.2 (3.6)	2.1 (1.5–2.8)	<0.001
Wound depth, mm	703/148	5.1 (6.0)	6.3 (8.7z0	–1.1 (–2.6–0.3)	0.13

* Gender is multiply-counted for patients with >1 wound.

† Relative risks for variables with >2 groups are calculated individually for each value against all other values combined, and are therefore not independent estimates.

‡ Age is multiply-counted for patients with >1 wound.

Conclusions of study

- Wound infection
  - wide wounds
  - adjacent skin trauma
- Suboptimal wound appearance
  - extremity wounds
  - wide wounds
  - incompletely apposed wounds
  - associated tissue trauma
  - Use of electrocautery
  - infection

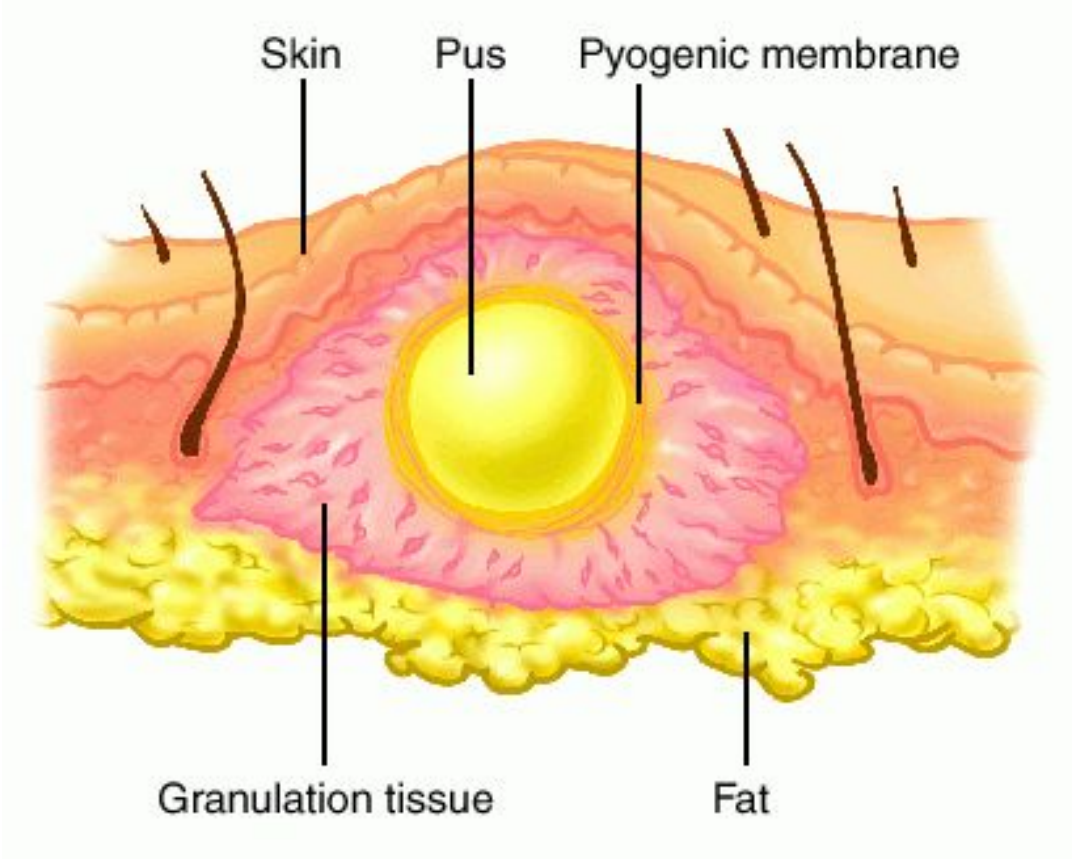
Scar management

- Scar massage probably helpful
- No great evidence for mederma or Vit E
- Silicone sheets have been used with positive results
  - Probably decrease longitudinal tension

Abscess Management

What is an abscess?

- **abscess (ab·scess)** (ab´ses) [L. *abscessus,* from *ab* away + *cedere* to go] a localized collection of pus buried in tissues, organs, or confined spaces.



Abscesses

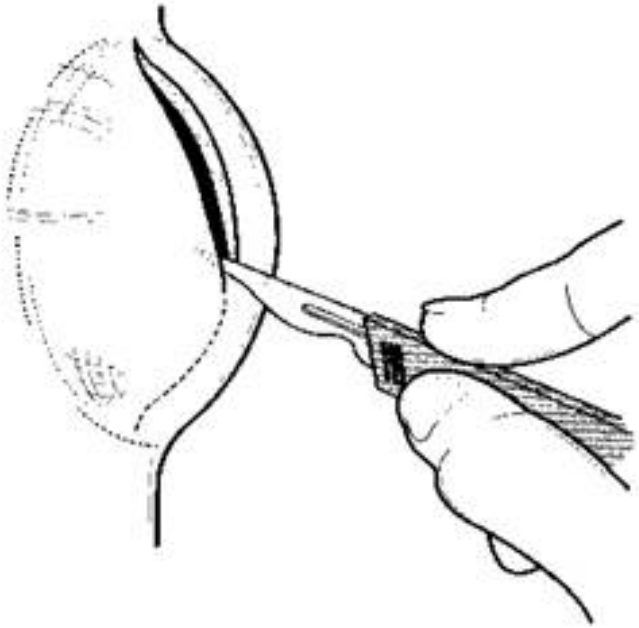
- Questions to ask yourself
  - Does it need I/D?
    - Poor antibiotic penetration into abscess with fibrous wall
  - Prophylactic antibiotics before I/D?
    - Consider endocarditis risk/immunocompromised
  - Needle vs. formal I/D?
    - Needle I/D is generally diagnostic for pus, but inadequately therapeutic and definitely painful
      - Consider ultrasound to identify pus pocket

Abscesses

- Performance of I/D
  - Local infiltration of lidocaine notorious for only superficial effect
  - Consider field block if possible
  - Incision with tension lines
  - ? Culture in the new microbiological climate
  - BEWARE THE PULSATILE ‘ABSCESS’

Abscesses

- I/D continued…
  - Incision should be kept open with wick, but not necessary to tightly “pack” abscess cavity
  - Remove in 48 hours
  - If continues with purulent drainage, may need to re-explore, re-irrigate and re-pack



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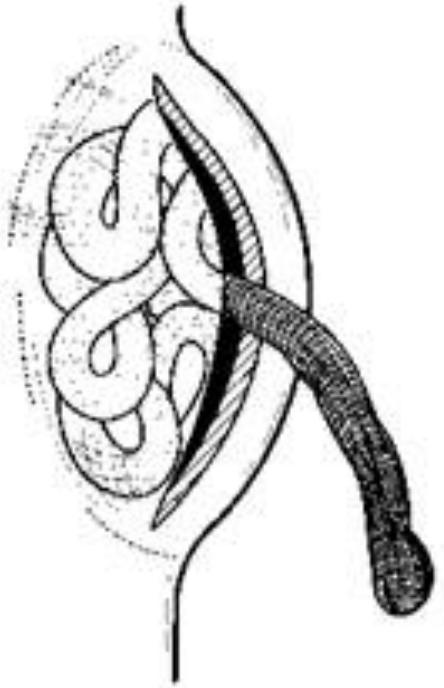

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Antibiotics with MRSA Abscess

- Lee et al, Pediatric Infectious Disease Journal. 23(2):123-127, February 2004
  - Followed 69 patients with MRSA abscesses
    - 96% drained, 65% packed
    - All got antibiotics, but only **7%** were sensitive
    - Only predictor of hospitalization (4 patients) was abscess > 5cm
    - Receipt of effective antibiotic not predictive of treatment failure
    - *Incision and drainage without adjunctive antibiotic therapy was effective management of CA-MRSA skin and soft tissue abscesses with a diameter of <5 cm in immunocompetent children.*

Antibiotics post I/D

- Probably wise to use antibiotics if signs of systemic illness, significant overlying cellulitis, or high-risk area/host
- Consider local resistance patterns for antibiotic choice…
- Some evidence that use of Bactrim may effect subsequent lesions (Randomized Controlled Trial of TMP-SMX for Uncomplicated Skin Abscesses in Patients at Risk for Community-Associated Methicillin-Resistant Staphylococcus aureus Infection, Schmitz, AEM 2010)

Our Staph resistance

- Data applicable to U of M Hospital in-patients only
  - Clindamycin – 41%
  - Doxy – 33%
  - Methacillin – 50%
  - Bactrim – 4%

Questions to consider

- When to start antibiotics?
- Is cephalexin an orphan?
- What about inducible resistance?

Now for some specific situations…

Perianal Abscess

- Infection arising in the crypto-glandular epithelium lining the anal canal
  - Secondary to obstructed glands
  - Bacteria can travel through crypts to inter-sphincteric space
- Common in infants, then peaks in 3rd-4th decade of life, male predominance
- E. Coli, Enterococcus, Bacteroides common

Perirectal abscess

- Predisposing Factors
  - Neutropenia/neutrophil dysfunction
  - Diabetes
  - Rectal surgery
  - HIV
  - IBD
  - Corticosteroid therapy
  - Hidroadenitis supporativa

Perianal Abscess

- Treatment is incision and drainage
- Pack with Iodophor
- Culture material as multiple organisms may be involved
- Often does not need antibiotics
- Large abscesses should be evaluated by surgery

Pilonidal Cyst/Sinus

- Historical perspective
  - Described by Herbert Mayo in 1830
  - Named by Hodges (pilus=hair, nidal=nest)
  - Also known as Jeep riders disease, led to 80,000 soldiers hospitalized in WW2, and 4.2 million sick days
  - Initially thought to be infected congenital hair containing sinus tract

Pilonidal Cyst/Sinus

- Pathophysiology
  - Acquired condition – enlarged and deformed hair follicles in natal cleft
  - Bacteria enter, cause local inflammation sealing mouth and creating abscess
  - When abscess breaks into subcutaneous fatty tissue, leads to pilonidal disease
- Staph Aureus most common
- Bacteroides most common anaerobe

Pilonidal Cyst/Sinus

- Average age of presentation – 21 years
- Risk factors
  - Male sex
  - Family predisposition
  - Obesity
  - Sedentary lifestyle
  - Repeated trauma
  - Occupation requiring prolonged sitting

Pilonidal Cyst/Sinus

- **History:**
  - Progressive tenderness after physical activity or a period of prolonged sitting, such as during a long drive.
  - Acute purulent drainage, pain, and/or swelling may be present.
  - Systemic manifestations are rare, but patients may have malaise and fever.
  - Eighty percent of symptomatic presentations are exacerbations or manifestations of chronic disease.

Pilonidal Cyst/Sinus

- Physical exam
  - Presacral midline edema and/or nodule
  - Fluctuance, warmth, tenderness
  - Purulent discharge from one or more lesions
  - Induration and/or cellulitis (usually minimal)
  - Visible or palpable tracts of 2-5 cm in length in chronic or recurrent disease
  - Fever (infrequent)
  - Nontenderness and/or nonfluctuance at rectal examination

Pilonidal Cyst/Sinus

- Treatment
  - I/D with incision lateral to midline
  - Evacuate all material
  - Break up loculations
  - Copious irrigation
  - Packing
  - Surgical follow up in 1 week
  - 40% recurrence rates

Steve@medetec, Picasaweb

Paronychia

- Infection of lateral nail fold
- Often starts as cellulitis, quickly progressing to abscess
- More common in females
- In children, finger sucking most common etiology
- Most commonly strep/staph
- Less commonly, herpetic or mycotic

Paronychia

M Lawrenson,
Wikimedia Commons

paronychia

Chris Craig,
Wikimedia Commons

felon

James Heilman, M.D.
Wikimedia Commons

Herpetic whitlow

Paronychia

- Emergency treatment
  - Digital block (+/-)
  - Elevate lateral nail fold
  - Irrigate with isotonic saline
  - In severe or horseshoe paronychia, may use a wick for 24 hours
  - Subungal abscess required removal of nail plate
  - Antibiotics if cellulitis present

Felon

- Infection in pulp of finger
- Can lead to compartment syndrome, tissue necrosis, tenosynovitis
- Midline incision
- Blunt dissection to avoid trauma to nerve or vessels
- Irrigation/packing

Plantar Puncture Wounds

- Problems with plantar puncture wounds
  - Frequent debris pushed into wound
  - Complex bacteriology
  - Force inflicting puncture
  - Bones/joints close to skin

Plantar Puncture Wounds

- Fitzgerald and Cowan – dated study of 887 plantar puncture wounds (mostly kids), 98% caused by nails
  - 3% had retained FB
  - In early presenters 8.4% had/got cellulitis
  - Late presenters 57% with cellulitis
  - 4% overall with serious infections
  - Staph and Pseudomonas most common

Plantar Puncture Wounds

- Management
  - Blind probing dangerous
  - Soaking probably not effective
  - Irrigation may be futile
  - Options
    - Conservative management
    - Enlarging wound edges
    - Coring out
    - Trimming of epidermal edges
    - ***Lack of data for best practice***
  - ***Follow up is important***

Plantar Puncture Wounds

- Prophylactic Antibiotics for plantar puncture wounds
  - Pennycook et al. – nonrandomized, uncontrolled observation study of physician choice antibiotic care showed decrease in infection rate with antibiotics
  - Gonzalez – many physicians prescribe prophylactic antibiotics for fear of lawsuits, since infection rate is high
- Best choice is fluoroquinolones, covers most staph, strep and pseudomonas – risk/benefit in kids. No good studies!

A few references

- Wounds and Lacerations: Emergency Care and Closure, Alexander T. Trott
- Lacerations and Acute Wounds, An Evidence Based Guide, Singer and Hollander
- http://www.jpatrick.net/WND/woundcare.html
- http://emedicine.com/derm/TOPIC828.HTM#Multimediamedia15

- Note: Some diagrams were copied from the above websites