Serial Sharp Debridement and Formulated Collagen Gel to Treat Pressure Ulcers in Elderly Long-term Care Patients: A Case Study

Jennifer K. Agosti, RN, CWCA, FACCWS, CFCN, DAPWCA; Lois A. Chandler, PhD; Caryn M. Anderton, BS; and Rita M. Clark, RN, BSN

Abstract
Clinicians treating pressure ulcers in the elderly in long-term care often face psychosocial, financial, and patient quality-of-life challenges; as such, they seek to identify products that meet wound healing goals as expeditiously as possible. The purpose of this case series was to evaluate outcomes of serial sharp debridement and the application of a formulated collagen gel in patients with chronic, nonhealing pressure ulcers. Three patients (two women ages 82 and 74 years of age and one man 82 years old, all incontinent of bladder and bowel with numerous comorbidities) had wounds >18 months’ duration on the buttocks or coccyx that failed to improve despite the use of a wide variety of treatments, including negative pressure wound therapy. All wounds were debrided at the start of treatment and weekly thereafter if necessary, followed by application of the collagen gel. The gel was covered with a sterile bordered gauze and, if needed, a semipermeable dressing. Dressings were left in place for up to 1 week. Two ulcers reepithelialized completely after 4 to 5 weeks of care, and the wound bed of the third ulcer was ready for grafting after 6 weeks of care. No adverse events occurred. Nursing staff appreciated the reduced dressing change frequency, although dressing maintenance remains challenging in patients with frequent incontinence episodes. Randomized clinical trials to evaluate the efficacy of this treatment approach compared to the use of traditional moisture-retentive dressings are needed.

Keywords: case study, pressure ulcer, long-term care, debridement, collagen


Potential Conflicts of Interest: Ms. Agosti received compensation for conducting the study and writing this manuscript from, and Dr. Chandler and Ms. Anderton are employees of, Cardium/Tissue Repair Company, San Diego, CA.

In many settings, including long-term care facilities (LTCFs), pressure ulcers are costly to treat, negatively impact the patient’s quality of life, are associated with increased morbidity and mortality, and require substantial resources for assessment and treatment.¹

The most frequent site for pressure ulcer formation is on the lower part of the body, including over the sacrum, the back along the spine, the buttocks, the hips, and on the heels.²,³ Furthermore, the LTCF population is generally elderly and debilitated and incontinence is common, altering tissue tolerance to pressure.¹ Based on clinician observation, this raises yet another challenge to treatment regimens — namely, the impracticality of products that are difficult to maintain due to incontinence and/or are very costly to reapply. Moist dressings and infection control are often the first line topical therapy in treating pressure ulcers.¹,² For non-responsive ulcers, negative pressure wound therapy (NPWT) is commonly employed as an adjunctive therapy,¹,² but its drawbacks include expense and incompatibility with some wound locations. If advanced wound care products could be used effectively by LTCF wound specialists, the cost of that care would be lower.

Collagen. Collagen plays an essential role in each phase of the normal wound healing cascade.⁵ One of collagen’s most important functions in wound repair is to provide a physical scaffold for cellular adhesion, migration, and proliferation.
Type I formulated collagen gel (Excellagen®, Cardium/Tissue Repair Company, San Diego, CA) was cleared for marketing in 2011 by the US Food and Drug Administration (FDA) for use in the treatment of a variety of dermal wounds. The product consists of a sterile homogenate (gel) of highly purified type I bovine dermal collagen in a physiologic buffer and is manufactured using a specialized process that maintains the collagen’s three-dimensional fibrillar structure and, as such, its structural/functional properties. For example, incubation of type I formulated collagen gel with human platelets in vitro results in platelet activation and release of platelet-derived growth factor. Originally developed to deliver advanced DNA-based biologics, the gel has undergone extensive preclinical safety testing. Type I formulated collagen gel is contraindicated in individuals with known sensitivity to products of bovine origin.

The effect of the gel on diabetic foot ulcers (DFU) (mean ulcer duration 17 months) was evaluated in a multicenter, randomized, controlled, double-blind study in 22 wound care clinics throughout the US. Patients in the intervention group (n = 31) received one or two (day 1 and week 4) applications of collagen gel in addition to standard care therapy that included offloading, debridement, and weekly secondary dressing changes. Almost half (45%) of the patients treated with only one or two applications of type I formulated collagen gel achieved complete wound closure within 12 weeks compared with 31% of patients receiving standard care. Rate of wound closure during the first 2 weeks of care was statistically significantly different between the two groups (average 0.137 cm/week for the intervention and 0.063 cm/week in the control group; P = 0.032).

Although of different etiologies, chronic pressure ulcers and chronic DFU both have been associated with imbalances in the wound environment that contribute to a nonhealing phenotype, and it has been suggested that this may be overcome, in part, by topically applied collagen.

**Purpose**

The purpose of this case study was to evaluate the use and effect of type I formulated collagen on granulation tissue formation and reepithelialization in chronic pressure ulcers. Cost-effectiveness, medical complications, patient discomfort, and nursing time also were assessed.

**Methods**

**Patient sample.** Patients residing in two LTCFs, each with 120 beds, in Pennsylvania (US) were eligible for the gel application if they had 1) an open pressure ulcer of at least 2.0 cm in diameter that had not healed using NPWT, and 2) no symptoms or documented evidence of an active wound infection or osteomyelitis. Data were collected between April and June 2013. All patients received standard pressure ulcer management per the facilities’ established protocols: repositioning at least every 2 hours, low-air-loss support surface for bed, time out of bed limited to no more than 2 hours every 24 hours, and incontinence care every 2 hours and as needed for incontinence episodes between scheduled care. Incontinence care included the use of evidence-based protective ointments, creams, and disposable incontinence briefs and pads designed to wick away moisture. Variables such as approach to nutritional management and degree of dependence for mobility, toileting, and feeding were considered and standardized with regard to care routines and products utilized for incontinence care while maintaining the individual patient’s needs based on diagnosis and comorbid factors.

**Data collection.** Following agreement to participate through informed consent of the patient (as applicable) or the family member responsible for the patient, patient screening was completed to determine eligibility with the inclusion criteria for the study. Patient demographic variables (age, weight, comorbidities/diagnosis), laboratory studies, nutritional status, and the use of offloading devices were documented. Ulcer history was obtained from the charts, and the following wound assessment variables were obtained weekly after the gel application was started: tissue type and amount, drainage type and amount, wound edge and periwound condition, and wound dimensions (length x width x depth in cm using a ruler). All information was documented in each patient’s medical records. Each ulcer was assessed weekly by the same clinical wound specialist; actual care was provided by staff nurses. Incontinence care procedures, as described above, had been in place before conducting this study.

**Care procedures.** Patients with pressure ulcers receive interventions in line with best practices for treatment of wounds (including moist wound healing and debridement as indicated), prevention of additional skin breakdown, maintenance of functional abilities, and nutritional monitoring. This standard of care also may include alternating pressure mattresses and/or low-air-loss mattresses, air cushion to seating, and restorative nursing to maintain mobility/strength.

**Key Points**

- Patients with pressure ulcers (PUs) and multiple comorbidities, especially incontinence, can present many challenges, including nonhealing of their wounds.
- The author describes three patients with long-standing PUs that failed to heal.
- Wounds improved or healed after changing the topical protocol of care to sharp debridement as needed followed by the weekly application of collagen gel and protective dressings.
- Controlled clinical studies are needed to evaluate the efficacy and effectiveness of this protocol of care.
for continued participation in scheduled toileting programs. Sharp debridement (removal of tissue at the bedside utilizing a surgical instrument such as a scalpel or curette) was performed before initiating use of the collagen gel treatment, with subsequent sharp debridement performed at each weekly visit as clinically indicated by the presence of nonviable tissue. Staff nurses were educated on the product indications and actions and the recommended frequency of dressing changes (once weekly).

Wounds were cleansed postdebridement (or before application of weekly treatment if debridement was not performed) with saline-based wound cleanser.

Based on prior clinical use of type I formulated collagen gel in DFUs and the product’s instructions for use, it is recommended that the product be applied to the entire wound surface in a thin layer. At each application, 1.0 cc of the gel was applied for case study patients 1 and 3 and 2.0 cc was applied to the wound of patient 2. The secondary dressing for all patients was a nonadherent, hypoallergenic bordered gauze dressing. When deemed necessary, a semipermeable cover dressing was applied as well.

Patient comfort was evaluated by use of the Wong-Baker FACES Pain rating scale (FPS). Studies have shown the FPS is an appropriate tool for use with older adults in clinical practice to measure pain intensity. In addition, verbal and nonverbal cues of discomfort (ie, facial grimacing, sweating, and restlessness) as determinants of the patient’s comfort level were assessed and documented throughout each procedure.

Nursing experience with the collagen gel was informally evaluated through one-on-one interviews with the lead clinician using three open-ended questions to which the nurses verbally responded: 1) Did you have a positive or negative experience using the collagen gel? 2) How do you feel this product compares to other products in meeting time constraints and ease of use? 3) Can you comment on the outcomes of the patients treated with this product?

Results

Three patients met the inclusion criteria. Two additional patients qualified but declined to participate in the study. All three patients had a wound of at least 18 months’ duration and had been unsuccessfully managed with NPWT for at least 4 weeks.

Patient 1. Ms. D is an 84-year-old who had resided in the LTCF for 3½ years. Her comorbidities include Alzheimer’s dementia, multiple daily episodes of bowel and bladder incontinence, and hypertension. She is mobile to participate in repositioning, transfer, and ambulate with a wheeled walker and with the assistance of one caregiver providing constant cues with step-by-step instructions. Her current medications do not include anything that might affect wound treatment, such as steroids or other medications known to interfere with wound healing.

Ms. D developed a nonhealing Stage III pressure ulcer 3 years prior on the right inner buttock. Extensive chart review disclosed the wound bed had not achieved >50% granulation tissue at any point in time over the past 3 years. Multiple variables potentially factored into this problem, including incontinence of bowel and bladder, fluctuating nutritional intake, the daily amount of time spent out of bed, and two wound infections. Twice during the past 3 years, the wound had been cultured via swab method, with results positive for methicillin-resistant Staphylococcus aureus (MRSA). Each confirmed infection was treated with an appropriate antibiotic regimen. Following each round of antibiotics, the wound bed improved to a higher percentage of granulation tissue (50%). However, although chart data showed symptoms of infection had resolved upon completion of each antibiotic cycle, the wound lingered at the 50% slough level and granulation and did not continue to progress.

In addition to receiving standard care, prior local wound treatments included NPWT, collagenase, and hydrofiber sodium carboxymethylcellulose 1.2% with ionic silver. Ms. D’s incontinent episodes necessitated the need for more frequent NPWT dressing changes than the standard three times weekly; she also complained of pain/discomfort with the use of NPWT, despite a lower setting (-80 mm Hg) on continuous therapy. The treating physician usually orders NPWT at -125 mm Hg; however, to determine if a lower pressure would provide more comfort to the patient, in this case NPWT was ordered at -80 mm Hg.

Due to the ongoing challenge of the incontinence and the inability of previous treatment interventions to increase the amount of granulation tissue, the use of collagen gel was discussed with the patient’s physician. Ms. D’s responsible party/legal power of attorney (POA) was informed of the treatment goals and educated regarding the product, application procedure, and the need for sharp debridement. The POA granted consent for the treatment regimen, and a physician’s order was obtained from the patient’s physician. Ms. D was premedicated as per her physician’s orders with a mild analgesic before each treatment.

At the start of the collagen treatment, Ms. D’s ulcer measured 2.4 cm x 1.9 cm x 0.5 cm (l x w x d) (see Figure 1a). The wound bed contained 50% yellow slough tissue, which was debrided by sharp method followed by cleansing. No uncontrolled bleeding occurred. The collagen gel (1.0 cc) was applied to the wound using the sterile flexible applicator tip included in the manufacturer’s packaging. A secondary dressing of nonadherent, hypoallergenic bordered gauze was applied. Ms. D tolerated the procedure well with no observed symptoms and/or verbalized complaints of discomfort throughout the procedure. At the week 1 visit, the wound had decreased dramatically to 0.5 cm x 0.5 cm x 0.2 cm with no slough tissue present in the wound bed (see Figure 1b). No debridement was indicated due to the presence of 100% granulation tissue in the wound bed. The wound was cleansed and 1.0 cc of type I formulated...
Collagen gel was applied. By the week 2 visit, the wound bed presented with epithelial tissue and further reduction in size to 0.3 cm x 0.3 cm x 0.1 cm (see Figure 1c), and no debridement was indicated at this visit. At the week 4 visit (after four collagen gel applications), the wound had completely epithelialized, the treatment was stopped, and preventive skin care measures including the use of protective ointments with routine incontinence care were implemented (see Figure 1d). Although Ms. D remains at high risk for skin breakdown (Braden Score 12), her overall prognosis has improved.

Patient 2. Ms. F is a 72-year-old with multiple sclerosis, muscle spasms, bowel and bladder incontinence, and multiple joint contractures. She is mentally competent to make her own healthcare decisions. She was admitted to a LTCF 27 months prior with a Stage IV pressure ulcer on her coccyx, acquired at home. Retrospective chart review revealed no substantial improvement in the ulcer's diameter or depth for the entire length of her stay at the LTCF. Ms. F received antibiotic intervention three times in the past 2 years for MRSA in the wound, confirmed via swab culture. With each cycle of antibiotics, wound drainage decreased, periwound erythema resolved, and wound odor improved. However, during each series of antibiotic treatment for the wound infection, Ms. F experienced Clostridium difficile (C-diff), which required metronidazole treatment. Existing incontinence was complicated by the numerous diarrheal stools typical with C-diff. Intermittent sharp debridement had been performed throughout the past 27 months with the lowest percentage of slough tissue documented as 25% preceding collagen treatment.

Due to the lack of progress, the physician and Ms. F agreed to try the collagen gel. Ms. F was educated by the team about the indications, application process, and need for sharp debridement before collagen gel application. Written informed consent was received from Ms. F to commence treatment as ordered by her physician. Before initiating sharp debridement, due to Ms. F’s medical conditions and impaired sensation in the lower body, she was assessed by touch and vibration testing methods; it was determined she was unable to feel sensation.

At the start of the collagen treatment, Ms. F’s ulcer measured 5.0 cm x 5.0 cm x 3.1 cm, with a 2.0-cm undermined area from 1 o’clock to 3 o’clock (see Figure 2a). The wound bed contained 40% slough tissue, some of which was stringy and loosely adherent and some firmly attached to the wound bed. Sharp debridement was performed to remove the nonviable tissue. The wound was cleansed postdebridement with saline-based cleanser. No uncontrolled bleeding occurred. Collagen gel (2 cc) was applied to the wound bed and covered with a secondary dressing of bordered gauze with a final reinforcement of a thin semipermeable hydrocolloid film to prevent frequent dressing changes due to the ongoing fecal incontinence. Use of a cover dressing had not been employed on Ms. F previously. Ms. F denied any discomfort throughout the procedure.

At week 1, the wound measured 5.0 cm x 5.0 cm x 2.5 cm, and wound depth decreased by 0.6 cm; the undermined area had decreased by 1.5 cm at the center, with undermining from 1 o’clock to 3 o’clock measuring 0.5 cm (see Figure 2b). Slough tissue in the wound bed was assessed to be 40% and was again debrided. Five additional weekly visits occurred, for a total of six visits. At week 2, the wound measured 4.9 cm x 5.0 cm x 2.0 cm (see Figure 2c). At week 3, the wound measured 3.8 cm x 4.2 cm x 2.0 cm, representing a 59% decrease in wound volume; however, 20% slough tissue persisted at that time (see Figure 2d). Slough tissue continued to decrease throughout the next two visits (see Figure 2e,f) until 100% granulation tissue was achieved at week 6, when the final measurements were 4.1 cm x 4.9 cm x 1.6 cm, with minimal undermining of 0.7 cm from 1 o’clock to 3 o’clock (see Figure 2f).
Mr. G required total assistance with all care. Repositioning and transfers occur via mechanical lift. He is completely incontinent of bowel and bladder and does not indicate or perceive his toileting needs. Despite multiple attempts for scheduled toileting, bowel and bladder incontinence care were implemented. Despite remaining skin breakdown (Braden Score 10), her clinicians believe her overall prognosis improved with the successful wound granulation, enabling previously not possible surgical closure of this chronic wound.

**Patient 3:** Mr. G, 82 years old, was admitted to a LTCF 18 months prior following a cerebrovascular accident (CVA) with a nonhealing Stage III pressure ulcer on his coccyx. Mr. G has left hemiparesis, dysphagia, multi-infarct dementia, and atherosclerosis. He requires a gastrostomy tube for all nutrition and hydration secondary to the dysphagia and also has a tracheostomy tube in place due to his inability to manage and effectively clear lung secretions. He has expressive aphasia but is capable of using a communication board to point to pictures, words, and simple phrases.

Mr. G’s ulcer developed during his acute inpatient hospitalization following the CVA. Retrospective chart review revealed the ulcer had not changed much in the past 18 months, fluctuating between a volume of 2.7 cm³ (1.0 cm x 1.8 cm x 1.5 cm) and 1.8 cm³ (1.1 cm x 1.4 cm x 1.2 cm). Documentation over the previous 15 months consistently noted the wound bed had 50% slough tissue with smooth wound edges (epibole). Wound drainage was consistently described as clear yellow; however, twice in the past 18 months, the drainage was described as thick yellow, at which times swab cultures were obtained. Results of both cultures were negative. The primary factor thought to be impeding wound healing is ongoing episodes of contamination secondary to incontinence of bowel and bladder.

At the time of the study, Mr. G required total assistance with all care. Repositioning and transfers occur via mechanical lift. He is completely incontinent of bowel and bladder and does not indicate or perceive his toileting needs. Despite multiple attempts for scheduled toileting, bowel and bladder retraining was ineffective, as were attempts to predict or prompt elimination patterns.

Past treatment interventions for his ulcer include collagenase and iodine-impregnated dressings. NPWT also was utilized, despite the presence of slough tissue; the physician’s rationale was that the slough tissue may benefit from the mechanical debridement of the foam dressing medium. NPWT and the topical treatments were challenging due to required dressing change frequency secondary to unpredictable and total bowel and bladder incontinence. An additional challenge was the patient’s wife’s insistence that he stay out of bed for more than 2 hours at a time during her three-times-per-week visits.

Adjunctive wound management, in place since admission to the LTCF, includes dual air therapy, alternating pressure and low-air-loss mattress, air cushion for out of bed seating in a reclining wheelchair, repositioning foam wedges to maintain position changes, and nutritional support via gastrostomy tube feedings. Mr. G also receives passive range-of-motion exercises for both upper and lower extremities to maintain joint movement and prevent contractures.

Considering the challenges of past interventions, discussions were initiated with the physician and Mr. G’s wife, who is his legal POA, to reach an agreement to revise the treatment plan. Education was provided on the indications for use of the collagen gel, the application procedure, and need for sharp debridement as part of the treatment protocol.

At the start of the collagen treatment, Mr. G’s wound measured 1.1 cm x 1.4 cm x 1.2 cm with 50% yellow slough tissue visible in the wound bed (see Figure 3a). Sharp debridement of the wound bed and indurated edges was performed following premedication with a mild analgesic. No uncontrolled bleeding occurred. Mr. G demonstrated no pain or discomfort. Following postdebridement cleansing, 1.0 cc of collagen gel was applied and covered with a secondary dressing of bordered gauze and a semipermeable hydrocolloid film to prevent contamination.

At the first weekly follow-up visit, the wound measured 0.8 cm x 1.0 cm x 0.4 cm (see Figure 3b). The wound bed had 20% slough tissue present, which was debrided, and the treatment protocol was continued. At Mr. G’s second weekly follow-up, his wound measured 0.7 cm x 0.2 cm x 0.2 cm, a volumetric decrease of 98% (see Figure 3c). By the third follow-up visit, the wound bed was free of nonviable tissue and no longer required sharp debridement. Measurements at the third follow-up visit showed the wound had further decreased in size (0.2 cm x 0.2 cm 0.1 cm). The protocol was continued as described, and wound closure progressed. At the fifth weekly follow-up visit (after six applications of type I formulated collagen gel), the wound had reached 100% epithelialization (complete closure, see Figure 3d). At this point, preventative skin care measures of protective ointment with routine incontinence care were implemented. Despite remaining
at high risk for skin breakdown (Braden Score 9), Mr. G’s overall prognosis improved.

Nurse feedback. Seven out of nine nurses who participated in the informal follow-up provided positive feedback regarding the ability of the dressing combination to remain in place for at least several days. Three nurses believed maintaining a weekly dressing on LTCF patients with incontinence is difficult. Nine out of nine nurses agreed that the amount of time the dressing required for application was less than the time they usually expect to dedicate to dressing changes, and its ease of use (compared to daily or multiple times daily dressing changes) was more conducive to their busy schedules. Two nurses mentioned the potential challenge of having a qualified clinician on hand to perform sharp debridement. All nine nurses were satisfied with the wound outcomes for the patients in these case studies.

Discussion
The purpose of this study was to evaluate the healing effect of type I formulated collagen gel on chronic pressure ulcers. All three patients had been treated previously with various wound interventions over substantial periods of time without improvement in the wound bed or healing. By following a weekly treatment regimen with debridement as deemed necessary and topical application of collagen gel and protective dressings, the three patients in this case series were able to achieve the goals of their individual treatment plans within 5 to 6 weeks.

These observations are encouraging. Graumlich et al. compared the results of using granular bovine collagen (n = 35) to hydrocolloid dressing (n = 30) in patients with pressure ulcers. No significant differences were observed, and it was concluded that collagen was more expensive to use. However, the product was a granular collagen product that was applied daily, not weekly.

Piatkowski et al. reported the results of a randomized, controlled pilot study in stagnating pressure ulcers comparing use of a native collagen sponge (n = 5) to a foam dressing (n = 5). The study included an analysis of protease content in wound fluid from treated patients; the findings confirmed the ability of the native collagen dressing to modulate protease levels, establishing an environment more favorable for healing. Although Piatkowski et al. do not report details regarding frequency of dressing application, a rapid onset of healing with the collagen dressing was noted, similar to that reported for a single application of type I formulated collagen gel in DFUs, as well as a higher incidence of closure compared to the foam dressing.

Previous NPWT. Each of the three patients in this series had at some point received treatment with NPWT. Review of several NPWT manufacturers’ instruction manuals revealed NPWT is not indicated in the presence of nonviable tissue. However, inconsistencies exist in the literature regarding the risks and benefits of using NPWT in the presence of some slough tissue. A 2009 anecdotal poster presentation described the use of NPWT in 13 wounds, eight of which had varying degrees of devitalized tissue present when NPWT treatment was initiated. The study supported the hypothesis that NPWT aides in debridement of slough tissue; all eight patients were free of nonviable tissue at study termination. Nain et al. compared the rate of ulcer healing with NPWT to conventional moist dressings on DFUs, stating sharp debridement was performed to remove necrotic and slough tissue as far as possible. That study found NPWT improved healing 20% over the moist wound dressing, despite the presence of some slough tissue with the NPWT patients. A more recent pilot study by Ashby et al. involving patients with Stage III and Stage IV pressure ulcers compared NPWT to standard care with hydrocolloid, alginate, or foam dressings. Although not intended as an efficacy study, Ashby noted a lower average number of weekly visits with NPWT (3.1) versus standard care (5.7). In the present case series, all wounds had failed to heal during prior NPWT; Ashby reported closure with NPWT in only one of six cases and none with standard care.

Mitigating factors of wound management, including turning and repositioning timetables, quality support surfaces, incontinence care programs, and the frequency and timeliness of sharp debridement, must be considered as potentially important variables. Each of the trial patients had prior turning and repositioning programs, routine toileting every 2 hours as needed for incontinent episodes between scheduled toileting, utilization of protective ointments and garments to wick away moisture from incontinence, and appropriate support surfaces in place preceding this study. However, routine sharp debridement was not performed.

Limitations
The small sample size and the change in two topical treatment variables — serial sharp debridement and topical collagen — hamper the ability to draw conclusions. Maintenance debridement is frequently recommended to ensure the best chance of healing chronic wounds.

Conclusion
The purpose of this study was to evaluate the use and effect of type I formulated collagen on healing of chronic pressure ulcers in a LTCF setting. Three patients with wounds of at least 18 months to 3 years duration, and well-documented prior therapies (including NPWT) were studied. All three patients responded favorably to a treatment regimen of weekly debridement (if needed) and weekly application of type I formulated collagen gel. No adverse events occurred. Two of the three patients achieved complete wound closure in 4 to 5 weeks. The third patient, with the largest wound (78 cm² at start of treatment with collagen) achieved 100% granulation and a 59% reduction in wound volume after 6 weeks. Cost-effectiveness, medical
complications, patient discomfort, and nursing time were also assessed, and study nurses agreed that weekly use of type I formulated collagen gel required less time and was more compatible with their busy schedules than standard care of daily (or multiple times daily) dressing changes. Formal study of the clinical efficacy and practical benefits of type I formulated collagen gel in the treatment of pressure ulcers is required and should include more patients and a control group receiving conventional moist wound dressings, as well as sharp debridement and pressure offloading.

References