Clinical Study

Is Single Use Portable Incisional Negative Pressure Wound Therapy System Suitable for Revision Arthroplasty?

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Incisional negative pressure wound therapy (INPWT) has been used for high-risk surgery across specialties but has yet to be utilised for revision hip and knee surgery. Between 2013 and 2014, patients who underwent revision arthroplasty by the senior author were identified. 36 (9 hips and 27 knees) operations in 36 patients identified 18 (8 male, median age 77 (61–86)) who received standard dressing and 18 (12 male, median age 67 (58–81)) who received single use portable INPWT dressings (4 hips, 14 knees). Wound complications were seen in 3 (2 knees) from the standard group and 1 (hip) in the INPWT group ($p = 0.14$). There was no statistical difference in age or gender between groups. Risk factors (BMI > 30, smoking, and diabetes) were identified in 9 patients, median ASA 3, in the standard group and 10 patients, median ASA 2, in the INPWT group. There were no dressing related complications. This is the first study of INPWT with a low pressure single use 80 mmHg dressing with revision arthroplasty. This initial study showed a threefold decrease in wound complication in the INPWT group and that INPWT is a safe alternative to standard dressings.

1. Introduction

The use of negative pressure wound therapy (NPWT) and incisional NPWT is growing. More evidence is available to support its use and the technology has evolved and become more user-friendly and easier to apply and not cumbersome for the patient. Many studies have looked at INPWT use in plastic, general, cardiothoracic, and neurosurgery and it has been shown to be effective at reducing wound complications [1–3].

Surgical Site Infections (SSI) and persistent wound drainage are well-recognised complications with a reported incidence of approximately 1–3% in the general orthopaedic population [4]. Of these there are certain operative and patient groups, for example, trauma and raised body mass index, that have an associated higher risk [5]. Tibial plateau, calcaneal, or pilon fractures are known to have a high incidence of wound complications estimated at 10–40%, with promising results with the use of INPWT [6]. Revision hip and knee arthroplasty surgery is also associated with a rate of wound

complication, 2% and 5%, respectively [5]. Despite this there are no studies looking at the effect of INPWT on this group. Saleh et al. and Pulido et al. extensively described risk factors associated with higher rates of periprosthetic infection such as malnutrition, excess anticoagulation, obesity, diabetes, and a high American Society of Anesthesiologists (ASA) score [7, 8]. However Patel et al. and Weiss and Krackow identified persistent wound drainage lasting greater than 48 hours after hip arthroplasty as also a risk factor for periprosthetic joint infection [9, 10]. As patients are optimised preoperatively, the dressing optimises the wound healing potential postoperatively by removing the excess wound fluid.

There are currently no standard guidelines for managing surgical wounds. Incisional NPWT is a relatively new application of the technology, with only a few studies in the published literature and only three studies looking at primary hip and knee arthroplasty [11–13]. By minimising the seroma around the wound, increasing local tissue perfusion, and angiogenesis this may decrease the wound complication rates [14, 15].

FIGURE 1: Smith & Nephew PICO dressing.

The aim of our study was to determine the complication rate associated with a single use INPWT system and the rate of wound infection in revision hip and knee arthroplasty.

2. Materials and Methods

Between January 2013 and January 2014, all patients who underwent revision arthroplasty surgery by the senior author were identified and case notes reviewed. 36 (9 hips and 27 knees) operations in 36 patients identified a control group of 18 (8 male, median age 77 (61–86)) who received standard dressing of blue gauze cotton wool and crepe bandaging for knees or pressure dressing for hips and 18 (12 male, median age 67 (58–81)) who received single use portable INPWT (PICO Smith & Nephew, Figure 1) dressings (4 hips, 14 knees).

Patients were allocated to the different dressing groups based on time of presentation. Prior to July 2013 all patients were in the standard dressing group and then all subsequent revisions that met the inclusion criteria were given the portable INPWT. Whilst not being prospective computer randomisation, this method does prevent allocation bias as at no point were patients deemed “more” or “less” at risk of wound complications and their dressing choice changed.

All patients had intraoperative cefuroxime or clarithromycin if penicillin allergic after appropriate microbiological samples were taken. Surgical approach to all revision knee patients was medial parapatella, under tourniquet with one drain placed. All revision hip arthroplasties were via an anterolateral approach. Wounds were closed with surgical clips and one drain was placed in all cases. All dressings were placed in theatre before the drapes were removed; then cotton wool and crepe bandage were applied to the knee replacements. Hip replacements received a surgical pad and pressure dressing.

Postoperatively, patients went to an elective orthopaedic ward; all drains were removed at 48 hours on the ward. All outer dressings were removed at 72 hours. As per the manufacturers guidelines, the INPWT dressing was changed at 7 days for a standard dressing. Clips were removed at 14 days by community arthroplasty nurse specialists. Antibiotics

TABLE 1: Demographics of patients in both groups.

	Standard	INPWT
Total number of patients	18	18
Median age (years)	77	67
Median BMI (kg/m ²)	30	30.2
Median ASA	3	2
Surgical procedures		
Hip	5	4
Infection	1	1
Cup	4	2
Stem		1
Knee	13	14
Infection	1	1
Malalignment	2	1
Aseptic loosening	3	3
Anterior knee pain	7	6
UKR to TKR		2
Instability		1

were continued for 6 weeks via a peripherally inserted central catheter if the revision was for infection. For all other revision arthroplasties 2 further doses were given. Patients were followed up 6 weeks postoperatively. Wound complications and dressing associated complications were recorded.

Inclusion criteria consisted of all revision knee and hip arthroplasty surgeries carried out by the senior author in the specified time frame. Exclusion criteria consisted of known allergy to the INPWT dressing or any adhesive dressing that was similar. The primary outcome measure was wound infection requiring further surgery or antibiotics in addition to those described above. Secondary outcome measures included any dressing related complications such as blistering. We obtained local research and development departmental approval before initiation of this study and patient medical records were used to collect data.

3. Results

In the standard dressing (control) group, 5 hips and 13 knees, the 5 hip revisions were as follows: 1, infection; 4, aseptic loosening of the cup. 13 knee revisions were as follows: 7, persistent anterior knee pain requiring patella resurfacing; 3, aseptic loosening; 2, malalignment; and one, infection. In the INPWT group, 4 hips and 14 knees, the 4 hip revisions were as follows: 1, second stage revision after infection; 2, aseptic loosening of the cup; and 1, aseptic loosening of the stem. The 14 knee revisions were as follows: 6, persistent anterior knee pain; 3, aseptic loosening; 2, revision unicompartmental knee replacements to total knee replacement; 1, malalignment; 1, infection; and 1, instability (see Table 1).

The median was ASA 3 in the standard group and ASA 2 in the INPWT group. There were 9 patients with identifiable risk factors in the standard group and 10 in the INPWT group (see Table 2).

TABLE 2: Medical comorbidities.

	Standard	INPWT
Patients with risk factors	9	11
None	9	7
BMI	9	9
Diabetes	1	1
Smoking		1
Antiplatelet drugs	2	2

There was no significant difference between the groups regarding age or gender. Neither group experienced any dressing related complications, such as blistering, maceration, or skin tearing.

Wound complications were seen in 3 (2 knees) from the standard group and 1 in the INPWT group ($p = 0.14$). In the standard group, wound complications were seen in 1 hip, which was being revised for infection where the patient had a BMI of 44 and type 2 diabetes. Two knees had wound complications, both for anterior knee pain, where one of the patients had a BMI of 48 and the other had no risk factors other than revision surgery. In the INPWT group the wound complication was seen in a revision hip arthroplasty for aseptic loosening of the femoral stem with only identifiable risk factor of BMI 37.

4. Discussion

NPWT has been widely accepted in the treatment of open wounds by secondary intention; however the role of INPWT is less clear. Although emerging criteria are starting to be defined such as high-risk lower extremity fractures, for example, tibial plateau, pilon, and calcaneal fractures as described by [1, 3], Stannard et al. reported both a decreased dehiscence rate in patients with high-risk lower extremity wounds with INPWT, 8.6% versus 16.5% with standard dressings, and decreased infection rate of 9% in the INPWT group versus 16.5% in the standard group with the relative risk of developing an infection being 1.9 times higher in control patients than in patients treated with INPWT [6].

Certain subgroups of elective orthopaedic surgery have a higher rate of wound complications, seen with 30-day and 90-day readmissions, such as that with revision total hip arthroplasty, with Schairer et al. showing at 90 days that primary THA (5%) had a lower unplanned readmission rate than revision THA (10%, $p < 0.001$) [16, 17]. Wound discharge has been considered as an important risk factor for wound complications with Patel et al. estimate that each day of persistent wound drainage increases the risk of infection by 42%, as the path that allows fluid to egress is a potential conduit for retrograde bacterial contamination into the wound [9]. Thus, one goal in managing persistent postoperative wound drainage is to minimise the time to achieve a dry, healed wound. Pachowsky et al. reported on decreased seroma formation with the use of INPWT in hip arthroplasty patients and concluded that this leads to improved wound healing [12].

Complications associated with INPWT have been reported. Howell et al. stopped their prospective randomised study early when 63% (15 of 24 knees) of those entered developed skin blisters compared to none in the standard group [13]. It is worth noting that the manufacturer has raised the possibility of incorrect dressing application as a contributing factor to these poor results and emphasises that those results have not been encountered elsewhere.

5. Conclusion

Our study is unique in that this is the first reported study to use a single use portable low pressure, 80 mmHg, INPWT dressing on high-risk revision knee and hip arthroplasty surgery. We showed a decrease in the number of wound complications when compared to standard dressings. Although not statistically significant, these results are encouraging. We also did not sustain any dressing related complications that have been previously published. There are of course limitations to this study such as the study size, retrospective nature, and the heterogeneous mix for causes of revision surgery, but the above points are important and should encourage further research into this new application of existing technology.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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