

Wounds

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Essential Surgical Skills

Recommended skills to be gained by the end of Post Graduate Year 2 (PGY2) prior to entry into Surgical Education and Training (SET)

Recommended skills for General Practice Proceduralists

Produced by
Skills Education Committee
 Royal Australasian College of Surgeons

Skill 5 - Surgical wounds and tissue handling			
Elements	Observe	Describe	Perform
Wound management			
Wound classification	✓	✓	
Clean versus contaminated	✓	✓	
Necrotising infections	✓	✓	
Mechanism of wounding	✓	✓	
Wound healing & factors affecting wound healing	✓	✓	
Dressings	✓	✓	✓
Debridement	✓	✓	✓
Wound closure	✓	✓	✓
Healing by primary intention	✓	✓	✓
Healing by secondary intention	✓	✓	✓
Delayed primary closure	✓	✓	✓
Vacuum assisted wound management	✓	✓	✓
Atraumatic tissue management			
Careful tissue handling	✓	✓	✓
Traction and retraction	✓	✓	✓
Correct application of instruments	✓	✓	✓
Neuro-vascular protection	✓	✓	✓

Skill 6 - Insertion and care of tubes and drains			
Elements	Observe	Describe	Perform
Use of drains and tubes			
Indications for safe use		✓	
Functions of tubes		✓	
Drain security	✓	✓	✓
Drain complications	✓	✓	
Urinary catheter			
Urethral	✓	✓	✓
Supra-pubic	✓	✓	
Nephrostomy tube	✓	✓	
Wound drains			
Suction versus passive	✓	✓	
Open versus closed	✓	✓	
Vascular			
Arterial	✓	✓	✓
Venous	✓	✓	✓
Peripheral	✓	✓	✓
Central	✓	✓	
Other drains and tubes			
Naso-gastric/Naso-enteric	✓	✓	✓
Intercostal catheter - Under water seal drains	✓	✓	✓
Gastrostomy	✓	✓	
Jejunostomy	✓	✓	
Radiologically placed drains	✓	✓	

Skill 5 - Surgical wounds and tissue handling

Elements

Wound management

Wound classification

Clean versus contaminated

Necrotising infections

Mechanism of wounding

Wound healing & factors affecting wound healing

Dressings

Debridement

Wound closure

Healing by primary intention

Healing by secondary intention

Delayed primary closure

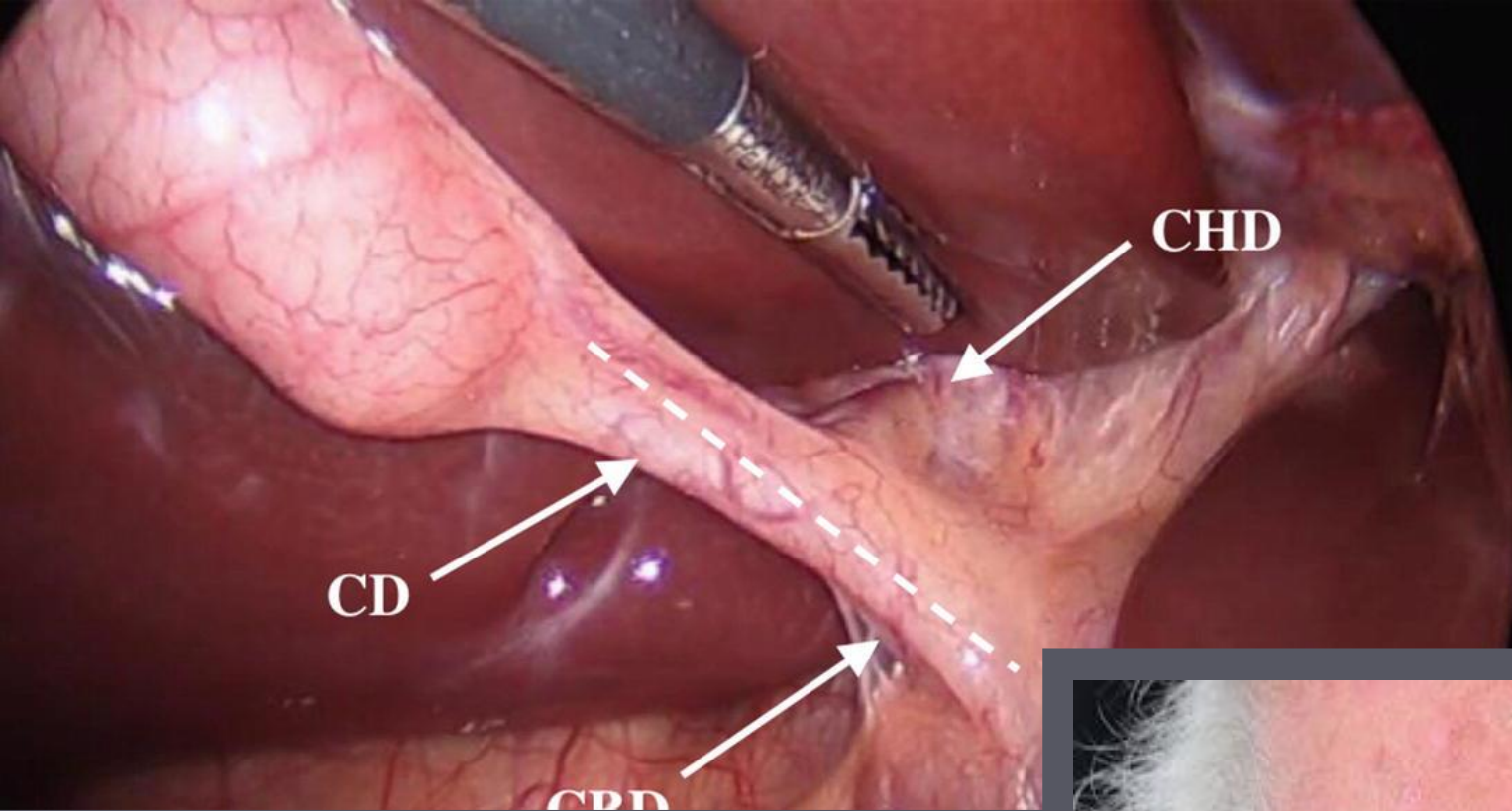
Vacuum assisted wound management



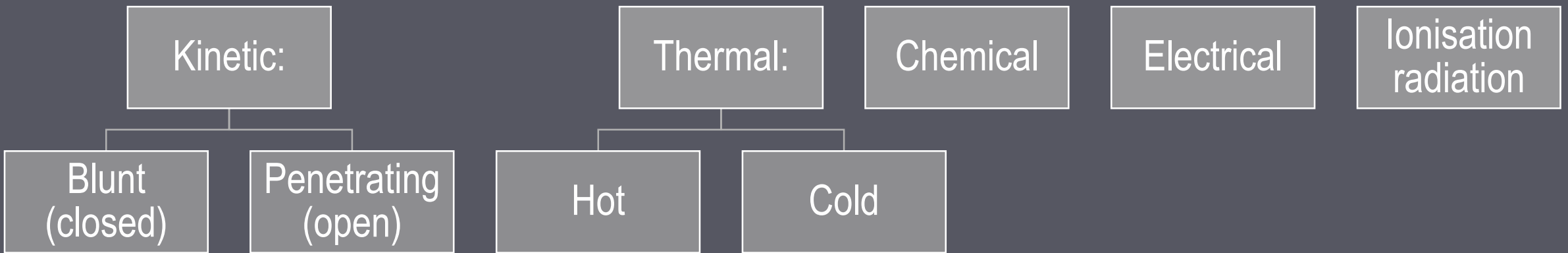
Wound classification

	Clean	Clean-contaminated	Contaminated	Dirty
Environment	Sterile	Non-sterile	Non-sterile	Non-sterile
Mechanism	Surgical incision	+ minor break in sterility	+ major break in sterility	+ infected, neglected or containing debris
Location	Non-inflamed tissue <u>NOT IN</u> respiratory, alimentary or genitourinary tracts	Non-inflamed tissue <u>IN</u> respiratory, alimentary or genitourinary tracts	Non-purulent inflamed tissue contaminated with spillage from alimentary tract	Purulent inflamed or devitalised tissue subjected to prolonged contamination e.g. crush injuries, shrapnel injuries, penetrating trauma
Closure	Primary	Irrigation → primary	<ul style="list-style-type: none"> Irrigation → primary Delayed primary 	<ul style="list-style-type: none"> Debridement → irrigation → delayed primary Secondary intention
Infection rate	<1%	<5%	<25%	<50%





Mechanism of wounding



Kinetic



- Blunt (closed):
 - Cause both direct and indirect injuries:
 - Direct = bursting of superficial tissues raggedly
 - Indirect = deceleration causing compression or deformity of deeper structures



- Penetrating (open):
 - Cause trauma in the path of penetration



Thermal

Hot:

- Dry (burn) or wet (scald)
- Coagulative necrosis
- Classification based on depth of necrosis
 - Epidermal
 - Dermal – superficial and deep, may require grafting
 - Subcutaneous tissue - full thickness requiring debridement and grafting

Cold:

- Dry (chilblains), wet (trenchfoot) or frozen (frostbite)
- Endothelial injury, stasis and occlusion causing delayed coagulative necrosis







Other mechanisms

Chemicals:

- Burn - exothermic reactions
- Liquefaction - strong acid or alkali
- Delipidation - petrochemicals
- Vesicle formation – gases

Electricity:

- Electrical to thermal energy conversion along line of conduction
- In limbs, may cause compartment syndrome or myoglobinuria → renal failure

Ionising radiation:

- Damages DNA, cellular fibres and membranes leading to cell death or mutations
- Rapidly dividing (skin) cells affected more than others (nerves) impairing wound healing



Wound healing

Healing requires:

- Generation of capillaries on both sides of wound
- Generation and cross linking of collagen on both sides of wound
- Rearranging cross-linked collagen into regular bundles to contract and increase scar strength
- Regrowth of epithelium across defect

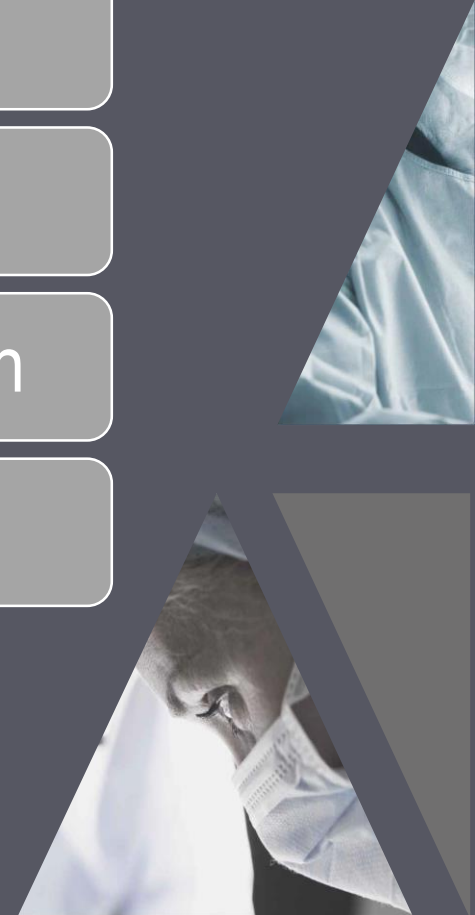
The body heals via regeneration or connective tissue deposition (scar formation). Most wounds heal via the latter.

Haemostasis

Inflammation

Cell proliferation

Remodelling



Haemostasis (mins)

- Haemostatic plug comprised of platelets is formed, which stops bleeding and provides a scaffold for infiltrating inflammatory cells



Inflammation (hours)

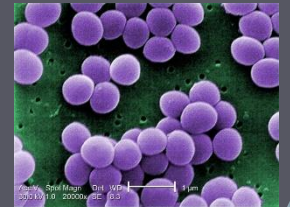
Breakdown products of complement activation
Chemokines released from activated platelets
Other mediators produced at the site of injury



Monocyte



Neutrophil



- Macrophages are the key monocyte in the repair process:
 - M1 - clear microbes and necrotic tissue and promote inflammation in a positive feedback loop
 - M2 - produce growth factors that stimulate the proliferation of many cell types in the next stage of repair

Cell proliferation (days)

Cytokines and growth factors cause migration and proliferation of several cell types to close the now-clean wound:

- Epithelial cells migrate over the wound to cover it
- Endothelial and other vascular cells proliferate to form new blood vessels – angiogenesis
- Fibroblasts migrate to the wound and deposit Type 3 collagen to form a scar (TGF- β). Some fibroblasts become myofibroblasts

The combination of fibroblasts, vessels and inflammatory cells (mainly macrophages) forms granulation tissue which is pink, soft and granular



Cell proliferation (days) cont.

Angiogenesis:

- Vasodilation and increased permeability (VEGF)
- Endothelial cell migration and proliferation (VEGF)
- Remodelling into capillary tubes (MMP)
- Recruitment of pericytes (capillaries) and smooth muscle (arterioles) to form mature vessel
- Suppression of endothelial proliferation and migration, and formation of basement membrane



Remodelling (months)

- Remodelling increases strength and reduces scar size
- MMPs achieve this by replacing earlier Type 3 collagen (small irregular fibres) with Type 1 collagen (large cross-linked fibres)
- Strength may recover to 70% to 80% of normal skin by 3 months

Summary of main events in wound healing:

- Haemostasis
- Inflammation
- Cell proliferation
 - Granulation tissue: vessels, fibroblasts (collagen) and inflammatory cells (regulate)
- Remodelling



Factors affecting wound healing

Impaired healing is related to disruption of tissue mechanics, vascularity or collagen deposition

Consequences vary from superficial infection to complete dehiscence

- Local factors:
 - Vascular i.e. acute or chronic ischaemia and venous congestion, wound tension, irradiation
 - Infection i.e. contamination, foreign bodies, dead space, suture choice
- General factors:
 - Systemic vascular i.e. hypovolaemic shock, anaemia, hypoxia
 - Systemic infections i.e. septicaemia
 - Immune system i.e. immunosuppression or deficiency, tobacco use, malignancy
 - Nutrition i.e. obesity, malnutrition (protein, Zinc, Iron and Vitamins A and C)



Debridement



Administer antibiotic

Administer anaesthetic

Perform gross decontamination with antiseptic and scrubbing brush

Plan closure method

Depilate if required

Prep and drape surgical field avoiding alcohol-based solutions

Remove:

- Devitalised tissue
- Foreign bodies
- Bacterial inoculum
- As much as necessary to create clean freely bleeding surfaces

Irrigate the wound to further reduce risk of infection

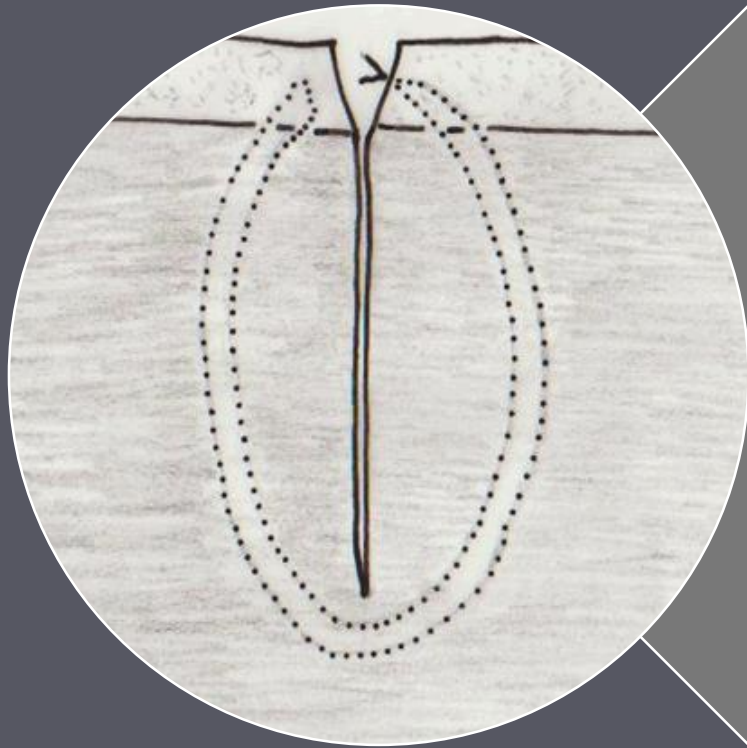
Either close or temporise wound and dress



Debridement cont.



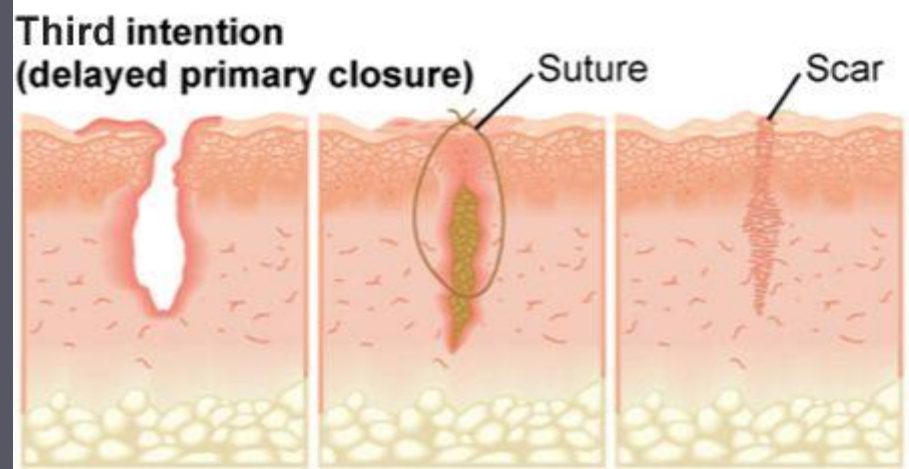
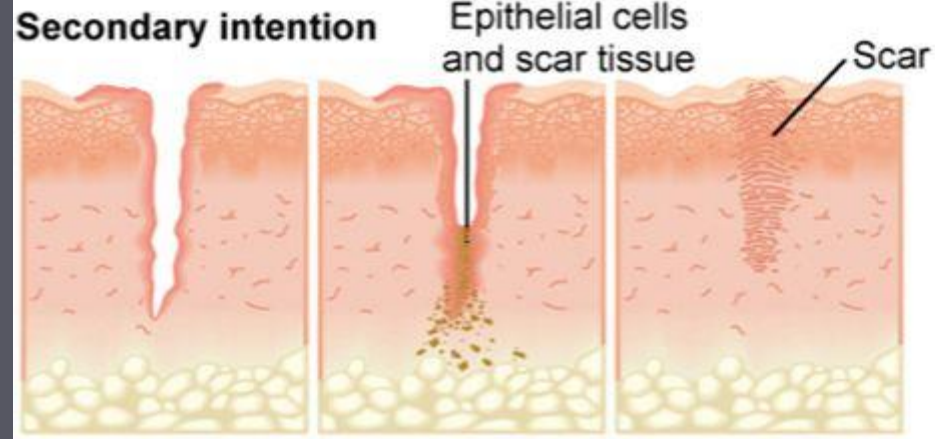
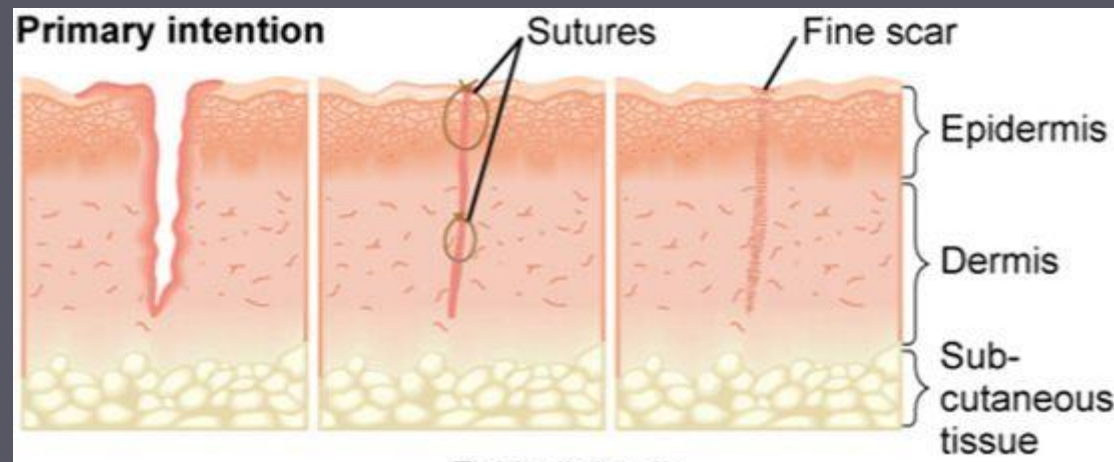
Wound closure



3 forms:

- First intention (primary closure)
 - Fibrinous adhesion (24hrs)
 - Granulation tissue
- Second intention
 - Granulation tissue
- Delayed primary closure
 - Initially second intention then wound edges closed to speed healing





Dressings

- Principles:
 - Rate of epithelialisation is increased in moist wound environments provided the surrounding skin does not become macerated
 - Potentially infected exudate should be removed from the wound
 - Wound site should be splinted if in a mobile region or repair of tendon, nerve, vessel or bone was performed
 - Dressings are selected based on:
 - Size
 - Cost
 - Absorptive qualities
 - Antimicrobial properties



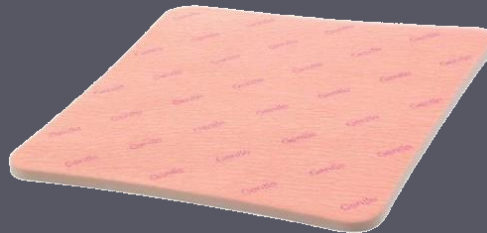
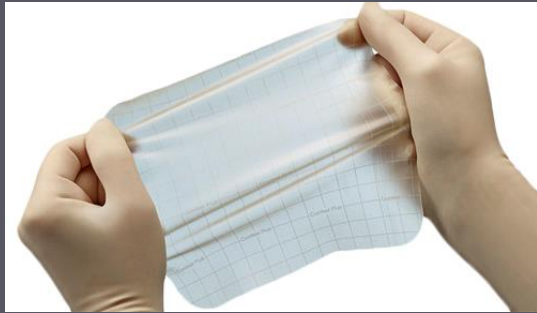
Dressing types

Non absorptive

Maximally absorptive



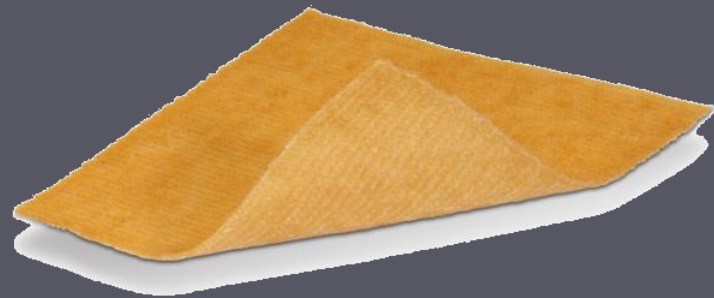
Films | Hydrocolloid | Gauze | Alginate | Foam | Pads | Negative pressure systems



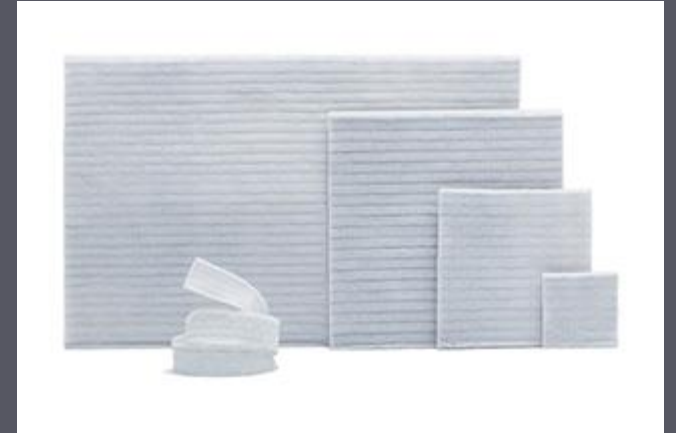
Dressing types

- Antibacterial properties:

Honey



Silver



Simple

Vacuum-assisted wound management



PICO (\$200)
Continuous 80mmHg
40mls (300mls)
7 days



Pravena (\$400)
Continuous 125mmHg
45mls (S), 150mls (L)
7 days



VAC (\$150/day)
Both <200mmHg
1000mls
<7 (3) days

Complex

Vacuum-assisted wound management



VAC Vera (>\$150/day)
Intermittent <200mmHg
1000mls
<7 (3) days



ABTHERA (\$750/day)
Continuous 150mmHg
1000mls
<7 (3) days

Questions?

