



# CLINICAL PRACTICE GUIDELINE PRESSURE INJURIES AND SKIN HEALTH IN PARA SPORT

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## GLOSSARY/DEFINITIONS

Term	Definition
AIS	Australian Institute of Sport
ASC	Australian Sports Commission
AT	Assistive technology
<b>Compression therapy garment</b>	A product or device which applies pressure to the external surface of the leg-resulting in reduction of a swollen limb.
DACC	Dialkyl carbamoyl chloride
DVT	Deep vein thrombosis
<b>Epithelialisation</b>	Pink tissue that occurs in final stage of wound healing.
<b>Eschar</b>	Necrotic tissue, non viable tissue that is usually black or brown. It can be dry, hard of soft tissue.
GI	Gastrointestinal
<b>Granulation</b>	Red, moist, healthy tissue.
<b>Haemoserous</b>	Clear, yellow fluid with a pink tinge.
<b>Hypergranulation</b>	Red uneven granulation tissue - Bleeds easily and often a sign there are microorganisms in the wound.
<b>Health Care Practitioner (HCP)</b>	medical doctors, physiotherapists, nurses, and other allied health practitioners who have the expertise and experience guide assessment, prevention, and management of pressure injuries for athletes in para sports.
<b>Moisturiser</b>	A product that adds moisture to the skin, not necessarily trapping moisture in the skin.

Term	Definition
<b>NDIS</b>	National Disability Insurance Scheme
<b>Necrotic</b>	Dead tissue in the wound bed.
<b>NSAID</b>	non-steroidal anti-inflammatory drugs
<b>Occlusive dressing</b>	A dressing often made of film/ plastic like material or foam and allows moisture and sweat to accumulate beneath-does not breathe.
<b>Primary intention</b>	Wound edges that can be pulled together and closed with products such as steri strips, glue, sutures.
<b>Purulent</b>	Discharge from a wound that is thick yellow, brown, green and may have bad odour.
<b>REDS</b>	Relative Energy Deficiency in Sport
<b>Secondary intention</b>	Wound edges that do not come together and require a dressing to promote granulation from the clean base of the wound and the edges.
<b>Serous</b>	Clear yellow wound fluid.
<b>Slough</b>	Necrotic tissue usually yellow in colour.
<b>TENS</b>	Transcutaneous electrical nerve stimulation.
<b>Turgor</b>	Elasticity of skin- skin should be stretchy.
<b>WADA</b>	World Anti-Doping Agency

# INTRODUCTION

## Scope

This document is intended for medical doctors (referred to as doctors henceforth), physiotherapists, nurses, and other allied health practitioners to guide assessment, prevention, and management of pressure injuries for athletes in para sports. It also includes practical fact sheets to provide education and advice to athletes and support staff.

## A note on language

Athletes in the context of this guideline refer to para athletes or athletes with disability. Athletes will present with a range of health conditions and impairments. The aim of this guideline is to keep information generic, however targeted towards athletes who, because of their impairment, are at increased risk of pressure injuries. Where necessary, an athlete may be described according to their health condition, such as, an athlete with spinal cord injury, to highlight a specific point.

Pressure injuries can be described as either pressure wounds or skin injuries. These terms may be used interchangeably, however in this guideline, all reference will be made to pressure injuries, unless it is important to differentiate.

Athletes may have various supports around them, including coaches and personal carers. Some larger high performance sport teams may have support staff such as doctors, physiotherapists, nurses, dietitians, occupational therapists and prosthetists (referred to broadly as health care professionals (HCP) henceforth). It is important to consider the unique structure of an athlete's support network, and where necessary, this will be highlighted. In practice when an athlete has concerns about a potential pressure injury or skin issue, the priority will be notifying the most available HCP as soon as possible (in a sport setting this is often a physiotherapist), who will then be able to guide the involvement of other team members.

## Confidentiality and consent

It is important to remember that prior to sharing any information provided by an athlete, their consent must be obtained unless there is a belief the athlete is at risk to themselves or others<sup>1</sup>. An athlete has the right to withdraw their consent at any time<sup>1</sup>.

When gaining athlete consent to share information, the HCP must clearly explain:

- Who the information is being shared with
- How/where the information is being shared (important to consider location if sensitive information being shared in person)
- What information is being shared (this may vary, based on role.)
- Consent must be informed. Health risks associated with withholding consent should be made clear<sup>1</sup> (for example, if coaches are not aware of a skin issue, then they might not modify training and travel/transfers to allow for optimal healing)

## What is a pressure injury?

A pressure injury results from friction, shear and/or sustained pressure to the skin and or underlying bone and tissue and can present as either an area of non-blanching redness, discolouration, or a wound. It should be noted that a pressure injury does not always result from pressure alone, however the term is used to encompass all the above described mechanisms<sup>2</sup>. Pressure injuries predominantly occur over a bony prominence such as the sacrum, ischium, greater trochanters, elbows, spinous processes, and calcanei, and are challenging when there is compromised sensation and/or circulation<sup>2</sup>.

Pressure injuries have a significant impact on both the health care system and an individual's general health and well-being. In 2020, the total cost associated with pressure injuries in Australian public hospitals was \$9.11 billion, of this, \$3.59 billion was associated with the cost of treatment<sup>3</sup>. Pressure injuries can vary from minor, with a short healing time, through to major pathology associated with significant complications, such as osteomyelitis which can have serious consequences on an individual's health.

Pressure injuries can also have a significant impact on an athlete's wellbeing. A pressure injury may result in reduced independence and increased care needs. Reduced training and/or competition availability from a pressure injury may be an additional psychosocial stressor on the athlete<sup>4</sup>.

Many resources are available on the prevention and management of pressure injuries in hospital and residential care settings. However, there is a paucity of resources to guide the prevention and management of pressure injuries for para athletes.

In the lead up to the 2012 Paralympics Games, a voluntary survey of 16 athletes found nine athletes had sustained a skin injury in the preceding year<sup>5</sup>. Of those who reported a skin injury, all had a spinal cord injury with altered sensation below the level of the injury. Most of the skin injuries occurred on the sitting bones (ischial tuberosities). These injuries caused between one to four weeks of lost training time, with one athlete reporting three months of altered training<sup>5</sup>. Treatment of injuries included dressings, with or without the guidance of a nurse, or self-management by the athlete. Only two of the nine athletes who acquired skin injuries adapted their equipment because of the injury<sup>5</sup>.

To achieve best outcomes in the prevention and management of pressure injuries, a multidisciplinary team of HCPs that includes doctors, nurses, physiotherapists and other allied health practitioners should be utilised. The athlete, support staff and coaches should be included in discussion and decisions regarding pressure injury management.

## RISK FACTORS

**Table 1: Extrinsic and intrinsic factors that influence skin integrity.**

Extrinsic factors influencing skin integrity may include:	
<b>Pressure</b>	Prolonged pressure causing skin injuries is often a major contributing factor to the development of pressure injuries.
<b>Moisture</b>	The skin is normally soft, supple, and hydrated but not wet or moist. Correct hydration is important.
<b>Sheer</b>	A force whereby the layers of skin begin to separate from each other
<b>Friction</b>	One surface remains stationary while the other moves repeatedly over the stationary surface, causing damage.
<b>Previous pressure injury</b>	The risk of pressure injury is higher where a previous injury has occurred.
Intrinsic factors influencing skin integrity may include:	
<b>Nutrition</b>	Insufficient nutrient intake.
<b>Body Morphology</b>	Significant changes in body weight or shape can increase risk of pressure injury.
<b>Oxygenation</b>	Oxygen supply to the skin is via the small blood vessels. Anything that obstructs these vessels can lead to skin damage. Pressure is one factor. However, hyperlipidaemia and smoking will also cause damage to small blood vessels.
<b>Skin Temperature</b>	Skin can withstand cold temperatures more than hot temperatures. However, both hypothermia and hyperthermia will put skin at risk of further injury.
<b>Chronic Illness</b>	Any illness can have negative impacts on an individual's overall health. When presented with a wound that is slow to heal, the attending HCP needs to consider the potential impact of the illness on the healing process.

### Risk assessment

Conducting a risk assessment using the Braden or Waterlow scale provides an estimate of the level of risk of developing a pressure injury.

# PREVENTION AND MANAGEMENT

There is considerable overlap in the prevention and management strategies when addressing skin care and pressure injuries for athletes in para sports. The best prevention is regular pressure area care and reducing pressure, friction and shear at high risk sites (sites of previous injuries and over vulnerable bony prominences). Consequently, the content of this section is combined to cover relevant information for both prevention and management.

## Medical considerations

Athletes may have medical comorbidities that increase their risk of pressure injuries. These need proactive consideration to protect the athlete from injuries that can potentially compromise their health, as well as their training and performance. Examples of such comorbidities include the following:

1. Sensory loss is a critical risk factor for the development of pressure injuries. Examples of conditions associated with sensory loss:
  - Spinal cord injuries with sensory loss below the level of the spinal cord lesion.
  - Diabetes mellitus – diabetic neuropathy (typically affects lower limbs) is a long-term complication of poorly controlled diabetes. Foot care is particularly important for individuals affected by this condition.
  - Neurological disorders such as multiple sclerosis, acquired brain injury, peripheral nerve injury can all result in variable sensory loss<sup>6</sup>. An individualised approach to risk assessment needs to be taken in all cases.
2. Loss of thermoregulatory control:
  - This is a major consideration for winter sport athletes such as sit-skiers with spinal cord injuries. Athletes can be exposed to cold temperatures for prolonged periods both in training and competition (sitting on chairlifts, waiting in line for slope access etc). Interventions to prevent excessive cooling of lower extremities are extremely important (e.g., thermal layers; sheepskin boots).
3. Venous insufficiency can be associated with peripheral oedema, putting the skin under tension in circumstances of poor tissue perfusion and hypoxia. Contributors to venous insufficiency can include:
  - Prolonged sitting by athletes with spinal cord injuries.
  - Venous stasis due to impaired muscle pump function. This largely affects athletes with a spinal cord injury, but will also apply to athletes who use wheelchairs because of other impairments such as lower limb amputation/s.
  - Deep vein thrombosis is a less common cause of venous insufficiency but should always be considered, particularly after long-haul travel or prolonged immobilisation.
  - Aging – some para athletes enter sport later and continue to compete into middle-age. Aging is an independent risk factor for venous insufficiency, regardless of other comorbidities<sup>7</sup>.
4. Lymphoedema:
  - Lymph node dissection or radiotherapy in the treatment of malignancy.
5. Poor nutrition:
  - Poor nutritional knowledge is a risk factor for skin pressure injury development and contributes to delayed healing once a pressure injury has developed. See [nutrition section](#) for further information.
  - Impairments that impact digestion (e.g., dysphagia; previous bowel surgery/anastomoses).

6. Social risk factors:
  - Smoking directly affects peripheral vasculature and circulation.
  - Excessive alcohol consumption.
  - Social/financial disadvantage can impact upon quality of nutrition; quality of clothing used for training and competition; maintenance and quality of equipment.
  - Poor/insufficient social supports.
7. Adverse reactions to medications:
  - Sun sensitisation – e.g., tetracycline antibiotics.
  - Drug eruptions – e.g., antibiotics, non-steroidal anti-inflammatory drugs (NSAIDs).
8. Skin trauma secondary to use of wheelchair/mobility aid:
  - Friction burns to hands.
  - Friction burns to axillae from use of crutches.
  - Acute skin trauma from wheel of chair/spokes.

## Optimising management of medical comorbidities

No two athletes have the same medical comorbidities, or the same overall risk profile for skin pressure injuries. Therefore, each athlete needs an individualised and holistic plan to optimise their skin health and minimise their risk of injury. Consideration needs to be given to domestic circumstances, daily training environment, and domestic and international competition plans. Key features include the following:

1. Education around key risk factors and risk mitigation strategies:
  - Regular re-positioning.
  - Regular skin checks.
  - Optimal cushioning and equipment.
  - Prompt showering and dressing in dry clothing after training and competition.
2. Optimisation of medical management of conditions that impact skin health will necessitate the athlete having an on-going therapeutic relationship with their general practitioner, team doctor or sports institute doctor. In turn, these practitioners may need to engage with the athlete's treating specialists:
  - Endocrinologist for diabetic control.
  - Neurologist for management of multiple sclerosis and other neurological conditions.
3. Oedema prevention and control:
  - Compression garments to reduce oedema secondary to venous insufficiency or lymphoedema.
    - Garments to be reviewed annually by specialist therapist (physiotherapist, physiologist or occupational therapist) with appropriate expertise and experience.
    - Athlete may require different compression garments for activities of daily living and training.
    - Awareness that modern compression garments may be expensive and cost prohibitive.
    - Customised compression garments may be required to ideally support some athletes (e.g., amputees, athletes with limb dysmelia).



4. Optimise nutrition [see **Nutrition section**]
5. Continence management is important in the prevention of pressure injuries and other skin conditions. Moisture from incontinence can lead to skin break down. Increased friction and sheer can cause incontinence associated dermatitis. Ensure the skin is dry and any continence aids are regularly changed. The use of barrier creams can also be effective. If an athlete is experiencing **continence issues**, they should be encouraged to consult a continence nurse.
6. Education and assistance with smoking cessation or moderation of alcohol consumption.
7. Appropriate counselling around possible drug reactions.

## Medications that may impair wound healing

1. Some medications may impair wound healing and therefore prolong damaged skin integrity. This needs consideration when prescriptions are issued to athletes with pressure injuries<sup>9</sup>. Relevant examples of such medication include:
  - Steroid medications inhibit fibroblasts and reduce collagen formation and re-epithelialisation.
  - Nonsteroidal anti-inflammatory drugs block the inflammatory cascade and have been shown to delay healing in animal studies.
  - Angiogenesis inhibitors (for example, some immunotherapy agents).
  - Sulphonamide antibiotics — some studies suggest an association with delayed skin healing<sup>9</sup>.
  - Anticonvulsants: animal studies have documented delayed skin healing in association with gabapentin and pregabalin<sup>10</sup>.

2. Risk vs reward:

Consideration needs to be given to the importance of the use of a particular medication, balanced against possible delayed wound healing. In the case of an athlete being treated with a long-term immunotherapy drug to successfully manage a malignancy, the medication should be continued despite risks to the skin. However, consideration of whether to continue systemic corticosteroid medication may be different in an athlete who is taking the medication to manage severe asthma, as opposed to an athlete who is taking the medication for an exacerbation of allergic rhinitis.

## Pain Management

Pain associated with pressure injuries is variable. Symptom severity can be influenced by<sup>9</sup>:

- Site — is the injury site subject to unavoidable repeated pressure.
- The number of tissue layers involved.
- Sensory integrity at the injury site.

Appropriate pressure injury management will positively influence the pain being experienced. Management decisions include dressing type; use of cushions; equipment modifications; padding. It is also important to address the subject of pain directly with the athlete. Appropriate steps can include:

1. Pain assessment:
  - Direct history from athlete, including use of numeric rating or visual analogue pain scale.
  - Indirect assessments such as blood pressure monitoring in athletes with spinal cord injury with a history of autonomic dysreflexia [painful stimuli below the level of the spinal cord lesion can cause hypertension].
2. Medications:
  - Topical analgesia may be detrimental if applied to damaged skin.
  - Simple oral analgesia such as paracetamol should be used first line for pain management. If effective, the athlete should be advised to take the medication regularly, rather than waiting for pain to return or worsen.

- NSAIDs can have an anti-proliferative effect on skin and blood vessels, and thereby impair healing. They should be used with caution in this setting and their prescription balanced against the athlete's requirement for pain control.
  - Stronger opiate type analgesia may be required but should be prescribed with caution. The athlete should be warned regarding potential side effects including nausea, constipation, drowsiness and confusion.
  - Adjunctive agents, such as low dose amitriptyline, can be considered. This may be especially beneficial if pain is associated with sleep disturbance.
  - The prescribing doctor needs to consider the World Anti-Doping Agency (WADA) Code at all times when managing athletes in designated testing pools.
3. Non-pharmaceutical pain management options for consideration:
- Optimisation of equipment and off-loading of pressure areas.
  - Regular re-positioning of athlete.
  - Clinical psychology/mindfulness.
  - Acupuncture (with due consideration given to skin health at treatment site/s).
  - Transcutaneous electrical nerve stimulation (TENS).
  - Ice/cooling is unlikely to be appropriate since it will result in vasoconstriction and reduced circulation to the region of damaged skin.

## Infection management

Infection is a common and potentially serious complication of pressure injuries. The injury can quickly escalate from an inconvenience to a serious medical condition, should the injured area become infected. Prevention and early management of potential infection is the priority.

HCPs must be able to recognise signs and symptoms of infection. It should be noted that para athletes with certain medical conditions may present late or with atypical symptoms. Signs and symptoms of infection include<sup>(11)</sup>:

- Wound or skin changes:
  - Erythema of the skin surrounding a wound
  - Warmth
  - Malodorous wound
  - Increased amount, or viscosity of wound exudate
  - Bridging or pocketing within adjacent tissue
- Worsening pain at the wound site without an alternate explanation
- Systemic symptoms/signs:
  - Fever
  - Malaise, including decreased training capacity
  - Local lymphadenopathy (enlarged and tender nearby lymph nodes)
  - Tachycardia

- Severe or late signs of infection may include the above plus:
  - High fever or hypothermia
  - Delirium
  - Multi-organ failure
  - Septic shock (including hypotension)

There are different ways in which infection can manifest:

- **Cellulitis** – When bacteria (or sometimes fungus) overwhelm the body's immune system, the infection can spread from the wound to the surrounding skin and soft tissues, causing a spreading skin infection<sup>[11]</sup>. This requires careful observation to monitor for spread by marking the affected area, and early use of oral antibiotics targeted to the organism that has caused the infection. In more serious cases, intravenous antibiotics are required. An early wound swab (prior to commencement of antibiotics) can help guide the most appropriate antibiotic treatment.
- **Abscesses and collections can develop underneath or adjacent to a pressure injury and are a result of infection encapsulated in a pocket of connective tissue or cyst**<sup>[11]</sup>. These collections of pus are not usually penetrable by antibiotics, therefore require incision and drainage to release the contents. In most instances, the wound heals by secondary intention to ensure the abscess or collection does not reaccumulate.
- **Osteomyelitis is an infection involving bone. Given that pressure injuries frequently occur over bony prominences, seeding into the underlying bone is a risk**<sup>11</sup>. On top of intravenous antibiotic treatment, osteomyelitis may require surgical debridement of necrotic tissue or bone, or even amputation. If an athlete has a prosthetic joint or surgical hardware in situ, this can be highly susceptible to infection and difficult to treat. Prosthetic joints and/or hardware may need to be removed to clear the infection.

It is also important to take other environmental factors into consideration. Certain water sport athletes may be exposed to atypical pathogenic organisms that could influence the likelihood of a pressure injury becoming infected and influence the most appropriate treatment of infection.

More information about the selection of appropriate dressings for an infected pressure area can be found in the [Choosing dressing type](#) section.

Refer to the [International Wound Infectious Institute Wound Infection in Clinical Practice document](#) for further information on prevention and management of wound infection. This document also contains useful information on how to best take a wound swab for culture.

## When/who/how to refer

Athletes and practitioners should understand what signs or symptoms require referral to other specialised care. Referral may occur to assist with acute management, and/or for specialist input to address factors related to the pressure injury. A decision to refer will be influenced by the experience, training, and resources available to athlete and involved practitioners.

Other sections of this document provide further details about the role of different discipline areas providing specialised care. The guide below suggests circumstances that may require referral:

**Table 2. Circumstances that may require a referral to a specialist.**

<b>Doctor — primary care or clinic setting</b>	<p>This could be a general practitioner or team doctor for the athlete.</p> <p>For assessment and treatment of potential or suspected infection, including cellulitis, abscess, collection or osteomyelitis.</p> <p>For consideration of incision and drainage of abscesses or collections, noting that some may require onward referral for surgical input.</p> <p>For pain management.</p> <p>For review of medical risk factors, comorbidities or pre-disposing factors.</p>
<b>Hospital setting, including surgical specialities</b>	<p>This may be through the emergency department, or by direct referral to an admitting doctor.</p> <p>Can be required for surgical intervention including drainage of more serious abscess or collections; debridement; management of potential osteomyelitis.</p> <p>Consideration of intravenous antibiotics if infection is severe. In certain circumstances this may be completed through an outpatient or 'hospital in the home' setting.</p>
<b>Specialised wound nurse</b>	<p>May be indicated when the support network responsible for the athlete in his/her daily training environment does not have the requisite expertise or requires expert advice.</p>
<b>Dietitian</b>	<p>Given the importance of optimal nutrition and hydration to the healing of skin pressure injuries, a dietitian should be involved in all cases where nutrition may be a limiting factor for healing.</p>
<b>Prosthetist</b>	<p>For athletes required to wear prostheses at sites of skin pressure injuries, consideration should be given to seeking review by a prosthetist to ensure that the fit is optimised and local pressure minimised.</p>

## Nutrition

Nutrition plays an important role in both the prevention and treatment of pressure injuries. The dietitian can complete a thorough assessment of the athlete's dietary intake, identifying any deficiencies. When an athlete has a history of pressure injuries, or has a current pressure injury, it is important to work closely with the support team to ensure all potential areas of concern are addressed.

### Nutrition-based prevention strategies

- Consuming a well-balanced, nutritionally complete diet. Impaired nutritional status and insufficient nutrient intake are significantly associated with the development, and subsequent healing, of pressure injuries. Therefore, potential prevention measures may include blood screening for nutrient deficiencies when clinically indicated [e.g. albumin, zinc, ferritin, vitamin B12, folic acid, haemoglobin]<sup>12</sup>.
- Ensuring energy intake reflects energy expenditure, to limit weight fluctuations of more than 5-10%. Specifically, non-deliberate weight loss, as well as significant weight loss over a short period of time, indicates that nutritional needs are potentially not being met, and will also lead to less fatty tissue padding which can increase risk. In addition, significant increases in body mass may increase the risk of pressure injuries through changes to fit of the athlete's wheelchair or prostheses. Regular weight monitoring may be important in high-risk athletes.
- Limited alcohol consumption. Alcohol consumption may indirectly cause increased risk of pressure injuries through various means including excessive energy intake, interference with nutrient intake, accidental injury if drinking to excess, and dampened immune response.
- Caffeine intake across the day, as well as consuming caffeine later in the day is likely to interrupt sleep, and hence should be managed appropriately. Sleep is crucial in the healing process.

### Nutrition recommendations in the case of a pressure injury

- Maintaining a well-hydrated status is considered one of the most important external factors responsible for optimal healing, and so must be made a priority in the case of a pressure injury. Hydration plays an important role in the preservation and repair of skin integrity, through supporting blood flow to wounded tissue and to prevent additional breakdown of skin<sup>13</sup>. Monitoring urinary output through frequency, volume, and colour, can give the individual an indication of their hydration status. Use of water-soluble electrolytes (particularly in the evening) could be useful in maintaining optimal hydration levels while also avoiding sleep disruptions due to frequent toileting overnight.
- Wound healing requires sufficient energy intake. Therefore, caution should be exercised when decreasing overall energy intake in response to inactivity, as requirements for wound healing may outweigh the reduced energy expenditure of reduced training load, or even bed rest. The specific energy requirements for wound healing are unknown, and depend upon other comorbidities, the stage of the wound, and the level of activity the athlete can complete and should be assessed on a case-by-case basis by a sports dietitian. Athletes should be screened for potential Relative Energy Deficiency in Sport (REDS), which may impact on the healing capability.
- Increased protein intake is associated with enhanced healing rates. Ensure protein intake is adequate (intake between 1.5-2g Pro/kg/d, noting that recommendations vary depending on the stage of the wound)<sup>13</sup>. A dietary assessment should be undertaken by a sports dietitian, whereby consideration of activity levels can be assessed, along with overall energy intake or expenditure and gastrointestinal (GI) maintenance and appetite. If the athlete is unable to exercise with the pressure injury, there is a higher risk of muscle loss and an increased resistance to muscle protein synthesis. Therefore, it is recommended that regular doses of protein are consumed across the day, including just prior to bed. A dose of at least 0.3g protein/kg BM at each time point is suggested during this period.
- Vitamin C and Zinc can assist with skin repair, integrity, and preservation<sup>13</sup>. Zinc has a role in collagen formation and protein synthesis, and zinc deficiency can cause poor wound healing. The recommended dietary intake for adults in Australia for zinc is 8mg/day for females and 14mg/day for males<sup>14</sup>. It is not recommended to supplement zinc unless a deficiency is suspected<sup>15</sup>. Instead, aim for foods rich in zinc, such as red meat, legumes, nuts, seeds and fortified cereal. Vitamin C is a co-factor involved in the production of collagen, and hypothesised to be important for tissue repair and regeneration.

However, larger doses have not shown to be more effective than lower doses. Encouraging athletes to include 1-2 servings daily of Vitamin C rich foods is recommended to reach the recommended daily intake (RDI) of 45mg<sup>14</sup> / day (e.g. citrus & tropical fruits, berries, kiwi fruit, tomatoes and capsicum).

- Supplementing with arginine, in combination with fish oils has been used successfully as part of a holistic wound healing strategy, and appears to be more effective than either supplement given alone<sup>16</sup>. After discussion with a dietitian, supplementation of arginine is recommended in the case of wounds that are failing to heal or require rapid healing. Arginaid<sup>TM</sup> by Nestle, and Juven<sup>TM</sup> by Abbott contain arginine and other important nutrients specifically designed for wound healing. Supplement safety is a key consideration in the athlete population, so discussion around supplementation with a sports dietitian is recommended. In addition, foods containing fish oils (salmon, sardines, mackerel, and tinned tuna) should be included 2-3 times per week in the diet of an athlete with a pressure injury. Fish oil supplementation of >1,000mg per day dose should be considered if the athlete does not consume adequate fish.

## Psychosocial factors

Assessment and management of pressure injuries addresses physiological factors. However, equally important, is the recognition of an athletes' mental health and psychosocial wellbeing<sup>4</sup>.

Athletes' mental health and psychosocial wellbeing can contribute to, and be exacerbated by, pressure injuries<sup>4</sup>. Pressure injury management can often be prioritised over other health domains, leading to feelings of isolation due to reduced participation in meaningful activity. This can compound an athlete's ability to make decisions or hinder the athlete from seeking assistance<sup>4</sup>. Fostering a partnership and recognising that no two athletes are the same can help counter some of these issues.

Building and maintaining a partnership with athletes in preventing and managing pressure injuries is paramount<sup>17</sup>. This can be challenging in a team environment where there is a change in support staff over time. Strategies to help manage this can include:

- Early definition of responsibilities and expectations.
- Identifying and negotiating priorities.
- Setting common goals.
- Building mutual trust and respect<sup>17</sup>.

A good partnership acknowledges the expertise that both HCP and athletes bring, with everyone working towards self-management<sup>17</sup>. A starting point for HCP can include identifying:

- How well the athlete knows their body.
- What strategies do they have and use for pressure care<sup>17</sup>.

Not all pressure injuries can be avoided<sup>17</sup>. Stigmatising or blaming athletes who develop pressure injuries does not help the individual<sup>17</sup>. People with pressure injuries may not engage in prevention or management strategies due to a perception that they are 'difficult'<sup>18</sup>. Open communication, steering away from emotive language, and fostering an environment that normalises the experience of pressure injuries may help athletes, HCP and team staff to learn from each other. This environment can potentially promote early detection and reduce the impact pressure injuries have on the athlete and their team.

Athletes with a disability can present with varied experiences and abilities, shaping different behaviour and attitudes towards pressure injury prevention. Identifying athletes' styles and attitudes towards pressure injury prevention can inform self-management strategies<sup>19</sup>. This includes identifying athletes':

- Lifestyle priorities.
- Perceived trade-offs between what is required to manage skin integrity and living life.
- Potential competing interests, roles, and responsibilities.
- Coping and problem-solving strategies for preventing pressure injuries.
- Potential fear of going to hospital<sup>4</sup>.

While self-management is the goal, not all athletes will have this ability, all of the time. Influencing individual factors include:

- Time since acquiring impairment.
- Co-morbidities.
- Being unwell<sup>17</sup>.

Influential environmental factors may include:

- Limited social supports or living alone.
- Insufficient personal care.
- Carer fatigue.
- Financial concerns.
- Unsustainable work, family and/or athlete commitments<sup>4</sup>.

Monitoring these factors over time will optimise pressure injury prevention and management.

## Environment, training and sport specific considerations

An athlete's environment can influence susceptibility to skin breakdown. Environmental factors include ambient temperature and humidity, and immediate training and competition environments such as those associated with water-based sports or extreme weather sports such as skiing or snowboarding.

Athletes with a disability may be susceptible to skin breakdown in lieu of environmental conditions due to altered vascular supply, sweating response, temperature control, or autonomic response. These secondary complications are more commonly experienced among athletes who have neurological impairments, such as spinal cord injury or multiple sclerosis. However, they may also be encountered by athletes with other health conditions such as those with severe burns and scarring, or diabetes mellitus. In response to the environment, athletes with neurological conditions may also experience increased spasm which may exacerbate shearing and skin damage. Athletes with limb deficiency, and whose limb interfaces with a prosthesis, may also be vulnerable to moisture and shearing.

Beyond trying to control ambient temperature through air conditioning and clothing, training and environmental conditions can be difficult to manage. Hence, attention can be directed towards strategies to help mitigate impact, including anticipating a change in environmental conditions which could influence skin health. Given the variability different health conditions bring, each athletes' response to the environment will be different. A checklist for successful management can include the following:

- Does the athlete have a health condition whereby the environment may impact their skin health? (i.e. spinal cord injury, spina bifida, amputation, multiple sclerosis, severe burns and scarring)
- Does the athlete know how to manage their health, including skin, in certain environments?
- Is the athlete on any medication that might impair their ability to regulate body temperature (beta blockers and anti-histamines for example can interfere with sweating responses)?
- Is the athlete entering a new training or competition environment?
- Is the athlete training or competing in extreme conditions (e.g., of temperatures or altitude)?
- Is the athlete training or competing in a vulnerable environment? (i.e. open water, windy conditions)
- Is the athlete using a new piece of equipment that hasn't been tested in a new training or competition environment?
- Is the athlete having to wear layers of clothing to manage cold weather, which could cause adverse pressure or shearing?
- Is the athlete having to wear less clothing to manage hot weather, which could cause adverse pressure or shearing?

- Does an athlete need protection from the sun (sunburn could lead to skin damage, which could inadvertently lead to a pressure related issue)?
- Does travel for training or competition include a long-haul flight (this could influence hydration levels, and expose the athlete to risk of prolonged pressure being applied over bony prominences)?

This list of considerations is not exhaustive but provides a guidance on how the environment and training/sport specific factors may influence the management of skin health in athletes with disability.

### Additional resources:

<https://www.health.nsw.gov.au/environment/beattheheat/Pages/information-for-health-professionals.aspx>

<https://www.msaustralia.org.au/news/impaired-sweating/>

<https://scireproject.com/evidence/autonomic-dysreflexia/other-autonomic-dysfunctions/thermodyregulation/>

[https://aci.health.nsw.gov.au/\\_data/assets/pdf\\_file/0018/236151/Burns-PT-OT-Guidelines.pdf](https://aci.health.nsw.gov.au/_data/assets/pdf_file/0018/236151/Burns-PT-OT-Guidelines.pdf)

## Travel

Travel can increase an athletes risk for pressure injuries due to the following factors:

- Difficult transfers in and out of the aeroplane seat and aisle chair.
- Prolonged time sitting (usually first on and last off the plane).
- Those who use air-cell cushions (e.g. Roho) in a pressurised cabin will find that their cushion pressure increases in-flight.
- The increased height of the plane seat plus cushion can mean feet are unsupported. While the plane seat cushion can be removed, airlines do not approve of this.
- When athletes with impaired sensation fall asleep during travel, they can be in a suboptimal position without realising (e.g. hip region against the arm rest).
- Dehydration during travel is common due to pressurised air and reduced fluid intake. Dehydration makes skin more fragile and susceptible to injury.

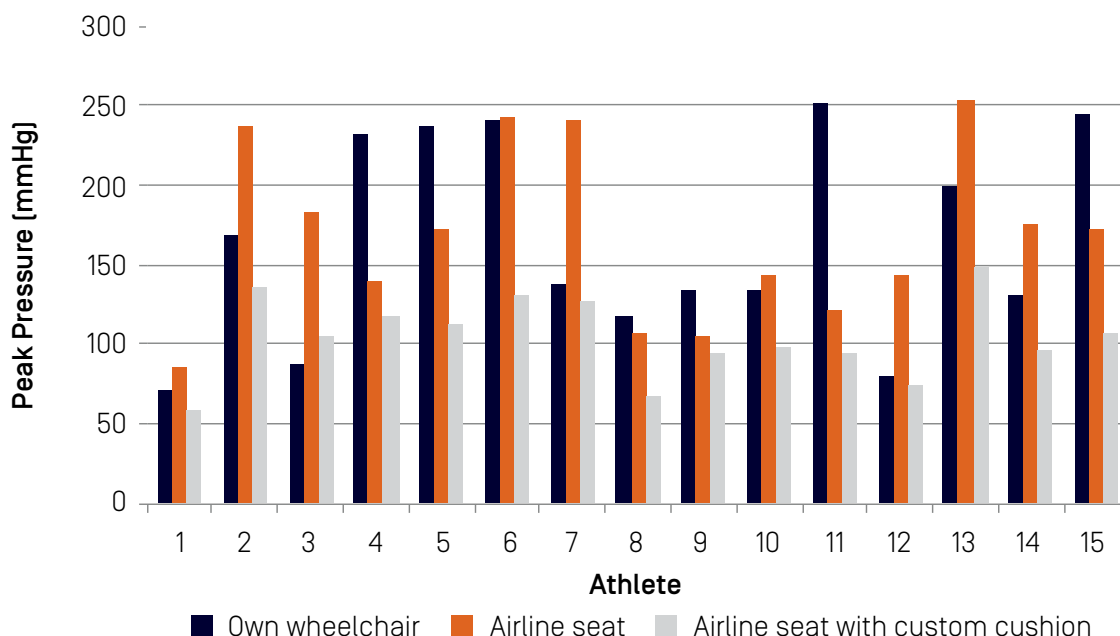
Analysis of injury data collected in relation to the Australian 2012 Paralympic Games team revealed nurses and doctors treated seven travel-related skin injuries within the first five days of athlete arrival into the village<sup>5</sup>. This was reduced to one athlete following a concerted effort in this area for the Rio 2016 campaign<sup>20</sup>. There are several measures that can be taken to reduce the incidence of skin injury in relation to long haul travel.

**Travel cushions:** A seat cushion can reduce the likelihood of pressure injuries by directing pressure away from critical areas (such as the sacrum, ischial tuberosities) as well as increasing the total contact area<sup>21</sup>. In a study by Paralympics Australia from 2013 to 2016, it was discovered that individualised, custom foam cushions provided maximum increase in contact area while reducing pressure over bony prominences<sup>22</sup>.

Individual measurements obtained during the cushion fitting process for the Australian Wheelchair Rugby team revealed some athletes had very high peak pressures in their own wheelchair<sup>22</sup>. Many of these athletes had no sensation in the buttock region and over 40% had a history of a skin pressure injury<sup>22</sup>. As demonstrated in figure 1, all athletes experienced reduced pressure using a customised cushion in comparison to sitting directly on the airline seat<sup>22</sup>.



Figure 1; individual athlete peak pressures in own wheelchair (blue), airline seat (orange) and airline seat with customised cushion (grey)<sup>22</sup>



Travel cushions can be produced by a seating specialist and the outcome should be measured with a pressure mapping device.

**Pressure relief in flight:** Athletes with impaired sensation and/or circulation should try to relieve their seating pressure (push up through arms to lift butt off the chair slightly for a few seconds) and change positions slightly every hour when awake. However, athletes without triceps function (e.g., quadriplegic athlete with a lesion above C6) might not be able to lift themselves and may need an assisted pressure relief lift regularly. Using an alarm as a reminder can help, however athletes should not be encouraged to wake for pressure relief unless they are at particularly high risk.

**Hydration:** Athletes should be encouraged to hydrate effectively for travel and to pack products that will assist (e.g. electrolyte tablets). Ensure athletes understand the link between dehydration, urinary tract infection, and skin injury. Hydration is discussed further in the [nutrition section](#).

**Clothing:** Ensure clothing for travel is suitable. There should be no buttons or pockets in the rear of pants as these can produce a point of pressure. Fabric should be cotton, to ensure it is breathable and non-slip. Shoes should not be new. For teams encouraging uniforms on a flight, check these are suitable for para athletes.

**Prostheses and orthoses:** Athletes who wear prostheses or orthoses may experience changes to limb shape during travel (long haul flights in particular) due to fluid retention. This is especially common in the lower limbs. Consequently, it may be best for athletes to remove their prostheses for flights. Fluid retention can be minimised by wearing compression garments, custom stump liners or a liner plus socket during the flight. It also helps to move the limb regularly and elevate when possible. Athletes who remove prostheses for flights may need to use crutches upon arrival instead of walking on the prosthetic limb. This should be encouraged to prevent skin breakdown or pain in the stump. Increases in limb volume may take several days to reduce/resolve after a long flight, and this should be considered with prosthetic wear in the days after a flight. Many airports provide assisted transport or wheelchair loan within the airport, and this can be booked ahead of travel. It can be especially helpful during international transits.

**In-flight transfers:** Extra care should be taken with transfers in flight. Sitting in the aisle seat is often most beneficial as the athlete has less distance to transfer across. Arm rests and seat buckles are challenging at times – make sure buckles are out of the way before transferring. The athlete should always oversee their own transfer and request help in the specific way required. Before the transfer takes place, encourage the athlete to talk through the process and outline the role any assistants will take. Use padding over the arm rest if needed and allow extra clearance space.

**Use of pressure garments:** Medical grade compression socks can be an advantage during travel to reduce fluid accumulation and risk of deep vein thrombosis (DVT). It is very important to reduce any additional pressure caused by wrinkles and slippage. Many athletes with spinal cord injury will require assistance applying compression socks.

**Carers:** In sport, carers are sometimes responsible for multiple athletes. In the team environment, carers having clarity on which athletes they are responsible for is vital. Importantly, they should know which athletes have a history of skin injury.

It can be useful for athletes to travel with a medical care plan or summary provided by their usual medical team. Written medical summaries can provide vital information in the event of a medical emergency, particularly on a plane when phone calls may not be possible. These can be carried by the athlete and with their consent, any relevant team staff or carers. Information may include:

- A general medical history/summary.
- Specific attention to any prior history of travel-related medical issues.
- A list of regular medications.
- A list of any allergies.
- Any care or treatment plans in place for symptoms or issues that may arise for this athlete during travel.
- Other pertinent information (e.g. details of a ventriculoperitoneal shunt).

**Skin checks:** Athletes need to check the skin around all bony prominences and areas at risk before and after long-haul travel. This can be done as a self check with a mirror (or multiple mirrors), but it is often easiest for a carer or team medical representative to check skin routinely. Refer to [monitoring section](#) for how to perform skin checks.

Other signs of skin injury can include increased muscle tone and sweating (both are indications of a local pain response). Unfortunately, these are often confused with jet lag symptoms.

## Wheelchairs

### Importance of correctly fitting wheelchairs

Having a wheelchair that is appropriately sized and scripted to suit the athlete's functional ability is an important factor in pressure injury prevention and management. If positioning in the wheelchair does not match the physical capabilities of the athlete, then adaptive postures such as rotation or leaning to one side, are used to compensate. This can result in uneven loading. For instance, if the wheelchair is too wide it can encourage the users' hips to sit lower to one side leading to a pelvic obliquity and increased risk of injury to the lower side. If too narrow, it may cause pressure injury at the sides where the greater trochanters can rub on the side guards.

How a wheelchair is set up can impact risk for pressure injury because alignment of the pelvis and trunk when sitting influences pressure distribution. The functional level of an athlete who uses a wheelchair needs to be considered when setting up seating and wheelchair configuration. For example, an athlete with a spinal cord injury where abdominal function is compromised will need to sit with some posterior pelvic tilt for stability.

It is important that a wheelchair and seating script is conducted by a practitioner with appropriate expertise and in collaboration with the athlete. This will ensure equipment is functional and beneficial to their needs.

### Simple changes that can influence pressure

Modifications to a wheelchair set-up can influence pressure, negatively and positively. It is important to consider the impact some commonly adjustable parts on a wheelchair can have, such as:

- Footplates or armrests too low: This can lead to sliding or slumping that can cause more pressure and shearing at the coccyx or sacral area.
- Footplates too high (e.g. knees much higher than hips): This can increase the direct pressure at the ischial tuberosities.
- Backrest angle too open/tension adjustable back straps too loose: Results in slumping and leads the pelvis to go into excessive posterior pelvic tilt, resulting in increased pressure at the coccyx and sacrum.
- Backrest angle too upright/tension adjustable back straps too tight: If the athlete does not have abdominal strength or trunk control to sit fully upright, or their hip range of motion is not sufficient to sit fully upright for a sustained period, they may slide forward to open their hip angle for stability. This movement causes shearing between the skin and pelvis and can result in a pressure injury at the ischial tuberosities and sacral area.
- Adding more foam to the cushion to make it comfortable: This can raise the seat height, so the backrest height is no longer correct, can make wheelchair propulsion less efficient and render the footplate and armrest heights (if armrests are on the chair) effectively too low. It is important to ensure the wheelchair can be adjusted to match the different sitting height.

### Methods for assessing pressure

There are several factors that influence pressure injury development, such as blood pressure, moisture at the skin, continence, nutrition and history of a previous pressure injury. Peak sitting pressure is one other factor that can influence pressure injuries and is measurable. A pressure mapper can be used to assess peak pressure loads and identify potential areas of concern in seating. Pressure mapping can be used as an educational tool for athletes who use a wheelchair and their support team as it can show in real time the impact certain postures or cushions can have.

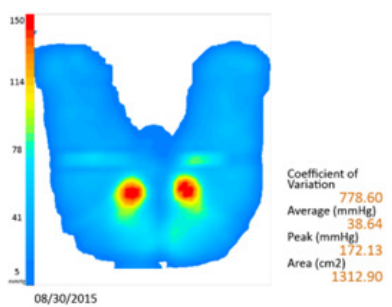


Figure 2<sup>22</sup>

Paralympics Australia (PA) has a pressure mapping device and expertise in its use. Contact PA (Ross Pinder email: [ross.pinder@paralympic.org.au](mailto:ross.pinder@paralympic.org.au)) for options to access the technology.

## How to alleviate pressure in a wheelchair

It is important athletes are aware of techniques to help alleviate pressure and use these during the day. The most common techniques are to do a side lean, lift up through the arms or a forward lean. Additional detail on techniques for travel are outlined in the [travel health section](#) of this resource.

### Forward leaning technique

The forward lean technique can be very effective, provided there is enough forward head room to do it. The athlete leans as far forward as able (within individual safety limits regarding falling from the wheelchair) by either hugging knees/reaching to toes, reaching across a table or holding a seat or object in front and pulling forward so more weight is through the under thighs instead of the buttocks. Hold this for up to 1- 2 minutes if possible, every 20-30 minutes<sup>23</sup>.

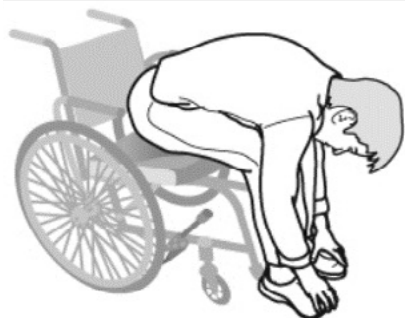


Figure 3 Forward leaning technique<sup>24</sup>

Below are pressure map images of the effect of using the above technique. The leaning forward pressure image on the right is an image when leaning to a level approximating the space available in a domestic economy airline, eg approximately two thirds of the distance as shown in the above image.



Figure 4 pressure mapping- sitting upright in airline seat<sup>22</sup>



Figure 5 pressure mapping- leaning forward in airline seat<sup>22</sup>

## Side leaning technique



Figure 6 Images of leaning techniques from Model Systems Knowledge Translation Center<sup>24</sup>

It is recommended to pressure relieve at least every 20-30 minutes for up to 1- 2 minutes if possible<sup>25</sup>. For the above side leaning techniques do not lean for 2 minutes in just one direction but do a combination of both sides and a variety of these techniques. Side leaning relieves pressure to one side but significantly increases on the opposite side, as illustrated in the pressure map below. It is therefore important to lean to both sides.



Figure 7 pressure mapping side lean on airline seat<sup>22</sup>.

## Upper body lift

Do a “lift” holding your armrests to lift your bottom off the seat. NOTE: This technique will have a long term impact on your upper limbs, especially your shoulders. Where possible use the leaning techniques.

## Transfers

Transferring in and out of a wheelchair can increase shearing risk factors considerably if a poor technique is used. Shear can be a factor in producing damage and ischemia of the skin and deeper tissues from perpendicular forces. If the athlete is unable to lift and pivot through the upper body, consider using a slide board with friction reducing material such as a slide sheet cut to size. Direct impact causing pressure can also occur with poor transfers, for example the person lands on the side guards or wheels during a transfer. It is important to work with a physiotherapist with experience in the area to develop and maintain transfer skills. Transfer technique may change over time due to age-based progression of muscle weakness or as a result of injury (e.g. shoulder or wrist injury). If injury impacts transfers, then a physiotherapist can help maximise ongoing independence, and can advise on safe techniques for the athlete and their supports if applicable.

The style of transfer to get in and out of the wheelchair should always be considered when getting a wheelchair and seating prescribed or if the set-up is being modified. It is important the wheelchair and seating set up supports the best method of transfer.

The level of contouring and material used in a cushion and its cover can impact on transfer ability therefore it is important to consider the right cushion to match the most effective transfer style.

## Cushions

The selection or provision of the correct cushion for an athlete who uses a wheelchair is vital to pressure management as well as functional use of the wheelchair. There are several types of wheelchair cushions available, each with differing properties and requirements for maintenance. A summary of the types can be seen in the below table.

**Table 3. Comparison of cushion types for the prevention of pressure injuries.**

Comparison of cushion types for the prevention of pressure injuries					
Cushion Type	Air only (eg Roho or Star)	Foam/ air combo (eg hybrid elite or Jay Fusion air)	Gel/fluid and foam combo (eg Jay 2, Jay fusion fluid)	Foam only (mass produced) – eg Ride forward, Spex contour.	Custom foam contoured
<b>Potential benefits</b>	<p>Allows immersion and when set correctly and maintained at the correct level has a high level of pressure relief properties</p> <p>Waterproof (actual cushion – not cover)</p> <p>Easily cleaned</p> <p>No weight limit</p>	<p>Can make custom foam surrounds with air inserts to create a very custom cushion for users with higher pressure or postural needs.</p> <p>Good pressure distribution when set up correctly.</p> <p>Provide firmer front for transfers</p>	<p>With regular repositioning and kneading can provide good immersion and pressure distribution.</p>	<p>Lighter weight</p> <p>Less expensive</p> <p>Stable structure</p> <p>Potential to be customised</p>	<p>Highly accurate shape capture (if done correctly)</p> <p>High level of surface area contact and can offer high degree of pressure management.</p> <p>If done using 3D scanning and routing then is reproducible.</p> <p>Very stable seat</p>
<b>Potential limitations</b>	<p>Cushion is heavy</p> <p>Can feel too dynamic. If the user has impaired sitting balance the movement in the air can effect balance.</p> <p>Training and maintenance required – need to check daily</p> <p>Set up requirements are very specific – see link below for more details.</p>	<p>Can feel too dynamic. If the user has impaired sitting balance the movement in the air can effect balance.</p> <p>Training and maintenance required – need to check the air component daily</p> <p>Set up requirements are very specific – see link above for more details.</p> <p>Foam sections not waterproof</p> <p>Expense – if custom made.</p>	<p>Requires frequent kneading of the fluid to keep it in place</p> <p>Can feel too dynamic and the movement can effect users with impaired sitting balance.</p> <p>Can encourage slouched postures and exacerbate posterior pelvic tilt (not always appropriate for users with coccyx or sacral pain/pressure issues.</p> <p>Very heavy</p> <p>Can feel cold initially</p> <p>Weight of user needs to be factored in</p>	<p>Foam not waterproof, therefore ensure there is a waterproof cover if continence is an issue.</p> <p>Lower weight capacity</p> <p>Shorter life span</p> <p>Lower pressure management properties (use for lower risk users)</p>	<p>Expensive</p> <p>Higher level of expertise needed.</p> <p>Takes greater time.</p>
<b>Transfer considerations</b>	<p>If the user when transferring needs to lean a hand on the cushion front edge an air only is not suitable as it will move and compress too much.</p> <p>Can make moving back into a seat difficult as the pelvis is immersed so low.</p>	<p>The firmer front section of foam enable a user to place their hand on it to support a pivot transfer.</p>	<p>The firmer front section of foam enable a user to place their hand on it to support a pivot transfer.</p> <p>If the fluid isn't kneaded flat before transfer the fluid indent may make transfer and moving fully back into the seat difficult.</p>	<p>Often can use a higher density at the front to enable support for hand placement for transfers</p> <p>Less contoured shape will usually enable the user to move back into the seat more easily at transfer</p>	<p>Transfers need to be consistent and the user has to sit in the same position to align with the contours each time.</p> <p>If using higher side contouring this can significantly limit capacity for pivot transfers.</p>
<b>Expected lifespan of the cushion</b>	<p>Punctures and valve damage are the limitations. If these don't occur an air cushion may last over 5-10 years with proper care of it.</p>	<p>The foam sections will likely require replacement every 12-18 months if using a handmade custom one. The Hybrid elite or Jay Fusion options while less custom use firmer foam surrounds and may last over 2 years with appropriate care.</p>	<p>1-2 years</p>	<p>6-12 months approx.</p>	<p>Approx. 12 months</p>

**Important note:** If an athlete uses an air based cushion (eg Roho or star cushion) it is essential that they and their supports are familiar with the cushion including how to check the inflation level and how to adjust it appropriately (refer to attached link for example of the Roho procedure — [https://www.enable.health.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0004/353173/Roho\\_Cushions.pdf](https://www.enable.health.nsw.gov.au/__data/assets/pdf_file/0004/353173/Roho_Cushions.pdf))

## When to review a day chair and seating

Consider an athlete's body and functional changes. If an athlete is new to a sport, body composition changes may initially occur rapidly as training and conditioning increases. Review of a wheelchair and seating should occur as changes to body composition and function happens to ensure the wheelchair and seating continue to offer the appropriate level of support.

It is recommended to review the wheelchair and seating following injury to ensure compensatory techniques aren't impacting pressure management and posture.

Any time discomfort or pain becomes an issue because of sitting in the wheelchair a review should occur. A 12 monthly review is a recommended preventative minimum standard, and more frequent reviews will be required for many athletes.

For Australian based athletes with a National Disability Insurance Scheme (NDIS) plan, ensure the plan has funds allocated for regular therapy reviews and an assistive technology (AT) budget for seating modifications or changes. NDIS considers a wheelchair will last five years but act immediately if requirements change and there is a rationale for a new wheelchair. Additional clinical justification and more paperwork might be required but it is possible for wheelchairs to be funded sooner via the NDIS.

## Commode/toilet/shower chair

If an athlete uses a wheelchair, they will likely require some seated support for personal care. It is important to match equipment with the local environment and the athlete's function. Options exist for self-propelling or static shower chairs as well as mobile commodes that can be used for toileting and showering. Assistive devices such as bath boards also exist to enable personal care over a bath if a shower cubicle is not an option.

An athlete's travel needs should be considered. Folding frame options may make luggage and travel requirements easier. Alternatively, consider hiring equipment locally from the state or country being travelled to. For para athlete sporting events, appropriate facilities may be provided at the accommodation by the local organising committee, but this should be investigated and confirmed prior by support staff.

If pressure risk is high, consider the padding on the seats. Some shower commodes only have hard plastic seats with slits for water drainage which can be problematic for pressure injury. Consider padded commode style seats instead or take additional padding to place on top of seats.

It is possible to get custom made shower commodes. If the athlete has custom seating requirements for pressure injury management, consider this option and consult an appropriate occupational therapist for assistance.

## Beds and mattresses

If an athlete is identified as having moderate or high pressure injury risk, or a history of pressure injuries, it is recommended to use a higher rated pressure relieving mattress. It is important to match the mattress style with the functional needs of the athlete. For instance, if an athlete performs a pivot transfer and needs to lean heavily onto the mattress as part of the transfer, an air-based mattress may be inappropriate. Consult an experienced occupational therapist for advice on equipment and mattress options and suitability of items for the athlete's function.

If a higher than standard mattress or overlay is used at home for pressure management, consider the travel needs for mattresses. An overlay may be required on an athlete's travels, or equipment may need to be hired from local suppliers at the location being travelled to. An overlay may be an option for use at home as well. Consider any changes the added height from the overlay might have for transfers.

Involve an occupational therapist and/or physiotherapist currently working with the athletes to assist with bed-based needs if possible.

## Sporting equipment considerations

Appropriately scripted equipment is the key to performance and pressure care management. It is important athletes, particularly those starting out in a sport, have access to equipment that is prescribed to their needs and dimensions. It is not uncommon for second hand or loan equipment to be used by individuals as they start their sporting career.

- If an individual must use second hand equipment, there are some strategies that can be used to assist:
- Avoid second hand seating. Always use a seat insert, cushion or body support system within the equipment that is individualised to the athlete. This should be assessed and made by appropriate staff i.e. a seating specialist, and involve the coach.
- If there is a choice of equipment (when the athlete's weight and size is stable) between slightly too big versus slightly too small, it is recommended to choose the slightly too big because modifications to the seating can be made, for example adding foam sections at the side if too wide can make the seating work. If too small, the athlete will have to rotate to fit, which can cause issues for technique and injury from use of adaptive techniques and postures.
- Wheel configurations may be changed to alter chair height, chair rake/dump (forward to back angle of the seat), or pushrim access point. Always consult a technician or personnel skilled in chair adjustments and check the configuration change with other key personnel to ensure it has not raised the athlete's pressure injury risk. For example, increasing seat rake can increase the level of pressure at the ischial tuberosities.
- Use pelvic, leg or foot harnesses to improve support and positioning. Don't just always use the harnesses in the same spot as the last user of the chair. Shearing or movement in a chair can be a significant contributor to a pressure injury. Appropriate harness use, in combination with seating, can improve athlete stability and reduce movement and shearing in the seat.
- Use bolster blocks or spacers to get footplates to the correct height.
- Adjust backrest straps or add wedging to set up the backrest shape and angle to best support the user.

## Sport regulations

Be aware of the regulations within the athlete's specific sport for the seating customisations to ensure what is used is still within the rules. Occasionally for pressure management some additional customisation may be possible, but this must be assessed on an individual basis for the athlete by the sport's governing body. Consult the guidelines for the sport and contact the governing body for further clarification as required.

## Matching functional/performance output with pressure management

Conducting a risk assessment versus performance gains is sometimes required. Consider the time spent in the wheelchair or equipment in this process. Consider using a training seat and a competition seat combination. A competition seat in a shorter duration event might use a firmer set up for better power generation whereas the training seat, which the athlete will be in for longer periods and more regularly, may use a softer interface for better skin protection.

## Custom equipment considerations

The Australian Institute of Sport (AIS) and state sports institutes have engineering capability that may be accessible to certain athletes. Collaborate with engineers, in conjunction with other key personnel to develop individualised set ups to maximise performance (funding will need to be available). Ensure skilled and qualified personnel are involved to do the measurements and scripting with the athlete.

Testing pressure after any changes to set up is recommended. Pressure mapping is available through Paralympics Australia's seating specialist.

Custom equipment can take some time to be completed. Start the process with enough time ahead of major events. It is not recommended to go into major events with a brand new, untested set up. Allow up to 6 months for custom equipment to be completed and tested with the athlete. It is important that the athlete is available for trials and fittings as part of the process to enable greater accuracy and success.



## Prosthetics

It is important that prosthetics including socks and liners are correctly fitting and well maintained. If a prosthetic is not well fitting, for example there is movement between the skin and the liner, or it is too tight, pressure injuries and skin break down can occur. It is important that advice is sought from a prosthetist if there are any concerns of fit. Prosthetics should be reviewed at least every 12 months.

Foam or other padding should not be used to change the fit of a prosthetic as it can create pressure that can lead to pressure injuries. If there are signs of redness or wounds do not attempt to manage these without the input of a Prosthetist.

## Heat related challenges

Athletes, particularly those competing in summer para sports, can be exposed to varying degrees of heat and humidity as part of their training and competition. Changes in exposure to heat can occur with travel to competitions, or through training to acclimatise for example in a heat chamber. This can be a time of increased risk of skin issues for athletes and should prompt closer monitoring with skins checks.

Antiperspirant can help with increased perspiration, however, can also lead to skin breakdown. Antiperspirant use should therefore be trialled cautiously with the athlete being aware of potential risks. Heat related rashes, and limb volume changes can also occur.

## Skin checks

Some redness is expected on skin in areas of loading within prostheses, although it is important to understand “acceptable” and “unacceptable” levels of skin pressure. If redness is noticed upon removal of a device, observe area and note if “normal” skin colouring returns within a short period of time (5-10 minutes). If the redness does not disappear, re-check area in 2 hours. If the redness remains unchanged 2 hours after removal of the device then this should be addressed by a prosthetist at the earliest convenience. If the redness remains for a period of longer than 10 hours then discontinue use of the device – this is evidence of a pressure injury.

## Volume decreases

Some discomfort/pressure issues may result from changes in limb volume. It is advisable to add or remove a thin prosthetic sock and note if the pressure/pain has changed. If changing socks, it is important to monitor skin for signs of excess pressure.

- Types of liners
- Silicone liners reduce shear and are hypoallergenic. However they can become hot, creating a build up of sweat. If this is not monitored this moisture can cause skin break down. It is important to wash the liner daily otherwise bacteria can build up causing skin infections.
- Foam liners may cause more friction than a silicone liner. It is important to carry socks to maintain appropriate volume in the event of unforeseen changes.
- Polyurethane liners are soft and have more give. They may be an appropriate interface for users with large areas of skin grafts, or highly sensitive skin which is prone to pressure/breakdown

## Perspiration management

Perspiration is an issue for most amputee athletes. It is important to manage perspiration within the athlete's prosthesis to avoid skin breakdown and suspension issues. Some users wear specific moisture-wicking socks/stockings inside their liners. Others apply anti-perspirants to their skin in the days/weeks leading up to major competitions to reduce sweat accumulation within their liners. It is important to have a solution for sweat management in place well before any competition to avoid skin irritation issues.

Anti-perspirants are best applied as a roll-on immediately before going to bed, then washed thoroughly before applying a liner the following morning. This avoids buildup of residues within the liner which may cause irritation, breakdown and infection. Be cautious with aluminium-based anti-perspirants as these are very aggressive on skin and may cause irritation or breakdown.

## Infection

More information can be found in the section '[Infection Management](#)'.

Any topical creams should be applied sparingly, and liners cleaned thoroughly to avoid accumulation of residues; these residues may cause further skin challenges. Major infections may require cessation of use of your prosthesis while they heal.

## Emergency equipment

It is recommended that athletes travel with "spares" of commonly used parts within their prosthetic devices, such as a 4mm Allen key, a spare liner, spare socks (of varying thicknesses), and spare sleeves/seals (if used). It is also advisable to travel with an alternative form of mobility, such as crutches or a wheelchair, in case a major issue arises with the prosthesis. Longer trips may necessitate carrying spare locks/valves to ensure suspension of the prosthesis can be maintained if a part fails. Athletes should book for a review of their prosthetic devices well before any major travel to ensure all components are safe for use. Athletes should also avoid traveling with brand new prosthetic devices where possible to avoid risk of issues when away from Prosthetist support.

## Braces, orthoses and medical devices

It is important to ensure braces and orthoses are fitted correctly to prevent friction, shear and pressure. Regular checking of the skin at the site of the brace, orthosis and medical device is important. If it is only used when participating in sport, the site should be inspected prior to putting on and after removing. It is important that the brace, orthosis and medical devices are re-evaluated/fitted with any changes in body composition as this will change the fit and increase the risk of pressure injuries and skin damage.

## Clothing

Clothing can contribute to skin injury for athletes with compromised sensation or circulation, for example those with spinal cord injury, peripheral neuropathy or multiple sclerosis. When providing a new uniform, it is helpful to check that seams, zips or buttons do not increase pressure or friction in an area of impaired sensation. New shoes can also be a source of skin injury and should ideally be fitted by an expert. Socks that are seamless are ideal or alternatively can be used inside-out to prevent pressure from seams.

Athletes who use a wheelchair should check that clothing does not create focal skin pressure between their body and their seat. When a uniform is made from slippery fabric like satin or silk, then it can cause athletes to slide in their chair, altering seating posture and changing the way pressure is distributed. Seams or pockets can contribute to skin breakdown when they are between the skin and seat.

Fabric that retains heat (e.g. polyester) can lead to retention of sweat against the skin and this increases the risk of skin breakdown, skin infection and irritation. Cotton and wool can draw sweat away from skin which is preferable. Seam-free or flat seams are also advantageous.

# SKIN CARE/ASSESSMENT AND WOUND CARE

It is important to maintain good skin condition in the prevention of pressure injuries. The following skincare practices can be implemented to reduce risk of pressure and other skin injuries. A pH neutral body bar should be used rather than soap due to its harshness on skin. Ideally the same brand of wash and moisturiser should be used so they are compatible. Travel with the same soap to avoid selecting an unknown brand that may cause irritation.

Daily showering and cleansing of the skin is usually adequate. However, if there has been excessive sweating or soiling of the skin then more frequent cleansing is required. Try not to rub skin dry after showering but rather pat the area dry with a towel to reduce friction to the skin.

## Skin assessment

It is important both the athlete and the support team know the individuals' skin-colour and turgor. Make a note of how the skin feels over bony prominences as sometimes the skin can be already callused and hard-due to years of constant friction.

It is important to maintain moisture balance of the skin as too dry or moist can increase the risk of skin injury.

Any pre-existing skin issues should be recorded, including strategies that previously corrected the issue. Moisturisers are excellent for repairing dry skin, however, have different qualities and ingredients depending on the brand. Brands containing no perfumes or preservatives are preferable.

## History of pressure injuries

When conducting an assessment on an athlete with a history of previous pressure injuries it is important to consider the following factors.

- Location?
- Stage?
- How long ago was it?
- Healing time?
- Complications?
- Interventions?
- Dressing types used and contraindications to particular dressing types?
- Frequency of dressing changes?
- What was the cause/factors leading to the pressure injury?

## Wound assessment

Clinical assessment of a wound and surrounding skin is essential to determine the most appropriate treatment including dressing choice. Table 4 outlines the steps taken in clinical assessment of the area. Table 5 provides a description and visual depiction of the different stages of a pressure injury, and correlating dressing types and treatment options.






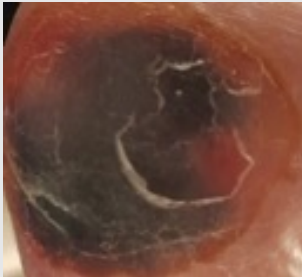
**Table 4. Wound assessment considerations and indications of severity.**

<b>Size and depth</b>	A deep wound may need to have dressing material applied to the base, to fill it to the surface. The dressing material should be applied in a manner that does not add pressure.
<b>How long has it been present</b>	The longer a pressure injury is present, the greater the risk of infection.
<b>Amount of exudate</b>	Exudate or ooze is important and requires consideration. High volume of exudate can be a sign of infection. Low volume of exudate usually means that the wound is healing. If the wound is too dry however, this can delay healing. Checking a dressing after it has been removed can provide useful information about the type of exudate. Infection should be suspected if the exudate is thick, malodorous or abnormal colour. Any suspicion of infection requires medical review.
<b>Viability of tissue</b>	Healthy tissue is red/pink in colour. Black, yellow or brown colour usually indicates non-viable tissue that needs to be removed.
<b>Stage of healing</b>	As a wound heals, the tissue colour gradually changes. Black/yellow/brown should change to red and then red changes to pale mauve or pink.
<b>Condition of surrounding skin</b>	Wound healing usually advances from the skin margins. The condition of the surrounding skin is therefore important. If the dressing is not appropriate for the exudate/ooze, the area around the wound may be white and soft. The dressing type and/or frequency of dressing change should be reviewed. Moisturisers and barrier creams can be helpful in preventing maceration.

## Stage of pressure injury

### Dressing types for stages of pressure injury

Table 5. Stage of pressure injury and appropriate dressing type/treatment.

Stage	Description	Dressing choice
<b>1</b> 	Intact skin with an area of non-blanchable redness. Painful in individuals with normal sensation <sup>26</sup> . The healing time is usually a few days to a week.	Simple protective dressing such as a non-adherent pad, mesh or foam.
<b>2</b> 	The top layer of skin is gone and the deeper layers of skin are exposed but no exposure of fat, muscle, tendon or bone <sup>26</sup> . Pain is usually present if at a site of normal sensation. The healing time is usually a couple of weeks.	Identify source of shear and friction.  Clean with an antimicrobial skin cleanser, cover with an antimicrobial dressing such as Inadine or Sorbact Compress and cover with a silicone foam and change second daily.
<b>3</b> 	Extension into fat but no exposure of tendon, muscle or bone <sup>26</sup> . These are complex wounds and are susceptible to infection <sup>27</sup> . Even if pressure, shear and friction are reduced, the healing time can be weeks to months.	Will have increased exudate, requiring an absorbent dressing such as a super absorbent pad or foam.
<b>4</b> 	Extension into deep layers. Muscle, bone and tendon may be visible <sup>26</sup> . These wounds can lead to serious medical complications and require input from specialists. The healing time can be months to years and in some case may never heal.	Are at risk of microbial overload/infection and will require an antimicrobial primary dressing and covering with a breathable absorbant pad. Antimicrobials include Cadexomer Iodine (Iodosorb/Inadine), silver dressings (Ag is usually on the packaging), medical grade honey (Melloxy), Dialkyl carbamoyl chloride (DACC / Sorbact), hypertonic saline (Mesalt).
<b>Unstageable</b> 	The wound is covered with necrotic tissue. Wound depth is uncertain. Wound should be labelled 'unstageable' until necrotic tissue has been debrided.	Remove as much necrotic tissue as possible. Dress second daily with an antimicrobial gel, powder or dressing.
<b>Suspected deep tissue injury</b> 	The skin is intact but the area is dark (in Caucasian skin) or feels boggy, hot and painful <sup>26</sup> . If the cause is removed, this tissue may recover. If exposed to further pressure, shear or friction, the tissue may break open to reveal the extent of the damage.	Keep dry until the eschar begins to separate itself. Paint with an antiseptic solution such as betadine daily and cover with a simple dry dressing and change daily. Once the black begins to lift then peel it away and treat according to the tissue beneath.

## Wound preparation

### Cleaning

All wounds require cleaning at each dressing change. If the water is safe to drink, it is safe to clean a wound, however, if in doubt use sterile saline. For wounds with signs of infection, use a surfactant cleanser such as Prontosan, Microdaycn, Grandacyn, Octenilin.

### Debridement - types of debridement, indications and who can perform them

Debridement is a term used to describe removing dead tissue from a wound. There are many types of debridement. It is important to understand your scope of practice prior to selecting your choice of debridement. Autolytic and mechanical debridement require minimal training. However, the other options should be performed or discussed with someone who is trained in the area prior to commencing debridement.





- Autolytic debridement- The use of dressings such as hydrocolloids, hydrogels and alginates to encourage breakdown of tissue by enzymes<sup>27</sup>.
- Mechanical debridement- The use of force to remove devitalised tissue. This can be done by scrubbing a wound with gauze or the use of debridement pad<sup>27</sup>.
- Chemical debridement- The use of chemical solutions to break down devitalised tissue. However, it is not regularly used due to the risk of toxicity and damage to surrounding skin<sup>27</sup>.
- Surgical debridement- Extensive removal of devitalised tissue by a surgeon often in an operating theatre under anaesthetic <sup>27</sup>.
- Sharp/conservative sharp debridement- The use of a scalpel and scissors to remove devitalised tissue. This can cause damage to other tissue if not undertaken by professional trained in the area<sup>27</sup>.
- Biological- The use of magots to remove devitalised tissue<sup>27</sup>.

## Choosing dressing type

It is important to consider the following when choosing dressing type:

1. Staging of the pressure injury
2. The function required of the dressing
  - Protect healthy tissue
  - Lift off dead tissue and clean the wound
  - Manage infection and colonisations
  - Manage wound odour

**Table 6. Dressing choice for wound type**

	Type of Wound	Management
	Infected wound.	Antimicrobial dressing, antibiotics, absorbent pad and light support bandage.
	Foot fungal infection.	Antifungal agents and dressings. Povidine iodine can be useful. Keep skin dry. Open footwear. Clean socks. Check shoe hygiene.
	Wound with undermining.	Light packing with a mesalt or sobact or gelling fibre. Cover with an absorbent dressing. Change daily or second daily. If bone is within the region, investigation may be required to exclude osteomyelitis.
	Blisters and stripping of the skin.	Antimicrobial dressings with no occlusion.

## Dressings for infected injuries

For infected wounds, antimicrobial ointments and impregnated dressings should be used, such as Cadexomer Iodine (Iodosorb/Inadine), any silver product ('Ag', the chemical symbol for silver, is usually on the packaging), medical grade honey (Melloxy), DACC (Sorbact impregnated cloth), or hypertonic saline (Mesalt). A hydrocolloid dressing is not an appropriate dressing type. For further information about the management of infection outside dressing selection, refer to the '[Infection Management](#)' section.

## Cavity wounds

If the wound is a cavity, caution needs to be taken when choosing a dressing. If wound borders are unknown, there is a risk of the dressing/parts of the dressing being left in the wound bed, adding a potential source of infection and delayed wound healing. If a wound has depth, then lightly filling the cavity with a wound product is desirable but the product must not break up when removed. The best products for lightly packing a cavity are Mesalt, Sorbact packing gauze or compress, and gelling fibres such as Aquacel, Durafibre, Biatian gelling fibre.

## Dressing reactions/allergies

The most common issue with wound dressings is allergy. The HCP should always check the dressing contents, usually found on the packet, against the athlete's known allergies. Redness, blistering and pain can occur, despite no known allergies. If this occurs, cease the product and make a note of the response to using that product. Taking into account other contributing factors.

## Frequency of dressing changes

Frequency of dressing change is based on many factors that include:

- Leakage
- Lifting
- Discomfort

Each dressing has a manufacturer recommendation for frequency of dressing change. For example, Mesalt for example is daily, Iodosorb is second to third daily. Adhere to manufacturer instructions, but when in doubt, change the dressing.

## Training and competition considerations

When choosing a dressing type it is important to consider whether a different dressing strategy is required for training/competition environments, as opposed to non-exercise environments. It is important to get the athlete's perspective on the most appropriate dressing for training/competition. A dressing that is too bulky or that interferes with training/competition is likely to be discarded, leaving the wound uncovered and at risk of infection.

## Scar management

Local pressure using tapes such as Hypafix is the first line of treatment. Silicone gel, such as StrataDerm is the next line of treatment. A scar that is recalcitrant to treatment may benefit from a combination of gel and a pressure garment. Pressure garments are usually custom made.



## Monitoring

Prevention of pressure injuries is preferable to post-injury management. Monitoring of skin through frequent skin checks is key to early recognition and prevention of pressure injuries. While skin checks are routinely recommended, individual compliance varies hence HCPs have an important role in reviewing compliance and educating on the important role of regularly monitoring.

The frequency of skin checks should be increased when there are any changes in skin, activities, equipment, body composition, and during travel. These changes can result in an increased risk of pressure injuries.

Skin checks should be performed at any site that contacts another object and/or at an area with reduced sensation.

This can be done as a self-check with a mirror (or multiple mirrors), but it is often easiest for a carer or team medical representative to check skin routinely. A method could include:

- Look for areas of blanching (whiteness), redness or pink skin that looks different.
- Feel for temperature increases (use the back of your hand).
- Palpate for any areas of fluid collection under the skin.

Regularly alleviating pressure is key to pressure injury prevention. See the [Wheelchairs](#) section for further guidance on techniques to help alleviate pressure. See the [Prosthetics](#) section for more specific guidance related to monitoring of pressure with a prosthetic.

## Documentation

Clear documentation is important in the management of pressure injuries. See document template as a guide. It is also important to add information on any referrals made and take regular photos of the wound, particularly if multiple HCP are involved.

# ACKNOWLEDGEMENTS

The authors wish to acknowledge Richard Goward, Victoria Moore, Rachel Harris and Emily Partridge for their significant input on the design and content of this guideline.

The authors would also like to acknowledge Rachael Watson, Angela Ballard, Samuel Carter, Bernadette Petzel, Matthew McShane, Holly Lipson, Greg Smith and Darren McMillan for their review and feedback on the content of this guideline.

# APPENDICES

## Appendix 1:

### Pressure injury prevention and management considerations for travel

#### NO HISTORY OF PRESSURE INJURIES

##### Pressure injury prevention

- Minimum twice daily skin checks
- (especially checking skin over bony prominences)
- Appropriate pressure care relief – discuss with OT, wound care specialist or equipment services provider if concerns
- Individualise bathing frequency. Wash and dry post exercise. Avoid hot water and excessive rubbing, Using moisturiser after bathing
- If incontinent, ensure adequate bowel/bladder program
- Moisturiser for dry skin. Use non occlusive, i.e zinc based creams over high risk areas
- Avoid massage over bony prominences
- Ensure adequate pressure care relief during travel
- Efficient transfers
- Have a pressure injury management/ prevention plan

##### Risk factors for pressure injuries

- Limited mobility and/or sensation
- Cognitive impairment
- Poor nutrition
- Comorbidities
- Aging skin
- Pressure from any hard surface
- Friction during transfers
- Shear from involuntary muscle movements
- Moisture – bowel or bladder incontinence, excessive perspiration, dry skin, wound drainage
- Poor nutrition or significant recent change in body

##### Discuss special considerations with coaches or support staff

- Transfers
- Assistive equipment
- Scheduling time for pressure relief

#### HISTORY OF PRESSURE INJURIES

- History of previous pressure injury including location and stage.
- Photo of locations of previous pressure injuries
- Staff checks of skin in combination with self checks- discuss frequency of this with athlete

##### Check transfer safety

- Hotel room set up, e.g does pillow need moving to other end of bed if particular preference of transfer side
- Transport
- Bathroom-bath/shower/toilet
- Athletes to advise most appropriate support

##### Checklist of specific equipment required and any that pose increased risk of skin injury.

##### For example:

- Bed
- Chair
- Shower chair
- Mattress topper
- Bedrails
- Bed stick
- Orientation of hotel room/moving around furniture if required

##### Inflight considerations

- Aisle seating
- Regular offloading manoeuvres
- Clothing- consider location of zips, buttons and seams
- Hydration
- Assistance with transfers
- Custom made travel cushion

#### ATHLETES WITH PRESSURE INJURY DURING TRAVEL WITH A TEAM

- Identify the cause of the pressure injury
- Refer to prevention/management section of document
- Remove all pressure from the pressure injury as much as possible
- Assess the pressure area
  - Number of ulcers / pressure areas
  - Location
  - General appearance
  - Size – length, width, depth
  - Stage
  - Wound exudate
  - Necrosis
  - Undermining
  - Sinus tracts
  - Infection
  - Healing
  - Wound margins / surrounding tissue – examine for signs of infection
  - Any changes to skin tell someone
- Photograph the wound
- Medical review essential for any of:
  - Fever >38°
  - Signs of infection (red, hot to touch, exudate)
  - Grade III or IV pressure areas
  - Worsening pressure areas
  - Feeling unwell

## Appendix 2: Wound Dressings-Types, Function, Uses

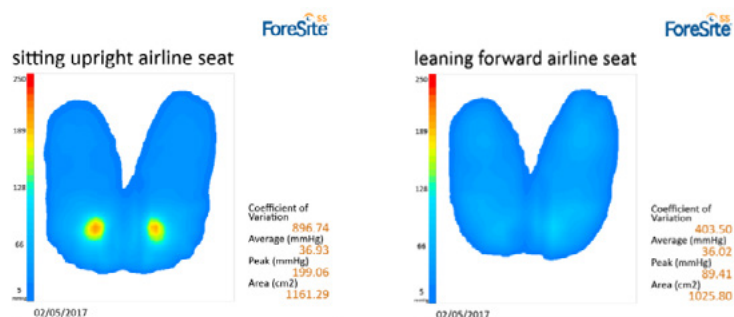
Generic name	Brand name	Function	Uses
<b>Low adherent pad</b>	Melolin, Cutilin, Telfa, Mediam 210	Protection of healthy tissue and absorption of minimal serous exudate	Superficial cuts and abrasions, secondary dressing on wound with low exudate
<b>Impregnated mesh dressing</b>	Adaptic, Urgotul, Mepitel	Protection of healthy granulation tissue, protection of fragile skin	On new skin grafts, on skin tears and on stage II pressure injury, friction blister and superficial partial thickness burn
<b>Foam dressing – adherent and non adherent</b>	Allevyn, Mepilex, Biatain silicone foam	Protection of healthy tissue, secondary dressing to manage moderate exudate	Stage II pressure injury, superficial cuts, padding but not a pressure injury device just used for padding and protection of injury
<b>Polyurethane film dressing</b>	Opsite, Tegaderm, Polyskin	Waterproofing and thin profile adhesive support dressing	Waterproof the dressing below and to hold dressing in place on areas of high friction due to its thin profile
<b>Hydrocolloid sheets</b>	DuoDerm, Comfeel, HydroCol	Aids autolytic debridement	Stage III pressure injury, sloughy superficial partial thickness wound, grazes and cracked heels
<b>Hydrogel-plain</b>	Solugel, NuGel, Purilon Gel	Rehydrate dry tissue, provide comfort	Aiding in removing scabs, Insect bites, stage IV pressure injury, superficial partial thickness burns
<b>Calcium Alginate</b>	Kaltostat, Algisite M, Melgisorb	Aids in stopping bleeding	Blood nose, fresh trauma bleeding wound
<b>Gelling fibre dressing</b>	Aquacel, Durafiber, Exufiber	Manages exudate by locking fluid in	Packing deep cavities, stage III and IV pressure injuries
<b>Cadexomer Iodine</b>	Iodosorb * many forms available	Kills micro-organisms, and can absorb some exudate	Infected wounds
<b>Microbial Binding dressing</b>	Sorbact * many forms available	Attracts micro organisms to itself –pulling bacteria out of the wound	Locally infected wounds, can be used as light packing in deeper wounds
<b>Enzyme alginate</b>	Flaminal Hydro and Forte	Kills micro-organisms and can absorb some exudate	Superficial partial thickness burns, abrasions, insect bites
<b>Medical honey</b>	Melloxy	Kills micro-organisms	Burns and locally infected wounds
<b>Antimicrobial mesh dressing</b>	Inadine	Kills micro-organisms	Superficial grazes and stage II pressure injury
<b>Silver dressings</b>	Acticoat * many forms available	Kills micro-organisms	Any wound where infection is an issue and also for inflammatory ulcers
<b>Hypertonic salt</b>	Mesalt	Draws fluid and slough out of "dirty" wounds	Sloughy ulcers, cavity wounds for packing, hypergranulation tissue
	Kenacomb	Manages inflammation and provides antimicrobial cover	Vasculitic ulcers, painful superficial burns and Intertrigo
<b>Cleansing solutions</b>	Prontosan, Microdaycn, Octenilin	Aids the removal of slough and debris from a wound	All wounds
<b>Povidine Iodine solution</b>	Betadine Antiseptic Solution	Antiviral, antifungal and antimicrobial actions	All wounds
<b>Absorbent dry pads</b>	Mesorb, Exudry,	Padding for comfort and absorbing moderate amount of exudate	High exudate
<b>Super absorbent pad</b>	Zetuvit Plus, Vliwasorb plus,	Absorbing heavy volumes of exudate and locking fluid in the dressing	Secondary dressing on pressure injuries stage II, III and IV, Leaking lower leg wounds

## Appendix 3: Compression Therapy Garments

Generic name	Brand name	Function	Uses
<b>Straight elasticated tubular bandages-one layer 6mmHg</b>	Tubigrip, Tubular Form, Coolgrip	Measure for size of limb to product sizing chart	Can be used in 3 layers, each with different lengths
<b>Light compression-8-15mmHg socks</b>	So Soft-Jobst	Measure for size of limb to product sizing chart	
<b>15-20mmHg socks</b>	Venosan MicroFiber, Jobst Travel socks, Sigvaris 120C	Measure for size of limb to product sizing chart	
<b>20-30mmHg socks</b>	Sigvaris, Venosan, Juzo	Measure for size of limb to product sizing chart	These and higher pressure would be prescribed by a health care practitioner.
<b>Velcro compression wraps</b>	L & R Ready Wrap, Jobst Farrow Wrap, Sigvaris Complex	Measure for size of limb to product sizing chart	
<b>Sequential Intermittent Compression Pumps</b>	MediRent	Measure for size of limb to product sizing chart	

## Appendix 4: Pressure relieving techniques and postural management during flight

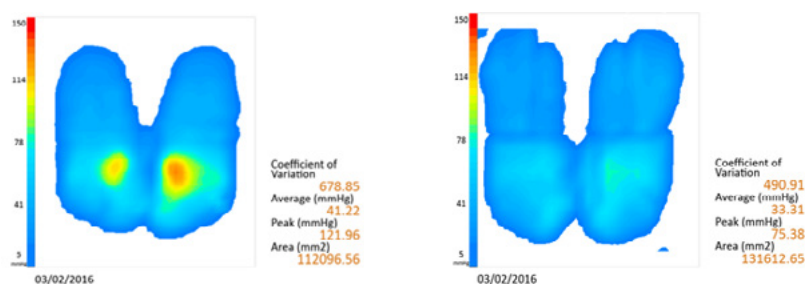
Physical weight shift regularly during flight when awake to aid with pressure relieving. As space permits lean forward (pull forward on the seat in front or use the overway table to lean down on) and hold for up to 1 – 2 minutes, if possible, every 20–30 minutes. The pressure map images show the pressure offset achieved by leaning forward in a simulated tight space like an airline. The more space to lean forward the greater the pressure relief will be.



Side leaning may also be an option if there is no one in the neighbouring seat/s to relieve pressure at one side at a time. Another option is to do a “lift” holding your armrests or pushing off the seat with the arms to lift the bottom off the seat. NOTE: The lift technique will load your shoulders more and side leaning will increase the load at the other side so ensure shorter durations of single sided leaning.

Other considerations:

- Athletes with a history of pressure injuries at the sacrum and coccyx should be cautious using sustained recline of the seat.
- Maximise floor contact via feet if possible, consider using a back pack on the floor to create the correct floor to seat height.
- If pressure issues at the elbows exist consider taking some soft foam or use clothing to place under the arms on the armrests
- Use a custom seat cushion if at higher risk of pressure injury for long haul flights. Paralympics Australia can assist with making a cushion for travel. Discuss this with your team manager for more details. Pictures below show the benefits of a custom cushion on the left versus bare plane seat on the right [yellow and red areas indicate higher pressure].



- If using an extra cushion on top of the plane seat consider taking spare clothes in your carry on or some small foam pieces to place on top of the armrests to maintain a good seat to armrest height.
- If using an air based cushion such as a Roho note that the internal pressure will increase as the plane gains altitude. Pressure of the cushion will need to be adjusted in flight and then re-inflated to the correct level upon landing. Only use an air cushion during flight if confident and proficient at adjusting and checking the correct level of your air cushion.
- Wear comfortable clothing without seams, buttons or zippers if possible.
- Ideally do a skin check post flight when possible to check for any issues.

## Appendix 5:

### Wheelchair considerations to reduce risk of pressure injury

#### Common maintenance issues

Regularly maintaining your wheelchair in best condition will make it easier to push and therefore reduce injury risk. Common things to check are:

- Tyre inflation
- Caster bearings
- Casters bolted too tight
- Hair/debris wrapped around casters (clean regularly)
- Frame twisted (from damage) causing the chair to not roll straight.

#### The correct fit and set up of the chair is essential

- The chair and seating should maximise your push efficiency and support your posture,
- If the chair fit is incorrect compensatory postures are often used which can lead to pressure injury.



#### Cushion care

Foam cushions should ideally be replaced at least every 12 months if used daily.

If you have changed chairs also review your cushion – it will likely need changing to suit the new chair.

#### Wheelchair considerations - things to help reduce pressure injury risk

Regular checks of your wheelchair and seating are recommended to make sure it is working to support you and not causing any potential injury risks.

#### History of pressure injuries?

- This increases your risk of future injury.
- Undertake regular skin checks.
- Use pressure relieving techniques when in your chair (eg lean forward)
- Consider pressure mapping. Paralympics Australia has a pressure mapper. Discuss with your Team Manager how to access a review.



Unwanted movement in the wheelchair can lead to pressure injuries from shearing or friction.

#### How to reduce leaning to one side?

- Ensure the cushion optimises the pelvis, eg. if your pelvis is lower to one side the spine will curve.
- Consider backrest type – is greater contouring needed.
- Ensure even and effective wheel access.

#### How to reduce shearing from sliding down your seat?

- Ensure the seat depth isn't too long, backrest angle is correct, footplate height and position is correct for you.
- Cushion type and fabric cover suits your needs.
- Consider clothing fabric worn to reduce sliding.
- Is the wheel height correct for pushing.

## Appendix 6: Pressure Injuries: A guide for athletes



### What is a pressure injury?

A pressure injury is damage to skin and/or underlying tissue which can present as either an area of redness or a wound. These usually occur over a bony prominence, but not always.



### What causes pressure injuries?

The most common cause of pressure injuries is constant pressure to sites. Other contributing factors are shear, friction, and prolonged moisture to the area.



### How do we prevent them?

Pressure injuries are often slow to heal once they have developed, so prevention is important. The best way to prevent pressure injuries is regular pressure monitoring and skin care, to remove/reduce pressure to sites or previous injury areas.

Regular skin checks by either yourself or others are important to identify at risk sites, and pressure injuries early.



### What to do when a pressure injury develops

Notify your usual health care practitioner (nurse, doctor, physiotherapist etc) who will develop a management plan suited to your individual needs to provide the best healing potential.

Cover the area with an appropriate dressing and remove/reduce pressure as much as possible from the site.



### Risk factors for pressure injuries

There are some factors that could make you more likely to have a pressure injury. These include constant moisture to skin, shear forces, friction, body composition changes, poor blood flow to an area of the body, the skin being very hot or cold, some chronic illnesses, impaired mobility/activity and reduced sensation/feeling to a particular area. Consider if any of these factors are relevant for you and discuss them with your healthcare practitioner.



### Identifying signs of infection

- Redness surrounding the wound
- Area of increased warmth around wound
- Any ooze or pus coming from wound
- Odour
- Fever
- Increased heart rate
- Fatigue

If you develop any signs of infection, you should have your wound reviewed by a medical practitioner as soon as possible.









### Types of cleaning solutions

- Chlorhexidine
- Iodine
- Prontosan
- 0.9% saline
- Sterile water



### Considerations for choosing dressing type

- The stage is the pressure injury
- Any signs of infection (see above)
- If the wound is very deep, caution needs to be taken when choosing a dressing

Stage	Description	Dressing choice
<b>1</b> 	Intact skin with an area of non-blanchable redness	Foam such as Allevyn or Mepilex border taking in consideration the build-up of moisture underneath and risk of skin breakdown. Hydrocolloid (Comfeel, DuoDerm)  Consider changing dressing after training
<b>2</b> 	Partial thickness skin loss	Hydrocolloid (Comfeel, DuoDerm)  Mepilex border  Allevyn border
<b>3</b> 	Full thickness skin loss	Hydrogel (intrasite gel- requires removal by irrigation when changing. Cover with Allevyn or meliplex border. However if surrounding skin is macerated apply melolin + fixumoll or cutiplast.  Intrasite comfort (intrasite gel impregnated gauze secondary dressing the same as with intrasite gel  Hydrofibre (aquacel)
<b>4</b> 	Full thickness tissue loss	Antimicrobial primary dressing and then covered with an absorbent pad that will breathe. Antimicrobials include Cadexomer Iodine- Iodosorb/Inadine, any silver product-Ag is usually on the packaging, medical grade honey- Melloxy, Dialkyl carbamoyl chloride (DACC)- Sorbact impregnated cloth, hypertonic saline- Mesalt.
<b>Unstageable</b> 	Depth of injury unknown	Ideally someone with skill will cut away as much necrotic tissue as possible and then dress second daily with an antiseptic- e.g. Iodosorb powder and dry pad and tape. Or any other antimicrobial dressing -changing and cleaning frequently.
<b>Suspected deep tissue injury</b> 	The skin is intact, but the area is dark or feels hot and painful.  If the cause is removed, this tissue may recover. If exposed to further pressure, shear or friction, the tissue may break open to reveal the extent of the damage.	Keep dry until the eschar begins to separate itself. Paint with an antiseptic solution such as betadine daily and cover with a simple dry dressing and change daily. Once the black begins to lift then peel it away and treat according to the tissue beneath



## Appendix 7: Documentation Template

<b>Name:</b>				
<b>DOB:</b>		<b>Mobile:</b>		
<b>Allergies:</b>			<b>Medications:</b>	
<b>Medical History:</b>			<b>Wound History:</b>	
<b>Type of wound:</b>			<b>Location/s:</b>	
<b>Date:</b>				
<b>Tissue:</b>	<b>Viable:</b> <input type="checkbox"/> Epithelialisation <input type="checkbox"/> Granulation <b>Non-viable:</b> <input type="checkbox"/> Eschar <input type="checkbox"/> Slough <input type="checkbox"/> Necrotic <input type="checkbox"/> Hypergranulation	<b>Viable:</b> <input type="checkbox"/> Epithelialisation <input type="checkbox"/> Granulation <b>Non-viable:</b> <input type="checkbox"/> Eschar <input type="checkbox"/> Slough <input type="checkbox"/> Necrotic <input type="checkbox"/> Hypergranulation	<b>Viable:</b> <input type="checkbox"/> Epithelialisation <input type="checkbox"/> Granulation <b>Non-viable:</b> <input type="checkbox"/> Eschar <input type="checkbox"/> Slough <input type="checkbox"/> Necrotic <input type="checkbox"/> Hypergranulation	<b>Viable:</b> <input type="checkbox"/> Epithelialisation <input type="checkbox"/> Granulation <b>Non-viable:</b> <input type="checkbox"/> Eschar <input type="checkbox"/> Slough <input type="checkbox"/> Necrotic <input type="checkbox"/> Hypergranulation
<b>Infection:</b>	<input type="checkbox"/> Surrounding redness <input type="checkbox"/> Pus <input type="checkbox"/> Odour <input type="checkbox"/> Febrile <input type="checkbox"/> Tachycardic <input type="checkbox"/> Feeling unwell	<input type="checkbox"/> Surrounding rednes <input type="checkbox"/> Pus <input type="checkbox"/> Odour <input type="checkbox"/> Febrile <input type="checkbox"/> Tachycardic <input type="checkbox"/> Feeling unwell	<input type="checkbox"/> Surrounding redness <input type="checkbox"/> Pus <input type="checkbox"/> Odour <input type="checkbox"/> Febrile <input type="checkbox"/> Tachycardic <input type="checkbox"/> Feeling unwell	<input type="checkbox"/> Surrounding redness <input type="checkbox"/> Pus <input type="checkbox"/> Odour <input type="checkbox"/> Febrile <input type="checkbox"/> Tachycardic <input type="checkbox"/> Feeling unwell
<b>Exudate:</b>	<input type="checkbox"/> Serous <input type="checkbox"/> Haemoserous <input type="checkbox"/> Frank blood <input type="checkbox"/> Purulent <input type="checkbox"/> Minimal <input type="checkbox"/> Moderate <input type="checkbox"/> Large	<input type="checkbox"/> Serous <input type="checkbox"/> Haemoserous <input type="checkbox"/> Frank blood <input type="checkbox"/> Purulent <input type="checkbox"/> Minimal <input type="checkbox"/> Moderate <input type="checkbox"/> Large	<input type="checkbox"/> Serous <input type="checkbox"/> Haemoserous <input type="checkbox"/> Frank blood <input type="checkbox"/> Purulent <input type="checkbox"/> Minimal <input type="checkbox"/> Moderate <input type="checkbox"/> Large	<input type="checkbox"/> Serous <input type="checkbox"/> Haemoserous <input type="checkbox"/> Frank blood <input type="checkbox"/> Purulent <input type="checkbox"/> Minimal <input type="checkbox"/> Moderate <input type="checkbox"/> Large
<b>Edges:</b>	<input type="checkbox"/> Normal <input type="checkbox"/> Abnormal	<input type="checkbox"/> Normal <input type="checkbox"/> Abnormal	<input type="checkbox"/> Normal <input type="checkbox"/> Abnormal	<input type="checkbox"/> Normal <input type="checkbox"/> Abnormal
<b>Surrounding skin:</b>	<input type="checkbox"/> Moist <input type="checkbox"/> Dry <input type="checkbox"/> Normal	<input type="checkbox"/> Moist <input type="checkbox"/> Dry <input type="checkbox"/> Normal	<input type="checkbox"/> Moist <input type="checkbox"/> Dry <input type="checkbox"/> Normal	<input type="checkbox"/> Moist <input type="checkbox"/> Dry <input type="checkbox"/> Normal
<b>Pain:</b>	<input type="checkbox"/> Mild <input type="checkbox"/> Moderate <input type="checkbox"/> Severe <input type="checkbox"/> Wound care only <input type="checkbox"/> Intermittent <input type="checkbox"/> Constant	<input type="checkbox"/> Mild <input type="checkbox"/> Moderate <input type="checkbox"/> Severe <input type="checkbox"/> Wound care only <input type="checkbox"/> Intermittent <input type="checkbox"/> Constant	<input type="checkbox"/> Mild <input type="checkbox"/> Moderate <input type="checkbox"/> Severe <input type="checkbox"/> Wound care only <input type="checkbox"/> Intermittent <input type="checkbox"/> Constant	<input type="checkbox"/> Mild <input type="checkbox"/> Moderate <input type="checkbox"/> Severe <input type="checkbox"/> Wound care only <input type="checkbox"/> Intermittent <input type="checkbox"/> Constant
<b>Treatment/ Dressing:</b>			<b>Plan:</b>	

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