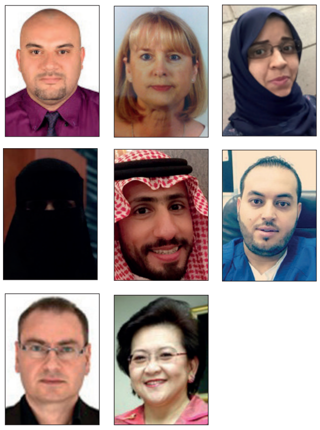
Comparison of collagen wound dressings versus self-adaptive wound dressings in pressure ulcer treatment



Authors (clockwise from top left): *Abdulkarem Iblasi, Patricia A Paine, Nahla AbdulGadir Tayyib, Talha Mistarihi, Abdulaziz Binkanan, Dareen Belal, Aungsuroch and Hussam Itani*

Hospitals use advanced wound care products, such as collagen and self-adaptive wound dressings (SAWDs), to manage pressure ulcers (PUs) with variations in clinical success. This study examines the use and efficacy of these dressings in PU treatment. Patient records were searched for PUs treated for 3 consecutive weeks with collagen dressings only (*n*=128), SAWDs only (*n*=179) or both dressings together (*n* =197). PU status was assessed using the Pressure Ulcer Scale of Healing. There was significant progress towards healing in all groups; however, healing was much slower in the group that received both dressings. Hospital wound care protocols should be revised to advocate the use of single rather than multiple bandages. Collagen dressings and SAWDs support PU progression to healing and should be used in practice. Further studies are needed to explore the most appropriate and cost-effective use of advanced wound care products in PU management.

***Abdulkarem Iblasi** is Clinical Nurse Manager – Wound Management, King Saud Medical City, Riyadh, Kingdom of Saudi Arabia (KSA) and PhD (c), Faculty of Nursing, Chulalongkorn University, Bangkok, Thailand; **Patricia A Paine** is Chairman of Wound Care Committee, Associate Chief Nursing Officer, King Saud Medical City, Riyadh, KSA; **Nahla AbdulGadir Tayyib** is Assistant Professor, Um-Al Qura University, Makkah, KSA; **Talha Mistarihi** is Clinical Nurse Manager, King Saud Medical City, Riyadh, KSA; **Abdulaziz Binkanan** is Head Nurse, King Saud Medical City, Riyadh, KSA; **Dareen Belal** is Assistant Chief Nursing Officer, King Saud Medical City, Riyadh, KSA; Associate Professor Police Captain **Aungsuroch**, PhD, Faculty of Nursing, Chulalongkorn University, Bangkok, Thailand **Hussam Itani** is Wound Care Consultant, Canada*

Wound bed preparation aims to promote the development of new tissue to enable healing (Miranda and Srinivasan, 2016). It involves removing unwanted tissue, such as necrotic tissue or slough, through debridement and the minimisation of bacterial load to reduce the risk of infection (White and Asimus, 2014).

Collagen dressings and self-adaptive wound dressings (SAWDs) are highly utilised in government hospitals in Saudi Arabia; the use of SAWDs doubled between 2014 and 2017. Current evidence supports the use of self-adaptive wound dressings (SAWDs) in pressure ulcer (PU) treatment (Iblasi and Itani, 2017). Dressings that contain collagen are widely used in the granulation phase of ulcer management (Held et al, 2015). The authors aimed to review the clinical effectiveness of these dressings, used separately and in combination, in the treatment of PUs in Saudi Arabia.

Wound physiology and dressings' modes of action

There are a number of physiological differences between acute and chronic wounds. In acute wounds, progression to healing occurs via the inflammatory and maturation phases; in chronic wounds, this process is disrupted and prolonged. Acute wounds that are progressing to healing are slightly acidic (pH 7), whereas chronic wounds are alkaline (nearer pH 9). During the acute wound-healing phase, fibroblasts make collagen, which is incorporated in the extracellular matrix and supports new tissue. Proteolytic enzymes are necessary to degrade necrotic tissue and repair damaged tissue (Sinclair and Ryan, 1994); however, in chronic wounds, there are high levels of these enzymes and decreased protease inhibitors, leading to excessive extracellular matrix breakdown, impeding/damaging new tissue growth. Bacteria also produce proteolytic enzymes, therefore reducing bacterial burden supports wound progression.

Miranda and Srinivasan (2016) stress the role of collagen dressings in improving the internal condition of the wound bed. They concluded that collagen helps endothelial cell migration and activates fibroblast activity to enhance healing. This conclusion is further supported by Shah and Chakravarthy (2015), who found that the addition of bovine collagen led to wound closure in 15 out

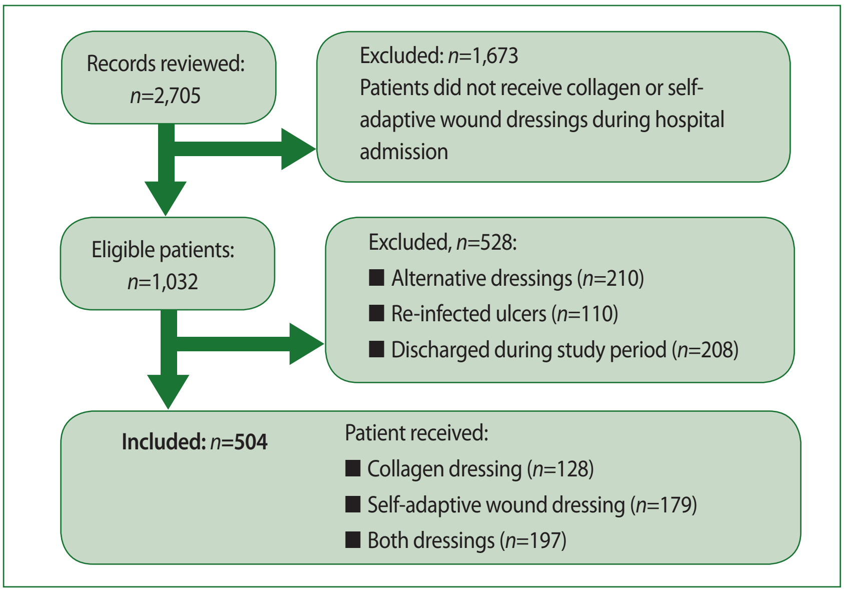


Figure 1. Participant selection procedure.

of 21 chronic wounds, with healing times ranging from 13 to 68 days. The role of collagen in the treatment of superficial wounds was studied by Held et al (2015), who reported a higher epidermal cell count and thicker epidermis with a collagen dressing than traditional wound dressings at 3 months.

Reducing protease levels is the ultimate goal of collagen administration (Miranda and Srinivasan, 2016). This type of dressing is used in PU management because collagen decreases protease levels in the wound bed, enhancing epithelialisation and accelerating healing (Kloeters et al, 2016). High levels of protease destroy growth factors, slowing progression to healing (Kloeters et al, 2016). Furthermore, a pilot study by Piatkowski et al (2012) comparing a collagen dressing with a foam dressing found the former supported angiogenesis and enhanced blood supply to the wound bed. Therefore, it can be concluded that collagen is significant in wound healing as it protects growth factors and promotes angiogenesis.

SAWD is a new technology that produces a moist wound environment (Iblasi and Itani, 2017), allowing growth factor penetration of the wound bed and improving blood supply to the area (Iblasi and Itani, 2017). SAWDs are cost-effective in the treatment of chronic wounds (Fischenich and Wolcott, 2013) as they can safely stay on wounds for longer than other wound dressing types (Bishop et al, 2010). Support is, therefore, growing for the use of SAWDs. The initial results of their use in PU treatment are promising (Iblasi and Itani, 2017).

Methods

This study retrospectively compared progress to healing among patients with PUs who were treated at the King Saud Medical City medical unit, surgical unit or intensive care unit and had received a collagen wound dressing, SAWD or both for a period of 3 weeks. Data were collected from between April 2016 and January 2018. All patient charts with a PU within the scope of the wound care service were reviewed. Approval for this study was granted by the Ethical and Institutional Review Board of King Saud Medical City (Number H1RI-26-Sep18-01).

Adults with a single PU whose dressing(s) — collagen, SAWD or both — was changed by wound care nurses only over a continuous period of 3 weeks were included. Patients with multiple PUs were excluded due to the strong possibility of confusion among the evaluators. Patients undergoing palliative treatment or chemotherapy, who were under 18 years of age or who received different dressing modalities were excluded.

Four professional wound care nurses trained by the principal author gathered data on progression to healing using the internationally-agreed Pressure Ulcer Scale of Healing (PUSH) tool (Choi et al, 2016a). This tool assesses PUs based on (Choi et al 2016b):

- Length x width, scored from 0 to 10
- Amount of exudate, scored from 0 (none) to 3 (heavy)
- Tissue type, scored from 0 (closed) to 4 (necrotic tissue).

Data collection

Pressure ulcers

The research team reviewed the patient files to identify PU condition on day 0, which was the day treatment with one of the three modalities was started, on day 14 and day 21. The assessment period was consistent with the hospital's PU dressing. For reliability purposes, 51 patient records (25 from the first group and 26 from the other two groups, 13 in each) were randomly chosen and reviewed by two different investigators. There was no significant difference between the initial and revised score in these files (P=0.761), therefore, the data collection processes was considered consistent, reliable and robust.

Table 1. Clinical and demographic characteristics of patients included in the study.

Variable	All	Dressing			P-value
		Collagen	Self-adaptive	Both	
Patients, n	504	128	179	197	
Age, years, mean ± SD	58.3 ± 14.24				
Male gender, %	56.2	57.8	55.9	55.3	0.9
Smoker, %	62.5	23.4	17.3	14.7	0.34
Length of stay, %:					0.28
• <6 days	29.8	33.6	29.0	27.9	
• 6 days – 1 month	53.4	54.7	54.7	51.3	
• >1 month	16.9	11.7	16.2	20.8	
Comorbidities, %:					0.01*
• 0	18.8	28.1	18.9	12.7	
• 1	14.1	10.1	16.2	14.7	
• 2	37.5	29.7	37.9	42.2	
• ≥3	29.6	32	26.8	30.4	
Admission unit, %:					0.9
• Surgical	6.0	5.5	6.7	5.6	
• Medical	67.3	67.9	66.5	67.5	
• Intensive care	26.8	26.6	26.8	26.9	
Ulcer stage, %:					0.45
• 2	8.91	8.6	10.1	8.1	
• 3	17.8	10.9	20.7	19.8	
• 4	24.6	28.9	23.5	22.8	
• Unstageable	47.5	50.0	44.7	48.7	
• Deep tissue injury	1.1	1.6	1.1	0.5	
Ulcer site, %:					0.02*
• Sacrum	46.3	39.8	52.0	45.7	
• Heal	29.7	31.3	31.3	27.4	
• Hip	13.9	14.8	13.4	13.7	
• Other	10.1	14.1	3.4	13.2	
Air mattress, %	80.0	85.1	83.8	76.1	
Repositioning/					0.06
24 hours, %:					0.01*
• <6 times	10.6	18.8	10.6	3.6	
• 6–11 times	21.3	18.0	23.5	22.8	
• >11 times	68.1	63.3	65.9	73.6	
PUSH, mean ± SD					
Day 0	13.0±1.7	13.0±1.8	13.1 ± 1.6	13.0 ± 1.7	0.72
Day 14	10.1±1.6	10.1±1.8	10.3 ± 1.6	10.0 ± 1.5	0.42
Day 21	8.8±2.0	8.0±1.9	8.1 ± 1.8	10.0 ± 1.5	0.02*

PUSH: Pressure Ulcer Scale of Healing; *significant difference

Factors that impede healing

The research team collected further information on factors that might affect progression to healing. The literature has shown that patients' age, gender (Guo and DiPietro, 2010) and hospital length of stay (Sung and Park, 2011) can impact healing. Comorbidities that could disturb progression to healing — including diabetes, congestive heart failure, nutritional insufficiency, diarrhoea for more than 3 days during the evaluation period, hypertension, viral hepatitis B or C, liver cirrhosis, cerebrovascular disease, history of smoking, anticoagulant use, and haematological disorders (Prompers et al, 2007) — were recorded.

Care-related factors

The use of PU mattresses and nursing compliance with repositioning standards, based on nursing notes, were recorded to determine consistency of care. The last wound dressing used before the treatment modality was revised was also recorded.

Data analysis

All analyses were carried out using SPSS version 20 (SPSS Inc, New York, USA). Univariate analyses were performed after individuals were stratified into three groups according to their dressing(s). Analysis of variance (ANOVA) tests were performed when comparing variables between groups. A *P*-value <0.05 was considered statistically significant. Results are presented as mean ± standard deviation for quantitative variables and as a percentage for categorical variables.

One-way ANOVA was performed to determine whether there were any significant differences between the mean effects of the three treatments. Then we performed Tukey multiple pairwise comparisons to determine the mean difference between pairs of groups.

Results

All 2,705 of the wound care service patient records were reviewed. Of these, 1,673 patients did not receive any of the dressing modalities being studied during hospital admission. A total of 210 records were excluded because patients had not received the same treatment modality for 3 consecutive weeks. A further 110 were excluded as during the 3-week period patients' ulcers had become re-infected and the topical wound dressing was switched to an antimicrobial dressing. Finally, 208 were excluded as patients had been discharged from the wound care service within 3 weeks and there was no further information about their wound progress after discharge.

A total of 504 patient records were included. Of these, 128 PUs were treated with a collagen dressing, 179 with a SAWD and 197 with both *[Figure 1]*. The dressing was not the same as before the evaluation, but this period is excluded from the comparison. The authors included the time when all patients received this dressing.

Table 2. Paired t-test of Pressure Ulcer Scale of Healing scores over time.

Dressing group	Paired difference					
	Mean ± SD	Upper	Lower	t	df	P-value
Collagen dressing	4.99±0.60	4.88	5.09	92.80	127	0.00*
Self-adaptive dressing	4.97±0.70	4.80	5.90	87.81	178	0.00*
Both dressings	2.81±0.56	2.73	2.89	69.50	196	0.00*

SD = standard deviation; df = degrees of freedom; t = XXXX; *significant difference

Table 3. Comparison of intergroup differences in mean effects (Δ PUSH).

Comparison	df	Mean squared	F value	P-value
Between-group	2	281.61	658.3	<2e-16*
Within-group (residual)	501	0.43		

PUSH = Pressure Ulcer Scale of Healing; df = degrees of freedom;
Δ PUSH = day 0 score – day 21 score; *significant difference

Table 4. Tukey multiple pairwise comparison of dressing groups.

Comparisons	Mean effect difference	Lower	Upper	P-value
Self-adaptive dressing–collagen dressing	–0.015	–0.193	0.163	0.980
Combination–collagen dressing	–2.175	–2.349	–2.000	<0.001*
Combination–self-adaptive dressing	–2.160	–2.319	–2.002	<0.001*

*Significant difference

The majority of patients were male 283 (56.2%), the mean age of the sample was 58.3±14.0 years and 62.6% were smokers. Many had multiple comorbidities; 189 (37.5%) had been diagnosed with two comorbidities. Just over half of the patients (269) had been admitted to hospital in the month before the evaluation period. In total, 339 (67.3%) were admitted to the medical wards.

The groups did not differ significantly in terms of age, gender, smoking habits, length of stay or the units to which they were admitted *[Table 1]*. The mean PUSH scores improved over time in all three groups *[Table 1]*. There was a significant difference in the average number of comorbidities between the dressing groups (*P*=0.01); a higher proportion of patients receiving a combination of dressings had two comorbidities (42.2%). These patients had more complex wounds.

Special pressure relief mattresses were used for 80% of patients. There was a trend towards higher use in the collagen group (85.1%) than the SAWD (83.8%) and combination (76.1%) groups (*P*=0.06).

Almost half (46.3%) of the PUs were on the sacrum. The prevalence of sacral PUs was higher in patients receiving a SAWD (52.0%) than in those given a collagen dressing (39.8%) or both dressings together (45.7%) (*P*=0.02). The majority of patients (68.1%) were repositioned more than 11 times a day, in accordance with hospital policy. Compliance with this policy was good, being 73.6% in the combined dressing group, 63.3% in the collagen dressing group and 65.9% SAWD group (*P*=0.01).

There was a significant improvement in PUSH scores all three groups (*P*=0.00) *[Table 2]*. There were also significant between-group differences in PUSH scores (*P*=2e-16) *[Table 3]*. Pairwise comparison found collagen dressings and SAWDs to have a similar effect when used separately. These dressings were significantly more effective when used separately than in combination (*P*=0.001) *[Table 4]*.

When single variables were examined, significant differences in effect were found for stage (*P*=0.000), comorbidities (*P*=0.000), ulcer site (*P*=1.1e-0.6) and patient repositioning (*P* =2.24e) *[Table 5]*. Adjusted ANOVA found the effects of the following pairs of variables to be significant:

- Stage and comorbidities (*P*=0.03)
- Stage and site (*P*=1.20e)
- Comorbidities and patient repositioning (*P*=0.003)
- Site and patient repositioning (*P*=0.023).

The effects of the combination of stage, comorbidities and site (*P*=0.002), as well as stage, comorbidities and patient repositioning (*P*=0.04) were also significant *[Table 5]*.

Discussion

The current study shows the value of applying SAWDs or collagen dressings to facilitate healing progression in PUs. The findings are consistent with evidence from previous studies demonstrating the benefits of collagen (Miranda and Srinivasan, 2016) and SAWDs in treating chronic wounds (Iblasi and Itani, 2017). The results also support the assertion by Held et al (2015) that manufactured collagen accelerates extracellular matrix development and enhances epithelialisation, as characterised by changes in PUSH score between weeks 1 and 3.

Government hospitals in Saudi Arabia have recently increased wound care service budgets and can now provide more than 57 advanced wound care items. There is, therefore, a need to standardise dressing use and utilise dressings in the correct manner. The results of the current study support the use of collagen and SAWDs in PU management. However, clinicians tended to combine both dressings in complex wounds with tracking or cavities, and these wounds were significantly slower to heal than those treated with just one type of bandage. Complex wounds may take longer to heal and are at greater risk of infection, which may explain these results. However, the use of both dressings together likely minimises the efficacy of SAWD; nurses packed collagen dressings into cavities, preventing SAWD from interacting directly with the wound

Table 5. Differences in effect for separate and combined variables.				
Variable	DF	Mean squared	F value	P-value
Separate				
Treatment	2	281.61	897.807	<2e-16[§]
Stage	4	1.88	6.000	0.000[§]
Comorbidities	3	1.32	4.197	0.001[†]
Site	3	3.32	10.593	1.13e-06[§]
Patient repositioning	2	4.24	13.528	2.24e-06[§]
Adjustment for 2 variables				
Dressing and stage	8	0.77	2.441	0.014 *
Dressing and comorbidities	6	0.57	1.806	0.097[‡]
Stage and comorbidities	10	0.62	1.98	0.035*
Dressing and site	6	0.54	1.711	0.118
Stage and site	7	1.63	5.205	1.20e-05[§]
Comorbidities and site	9	0.32	1.018	0.425
Dressing and patient repositioning	4	0.55	1.755	0.138
Stage and patient repositioning	4	0.61	1.954	0.101
Comorbidities and patient repositioning	6	1.03	3.279	0.004[†]
Site and patient repositioning	4	0.9	2.861	0.024*
Adjustment for 3 variables				
Dressing and stage and comorbidities	14	0.1	0.322	0.991
Dressing and stage and site	12	0.46	1.465	0.136
Dressing and comorbidities and site	15	0.21	0.661	0.822
Stage and comorbidities and site	13	0.78	2.488	0.003[†]
Dressing and stage and patient repositioning	7	0.58	1.844	0.078[‡]
Dressing and comorbidities and patient repositioning	11	0.06	0.195	0.998
Stage and comorbidities and patient repositioning	5	0.74	2.355	0.040*
Dressing and site and patient repositioning	4	0.09	0.289	0.885
Stage and site and patient repositioning	3	0.46	1.482	0.219
Comorbidities and site and patient repositioning	1	0.03	0.091	0.763
Adjustment for 4 variables				
Dressing and stage and comorbidities and site	4	0.24	0.749	0.559
Residuals	336	0.31		

[§]P< 0.0005; [†]P< 0.005; [‡]P< 0.1; *P< 0.05

bed. There is also a risk the exudate might cross the primary collagen dressing and increase the chances of bacterial growth. The two types of dressings may also interact with each other and have a negative effect on the wound bed, for example, SAWDs react to moisture levels at the wound bed that may be affected by the insertion of collagen. These issues mean the application of both dressings is not cost-effective.

Implications

This is the first study in Saudi Arabia to investigate the clinical effects of collagen dressings and SAWDs in PUs. Progression to healing continued following collagen dressing or SAWD application, suggesting that these products applied separately support a healthy wound bed and promote an ideal environment for healing.

Generally speaking, in deep, complex wounds nurses tended to use both dressings together, inserting collagen dressings into the cavities and using SAWDs as a secondary dressing. The results show that this is not an effective way of managing PUs and the hospital wound care protocol needs to be revised to reflect this. The results of this study highlight the importance of regularly reviewing evidence relating to wound dressings and updating dressing protocols to support their appropriate use in practice.

Limitations
This is a descriptive cohort study with no interventions. Furthermore, the study did not investigate the effects of the primary dressing and the consequence and frequency of dressing changes. Hospital protocols mandate collagen dressings and SAWDs be changed every 48 hours; however, patients may develop clinical conditions — such as diarrhoea or incontinence — that contaminate dressings and necessitate more frequent changes. The researchers were unable to determine the actual frequency of dressing changes for each ulcer. These limitations could affect the generalisability of the study findings.

Conclusion
There appeared to be a significant difference in the efficiencies of the various dressing modalities in this study. Combining both dressings was significantly less effective than using collagen dressings or SAWDs alone and may result in increased costs. The results, therefore, support the use of collagen dressing or SAWD in the treatment of PUs. Advanced wound dressings and their potential impact on progression to healing should be taken into account when devising best practice. WME

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