Wound Care Management:
A Seating Solution

ADVISORY

This case study may be inappropriate or hard to look at for some.
The sole intention of these images is for educational purposes only.

Introduction - Kalogon's Technology

60,000 Americans die annually from pressure injuries (PI) and PI complications, making pressure injuries one of the leading causes of preventable death in the United States (Hospital Acquired Pressure Ulcer Prevention, 2022). PIs develop through prolonged and unmitigated pressure and shear applied to the skin and deep tissues when lying down or remaining seated. Individuals and wheelchair users with impaired mobility, sensation and/or circulation are particularly vulnerable. In addition to their life-threatening complications, pressure injuries can greatly impact one's quality of life. Depending on severity, pressure injuries can take years to heal (a stagnating injury), require surgical intervention, and lead an individual to spend most of their time healing in bed and unable to engage in occupational or social activities (Cook, et. Al., 2020).

Wheelchair cushions are used to distribute pressure away from one's bony prominences as high pressures around these areas can restrict blood flow, leading to a PI. Wheelchair cushions today most often are static. They implement either immersive media, such as gel and air, or custom cutout regions and contouring to distribute a user's interface pressure. However both of these methods rely on the user lifting themselves out of the chair to re-distribute and relieve pressures on their buttocks and thighs. While static cushions can distribute pressure, they do not actively modulate pressure over time.

For those with limited mobility, performing routine weight shifts may be difficult. Many individuals may be unable to perform offloads and weight shifts themselves, and either rely on care teams and their family to provide pressure relief. Somemay perform limited offloading or do not perform pressure relieving movements frequently enough. Clinical recommendations suggest performing such movements every 15 minutes, and failing to do so can significantly increase the risk of pressure injury development (Stockton et. al., 2002).

The intent of the Kalogon Orbiter Smart Cushion is to 'bridge the gap' between clinically recommended pressure offloading regiments and movement feasible for those with limited mobility outside the care setting. Kalogon's technology is designed to assist in providing pressure redistributions and relief at the seated surface. The cushion, through the use of an active surface, aims to reduce interface pressures and reducepain experienced from sitting. The following case study highlights the cushion's use with an individual experiencing a stage 4 pressure injury.

Background

Ms. Z. is an 53-year old female with a spina bifida related L1 lesion resulting in complete flaccid paralysis and hydrocephalus (shunt in place). She presents with a 2-year-old chronic, slow healing stage 4 sacral pressure injury. Ms. Z. is single, lives independently, and is partially independent with performing ADLs, requiring some assistance of a caregiver for catheterization and transfers. She has a sigmoid diverting colostomy in place which required home health care. Ms. Z. reports no history of tobacco, alcohol, or illicit drug use. Until the age of nine she ambulated with braces and forearm crutches, then transitioned to a manual wheelchair. In June of 2020 she became a full-time powerchair user primarily due to reported shoulder dysfunction and upper extremity sensory and motor impairments resulting in a cervical spine fixation.

Eventually Ms. Z. developed a stage 4 sacral pressure injury. This wound was described as quarter-sized and covered by a layer of eschar. During this time the PI had not fully closed, and was self-managed at home using Calazime and a simple dressing. In March 2020, after an unrelated month-long hospitalization she was discharged home. During a transfer her mother noticed that the quarter-sized wound's eschar covering was cracked open and draining.

Significant past medical history includes:

- Spina bifida (paraplegia)
- Neurogenic bladder
- Hydrocephalus
- Chronic sacral pressure injury (stage 4)
- Recurrent kidney and bladder infections

Significant past surgical history includes:

- Multiple C1-C3 stabilizations
- Normal pressure hydrocephalus shunt (ventriculoperitoneal)
- Cardiac catheterization and pacemaker placement
- Sigmoid diverting colostomy

The Switch to Kalogon's Seating System

Throughout the two years of wound care and associated medical procedures, Ms. Z.'s stated goals included increased time in her powerchair, improved independence with self-care and a return to social activities including attending church, concerts, eating out, engaging in rehabilitation of both shoulders and a return to driving. Besides the medical consequences of the stage 4 sacral pressure injury, for Ms. Z., the most significant impact of her wound was loss of independence, time confined to her bed, disconnection from social activities and

loss of self-efficacy. While in the powerchair on her initial seating system, her self-reported back pain was an 8/10 even for short periods of time.

Ms. Z switched to use of Kalogon's smart cushion in July 2021 after consulting with her wound care clinician. Ms. Z reports her initial trial on the Kalogon cushion enabled her to comfortably sit in her power chair for 6 hours. Eventually she progressed up to 8 hours in her chair with a "break" in-between, reporting no greater than 6/10 back pain. Over the course of roughly 10 months after switching to the Kalogon Smart Cushion her stage 4 pressure injury fully closed. Now that her wound has closed and is stable, she feels her independence has returned.

"Now I can go and do what I have to on the Kalogon cushion."
-Ms. Z

In addition, Ms. Z. is thrilled about the "Sit-to-Wake" function of the Kalogon cushion, which turns on the cushion when she sits down. Given her upper extremity weakness, on-going shoulder and back pain as well as her lack of sensation, she has difficulty in implementing her regular off-loading/weight shift program while in her power chair. The cushion's automatic pressure redistribution feature, while not replacing offloads, has helped to aid her pressure relief regiment. Due to this, Ms. Z. states that this feature and the cushion have helped decrease her concern and anxiety of developing new pressure injuries or re-injuring her closed pressure injury.

Clinical Notes on Subject's Pressure Injury

The following are notes and skin checks from Ms. Z's clinical team tracking the progression of her pressure injury before and after use of the Kalogon Smart Cushion.

February/March 2020

During a month-long hospitalization in February 2020, the pressure injury did not increase in size, but a crack appeared on the wound surface. This was treated with Calazime and a zinc ointment covered by a simple dressing. Ms. Z was discharged home (March 2020). During help with a transfer, Ms Z's mother noticed the entire quarter sized wound was open and draining. Ms. Z was placed on complete bed rest. With a return to standard wound management, the wound status slowly improved.

June 2020

As a result of her chronic shoulder dysfunction, cervical spine dysfunction and chronic pain, Ms. Z switched to a chair with power setting function and set up with an air floatation cushion. The wound marginally improved with standard treatment, but still not back to baseline status.

July 2020

Ms. Z was hospitalized for the treatment of a kidney stone and significant worsening of the sacral pressure injury. No change in wound treatment regimen. Additionally, she dealt with a chronic C. Diff. infection throughout the summer of 2020.

September 2020 – June 2021

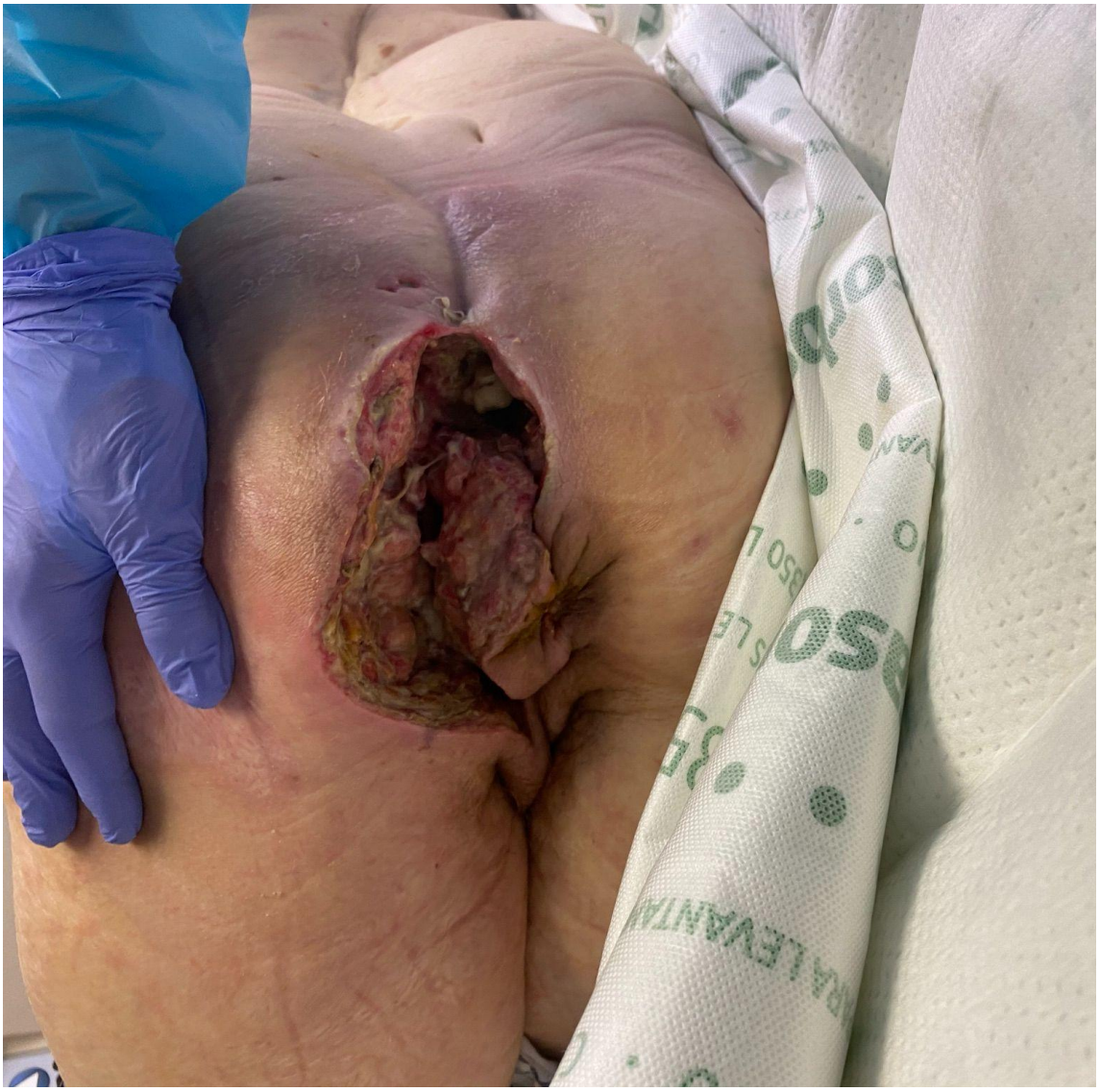
Ms. Z was seen and treated for a revision of her cervical spine stabilization due a continued worsening of her upper extremity motor/sensory dysfunction and chronic pain. Unfortunately, the surgical site developed a MRSA infection.

Initially, Ms. Z was discharged to home, but due to a continued exacerbation of her sacral pressure injury she was admitted to a skilled nursing and rehabilitation center. The wound had now progressed to a Stage 4, with a large abscess, osteomyelitis and complicated with Fournier's gangrene.

During this time a series of admissions and readmissions to both a hospital and long-term acute care hospital were required to perform a sigmoid diverting colostomy due to the location of the sacral pressure injury and abscess, stoma revisions due to infection, several courses of IV antibiotic therapy, and 3 surgical debridement procedures. The wound measured 15 x 8 cm and 6 cm deep – sacrum exposed.

Skin Check - Stage 4 Sacral Wound with Abscess

Image taken March 29, 2021



Ms. Z was again admitted to a skilled nursing and rehabilitation center where consultation with a wound care specialist was ordered in early June.

June 2, 2021

Wound description:

- 14 x 4.5 x 3 cm
- 3 cm tunnel @ 12-1 o'clock
- 100% granulation
- Epithelium - none
- Exposure - fecal

- Significant serous drainage
- No undermining
- Peri wound good

Wound treatment:

- Debridement and cleaning as required
- Wound Vac (125 mmHG)
- Redress and assess 3x/week
- Limited time in wheelchair < 4 hrs/day
    - Pressure reducing cushion – unspecified
    - Offloading when in bed

Treatment continues as above through July 20, 2021, with noted improvements to the wound's status.

Wound description:

- 7 x 4 x 2 cm
- 1 cm tunnel @ 1 o'clock
- 95% granulation
- 5% slough
- Minimal serous drainage
- Exposure - none
- Epithelium - none
- Peri wound – intact and moist

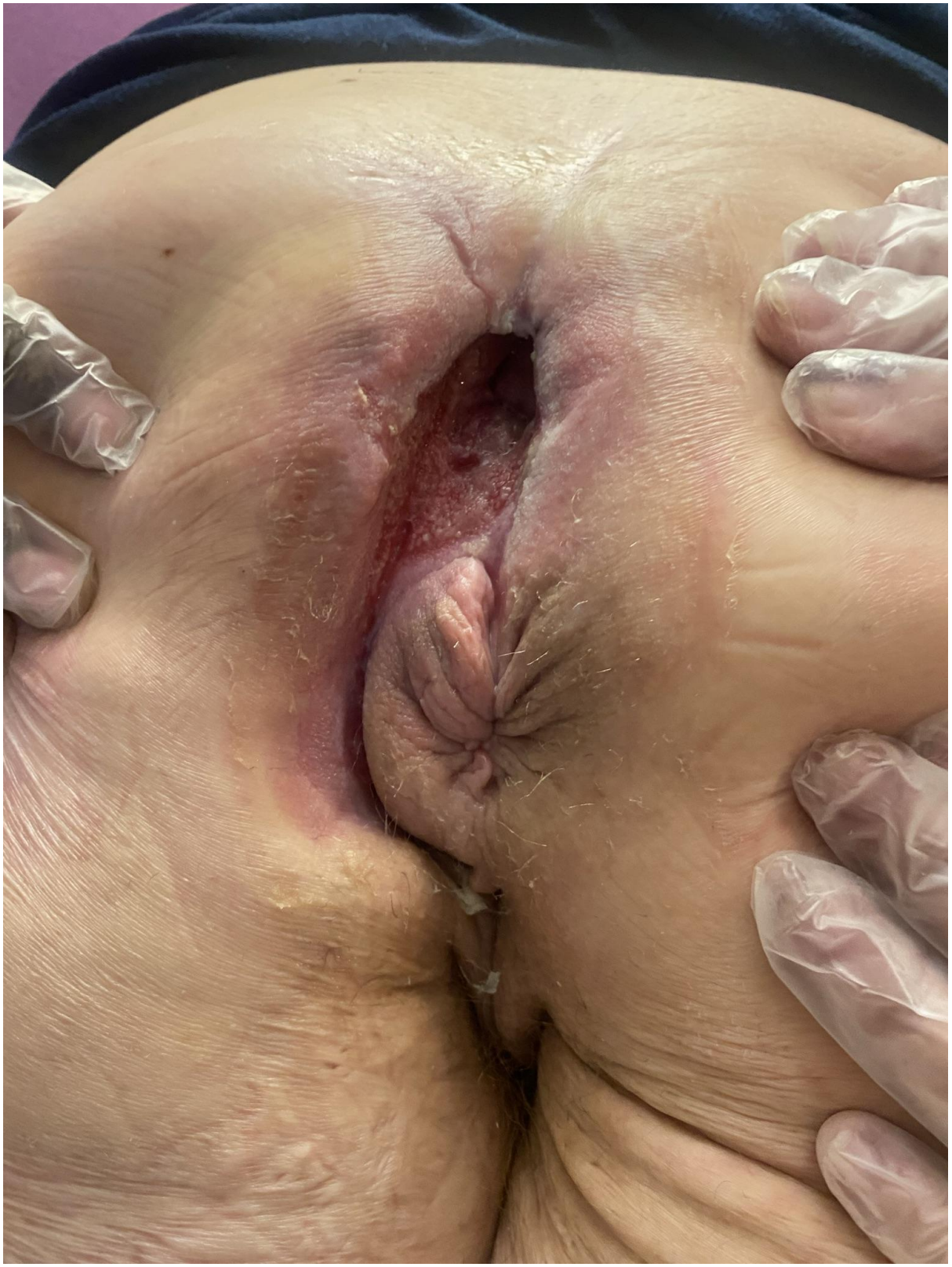
Wound treatment:

- Hydrofera - secured with Tegaderm
- Re-evaluate weekly
    - Change to Puracol – to decrease moisture when appropriate
- Continue to offload every 4 hours

July 2021 - Use of the Kalogon Smart Cushion Begins

Following consultation with her clinician, Ms. Z was referred to Kalogon for the assessment and installation of a Kalogon Smart Cushion.

Photograph of Sacral Stage 4 - July 5, 2021



August 10, 2021

Wound description:

- 4.5 x 1.5 x 0.8 cm
- 0.5 cm tunnel @ 1 o'clock
- 95% granulation
- 5% slough
- Minimal serous drainage
- Exposure - none
- Epithelium - none
- Peri wound – intact and moist

Wound treatment:

- Referral to a home care company

August 24, 2021

Wound description:

- 4 x 1.5 x 0.1 cm
    - Open .5 x .5 x .3 center of wound bed
- 1 cm tunnel @ 3 o'clock
- 100% granulation
- 0% slough
- Minimal serous drainage
- Exposure - NA
- Epithelium - edges
- Peri wound – intact and moist

Wound treatment:

- Mechanical debridement and wound cleaning
- Dressing not reported
- Wound Vac
- < 4 hours out of bed per day total
- Visits per week not documented

Next documented visit is October 1, 2021:

October 1 - 29, 2021

No documented wound assessment or treatment data available. However, at some point the Wound Vac therapy was discontinued.

Wound description:

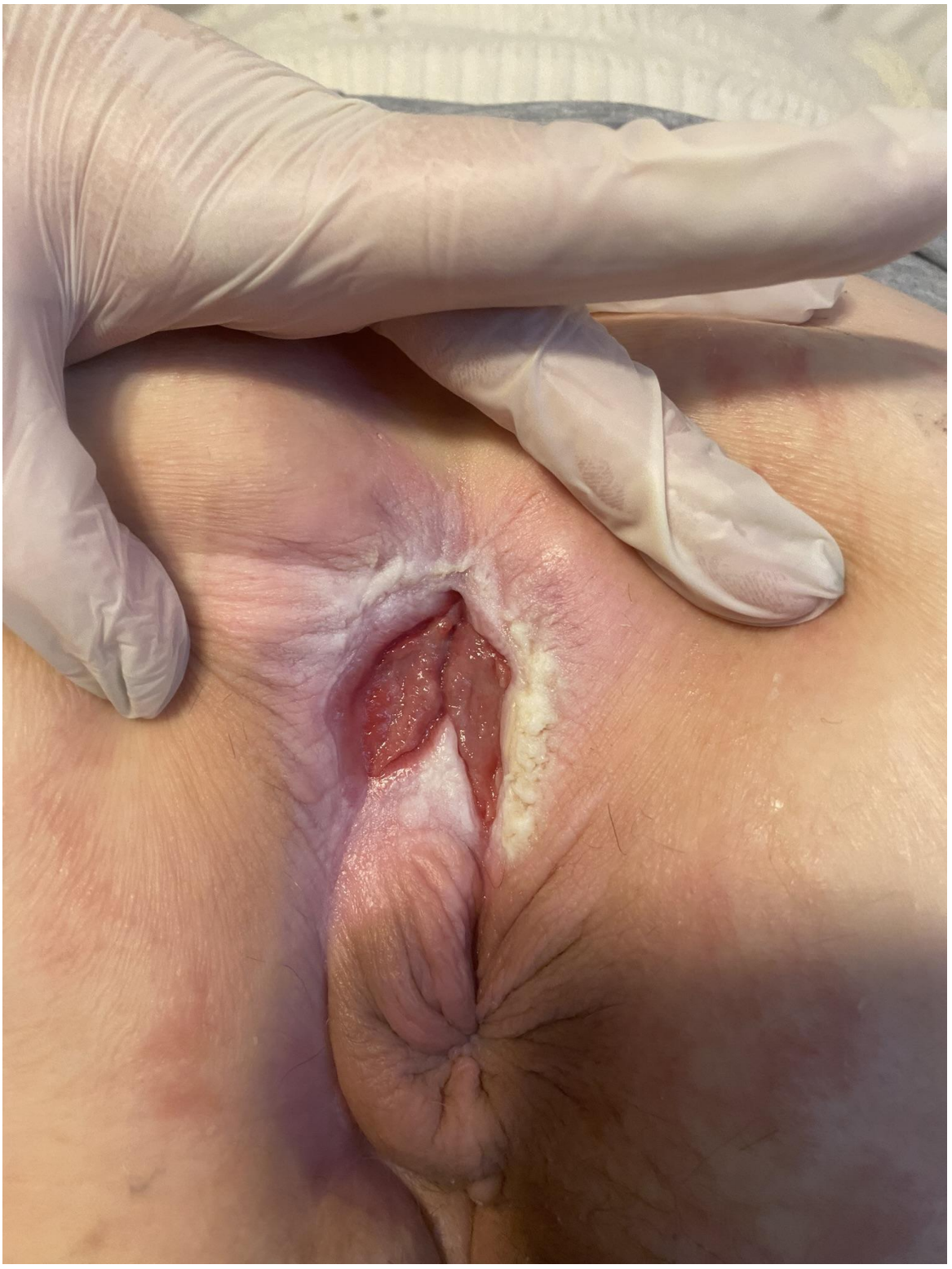
- "Wound healing well"

Wound treatment:

- Mechanical debridement and wound cleaning
- Dressing variable; Enluxtra
- Wound Vac
- Offload buttocks at all times
- < 4 hours out of bed per day total
- To be seen 2 times/week

Skin Check - November 16, 2021

- Stage 4 Sacral Wound – prior to amniotic cell allograft membrane and peri-wound amniotic stem cell injections



November 12, 2021 – Final Documentation from Home Care Provider

Awaiting skin graft consultation.

Wound description:

- Wound is stable but stalled
- 3.5 x 2 x 0.2 cm
    - Open .5 x .5 x .3 center of wound bed
- Tunneling - none
- 100% granulation
- 0% slough
- Minimal serous drainage
- Exposure - NA
- Epithelium - edges
- Peri wound – callus, scaring, and maceration

Wound treatment:

- Mechanical debridement and wound cleaning
- Dressing variable; Enluxtra discontinued and Prisma started
- Offload buttocks at all times

November 16, 2021 - Home Health Care and Assessment

Amniotic cell allograft membrane and amniotic stem cell injection assessment completed, and treatment commenced.

Wound Description:

- Wound is stable but stalled
    - Healing stage 4 – (current assessment stage II)
- 4.0 x 2.0 x 0.5 cm
- Tunneling - none
- Wound bed - 100% pink, granulation
- Moderate serous drainage
- Epithelium – pink, mild erythema
- Peri wound – callus, scaring, and maceration

Treatment:

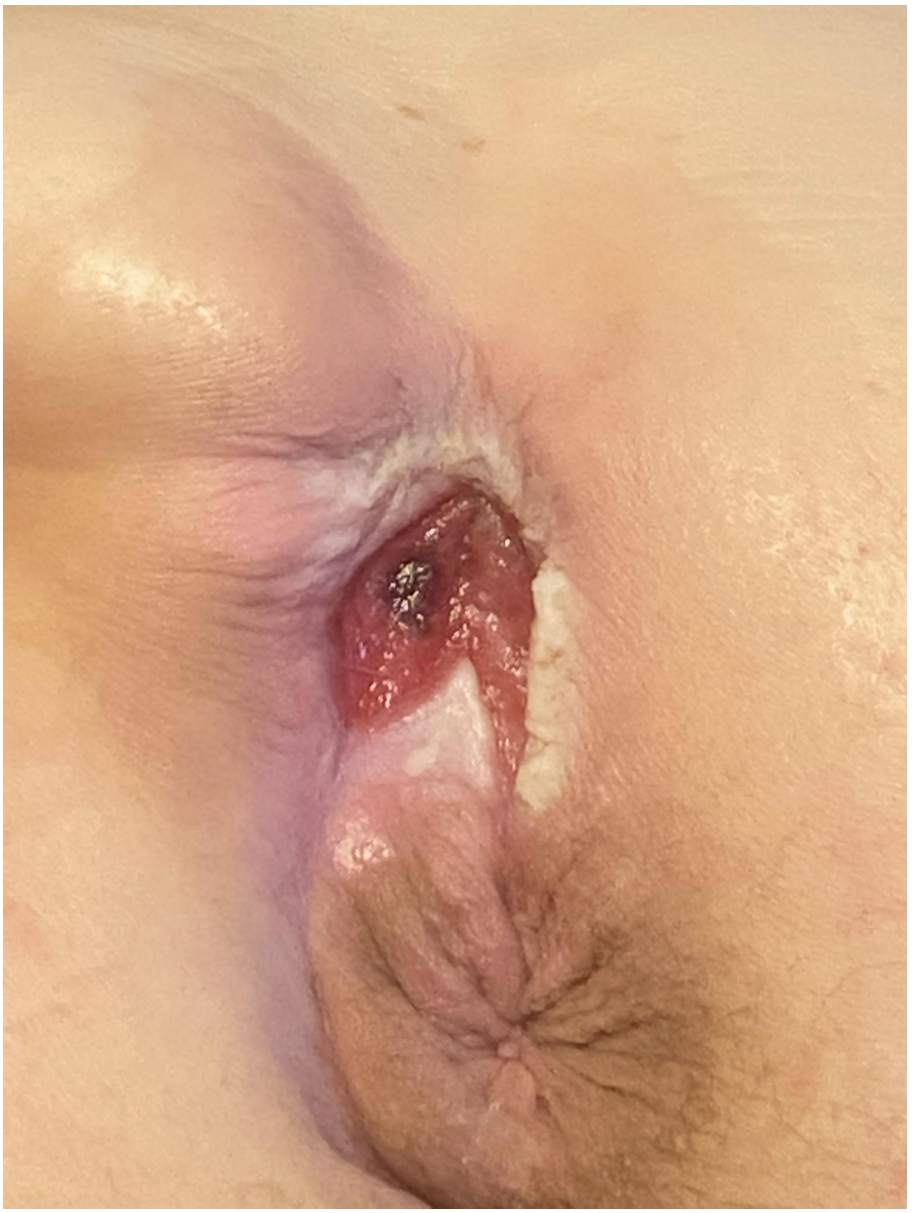
- Old dressing removed
    - Wound cleaned
- 4 x 6 amniotic cell allograft membrane (1) place directly onto wound bed
    - Foam dressing
    - Tegaderm/Duoderm
    - 1 week

November 23, 2021 Assessment

Treatment:

- Old dressing removed
    - Wound cleaned
- 4 x 6 amniotic cell allograft membrane (2) place directly onto wound bed
    - Foam dressing
    - Tegaderm/Duoderm
    - 1 week
- Amniotic stem cell periwound injection (1) 1 cc
    - 14 days

Sacral Pressure Injury during Skin Check - November 29th, 2021



November 30, 2021 Assessment

Treatment:

- Old dressing removed
    - Wound cleaned
- 4 x 6 amniotic cell allograft membrane (3) place directly onto wound bed
    - Foam dressing
    - Tegaderm/Duoderm
    - 1 week

December 8, 2021 Assessment

Wound is stable and closing

- Healing stage 4 – (current assessment stage II)
- 3.5 x 2.0 x 0.5 cm
- Tunneling - none
- Wound bed - 100% pink, granulation
- Moderate serous drainage
- Epithelium – pink, mild erythema
- Peri wound – pink, hyper granulation

Treatment

- Old dressing removed
    - Wound cleaned
    - Sharp debridement, wound edges
- Alginate packing
    - Foam dressing
    - Ostomy paste
    - Tegaderm
    - 1 week
- Amniotic stem cell periwound injection (2) 2 cc
    - 14 days

Dec 21, 2021 Assessment

Status - Wound is stable and closing

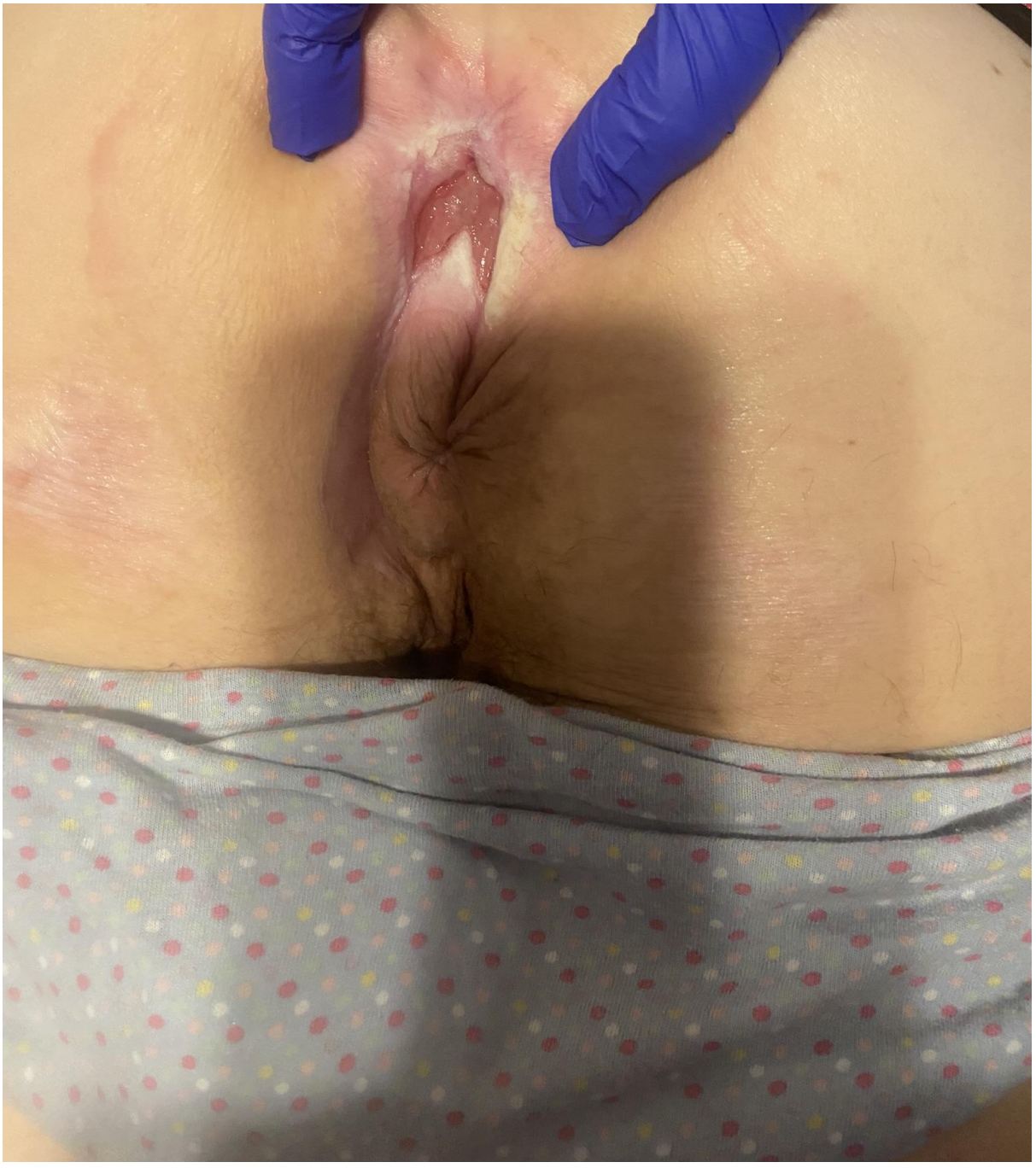
- Healing stage 4 – (current assessment stage II)
- 3.0 x 2.8 x 0.4 cm
- Tunneling - none
- Wound bed - 100% pink, granulation
- Moderate serous drainage
- Epithelium – pink, mild erythema
- Peri wound – pink, hyper granulation

Treatment

- Old dressing removed

    - Wound cleaned
    - Sharp debridement, wound edges
- 4 x 6 amniotic cell allograft membrane (4) place directly onto wound bed
    - Foam dressing
    - Ostomy paste
    - Tegaderm
    - 1 week
    -

Pressure Injury Progression during Skin Check - December 21st, 2021



December 28, 2021 Assessment

Wound is stable and closing

- Healing stage 4 – (current assessment stage II)
- 3.0 x 2.8 x 0.3 cm
- Tunneling - none
- Wound bed - 100% pink, granulation
- Moderate serous drainage
- Epithelium – pink, mild erythema
- Peri wound – pink, hyper granulation

Treatment

- Old dressing removed
    - Wound cleaned
    - Sharp debridement, wound edges
- 4 x 6 amniotic cell allograft membrane (5) place directly onto wound bed
    - Foam dressing
    - Ostomy paste
    - Tegaderm
    - 1 week
- Amniotic stem cell periwound injection (3) 2 cc
    - 14 days

January 11, 2022 Assessment

Wound is stable and closing

- Healing stage 4 – (current assessment stage II)
- 2.0 x 2.4 x 0.3 cm
- Tunneling - none
- Wound bed - 100% pink, granulation
- Moderate serous drainage
- Epithelium – pink, mild erythema
- Peri wound – pink, hyper granulation

Treatment

- Old dressing removed
    - Wound cleaned
- 4 x 4 amniotic cell allograft membrane (6) place directly onto wound bed
    - Foam dressing
    - Ostomy paste
    - Tegaderm
    - 1 week

January 25, 2022 Assessment

Wound is stable and closing

- Healing stage 4 – (current assessment stage II)
- 2.5 x 1.8 x 0.3 cm
- Tunneling - none
- Wound bed - 100% pink, granulation
- Moderate serous drainage
- Epithelium – pink, mild erythema
- Peri wound – pink, hyper granulation

Treatment

- Old dressing removed
    - Wound cleaned
    - Sharp debridement, wound edges
- 4 x 4 amniotic cell allograft membrane (7) place directly onto wound bed
    - Foam dressing
    - Ostomy paste
    - Tegaderm
    - 14 days
- Amniotic stem cell periwound injection (4) 2 cc
    - 14 days

February 1, 2022 Assessment

Wound is stable and closing

- Healing stage 4 – (current assessment stage II)
- 2.5 x 1.8 x 0.3 cm
- Tunneling - none
- Wound bed - 100% pink, granulation
- Moderate serous drainage
- Epithelium – pink, mild erythema
- Peri wound – pink, hyper granulation

Treatment

- Old dressing removed
    - Wound cleaned
    - Sharp debridement, wound edges
- 2 x 3 amniotic cell allograft membrane (8) place directly onto wound bed
    - Foam dressing
    - Ostomy paste
    - Tegaderm
    - 14 days

February 15, 2022 Assessment

Wound is stable and closing

- Healing stage 4 – (current assessment stage II)
- 2.5 x 1.5 x 0.2 cm
- Tunneling - none
- Wound bed - 100% pink, granulation
- Moderate serous drainage
- Epithelium – pink, mild erythema
- Peri wound – pink, hyper granulation

Treatment

- Old dressing removed
    - Wound cleaned
    - Sharp debridement, wound edges
- 2 x 3 amniotic cell allograft membrane (9) place directly onto wound bed
    - Foam dressing
    - Ostomy paste
    - Tegaderm
    - 14 days

March 3, 2022 Assessment

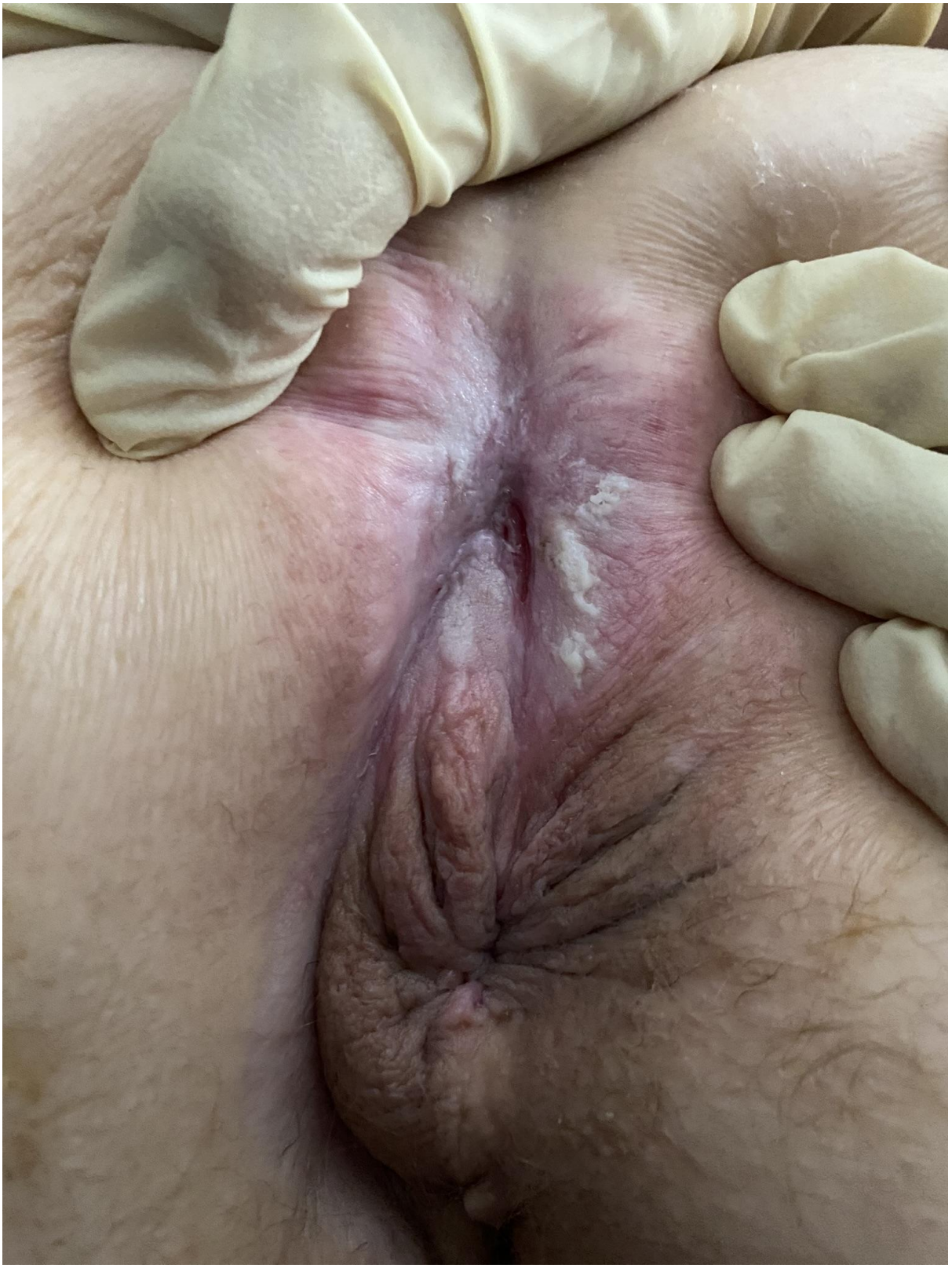
Wound is stable and closing

- Healing stage 4 – (current assessment stage II)
- 2.5 x 0.8 x 0.2 cm
- Tunneling - none
- Wound bed - 100% pink, granulation
- Moderate serous drainage
- Epithelium – pink, mild erythema
- Peri wound – pink, hyper granulation

Treatment

- Old dressing removed
    - Wound cleaned
    - Sharp debridement, wound edges
- 2 x 3 amniotic cell allograft membrane (10) place directly onto wound bed
    - Foam dressing
    - Ostomy paste
    - Tegaderm
    - 14 days

Pressure Injury during Skin Check- March 22, 2022



March 22, 2022 Assessment

Wound is stable and closing

- Healing stage 4 – (current assessment stage II)
- 2 x 0.6 x 0.2 cm
- Tunneling - none
- Wound bed - 100% pink, granulation
- Small serous drainage
- Epithelium – pink, mild erythema
- Peri wound – pink, small amount hyper granulation

Treatment

- Old dressing removed
    - Wound cleaned
    - Sharp debridement, wound edges
- 2 x 3 amniotic cell allograft membrane (11) place directly onto wound bed
    - Foam dressing
    - Ostomy paste
    - Tegaderm
    - 21 days

April 12, 2022 Assessment

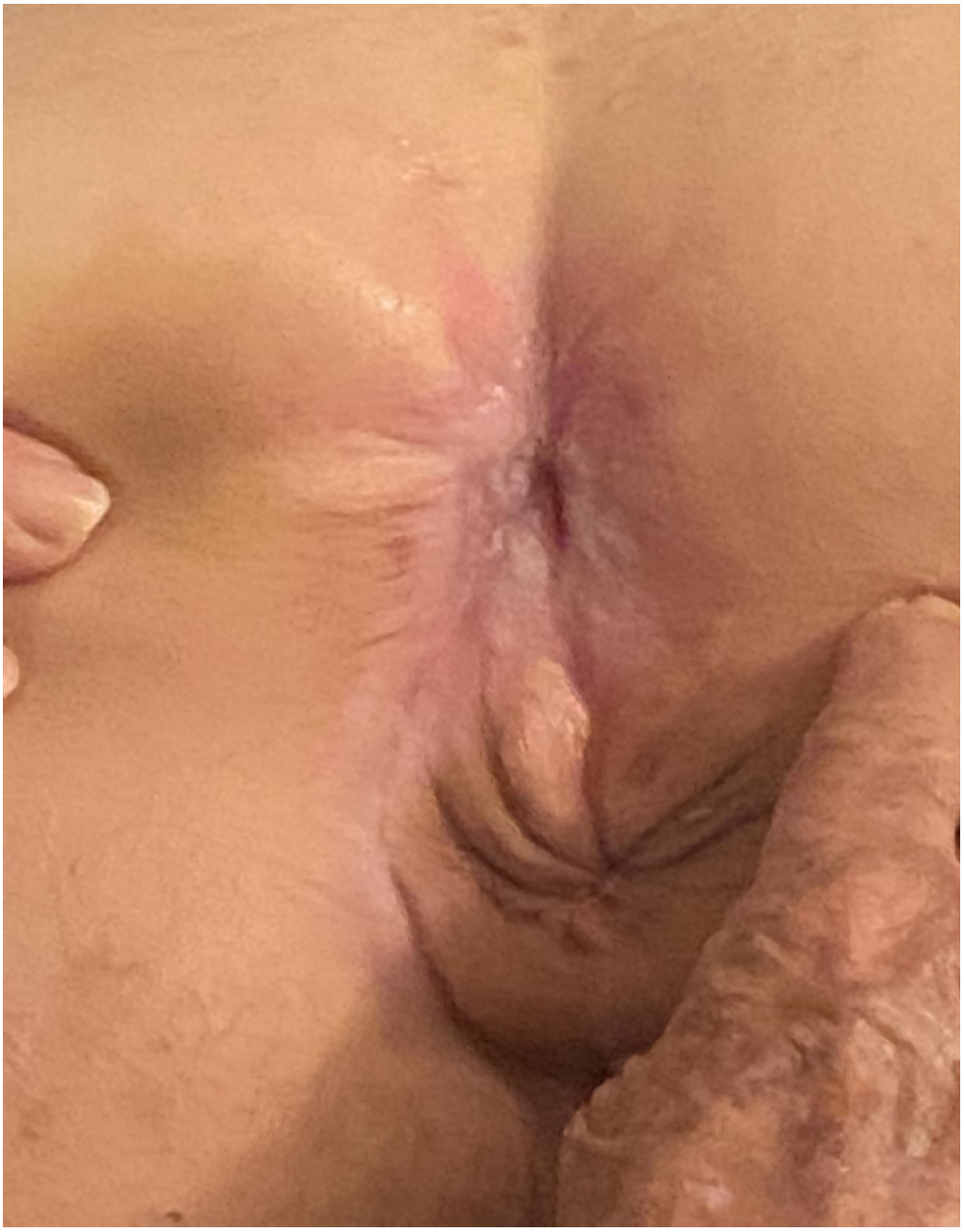
Wound is stable and closing

- Healing stage 4 – (current assessment stage II)
- 1 x 0.5 x 0.5 cm
- Tunneling - none
- Wound bed - 100% pink, granulation
- Small serous drainage
- Epithelium – pink, mild erythema
- Peri wound – pink, small amount hyper granulation

Treatment

- Old dressing removed
    - Wound cleaned
- 2 x 2 amniotic cell allograft membrane (12) place directly onto wound bed
    - Foam dressing
    - Ostomy paste
    - Tegaderm
    - 21 days

Skin Check - April 12th 2022



May 3, 2022 Assessment

Wound is stable and closing

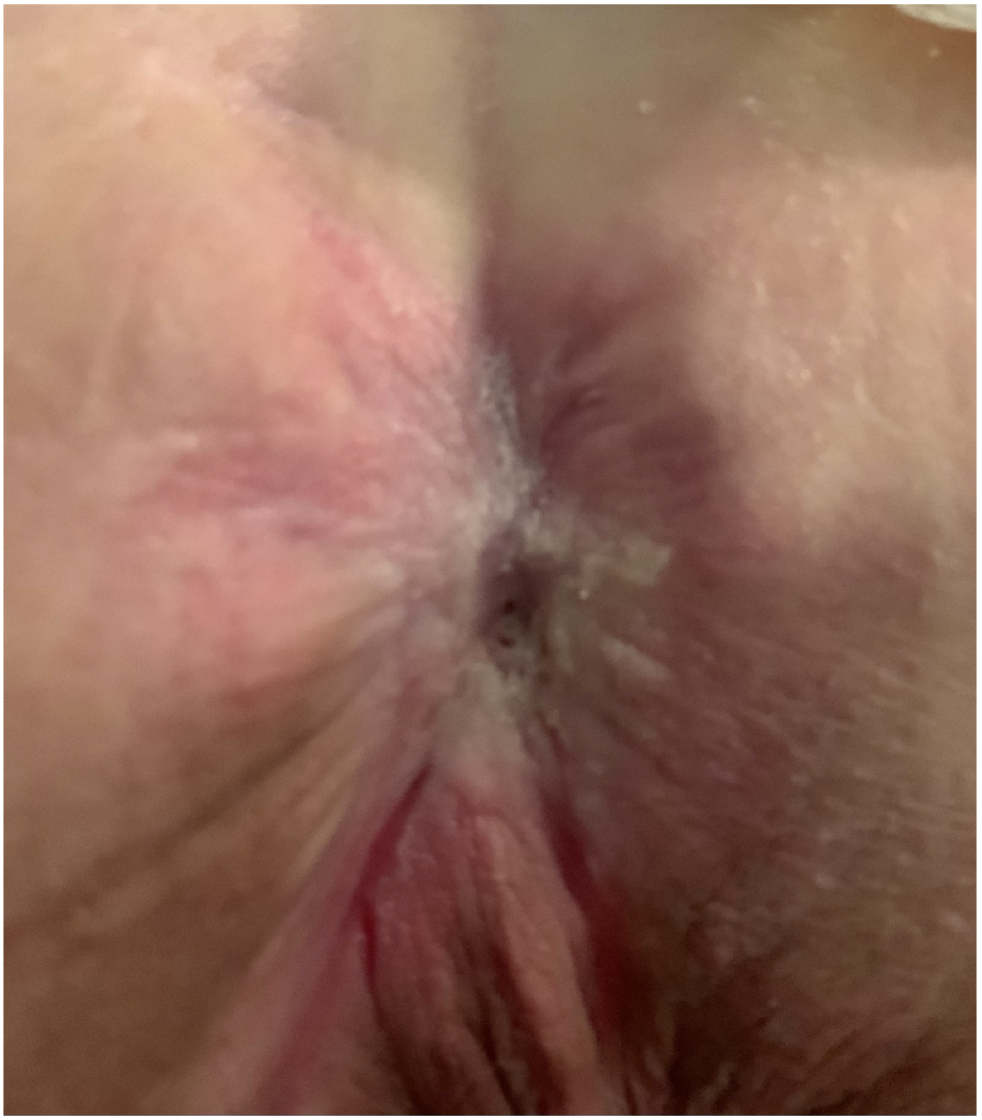
- Healing stage 4 – (current assessment stage II)
- 0.4 x 0.2 x 0.2 cm
- Tunneling - none
- Wound bed - 100% pink, granulation
- Scant serous drainage
- Epithelium – pink, mild erythema

- Peri wound – pink, small amount hyper granulation

Treatment

- Old dressing removed
    - Wound cleaned
- 2 x 2 amniotic cell allograft membrane (13) place directly onto wound bed
    - Foam dressing
    - Ostomy paste
    - Tegaderm
    - 21 days

May 24, 2022 – Stable and Closed Wound



May 24, 2022 Assessment

- Wound is stable and closing
    - Healing stage 4 – Wound closed
    - Peri wound – pink, small amount hyper granulation

Conclusion

Until July 2021, Ms. Z used a static air-flotation cushion to distribute her interface pressure while seated in her power chair. Due to Ms. Z's limited mobility and lack of sensation, she doesn't feel the discomfort of stagnant sitting. Like many wheelchair users she was not able to regularly perform pressure offloads as frequently as clinically recommended. Over time, she developed a pressure injury, which eventually progressed to a stage 4 with multiple complications requiring surgical intervention to manage.

After several years of static cushion use, Ms. Z and her clinical team decided to use Kalogon's Smart Cushion to augment her offloading routine following stabilization of her pressure injury. Through a combination of continued medical intervention and the Kalogon cushion's management of her interface pressure, Ms. Z. 's pressure injury improved to the point of closure over the course of 10 months.

Ms. Z following her wound's closure, redness is no longer visible around the affected area. She has recently been cleared by her clinician to resume driving, a key activity she lost. Once a key loss to quality of life, she now enjoys a greater freedom beyond the range of her power chair.. The timeline below highlights the course of her pressure injury treatment, both before and after using the Kalogon cushion.

September 2020 - June 2021

Series of hospitalizations for cervical spine stabilization, MRSA infection, progressively worsening of PI (client reported 15.0cm x 8.0cm x 6.0cm) Osteomyelitis, surgical debridement, sigmoid diverting colostomy and stoma revisions, standard wound management, bed rest restrictions

15.0cm x 8.0cm x 6.0cm

November 16, 2021 - May 24, 2022

Amniotic cell allograft membrane (13)
Amniotic stem cell injection (4)
4 hours out of bed at a time
Increasing community activities and self-care

4.0 x 2.0 x 0.5 cm → **CLOSED**

Present since 2014

Small sacral stable stage 3
Contained eschar covered

July 7, 2021

Kalogon Orbiter employed

May 24, 2022

PI closed

March 2020 - September 2020

PI exacerbation
Self-managed

June 2, 2021 - August 10, 2021

Standard wound management with wound vac
Bed rest restrictions, no more than 4 hours out of bed/day
No community activities

PI Stage 4
14.0cm x 4.5cm x 3.5cm
3.0cm tunnel
→ 4.5cm x 1.5cm x 0.8cm
1.0cm tunnel

June 2020

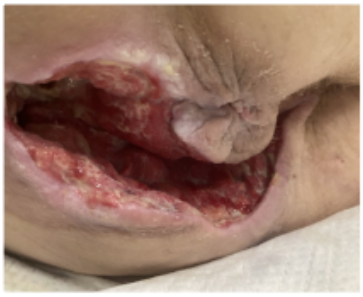
Switch to power chair
Static air cushion

August 24, 2021 - November 12, 2021

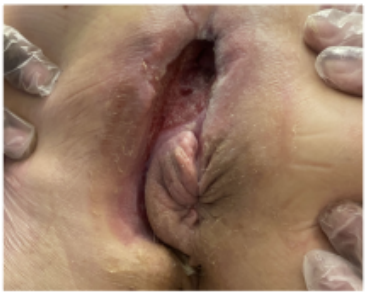
Standard wound management. No more than 4 hours out of bed at a time. Limited community activities and self-care

4.5cm x 1.5cm x 0.8cm
1.0cm tunnel
→ 3.5 x 2.0 x 0.2 cm

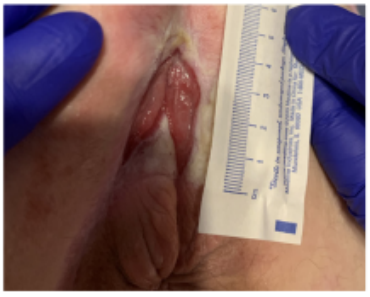
April 12, 2021



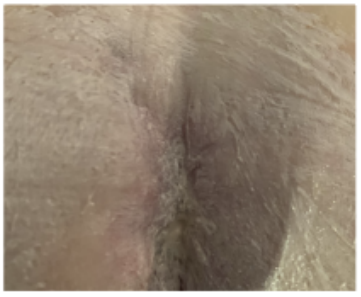
July 5, 2021



November 19, 2021



May 24, 2022



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