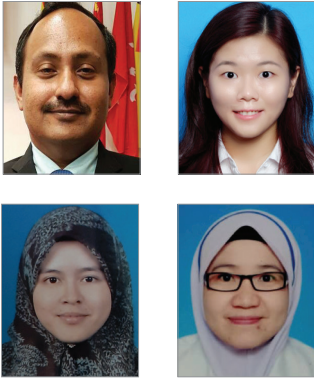


Efficacy of collagen-based wound dressings in wound healing



Authors:

Harikrishna KR Nair, Sylvia SY Chong, Noor Alina Binti Hj Md Isa, Siti Aishah Binti Khamis

The aim of this prospective case series was to evaluate the efficacy of collagen-based wound dressings in wound healing. Five patients were chosen by simple randomization from the Wound Care Unit, Department of Internal Medicine, Hospital Kuala Lumpur; one case of chronic venous ulcer, one case of post-split skin graft donor site, one case of wound dehiscence and two cases of diabetic foot ulcers, as a pilot study. All wounds were clean and non-infected. Collagen was applied to the wound at the wound interface. Dressings were changed twice a week and the patients were followed for up to 12 weeks to note wound closure. There were no adverse reactions or side effects or toxicity with the bovine collagen used in these cases. The results showed wound healing in terms of wound area reduction, as shown by the area measurements (length, width), as well as volume measurements (length, width, depth). Four of the five cases healed with complete epithelialization between 36 to 75 days, while one case showed a significant reduction in wound area. The authors found that dry collagen sheets are safe and efficacious when used on clean chronic wounds.

Harikrishna KR Nair is Head of Wound Care Unit, Department of Internal Medicine, Hospital Kuala Lumpur; **Sylvia SY Chong** is Research Assistant, Wound Care Unit, Department of Internal Medicine, Hospital Kuala Lumpur; **Noor Alina Binti Hj Md Isa** is Staff nurse Wound Care Unit, Department of Internal Medicine, Hospital Kuala Lumpur; **Siti Aishah Binti Khamis** is Staff nurse Wound Care Unit, Department of Internal Medicine, Hospital Kuala Lumpur

Chronic wounds include, but are not limited to, diabetic foot ulcers, venous leg ulcers, and pressure ulcers. They are a challenge to wound care professionals and a result of rising healthcare costs around the globe. The rising incidence of chronic wounds may also lead to a significant increase in expenses for patients and carers. Although they are not necessarily difficult to treat, an understanding of the underlying pathophysiology and specific attention is essential to help promote successful wound healing.

Overcoming the factors that contribute to delayed healing is the primary challenge in the treatment of chronic wounds and requires a comprehensive approach to wound care. When wounds fail to achieve satisfactory healing after 4 weeks of standard of care, reassessment of underlying pathology and the need for advanced therapeutic agents should be considered. However, the selection of an appropriate therapy is not always based on evidence.

Many wound dressings have been developed

to try to protect healing wounds from infection and to promote the wound healing process itself. A moist occlusive dressing helps to support the inflammatory phase by creating an environment with low oxygen tension (thereby activating factors, such as hypoxia-inducible factor-1) (Ke and Costa, 2006) and also by increasing the rate of re-epithelialization (Jones et al, 2006). Additionally, a limited amount of exudate retained in the wound allows for autolytic debridement, which serves to further promote successful wound healing.

Khan and Khan (2013) reviewed some important properties of collagen and how these have been used in certain collagen-based biomaterials. It was highlighted that these properties can help to provide opportunities for regeneration and development of human tissues in medicine and dentistry. They also stated that collagen has various advantages as a biomaterial and is widely used as a carrier system for delivery of drugs, proteins and genes. Two other comparative studies on collagen versus silver sulphadiazine dressing (SSD) in burn wounds, by Karthikeyan et al (2018)

and Sreenivasa et al (2018), showed that the collagen sheets used were superior to SSD as a burn dressing because collagen is well tolerated and provides multiple benefits. Overall cost benefit factors were also noted, when compared to conventional dressings.

A 60-patient prospective clinical study of collagen dressings in partial thickness burn patients by Kumar et al (2018) showed that a collagen sheet helps to promote early healing, decreases the need for analgesics and reduces the incidence of associated complications like infection. The morbidity of patients reduced as the resultant scar was smaller in the majority of the patients using collagen. The study showed that bovine collagen is safe and efficacious in the management of these partial thickness burn wounds (Kumar et al, 2018). There are several other studies which have demonstrated that collagen-based dressings are effective in first and second degree burns; in adults as well as paediatric patients (Ramakrishnan et al, 2013; Rai et al, 2013; Waghmare et al, 2016; Jain et al, 2017; Khurram et al, 2018).

Objective

To evaluate the efficacy of collagen-based wound dressings in wound healing.

Methods

Case study design

This study was done by simple randomization

whereby every fifth patient with a clean wound was included in the evaluation. The patients' ages ranged from 28 to 73 years old and cases varied from chronic venous ulcer to post-split skin graft (SSG) donor site, wound dehiscence and diabetic foot ulcers. The evaluation was carried out in an outpatient setting at the Wound Care Unit, Kuala Lumpur Hospital, Malaysia (WCUHKL). All wounds selected for this evaluation were clean. Wounds were assessed following the TIMES (T = tissue, I = inflammation/infection, M = moisture imbalance, E = edge/epidermal margin, S = surrounding skin) concept. Standard wound care was performed by cleansing the wounds with distilled water, before application of a collagen-based wound dressing at the wound care clinic. Dry collagen sheets were applied to the wound, followed by a polyurethane foam dressing. Dressings were changed twice a week and the patients were followed for up to 12 weeks to note wound closure. Two-layer compression bandaging was used according to standard of care in the management of venous ulcers. Diabetic foot ulcers were offloaded using padding and proper foot wear.

Results

The results showed wound healing in terms of wound area reduction, as shown by the area measurements (length, width), as well as volume measurements (length, width, depth).

Case study 1

A 73-year-old female presented with a chronic venous ulcer, which she had developed 3 years prior due to a deep-vein thrombosis, as a complication of a femoral fracture. Medical history revealed that the patient had hypertension for the last 25 years. Over the course of 50 days [Figures 1a–d], the wound healed completely.



Figure 1a. Day 1:
On 23rd April 2019, the wound measured 4 cm x 3 cm



Figure 1b. Day 22:
On 14th May 2019, the wound measured 4 cm x 2.5 cm



Figure 1c. Day 29:
On 21st May 2019, the wound measured 3.5 cm x 2.5 cm



Figure 1d. Day 50:
On 11th June 2019, the wound was recorded as healed

Case study 2

A 42-year-old male with a medical history of diabetes mellitus and hypertension, and a surgical history of Ray's amputation of the left big toe in 2018. Over the course of 86 days, the size of the wound significantly decreased [Figure 2a–e].

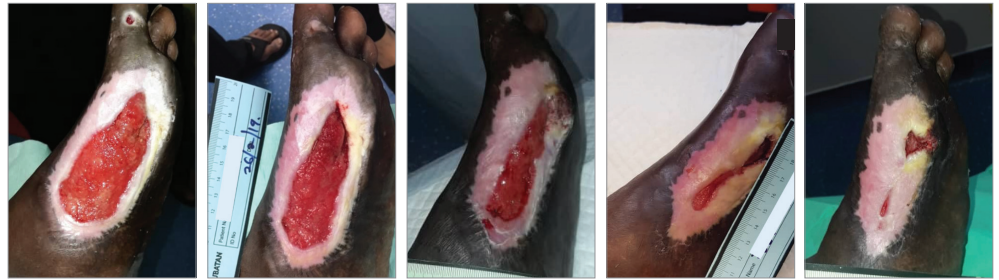


Figure 2a. Day 1: On 19th February 2019, the wound measured 10 cm x 6.5 cm
Figure 2b. Day 8: On 26th February 2019, the wound measured 10 cm x 6 cm
Figure 2c. Day 33: On 22nd March 2019, the wound measured 7 cm x 4 cm
Figure 2d. Day 58: On 16th April 2019, the wound measured 5 cm x 1 cm
Figure 2e. Day 86: On 14th May 2019, the wound measured 1 cm x 1 cm

Case study 3

A 28-year-old male with no known medical illness presented after an alleged motor vehicle accident. Suturing had been performed on 2nd January 2019. Wound dehiscence after surgery occurred on 11th January 2019. Follow-up care was carried out at a private clinic and the patient was referred to the wound clinic with a non-healing ulcer. The wound healing progress is depicted in Figures 3a–d.



Figure 3a. Day 1: On 18th February 2019, the wound measured 13 cm x 1.5 cm
Figure 3b. Day 8: On 25th February 2019, the wound measured 10 cm x 1 cm
Figure 3c. Day 29: On 18th March 2019, the wound measured 2 cm x 0.5 cm
Figure 3d. Day 36: On 25th March 2019, the wound was recorded as healed

Case study 4

A 35-year-old male with no known medical illness. An alleged motor vehicle accident took place on 18th January 2019. SSG was done on the right ankle joint, however, the donor site at the right thigh became infected on 21st January 2019. Subsequently, the wound was treated as a non-healing ulcer, even though infection was cleared. The wound fully healed and regained a healthy state over the course of 75 days [Figure 4a–d].



Figure 4a. Day 1:
On 14th February 2019,
the wound measured
16 cm x 10 cm

Figure 4b. Day 5:
On 18th February 2019,
the wound measured
14 cm x 6 cm

Figure 4c. Day 13:
On 26th February 2019,
the wound measured
3 cm x 3 cm

Figure 4d. Day 75:
On 29th April 2019,
the wound had
healed

Case study 5

A 68-year-old female with a medical history of diabetes mellitus. She suffered from a chronic venous ulcer for 3 years, following a deep vein thrombosis and had been followed up by the vascular team.



Figure 5a. Day 1:
On 18th February
2019, the wound
measured
2.5 cm x 2 cm

Figure 5b. Day 4:
On 21st February
2019, the wound
still measured
2.5 cm x 2 cm

Figure 5c. Day 29:
On 18th March
2019, the wound
measured
1 cm x 0.5 cm

Figure 5d. Day 36:
On 25th March
2019, the wound
measured
0.5 cm x 0.5 cm

Figure 5e. Day 43:
On 1st April
2019, the wound
was recorded as
healed

Four of the five cases healed with complete epithelialization between 36 to 75 days, while one case showed a significant reduction in wound area. There were no adverse or allergic reactions; toxicity signs and symptoms.

Discussion

A multidisciplinary team approach has helped to improve wound management in leaps and bounds. Collagen products have been used for years and are currently considered one of the most advanced dressings in our armamentarium. Collagen helps improve angiogenesis and by promoting epithelialization, also helps to kick-start healing. The type of collagen I:III ratio increases during the healing process, throughout the proliferative phase (Elgharably et al, 2013), as a more mature collagen matrix develops in the wound milieu. Applying collagen sheets to the wound will help to maintain a moist wound healing environment, especially in burn wounds.

This evaluation is on bovine collagen, namely Bio Coll-Skin Dry Skin. Therefore, infected wounds and patients who were allergic to bovine substances were excluded from this evaluation. Local case studies and case series' conducted are able to show the efficacy of collagen on many types of wounds. A limitation of local studies is in the sample size. However, this can be resolved by looking at studies conducted in India, which cover randomized control studies and prospective studies. Incidentally, all the studies showed safety and efficacy when collagen was used on different wounds. Pain was also alleviated and there were no safety issues or side effects documented (Ramakrishnan et al, 2013).

The paediatric age group was studied extensively, as burn wound management was a major indication for the usage of bovine collagen. Although the paediatric group is very susceptible to infection and other reactions, in this case, there were no adverse or allergic reactions; toxicity signs and symptoms. This bodes well for the usage of this type of collagen.

Conclusion

Dry collagen sheets are safe and efficacious when used on humans with various clean chronic wounds. The crucial aspect is to close the wound as quickly as possible and to prevent infection from setting in. A more robust trial with a larger sample size, such as a randomized control trial, will yield a better significant result.

Declaration of interest

Bio-Collagen Technologies Sdn Bhd supplied

the collagen-based wound dressings used for this evaluation. The author has no conflicts of interest to declare.

WAS

References

- Elgharably H, Roy S, Khanna S et al (2013) A modified collagen gel enhances healing outcome in a preclinical swine model of excisional wounds. *Wound Repair Regen* 21(3): 473–81
- Jain S, Tote DS, Kolte G et al (2017) Effect of moist dressing, collagen sheet dressing and epidermal growth factor in healing of chronic wounds. *Int Surg J* 4(8): 2594–99
- Jones V, Grey JE, Harding KG (2006) Wound dressings. *BMJ* 332(7544): 777–80
- Karthikeyan S, Sumithra P, Senthilkumar A (2018) Comparative study on collagen vs silversulphadiazine dressing in burns wounds. *Journal of Dental and Medical Sciences (IOSR-JDMS)* 17(8): 12–19 11
- Ke Q, Costa M (2006) Hypoxia-inducible factor-1 (HIF-1) *Mol Pharmacol* 70(5):1469–80
- Khan R, Khan MH (2013) Use of collagen as a biomaterial: An update. *Journal of Indian Society of Periodontology*. 17(4): 539–42
- Khurram Mohammed Fahud, Sheikh Mohd Tafazul, Ahmad Imran et al (2018) The efficacy of collagen-based dressings for treatment of scald burns in under 5 years paediatric population: a non-comparative, prospective single center experience. *Int J Community Med Public Health* 5: 4298–302
- Kumar AM, Arumugam SS, Anandan H (2018) A clinical study of collagen dressing in partial thickness burns. *International Journal of Contemporary Medical Research* 5(10): J17-J20
- Rai R, Sudarshan SH, Dsouza R et al (2013) Collagen dressing versus heparin dressing in burn wound management. *Journal of Evolution of Medical and Dental Sciences* 2(47): 9124–30
- Ramakrishnan KM, Babu M, Mathivanan J et al (2013) Advantages of collagen based biological dressings in the management of superficial and superficial partial thickness burns in children. *Ann Burns Fire Disasters* 26(2): 98–104
- Sreenivasa P, Purendar Reddy Perur (2018) A clinical study of collagen dressing over silversulphadiazine dressing in partial thickness burns. *International Journal of Contemporary Medicine Surgery and Radiology* 3(1): 43–46
- Waghmare M, Shah H, Tiwari C, Makhija D et al (2016) Collagen dressings in the management of partial thickness pediatric burns: Our experience. *Indian Journal of Burns* 24(1): 53–57