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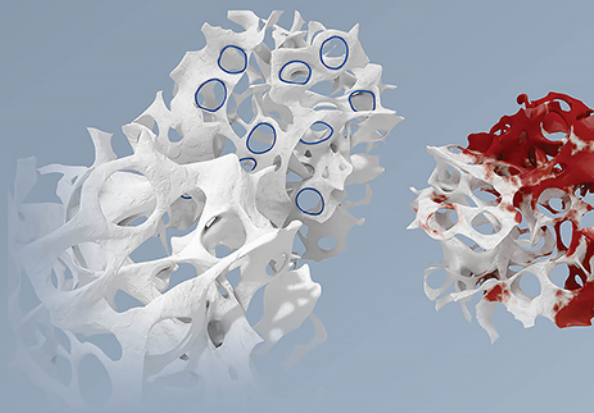

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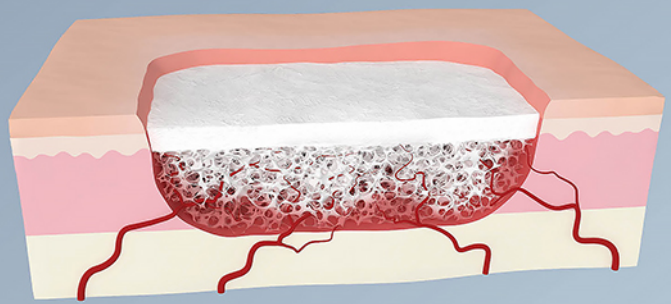

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ORIGINAL ARTICLE

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An advanced transparent hydropolymer wound dressing for undisturbed post-op management of surgical wounds following hip and knee replacement: A prospective observational series

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Abstract

Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are standardised surgical procedures for patients with complex comorbidities. The enhanced recovery after surgery (ERAS) protocol has shown reduced lengths of hospital stay and reduced postoperative complications. Currently, there is a paucity of recommendations in regards to dressing selection for postoperative wound care within the ERAS protocol. The aim of this study was to investigate the usefulness of a transparent hydropolymer wound dressing in suit for 14 days in 20 orthopaedic patients following hip or knee arthroplasty under the ERAS protocol. The majority of participants (90%) had a wear time of 14 days without the need for dressing removal. Clinicians rated the dressing very easy to apply with very good visibility of the incision line (100%). All participants reported the dressing to be 'very comfortable' (95%, n = 19) or 'comfortable' (5%, n = 1). Overall, the transparent hydropolymer dressing provided sufficient incision site visibility, reducing the need for dressing changes. To the best of our knowledge, this is the first study to show that the use of a transparent hydropolymer dressing in situ for 14 days to allow undisturbed wound healing.

KEYWORDS

early detection, enhanced recovery after surgery, postoperative wound care, surgical site infection

Key Messages

- undisturbed wound healing requires visual access to the wound, allowing patient independence as proposed by the ERAS protocols
- transparent design of the hydropolymer dressing allows full visibility of the incision, thereby easy wound monitoring of healing for health care professionals and the patient
- the use of the transparent hydropolymer dressing facilitates extended wear time because of the ability to see the incision site, conduct a visual assessment and refrain from unnecessary dressing changes

1 | INTRODUCTION

Hip or knee arthroplasty including total hip arthroplasty (THA), total knee arthroplasty (TKA) and unicompartmental knee arthroplasty (UKA) are standardised surgical procedures especially performed in older participants with complex comorbidities.[1-3] The procedures are linked to significantly improved participants' quality of life.[1,2] Although surgical procedures are routinely performed, postoperative wound complications are a significant burden on both clinic and patient such as pain management, immobility and long hospital stay. Despite advances in surgical technique, intraoperative practice and a growing menagerie of advanced wound care dressings, surgical wound complications such as surgical site infection or surgical wound dehiscence do occur, often an unwanted result of a combination of preoperative, intraoperative or postoperative factors.[4-6] Often, this is associated with considerable physical and psychological stress for the patient.[2] Despite the significant impact to patient healing and well-being, surgical wound complications are a considerable cost burden to health care settings. In an Australian study, Peel et al recently reported an increase of costs by 61% for participants who incur an SSI after arthroplasty, with estimates of an additional $97 million AUD to the acute health care setting within the first 30 days after surgery.[7] In France, the cost ranges from €306 to €26 815 for colorectal surgery and €2610 to €46 570 for other types of surgery,[8] in the United Kingdom, the cost of SSI to the NHS trusts is reported to be £35.2 annually,[9] and in the US acute care setting $3.2 billion annually.[10] These costs are attributable to extended hospital stay and clinical resources to manage the complication. Strategies in prevention and early detection ideally should incorporate current best evidence-based practice during the patient's entire surgical journey, particularly postoperative care. Solutions for wound management in the postoperative period to be coupled with the ERAS protocol remain absent from the literature.

Optimising patient outcomes following surgery provides an interdisciplinary approach with opportunity's to potentially reduce the occurrence of wound complications and extended lengths of stay in hospital. Implementation of evidence-based consensus statements for perioperative care in total hip replacement and total knee replacement surgery such as enhanced recovery after surgery (ERAS) society have reported favourable outcomes with reductions in length of stay and postoperative complications.[2] The consensus statement focuses on reduction of length of hospital stay, morbidity and convalescence time, which aims to reduce readmission rates and increase patient safety.[2,3] According to ERAS, preoperative hydration, improved nutrition and early patient mobilisation allow for early discharge on the first or second postoperative day.[2] Clinical data further demonstrate that early mobilisation is directly linked to length of hospital stay[2,11] but also positively influences physiological effects such as increased insulin resistance, muscle atrophy and reduced pulmonary function.[2,12] For early mobilisation of patients, therapies are required (such as postoperative wound dressings) that are fit for purpose and allow the patient to increase their full range of movement with ease of application and patient comfort being key factors for clinical utility.

Incorporating the element of postoperative wound care into the ERAS protocol for postoperative wound healing is yet to be explored. This may be because of a number of factors such as a the ERAS focus upon the perioperative/intraoperative environment, a paucity in level one evidence for dressing selection, availability and access to types of dressings and specialised wound care training. The primary function of postoperative wound care is to facilitate rapid incision closure while preventing contamination of the incision site and promoting minimal disturbance to achieve the best functional and aesthetic results.

Traditionally, wound dressings are used to protect the wound site from contamination and include traditional dressings such as cotton gauze.[13] Advanced wound dressings such as hydrocolloids, alginates or foams provide a moist wound environment, consequently promoting wound healing.[13,14] Over the last three decades, moist wound healing using advanced wound dressings has demonstrated to be more effective when compared with traditional dressings because of the positive influence of various wound healing factors.[13] A moisture-balanced environment creates optimal wound healing conditions for the action of cell and enzyme functions and growth factors, thus preventing complications like inflammation and infection.[14-16] In hydropolymer or hydrogel dressings, moisture balance is achieved by a three-dimensional network of hydrophilic polymers[17] that have the ability to absorb or donate liquid according to the hydration status of tissue.[18]

While being occlusive, a transparent hydropolymer dressing allows visual access to the wound, thus reducing unnecessary wound dressing changes because of improved visualisation of the wound without an unnecessary dressing removal. Numerous studies have demonstrated one of the primary reasons for a dressing change is to inspect the wound.[19-21] The use of a transparent dressing negates the need to remove the dressing and supports the principle of undisturbed wound healing (UWH) with favourable healing outcomes.[16,22]

According to our understanding of ERAS protocol, early mobility of the patient after surgery is a primary task to optimise patient outcomes. The ability of the patient to mobilise following either hip or knee surgery

requires a dressing that allows flexibility around joint surfaces. Currently absent from the ERAS protocol is a recommendation for the use of a dressing that allows a full range of movement and visualisation of the wound without removal: this study aimed to address this deficit. Furthermore, reduced dressing changes adhere to the principle of undisturbed wound healing (UWH), which prevents potential contamination of the incision site. We believe that modern wound dressings such as hydrogel dressings can be used to comply with principles of the ERAS protocol for infrequent dressing changes. Therefore, a transparent advanced wound dressing with a hydropolymer pad was used as postoperative dressing after arthroplasty. The dressing consists of an absorbent hydropolymer wound pad covered with a semipermeable, adhesive polyurethane film intended to be used on postoperative and other acute wounds. As the wound dressing is highly transparent, direct visual assessment of the wound is possible without removing the dressing. The design of the absorbent hydropolymer gel pad suggests a high potential for good flexibility and conformability in all directions when worn by the patient.

This study aimed to determine through an observational series the suitability of a transparent hydropolymer dressing for UWH for up to 14 days.

2 | MATERIAL AND METHODS

2.1 | Study design, participants and setting

This was an observational, prospective study examining a convenience sample of 20 participants (9 males, 11 females) undergoing elective primary hip or knee revision surgery performed between January and February 2020. Participants were recruited from a metropolitan hospital clinical setting in the initial surgical consult informed of the study and were invited to participate. Perioperative assessment included examination of the incisional peri-wound skin and asking the participant of any known allergies to hydropolymer, silicone or adhesive dressings. All participants received the ERAS pathway as part of standard practice. Following enrolment, participants attended the operative procedure, and following incisional closure, a transparent hydropolymer dressing was placed over the incision line while in theatre and before admission to recovery. Informed consent was obtained from all individual participants included in this study. The study has been performed in compliance with the ethical guidelines of the 1975 Declaration of Helsinki.

2.2 | Outcome measures

The primary outcome measures of this study were composite and defined as the number and proportion of patients with full wound closure (opposed sutured margins completely closed), with the dressing in situ for 14 days. Secondary outcomes include participant-reported satisfaction rating on dressing wear comfort was recorded during the study and clinician-reported ease of application and incision line visibility. Participants were asked to rate how comfortable the dressing was to wear as either not comfortable, comfortable or very comfortable. Study clinicians were required to rate the ease of application of the dressing (difficult, easy, very easy) on the incision site. Clinicians were asked to report on the visibility of the incisional wound through the dressing (poor visibility or good visibility). In general, the arthroplasty aimed for a minimally invasive and atraumatic procedure and included small incisions, no drainage of the incision site to allow faster mobilisation and earliest possible start of rehabilitation.

2.3 | Intraoperative procedure

The size of incisions ranged from 8 to 22 cm in length. Deep tissue was closed using sutures. Additionally, wound closure was achieved by surgical glue (2-octyl and n-butyl cyanoacrylate monomer) in THA surgeries, and by using staples in UKA/TKA. No drainage was used. After thorough drying of closed wounds and surrounding skin, the transparent hydropolymer dressing was applied following closure of the incision in theatre prior to admission to recovery. Dressing size was chosen according to incision length and the suitability for coverage of the joint.

During the hospitalisation period, participants were regularly monitored by visual assessment regarding wound status and overall condition. First dressing change was conducted on Day 14 to remove staples in study participants. The dressing was removed on Day 14, with their incisions closed for the majority of participants, and where clinically indicated no dressing was required. After discharge, participants were asked to maintain their normal daily hygiene routines, including washing and showering. Participants were then responsible for the care of their wound dressing. Physical therapy was commenced as early as possible to support improved rehabilitation outcomes. Participants were scheduled for a follow-up examination in the clinic on postop Day 20.

Study participants were required to complete a survey in order to understand the dressing wear comfort. Study clinicians were required to complete a survey in regard to

following dressing changes and wear time: ease of application and removal of dressing, wound status and healing process, and wound visual access.

2.4 | Statistical analysis

Data collected included descriptive statistics. Continuous data are described with medians and interquartile ranges (IQRs). A sample size calculation was not included as this pilot study will be used to design future comparative studies against current clinical practice.

3 | RESULTS

Participants included males and females with a median age of participants of 50 years (range 29-86 years) were recruited, Figure 1. Half of the participants underwent THA (N = 10, 50%), six participants UKA (30%), and four participants TKA including 1 revision (20%). Twenty participants were enrolled for primary THA or UKA/UTA. The wounds at the hip or knee (8-22 cm in length) of all participants were covered with the transparent hydropolymer dressing after primary closure by staples or surgical glue. Wounds were classed according to the Centers for Disease Control (CDC) wound classification system SWC: I, clean; II, clean/contaminated; III, contaminated; and IV, dirty.[23] All wounds were classified as clean I. Before application of the dressing, the peri-wound status of all participants was assessed as per the skin assessment protocol. Participants were discharged from the hospital between Days 0 and 3 in the postoperative period. Participants were provided with education and support for the management of their postoperative wound for the home care setting by the research nurse.

Participant's descriptive statistics are provided in Table 1. Dressing application was rated by the clinician using a rank of 'very easy' in 95% of cases (N = 18) and as 'easy' in 5% (N = 2). Similarly, conformability of the dressing was rated as 'very good' (95%, N = 18) or 'good' (5%, N = 2), while wound visibility at the beginning of

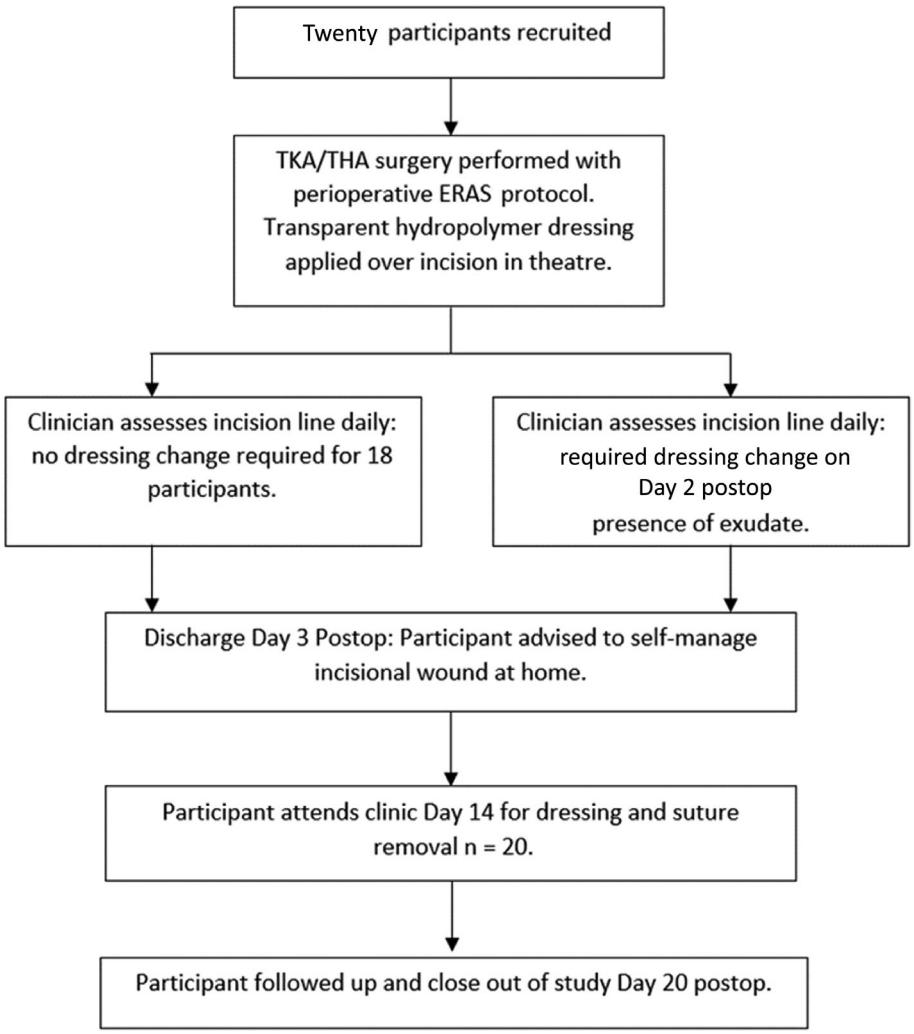

FIGURE 1 Participant flow chart

TABLE 1 Study participant characteristics

Characteristic	Subjects (n = 20)
Age, year	
Median (IQR)	50 (29-79)
Range	29-86
Age distribution, year, No (%)	
29-50	3 (15%)
51-71	7 (35%)
72-86	10 (50%)
Gender	
Females	10 (50%)
Males	10 (50%)

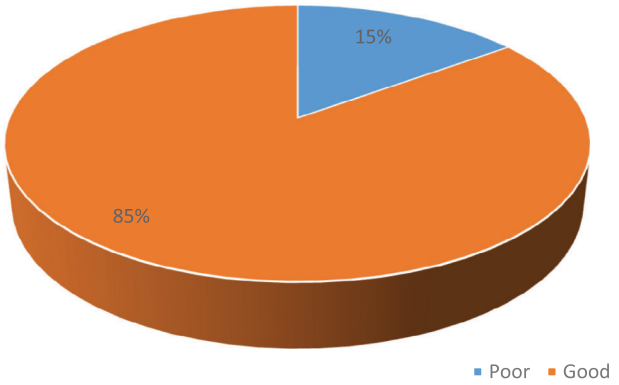

FIGURE 2 Clinician rating of incision line visibility

the treatment was 'very good' in all cases (100%, N = 20; data not presented). Immediately after application of the transparent hydropolymer dressing, levels of exudate/blood were assessed. Two wounds were recorded as having low to moderate exudate. Because of the presence of exudate on subsequent days, two participants required dressing changes and assessment on Days 2 and 4 during the postoperative period.

All participants underwent rehabilitation procedures following their surgery. After discharge from hospital, all participants were instructed to shower once a day. Intraoperatively applied dressings were intact in five cases (25%), whereas edges peeled off the skin in 14 cases (70%), however this did not warrant a full dressing change. Although edges of the wound dressings started to lift off the skin, especially in skin folds and wrinkles, full wound protection was maintained by the transparent hydropolymer absorbent pad of the dressing. Additional fixation of a small part of the edges was required for three of the participants, and this was completed by the community nurse who applied a non-woven adhesive bandage.

For all participants, wound closure was achieved by Day 20 following surgery. The participant's self-reported rating of dressing wear comfort was rated as 'very good' with no wound healing disturbance occurred. Wound visual access was rated as good' in 17 cases (85%), 'good' and 'bad' in three cases (15%) (Figure 2).

During the dressing changes conducted by the community nurses on Day 20, a participant survey was conducted to allow the participant to share their experiences about dressing removal. The results from this survey yielded the following findings: all of the participants reported minimal to no pain at dressing change or discomfort while wearing the dressing. All participants considered wearing comfort of the dressing to be 'very comfortable' (95%, N = 19) or 'comfortable' (5%, N = 1). An important factor for patient's comfort during wear was the possibility to still practice normal daily hygiene without feeling restricted by the dressing.

4 | DISCUSSION

Arthroplasty surgeries described in this study were performed according to the perioperative ERAS protocol, which was combined with an innovative transparent hydropolymer wound dressing for postoperative acute wound management. Furthermore, this observational study aimed to explore the potential of this advanced wound dressing for an extended wear time and its applicability in an ERAS pathway.

The potential of an advanced hydropolymer wound dressing that allows full visibility of the incision site without removal enables a longer wear time. The advanced hydropolymer wound dressing used in this study was applied over the incision in theatre and remained in place for 14 days with 95% of the participants without requiring a second dressing change. While 95% application adherence to the dressing was observed, two participants required a dressing change because of the presence of exudate. Safe application of the dressings for up to 7 days in linear postoperative wounds or donor sites with dry or minimal exudate levels was already described.[24] Similarly, dressing edges peeling off the skin was described in some cases but was also not negatively rated because of the hydropolymer pad remaining in situ.[24] In both studies, participants maintained normal daily hygiene including showering, which may increase the occurrence of a dressing peeling off the skin. In these cases, additional fixation with a non-woven adhesive tape was demonstrated to be beneficial.

Undisturbed visual access to the wound incision facilitated clinical assessment, which allowed the dressing to remain in situ during this study. A longer wear time as proposed by this study for the transparent hydropolymer

dressing to remain on the wound for up to 14 days without dressing removal promotes the practice of UWH. As recently summarised by Brindle et al, tissue trauma during dressing changes, frequency of dressing changes and wound healing in a timely manner because of uninterrupted wound healing phases are, among others, key characteristics for adequate wound healing requirements.[25] Furthermore, the overall recovery process and the use of a transparent hydropolymer dressing enabled the participants' independence to observe their wounds after surgery without additional medical help (eg, personal hygiene).[2] Empowering the patient to self-care, and the use of remote monitoring of wounds, has accelerated during the pandemic era, and the use of advanced therapies to facilitate this is a rapidly growing field.[26] The use of a transparent dressing to allow full visibility of the incision site and to see the healing progress remotely by a clinician through the use of digital technologies such as smartphones may remove the need for the patient to attend a clinic.

This study reports on an observational cohort of 20 participants who had total hip or knee replacement with the application of an advanced transparent hydropolymer dressing that allows full visibility of an incision site, which was worn for 14 days postoperatively. This study further reports positive outcomes in regards to the participant's experience and wound healing outcome. Postoperative dressing for wounds healing by primary or secondary intention has further been verified in case reports addressing various wound aetiologies.[27,28]

No adverse events were reported for the duration of the study. Overall, hydropolymer dressings and related material components are well-established in the medical sector and are known to be safe.[29] This study has several limitations; firstly, a powered sample was not used to test efficacy or other primary outcome measures such as surgical site infection or surgical wound dehiscence as it was beyond the scope of this study. Secondly, the class of surgery may impact on the occurrence of complications and the subsequent need to change a dressing because of wound hygiene and exudate levels. All of the surgical wounds in this study were class I, with no contact of contaminants from organs spaces, the respiratory, alimentary, genital or urinary tract. As such, the risk of contamination may be limited to contamination from skin flora or any break in aseptic technique intraoperatively. The authors contend that wear time and dressing change frequency may be more complex with those surgical wounds classed as II-IV because of increased contaminant risk, infection and exudate output, which may require more dressing changes and antimicrobial treatment. However, early visual detection of contamination and infection may be conducted rapidly with a transparent hydropolymer dressing, thereby enabling a quick response to prevent further escalation of the wound complication.

We propose that reduction in dressing changes, which is enabled by special features of the dressing such as transparency and waterproof capacity, is beneficial to supporting UWH. Less medical manipulation/treatment, for example, by dressing changes or wound complications, may lead to increased quality of life because of decreased traumatic interventions. However, larger powered trials are required to determine the clinical utility and comparative effectiveness of this therapy for the early detection and possible prevention of surgical wound complications such as surgical site infection and wound dehiscence. These trials are currently underway.

We were able to report, the advanced hydropolymer dressing used in this study is suitable to stay in place over a surgical incision for 14 days following surgery. We also conclude that transparency and conformability of the dressing contribute towards participants' comfort in allowing a range of movement over their joint and the ability to 'see and monitor' their incisional healing and seek medical assistance early. From this study, we report close monitoring of postoperative wounds is crucial to assess progress of incisional healing and identify early the occurrence of local signs of infection or dehiscence.

This study shows the use of an advanced, fully transparent hydropolymer dressing is a suitable postoperative wound dressing for incision wounds after hip or knee arthroplasty and can stay in situ over an incision site for 14 days. The dressing proved to be durable, performed well and was well-tolerated by participants. Furthermore, the use of this type of dressing allows extended wear time, patient flexibility in range of movement over hip or knee joints and provided patient comfort and support. Increased wear time of this dressing allows for mobilisation and early patient discharge, key tenants of the ERAS protocol. Further studies are currently underway to determine the validity of the use of this type of dressing as part of the postoperative care of patients under the ERAS protocol for orthopaedic surgery.

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CONFLICT OF INTEREST

The authors have no conflict of interests to declare in relation to this study.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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