Woundectomy, multidisciplinary wound care and closure – the most effective way to treat complex wounds

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Abstract
A variation on the concept of debridement is presented, which, along with a multidisciplinary approach to complex wound patients, followed by early reconstructive surgery, shows favourable outcomes for even the most complex wounds.

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Introduction

Debridement is typically defined as the removal of all foreign material and damaged tissue from a wound, and in more recent definitions includes the removal of all infected tissue as well.[1]

Chronic wounds vary significantly from the acute war wounds which originally gave rise to the definition of "debridement" by Dr P Riche in 1914.[2] Most chronic wounds have a typical cross-sectional anatomy (Figure 1), with a layer of biofilm representing the top layer in most wounds. This is typically followed by a layer of granulation tissue (of varying thickness and consistency). This granulation tissue layer may be absent in some cases, particularly the drier wounds which have been present for many months. In these wounds, one often finds that there is a layer of dry slough instead of granulation tissue.

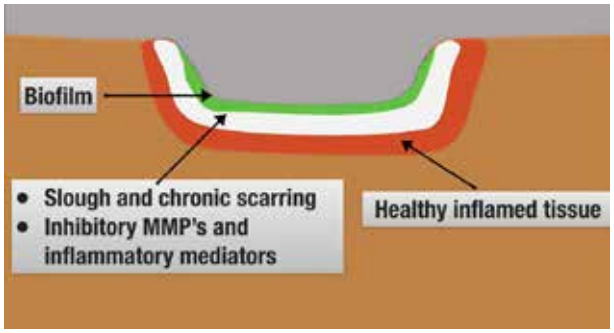


Figure 1. Schematic of the cross-sectional anatomy of a typical chronic wound.

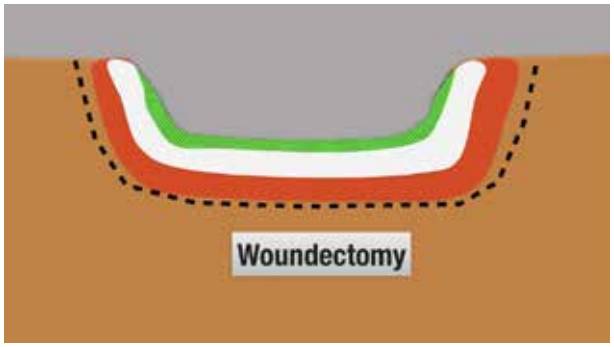


Figure 2. The principle of "woundectomy" differs somewhat to the classical description of debridement, in that all the layers of the chronic wound (as discussed above) are removed, including the layer of hyperaemic tissue.

The third layer is a layer of fibrotic tissue secondary to chronic inflammation. This layer too, can vary in thickness depending on many factors, such as chronicity of the wound, host response to an open wound and factors which increase inflammation, e.g. infection. Lastly, beneath this layer is a layer of healthy tissue which is hyperaemic as a response to the wound above.

"Woundectomy"

Debridement of a chronic wound typically involves removal of biofilm, slough and dead tissue and can be achieved using advanced wound dressings or various surgical modalities. The author believes that returning a wound to its acute state should involve more than this and that removing the wound, with all its aforementioned layers, in its entirety, is a prerequisite for accelerated wound healing, hence the term, "woundectomy". This can only be achieved surgically, using a scalpel or hydrodebridement (Versajet®, Smith and Nephew, Hull, UK). If one is to return a wound to its acute state, then the entire area of abnormal tissue, including the zone of hyperaemia should be excised, where possible (Figure 2), in the same manner that a neoplasm is excised.

In theory, this acute wound should now heal, either with conservative measures or with reconstructive surgery, provided all the local and systemic factors that interrupted wound healing in the first place, have been addressed. Once this is done, smaller wounds can usually be treated conservatively, while larger wounds ought to be reconstructed. This reconstruction can also take place immediately at the time of woundectomy, significantly reducing the time required to heal these wounds.

After woundectomy, the author treats most wounds with NPWT (negative-pressure wound therapy) until the correctable factors

have been addressed and the reconstruction takes place thereafter. The woundectomy could also be done after all the correctable causes have been corrected but doing it early has its advantages. By converting it earlier to an acute wound, one can evaluate the patient's wound healing capacity in response to the correction of the concomitant comorbidity by observing the quality and quantity of granulation tissue formation. If a reconstruction is planned then it is advisable to repeat the woundectomy at the time of the surgical reconstruction, albeit to a less aggressive degree, to ensure the removal of any biofilm formation.

Multidisciplinary wound care and closure

The author feels that "multidisciplinary" wound care is a more appropriate term for the care that needs to be delivered to these patients, as opposed to "interdisciplinary"[3] wound care. The latter term seems more appropriate to the usual approach to chronic wounds, where multiple disciplines become involved by one discipline referring to another, i.e. "interdisciplinary". It is the author's opinion that "multidisciplinary" implies that all disciplines are involved from the start of the patient's care. This can only be achieved if these patients receive the same care that, for example, cancer patients receive, where a group of practitioners from various relevant specialties sit around a table and discuss patients. There is no interdisciplinary referral in these cases, as all practitioners are immediately involved in the decision-making process.

This process has been implemented at an Advanced Wound Care Centre (AWCC) in Cape Town, where all complex wounds undergo a "woundectomy" and are discussed by a multidisciplinary team. All complex wound patients have a standard battery of microbiological and blood tests (to evaluate nutritional parameters, haemoglobin, vitamins and trace elements) and some require imaging (X-rays, nuclear medicine scans, etc.). Concomitant factors that could delay wound healing are identified by the team and are corrected under the guidance of the relevant specialist in that field.

When the team is satisfied that there should be no impediment to wound healing, the plastic surgeon on the team reconstructs the wound using a technique which is appropriate for that wound and patient. As mentioned above, wounds are occasionally allowed to heal by secondary intention if they are small enough or if the patient is not an appropriate candidate for surgery.

Using this approach has yielded favourable results, with most patients experiencing wound closure times that are a fraction of the time that the wound was present prior to presenting at the wound care centre. There are multiple benefits to this accelerated regimen, including psychological, financial (for the patients and medical funder) and the physical well-being of the patient. Having patients return to work earlier is an obvious benefit to the country as a whole.

Clinical cases

A series of patients are presented as examples of the typical cases dealt with at the particular Advanced Wound Care Centre. All patients gave consent for their clinical photographs to be published:

Case 1

A 33-year-old patient developed a fluctuant lump above her buttock, four years after lumbar spinal fusion surgery. An ultrasound revealed fluid and this was initially aspirated three times by another surgeon. Microbiology specimens failed to grow anything. Eventually, after an MRI scan demonstrated a collection which appeared to be connected to the hardware, she was taken to theatre and all the hardware was removed by the original surgeon. The wound was only partially closed and a NPWT dressing was applied to the open area. At this stage, *Pseudomonas aeruginosa* was cultured from the wound. As the surrounding tissue did not look infected, it was decided not to treat with antibiotics. After two weeks of NPWT and poor progress, she was referred to the AWCC with a complex wound (Figure 3).

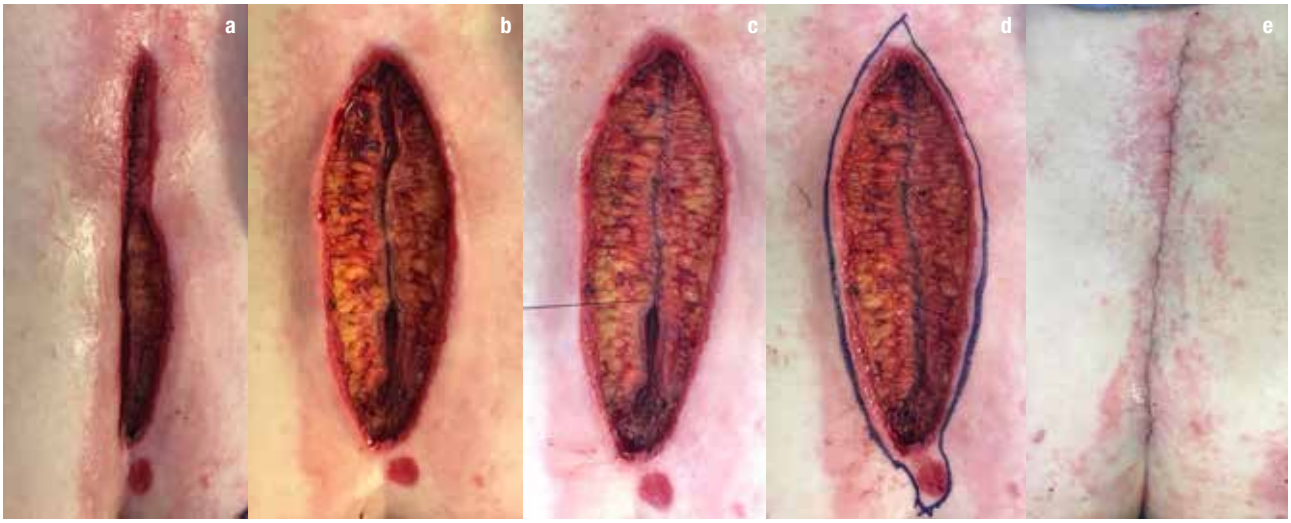
She had no other comorbidity or other confounding factors, other than the fact that she was obese (BMI 35). Having discussed her with the team, she required input from the dietician, dermatologist, infectious diseases physician, physiotherapist, psychologist and plastic surgeon.

Figure 3. Case 1. Partially closed, chronic wound over lumbar spine.

Figure 4. Case 1. Woundectomy, with excision of all chronic wound tissue, extending down (4 cm) to spinous processes (17 cm x 5 cm).

Figure 5. Case 1. Hypersensitivity to adhesives of most types of dressings, resulting in blistering of adjacent skin. The initial plan was to allow the deeper, smaller and less flexible cavity to fill with granulation, following which the larger, more superficial cavity would be closed in layers.

Figure 7. Case 1. Wound remained healed two months later.



Figures 6 a-e. Case 1. Sequence outlined in text; illustrating the initial closure of the deep cavity in layers, followed by releasing of this cavity from the superficial cavity by incising through the upper walls. The upper aspect of these walls was then oversewn, following which the skin edges were resected and sutured in layers.

She underwent a woundectomy (17 cm x 5 cm), which extended down (4 cm) to the spinous processes (Figure 4). NPWT was then used to cover the wound.

Her management was complicated by the fact that she was allergic to most adhesives (except Tegaderm®), making the seal of NPWT less reliable due to occasional blistering (Figure 5).

However, when the NPWT seals became problematic, the plastic surgeon on the team elected to try a new closure technique. First, a less aggressive surface woundectomy of both cavities, using hydrodebridement was done. The author believes that this must always be done prior to a direct closure to reduce the chance of dehiscence, as the wound surface is invariably covered with biofilm.

The walls of the deeper cavity of the wound were then sutured together to obliterate the dead-space. The upper aspects of the walls were then incised (Figure 6a) releasing the tension of this cavity's walls from the superficial cavity (Figure 6b). The upper aspects of the deep cavity's walls were then oversewn (Figure 6c), to isolate the deeper cavity from the superficial cavity. The skin edges were excised (Figure 6d) and the superficial cavity was then closed in layers, again, to obliterate any dead space that could accumulate fluid, which could result in infection and wound breakdown (Figure 6e).

As the patient was obese, which resulted in excessive tension on the closure, a Prevena® (Acelity™, San Antonio, USA) incisional NPWT system was applied to the skin. These devices have been shown to reduce wound complications in high-risk wounds.[4,5] One week later (seven weeks after presenting to the AWCC) the wound was inspected and was healing well, without any signs of infection or breakdown. Two months later, the wound remained closed without any signs of pathology (Figure 7).

Case 2

An 80-year-old, who had a T12-paraplegia following a rugby injury 50 years ago, developed a pressure injury over his left lateral malleolus four months prior to being seen at the AWCC. Prior to presentation to the AWCC, the wound was treated with conventional dressings for a month but due to poor wound progress was referred to a general surgeon. It was debrided at his local hospital and NPWT was instituted at this stage. After continuing with this for two months it was noted that the wound was deteriorating and was therefore referred to the AWCC.

The patient was an otherwise healthy, independent individual who looked after his wife with Alzheimer's disease. He had no other comorbidity and had no confounding factors that would affect wound healing.

He had a granulating wound (10 cm x 6 cm) over his left lateral malleolus with necrotic skin superior to this. Unfortunately, he also had an additional wound (3 cm x 2 cm) antero-superior to this, which had been created by the tubing of the NPWT (the patient's leg lay in external rotation when he was supine). His foot had an excessive amount of oedema for such a small wound (Figure 8).

Figure 8. Case 2. Left lateral malleolus wound (10 cm x 6 cm) with additional, smaller wound (3 cm x 2 cm) antero-superior to this. Note excessive left pedal oedema.

He required input from the infectious diseases physician, physiotherapist, lymphoedema therapist, wound care practitioner, nuclear medicine physician and plastic surgeon. Blood tests did not demonstrate any nutritional deficiencies but an X-ray was suggestive of osteomyelitis. This was confirmed by a white cell nuclear medicine scan (Figure 9) and was treated according to cultures, which grew Methicillin Resistant *Staphylococcus Aureus* (MRSA).

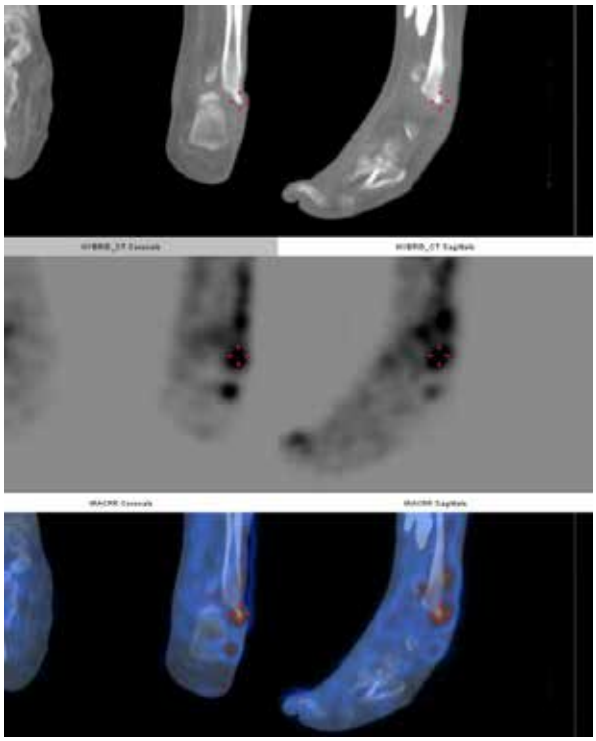


Figure 9. Case 2. Nuclear medicine white cell scan, indicating osteitis of the lateral malleolus.

Figure 10. Case 2. a) Left ankle wound two weeks after woundectomy and NPWT. b) After light hydrodebridement and excision of skin (another, less aggressive woundectomy) in preparation for definitive closure. c) Inferior wound partially closed and partially split skin-grafted and antero-superior wound closed.

He underwent a woundectomy using hydrodebridment while he continued his six-week course of antibiotics for osteomyelitis. Two weeks later there was sufficient healthy granulation in the inferior wound. The anterior wound still had exposed fascia, which usually does not granulate well (Figure 10a). The patient was taken to theatre for his reconstruction and all wounds were given a light hydrodebridment to remove biofilm. The superior wound skin edges were excised (Figure 10b) and the wound was sutured in layers. The narrow, upper aspect of the inferior wound was also partially closed with sutures to minimise the size of the defect and the inferior aspect of that wound was skin-grafted (Figure 10c). A polyvinyl alcohol (PVA) white foam NPWT dressing was place over the graft and closed wounds to increase the chance of graft take and reduce the risk of wound dehiscence.

Figure 11. Case 2. One week wound check following reconstruction. Wounds that were closed are healing well and graft has taken. Note swelling of foot has subsided in comparison to pictures of initial presentation.

The wounds were inspected one week later (three weeks after presenting to the AWCC) and he had 100% graft take and no wound dehiscence of the other wounds (Figure 11). Five months later these wounds were stable and remained healed.

Case 3

A 55-year-old lady was referred by a colorectal surgeon for assistance with a seemingly small, yet persistent wound of her lower abdomen. She had a resection of a benign sigmoid colon tumour eight months prior, which was complicated by wound dehiscence followed by open abdomen. This was treated with NPWT. She had eight attempted closures, which were partially successful but always complicated by the fact that the inferior aspect of the wound would open up again after a few weeks. She had two months of conservative treatment with NPWT with instillation but this was not successful.

On presentation, she was an obese (BMI 35), non-insulin dependent diabetic lady with a right-sided colostomy. She had a laparotomy scar with a small (1 cm x 1 cm) wound at its inferior aspect (Figure 12). On closer inspection, the wound was found to be a tunnelled wound, measuring 6 cm in length, with exposed, granulated bowel forming part of the floor of the tunnel. The latter was a critical observation, given the fact that woundectomy was planned which could result in bowel perforation. MRSA was also cultured in this wound, along with other bacteria.

Figure 12. Case 3. Small (1 cm x 1 cm), chronic abdominal wound at inferior aspect of laparotomy scar with right-sided colostomy bag in-situ.

Figures 13a and b. Case 3. Woundectomy markings to excise entire tunnel and its surrounding fibrotic tissue (15 cm x 6 cm). The floor of the tunnel (depth of 5 cm), which consisted of granulated bowel, was hydrodebrided.

The foul-smelling wound was a source of much embarrassment to the patient and resulted in her sleeping in a separate room to her husband. This placed considerable strain on their relationship in a time where she required as much support as possible. The inordinate amount of medical bills she had also added to her already strained relationship. She required input from the psychologist, dietician, physiotherapist, physician, colorectal surgeon and plastic surgeon.

A woundectomy was planned to include not only the tunnel but also the fibrotic scar tissue palpable beneath the skin around the tunnel (Figure 13a). She was taken to theatre, where a woundectomy (15 cm x 6 cm) was done, taking care not to allow any of the MRSA-lined tunnel to remain behind. The floor of the tunnel (depth of 5 cm), which contained the granulated bowel, was carefully hydrodebrided to allow for a completely uncontaminated wound to remain behind (Figure 13b).

The wound was then thoroughly washed out and closed in multiple layers to avoid any dead space (Figure 14a). The weight of the abdominal pannus on either side of the repair resulted in tension on the wound when the patient was supine. An incisional NPWT was therefore placed over the closed wound in order to minimise this tension on the sutures. The dressing was removed after one week and the wound was found to be healing well (Figure 14b). Sutures were removed on day 10.

With wound reconstructions of this nature, wound complications can be insidious and present after weeks or even months due to retained, deep-seated, necrotic, infected material. It is for this reason that the key principle of woundectomy is to ensure that none of the chronic

Figure 14. Case 3. a) Wound closed immediately following woundectomy. Incisional NPWT was applied to this. b) After removal of NPWT one week later.

Figure 15. Case 3. Wound has remained healed six years after closure (this picture taken at six months).

wound tissue remains behind, no matter how minute it is. Although the last available picture was taken at six months, the wound has remained healed after six years (Figure 15).

Discussion

The term "debridement" represents a spectrum of different methods used to remove unwanted tissue from wounds, with the "woundectomy" technique discussed in this article being the most aggressive. Moist wound healing and autolytic debridement is an example of the more conservative end of the spectrum. Returning a wound to its most physiological state is an important principle in managing chronic or complex wounds. It is likely that a "woundectomy", as described in this article, is occasionally undertaken by surgeons during debridement and this in itself is not new. The reason for proposing the term for this more extreme form of debridement, however, is to specifically define this form of debridement.

Usually, when wounds were referred to the AWCC, they were chronic wounds that had been present for many months or even years and there had been multiple attempts at closure prior to their referral. The wounds were usually colonised by multi-drug resistant organisms after having received numerous courses of antibiotics. These types of wounds are "problem-wounds" with complex pathophysiological processes within them that are not fully understood to this day.[6]

Some advanced wound dressings are designed to address one or more aspects of the pathophysiology processes. The author felt that the fastest and possibly the cheapest way to convert a "problem-wound" to a normal wound is to physically remove the "problem" by surgically removing the entire wound, hence the term "woundectomy". A woundectomy, as described above, converts a chronic, complicated wound to a normal acute wound in one operation, unlike some of the other forms of more conservative debridement. If woundectomy is a viable option for a particular patient then this obviates the need for most of the ever-growing multitude of expensive advanced wound dressings being developed.

However, this step serves little purpose if the patient is not looked at holistically to identify all the individual pathophysiological local and systemic processes, which resulted in the wound becoming chronic in the first place. A multidisciplinary team dedicated to dealing with patients with chronic wounds is invaluable to diagnose and treat the concomitant pathologies that these patients have. This two-pronged approach (woundectomy and multidisciplinary care) is mandatory to achieve success in these complex cases.

The AWCC mentioned in this article is fortunate to have a dedicated team of more than 18 individuals from various disciplines, all related to wounds, who meet once a month to discuss complex cases. This, the author believes, is true multidisciplinary care as opposed to clinics that have specialists available to see cases but do not have regular meetings to discuss them. This implies that someone in these clinics is tasked with having to make a diagnosis prior to referring the patient to the relevant specialty. Not even the most experienced general practitioner, who it could be argued has the widest scope of clinical acumen, will always be in a position to diagnose all pathologies that need to be referred to a specialist to be treated. Yet, most of these clinics are usually run by wound care nurses who are generally even less qualified to diagnose than a general practitioner. Having a team discussing a patient around a table, with all special investigations at hand, is the most effective way to pick up even the most unusual pathologies.

The author believes that at least one facility like the AWCC should be available in each province to serve as a tertiary referral centre and encourages the development of more such facilities. This is particularly useful for complex cases where multiple different dressing types or techniques have been attempted but wounds do not show any progress or repeatedly break down after closure. This more aggressive approach to wounds employed at an Advance

Wound Care Centre appears to result in shorter treatment times and should reduce costs. More research is needed to evaluate the latter as data continues to be collected. The return of patients to work sooner is an additional benefit, particularly in a country where unemployment is high.

Conclusion

The two-pronged approach with woundectomy and multidisciplinary wound management should heal even the most stubborn wounds, providing all concomitant pathophysiology is treatable.

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