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A randomised clinical trial of two different wound dressing materials for hip replacement patients

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KEYWORDS
Wound dressing;
Hip replacement;
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Summary This randomised controlled trial compared the clinical and economic effects of two different dressing materials in patients undergoing hip replacement surgery. The participants were randomised into group A ($N = 50$), in which the dressing material was a modern hydrofibre dressing (Aquacel) applied with adhesive polyurethane film or group B ($N = 50$), in which the dressing was a conventional wound pad dressing with fibre tape fixation. At the first change of dressing, 59% of the patients in group A had wound area reactions (blister, erythema, oedema, skin injury and haematoma) whereas the corresponding number in group B was 81% ($P = 0.02$). The average dressing material costs per patient by the third postoperative day were €14.70 in group A and €8.70 in group B ($P < 0.01$). However, the dressing material costs represented only about 0.02% of the total cost of hip replacement surgery. It is concluded that the modern hydrofibre dressing with polyurethane film fixation treats the surgical wound after hip replacement surgery better than a traditional wound pad dressing with fibre tape fixation.

Editor's comment
This fundamental but essential exploratory randomised controlled trial addresses many issues surrounding the postoperative dressing of orthopaedic wounds. The results indicate a rethinking of what many orthopaedic nurses and surgeons take for granted or never give the time to think about or research. **PD**

Introduction

The right choice of dressing material for a surgical wound promotes natural wound healing. A good wound dressing is pleasant to the skin, has good

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absorption capacity and protects the wound. It must not contain agents that are allergenic or toxic or which cause irritation. In orthopaedics in particular, the materials used to attach the wound dressings must also have elasticity to allow for postoperative oedema in the wound area, especially after major operations. The dressing must not restrict movement of the limb, stick to the wound, or cause mechanical injury or pain when changed. It should create and maintain appropriate levels of moisture and temperature over the wound. If the dressing is not sufficiently absorbent, the wound area is at risk of maceration (softening) because it will be excessively moist. A too warm, moist environment provides favourable conditions for microbial proliferation.

For various reasons, surgical wounds after hip replacement may be affected by prolonged tissue fluid exudate in cases where the dressing is insufficiently absorbent, thus causing the dressing to be changed frequently, which in turn irritates the surrounding skin and makes it prone to injury. A dressing wet with exudate may also expose the wound to microbial contamination from the surroundings. For the user, the dressing should be easy and quick to change.

Cost should also be considered when choosing the wound dressing. To keep the overall cost down, the frequency with which the dressing is changed should be as low as possible (Eronen and Hietanen, 1999; Iivanainen and Seppänen, 1999).

Wound dressings can be divided into passive and interactive dressings. Traditionally, passive dressings, that is, absorbent tape-fixated wound pad dressings, have been used for hip replacement surgery wounds. Mechanical skin irritation (possibly blister formation and skin injury) may be prevented by using either a spray or an applicator skin protection agent underneath the adhesive.

Interactive dressings, as the name implies, interact with the wound surface. A property common to interactive dressings is their ability to maintain a suitable moisture level around the wound. One example of an interactive wound dressing material is hydrofibre (Aquacel). A hydrofibre dressing is placed over the surgical wound and must itself always be covered by a dressing such as a polyurethane film or hydrocolloid plate. The dressing is absorbent, does not need frequent changing, and keeps the exudate, including microbes, within the dressing. The polyurethane film protects the primary dressing against environmental contamination and nursing staff against blood-borne viruses. Being transparent, a polyurethane film enables both the wound exudate and the surrounding area to be inspected visually. The characteristics of hydrofibre include gel formation in the exudative area of the surgical wound.

The healing of surgical wounds without infection is of key importance in postoperative care. Wound healing may be retarded for various reasons, for example because of tissue trauma and haematoma caused by a major operation and the associated oedema of the wound area. Slow wound healing increases the risk of microbial infection of the exudate, and microbiological samples are therefore taken from the wound and, if necessary, antimicrobial treatment is started. This increases the cost of treatment. Frequent changes of dressings also raise costs, as well as affecting the wound area.

The risk of skin injury of the site of surgery increases with the patient's age and the associated impairment of skin properties. Many illnesses impair nutrition, oxygen supply to the tissues and immune resistance. Certain medicines (cortisone, insulin and cytostatics) also influence the skin's vulnerability, retard wound healing and may make the skin prone to injury. Incision wounds made in different directions may influence muscle tension, while the fixation materials causing tension of the skin may cause skin injuries such as blistering (Milne et al., 1999).

Skin injuries in the surrounding area may also pose a risk of wound infection, either superficial or deep (Wright, 1994; Blaylock et al., 1995). Hospital infections are the greatest infection problem in countries with high living standards (Lumio, 1996).

The use of hydrofibre dressings has become common on infected, chronic wounds. Today, they are also recommended for the treatment of acute surgical wounds, for example in orthopaedics. These dressings are more expensive than conventional dressing materials and there is little study evidence of how well they function in the treatment of acute surgical wounds (Moore and Foster, 2000).

From clinical experience, the use of conventional dressing materials may be associated with skin problems in the area of the wound, for example, blister formation and skin injury around the wound underneath the fixation materials in hip replacement surgery patients. This study examines the clinical and economic effects of a hydrofibre dressing compared with a conventional wound dressing in patients following hip replacement.

Methods

The study comprised both women and men, attending the ORTON Orthopaedic Hospital, Invalid Foundation, Helsinki for hip replacement surgery and who met the inclusion criterion for the study and

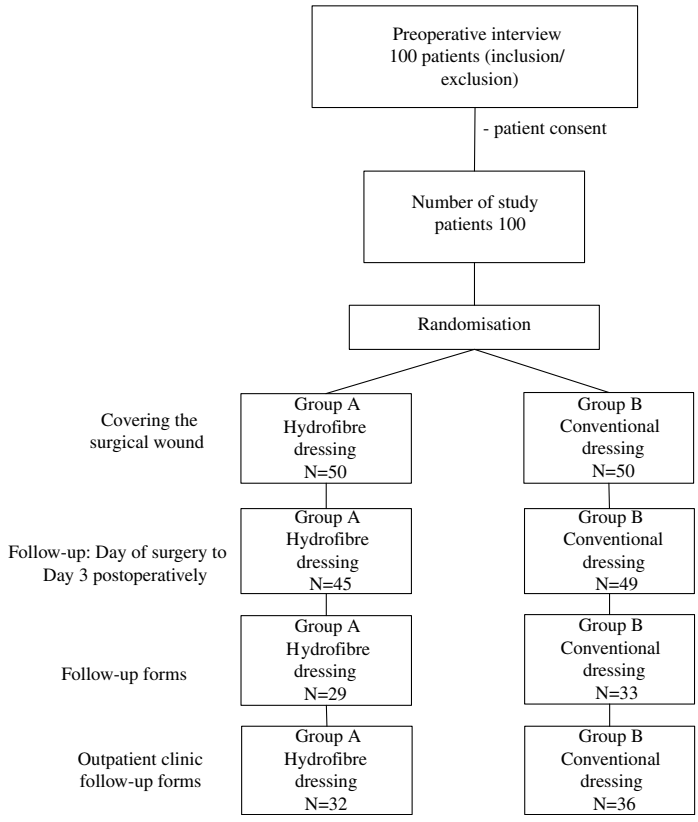

Figure 1 Flow chart of the study.

gave their consent to participate in the study. The inclusion criteria were a primary or revision arthroplasty of the hip for osteoarthritis (OA) or rheumatoid arthritis (RA). The exclusion criteria included insulin diabetes mellitus and re-operation because of infection. The course of the study is shown in Fig. 1.

A specialist nurse from the research team visited the patients on the evening before the start of the study. Based on the information given by the nurse, those who were willing to participate in the study confirmed their participation by signing the consent form. The nurse then interviewed the participants and inspected their skin status. The nurse recorded basic data on an evaluation form. This comprised of the patient number (the final part of the patient's personal number), the starting date of the follow-up (the day of operation), age, sex, the hip operated on (left/right), the ASA category reflecting the risk associated with anaesthesia, and the indication for the operation (OA/RA). The nurse also evaluated the skin status in the area to be operated on, recording whether the skin was thin or dry/scaling, whether there was any rash or skin injury, and whether or not the skin status was good. Any skin symptoms resulting from earlier surgical towels or wound tapes were also recorded.

Randomisation and study groups

The study population was drawn from a convenience sample of 100 successive patients in order of arrival. The patients were randomised into two treatment groups using numbered, sealed envelopes. Randomisation into group A ($N = 50$, hydrofibre dressing + polyurethane film) or group B ($N = 50$, conventional wound pad + fixation tape) took place in the operating theatre after the incision by opening the next envelope in numerical order.

Wound dressing in the surgical ward

Both treatment groups had written instructions on how to apply the wound dressing in the follow-up units (surgical ward, observation ward and bed wards). The surgical ward instructions specified exactly the wound dressing materials with their size measurements, for each group. In group B, the skin underneath the fixation material was protected using a skin spray, with the cost of this added to the other costs in this group as, in accordance with the hospital's general wound treatment instructions, it is used underneath the tape fixations when the dressings were changed. The cost of fixation

tapes was not included. For fixation of the drain dressing, a conventional bandage was used in both groups in this study.

The instructions in group A were to cover the proximal drain at a sufficient distance from the surgical wound dressing in order to enable removal of either the wound dressing alone or the drain dressing alone if necessary without having to remove all dressings. It was already known from experience that the larger dressing in group B could not be applied in such a way as to avoid removal of the entire dressing for drain removal or for changing the wound dressing, for example because of abundant exudation.

Change of dressing in the observation ward and bed wards

The observation ward and bed wards were instructed to follow the hospital's general wound treatment instructions (issued in 2000). Wound dressings were changed if the amount of exudation exceeded the absorption capacity of the wound dressing. In group A, this meant that the white area of the hydrofibre dressing was completely gelled because of bloody exudate and/or blood had accumulated underneath the fixation film. In group B, this meant that the backing of the dressing was saturated with blood or that exudate was escaping at the edges. In accordance with the study plan, the dressing in group A was not replaced by a new hydrofibre dressing since it was only intended to monitor how well the modern dressing functioned up to Day 3. If the dressings in both groups had to be changed, a conventional dressing was used. In subsequent changes of dressing (after the third postoperative day) when the amount of wound exudate had diminished, the instruction was to use thinner adhesive wound pad dressings in the normal way. In both groups, the instruction was to use skin protection spray underneath the adhesive fixation. The instructions regarding the wound dressing materials to be used are shown in Table 1.

Follow-up in hospital

For the follow-up, evaluation forms were used. Wound healing (appearance: good, macerated and dry blood), wound area findings (blisters, erythema, skin injury, haematoma and oedema) and change of dressings (time, reason and materials + quantities) were recorded up to Day 3 postoperatively, because the status of the surgical wound had to be checked by then. The follow-up forms were attached to the patient file and transferred from one treatment unit to another. The surgical ward, observation ward and two bed wards each had their own evaluation forms to be filled in by the treatment staff in accordance with the instructions given. Up to Day 3, 45 patients in group A were monitored (two had to be re-operated on, and in three cases the form was not filled in), and 49 in group B (one had to be re-operated on). Basic data on the final study group is shown in Table 2.

The treatment of skin injuries was documented in the treatment plans. The staff were experienced and thus follow-up of healing of the surgical area and recording of the wound dressings used and of changes in the wound surface were consistent and accurate. The occurrence of infections was monitored in accordance with normal hospital practice during the hospital stay.

On discharge, the patients were given a form for infection follow-up, which they were asked to return in a pre-paid envelope 1 month after the operation. The form contained questions about the healing of the surgical wound, including local signs of infection (pain or tenderness, oedema, heat, erythema and prolonged exudation in the wound area), whether a bacterial culture sample had been taken (microbial finding), whether antibiotic therapy had been started, and whether the infection had required hospital treatment.

Information about wound healing, any skin injury and its treatment and treatment costs were recorded on a follow-up form at the outpatient clinic at the Month 2 check-up.

Table 1 Wound dressing materials

	Group A (hydrofibre dressing)	Group B (conventional dressing)
Surgical ward	Hydrofibre + polyurethane film	Conventional dressing
At 1st change of dressing		
Observation ward/bed ward	Conventional dressing	Conventional dressing
After 1st change of dressing		
Abundant exudation	Conventional dressing	Conventional dressing
Scanty exudation	Adhesive wound pad	Adhesive wound pad
Dry wound	Wound tape	Wound tape

Table 2 Basic data, group A ($N = 45$) and group B ($N = 49$)

	Group A (hydrofibre dressing)	Group B (conventional dressing)
Age, years, mean (SD)	65.0(13.5)	64.3(11.8)
Sex f/m, *N/N*	29/16	34/15
BMI[a], mean (SD)	26.3(4.5)	26.1(4.2)
Operation, primary/revision, *N/N*	38/7	41/8
Osteoarthritis/rheumatoid arthritis *N/N*	42/1	44/2
ASA Class[b] 1—2, *N*	36	33
ASA Class 3—4, *N*	9	15

[a] BMI, body mass index.
[b] ASA Class, classification of risk from anaesthesia (1, healthy patient; 2, mild systemic illness; 3, severe systemic illness, independently mobile; 4, severe systemic illness and not independently mobile; 5, will live less than 24 h).

Table 3 Skin status at the first change of dressing in groups A and B

	Group A (hydrofibre dressing)	Group B (conventional dressing)	*P*-value
Blisters, %(*N*)	5(2)	15(7)	0.16
Erythema, %(*N*)	9(4)	33(16)	<0.01
Skin injury, %(*N*)	9(4)	23(11)	0.07
Haematoma, %(*N*)	25(11)	52(25)	<0.01
Oedema, %(*N*)	48(21)	67(32)	0.07
One of the above, %(*N*)	59(26)	81(39)	0.02

Results

There were no statistically significant differences in the basic data between the groups. In group A, 45% (20/45) had no need for a change of hydrofibre dressing (abundant exudation, leak at edges and drain removal) before Day 3 postoperatively, whereas in group, B the corresponding figure was 6% (3/49). Clinically, the skin status was better in group A than in group B patients (Table 3). A smaller proportion of group A patients (5%) tended to have blisters at the first change of dressing than in group B (15%) ($P = 0.16$). The same trend was seen regarding skin injury (9% vs. 23%, $P = 0.07$) (Table 3). Later, a change of dressing caused blisters/skin injury in another nine patients in group A after the use of conventional dressings had been started (Table 4).

The average cost of dressing material per patient by Day 3 postoperatively was €14.70 in group A and €8.70 in group B ($P < 0.01$). In cases of skin injury requiring treatment, either a silicone net or a hydrocolloid plate was used underneath the wound dressing. A single treatment of one skin injury (including clean gloves) costs €1.50—3.90.

Table 4 Blisters/skin injuries with change of dressing in groups A and B

	Group A (hydrofibre dressing)	Group B (conventional dressing)
At first change %(*N*)	14(6)	38(18)
After first change %(*N*)	20(9)	8(6)

The outpatient clinic follow-up form was returned by 71% (32/45) in group A and 73% (36/49) in group B. Contrary to expectations, the replies showed that the wound had usually healed during the hospital stay or soon afterwards. Thus, no extra cost was incurred after discharge. However, one patient (group B) had to see a dermatologist because of eczema caused by the tapes.

Discussion

In this study, the group A patients using the hydrofibre dressing until the first change of dressing had fewer skin problems, although this dressing was more expensive than the conventional dressing used in group B. Group A patients also exhibited less haematoma and oedema than those in group B, suggesting that the hydrofibre dressing absorbs postoperative bleeding better when there is no dry blood at the wound edges. This may also reduce postoperative pain and joint stiffness due to oedema. As the absorption capacity of the hydrofibre dressing is better, it can thus be expected to lower the costs of prolonged exudation and the cost of

any antimicrobial medication and change of dressing.

The hydrofibre dressing in group A patients was changed for a conventional one at the first change of dressing. In 45% of the group A patients, the hydrofibre dressing applied in the operating theatre remained in place until Day 3 postoperatively. It could be presumed that changing a hydrofibre dressing for a new one would reduce the need for a change of dressing even after the first change and would limit the mechanical skin irritation caused by several changes of dressing. In both groups, if the original dressing had to be changed for a conventional dressing at an early stage and the dressing had to be changed daily or more frequently, the area around the wound was prone to repeated mechanical irritation. Skin injury occurred in some of the group A patients after the change to a conventional dressing. It remains to be seen whether a hydrofibre dressing would be useful even when postoperative wound exudation is so abundant that the primary dressing has to be changed for a new hydrofibre dressing on the day of the operation or the first postoperative day.

In the wound infection follow-up, almost all patients with a superficial wound infection had a skin injury/injuries. The causes of the wound infections are related both to the patients themselves and to other causes, so the role of wound dressing alone in the aetiology of infection cannot be emphasised. In our study, the number of cases of infection was very low in both groups. The causes of the wound infections were not investigated.

During the study, it was found that the hospital had no uniform guidelines for treating skin injuries. The use of such guidelines would make it possible to assess their effectiveness and permit any necessary changes. Unified wound treatment practices are also known to lower costs (Teirilä, 2000). The costs of treating one skin injury increase rapidly if skin injuries occur frequently, are extensive, abundantly exudative and require daily care. The cost is particularly high when an infection occurs, as this delays healing and results in additional costs. Blister formation and skin injuries related to dressing result in extra costs anyway. Normally, there should be no skin problems in the area of the surgical wound.

Experience gained with the hydrofibre dressing is favourable. In the opinion of doctors and nursing staff, the dressing is handy and quick to apply. The dressing ''announces'' when it needs changing and is easy to remove in one piece. It also makes monitoring of postoperative bleeding easy. Patients prefer a smaller dressing because it causes no compression, does not come off or stick to clothes. When a hydrofibre dressing is covered by a polyurethane film, the fixation material covers a smaller skin area than, say, a microfibre fixation material, and skin irritation is reduced. During the early postoperative period, it is safe for the patient to take a shower without any special protection of the wound dressing since the film also protects the surgical wound from contamination by environmental microbes.

When a hydrofibre dressing is used the material costs are higher than for a conventional dressing. However, the dressing represents only about 0.02% of the total cost of a hip replacement operation. Some of the material costs of a hydrofibre dressing will probably be compensated for by the reduced need to treat skin injuries and the reduced need to change the dressing due to exudate saturation.

The hydrofibre dressing represents a new method for dressing a clean orthopaedic surgery wound. To summarise these study results, it may be said that the hydrofibre dressing was clinically better than the conventional wound dressing. Eventhough the immediate material costs of the hydrofibre dressing are higher than those of the conventional dressing, this versatile dressing may mean long-term savings overall.

References

Blaylock, B., Murray, M., O'Connell, K., Rex, J., 1995. Tape injury in the patient with total hip replacement. Orthopaedic Nursing 14, 25—28.

Eronen, O., Hietanen, H., 1999. Avoimen haavan paikallishoitotuotteiden valinnasta. Sairaanhoitaja 72 (5), 25—28.

Iivanainen, A., Seppänen, S., 1999. Haavan paranemisesta. Sairaanhoitaja 72 (2), 33—37.

Lumio, J., 1996. Sairaalainfektioiden merkitys ja ehkäistävyys. Duodecim 112, 857—865.

Milne, C., Pierpont Barrere, C., McLaughlin, T., Moore, A., 1999. Surgical hip dressings: a comparison of taping methods. Orthopaedic Nursing 18 (3), 37—42.

Moore, P., Foster, L., 2000. Cost benefits of two dressings in the management of surgical wounds. British Journal of Nursing 9 (17), 1128—1132.

Teirilä, I., 2000. Kirurgisen haavanhoidon teesit. Haava 4, 15—19.

Wright, M., 1994. Hip blisters. Nursing Times 90, 86—88.