DOI: 10.14744/etd.2019.24482

Manuscript Type: Original Article.

Title: Comparison of Aquacel Ag® Surgical Dressings and Standard Dressings on Wound Site Infection and Patient Comfort in Total Knee Arthroplasty

Running Title: Aquacel Ag Dressings in Knee Arthroplasty

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Cite this article as: Atilla H, Akdoğan M. Comparison of Aquacel Ag® Surgical Dressings and Standard Dressings on Wound Site Infection and Patient Comfort in Total Knee Arthroplasty. Erciyes Med J 2019; DOI: 10.14744/etd.2019.24482.

Abstract

Objective: The present study aimed to evaluate the effects of Aquacel Ag® Surgical Dressing on wound site infections and patient comfort in total knee arthroplasty.

Methods: The study included a total of 274 patients who were diagnosed with primary gonarthrosis and underwent total knee arthroplasty (TKA) at our clinic during 2016 and 2017. Aquacel Ag® Ag Surgical Dressing was applied in 139 patients (Group 1), and conventional gauze sponge was used in 135 patients (Group 2). Patient outcomes including the frequency of changing the dressing, pain due to dressing change, patient satisfaction, wound site infections, and formation of blisters were compared between groups retrospectively.

Results: Blister formation ($p=0.770$), and superficial infections ($p=0.500$) were similar in both groups. Duration of hospital stay ($p<0.001$), and number of dressing change ($p<0.001$) were significantly higher in conventional gauze dressing group. Patient satisfaction was significantly higher and pain scores during dressing change were significantly lower in the Aquacel Ag® group ($p<0.001$ for both). Also, the number of patients who could take a shower during the first three days of surgery was significantly higher in the Aquacel Ag® group ($p<0.001$).

Conclusion: The results of the present study showed that Aquacel Ag® Surgical Dressing significantly improves patient outcomes after TKA surgeries by decreasing postoperative complications, and enhancing patient satisfaction

Keywords: Aquacel®, silver dressing, gauze dressing, patient outcomes, patient satisfaction, total knee arthroplasty

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Introduction

Total knee arthroplasty (TKA) is currently the gold standard surgical approach in patients with end-stage symptomatic knee osteoarthritis (1). This method is widely applied in clinical practice, and patient outcomes including clinical healing and patient satisfaction are critical endpoints. Nevertheless, these surgeries are not without complications, and wound site complications like delayed healing, blister formation, or prolonged drainage were reported in about one-third of the total joint arthroplasty surgeries (2, 3). There are several factors associated with wound healing, which can be grouped as patient and surgery-related factors, and postoperative wound management (4).

Maintaining a moist environment is one of the key factors for a healthy wound healing. Exudate leakage from the vessels is primarily responsible from the moist environment at the wound site. Also, exudates contain several other components like growth factors that induce the healing, and contaminating microorganisms that possess a risk for postoperative infections (5). Postoperative infections after arthroplasty surgeries cause significant morbidity, and healthcare costs. It has been reported that annual cost of controlling wound infections can be as high as $250 million in the United States, and costs per patient can be even higher if the agent is an antibiotic resistant bacteria such as methicillin-resistant staphylococcus aureus (MRSA) (6).

Regarding the optimal postoperative wound care, modern dressings are in the focus of research for obtaining favorable outcomes in orthopedic surgeries (7). Current evidence suggests that postoperative wound healing may be enhanced by using occlusive dressings that provides moist environment and also a barrier for microorganisms (8). For TKA operations, the dressing of choice should also allow joint motion and inspection of the wound site, and should be cost-effective when the high number of surgeries is considered (4, 9, 10). The hydrofiber dressing with silver (Aquacel Ag®) is a highly adsorbent hydrocolloid (carboxymethylcellulose) wound dressing, which is converted into a soft gel in case of contact with exudate, and was shown to facilitate wound healing (4). It is a highly adsorbent material that can absorb up to 30 times of its weight without losing its integrity (11). When in contact with exudate, Aquacel Ag®

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transforms into a gel and provides a moist environment around the wound site to enhance the healing procedure.

Apart from the clinical benefits, patient satisfaction is also critical for evaluating the efficiency of Aquacel®. Based on the currently available literature, we aimed to assess patient outcomes in Aquacel Ag® applications in patients who underwent TKA.

Materials and Methods

In this study we retrospectively evaluated the patients who were diagnosed with primary gonarthrosis and underwent TKA at our clinic during 2016 and 2017. The patients with a skin disease that might negatively affect wound healing, patients with varicose veins or peripheral circulatory disorders, smokers, those under immunosuppressive treatment, patients with previous knee surgery (osteotomy, fracture, prosthetic surgery, etc.), and ASA 4 patients were not included in the study.

During a 2-year period, a total of 320 patients had TKA surgery at our clinic. Of those patients, 28 were excluded due to revision knee surgery, 12 were excluded due to smoking, 2 were excluded due to presence of a chronic skin disease, and 4 were excluded due to presence of varicose veins. Of the remaining patients, Aquacel Ag® Surgical Dressing had been applied in 139 patients (Group 1), and conventional gauze sponge had been applied in 135 patients (Group 2). Aquacel Ag® Surgical Dressing was applied to consecutive patients in a limited period of time in 2017 upon availability of the product in the clinic. Standart gauze dressing had been applied to the rest of the patients. Patient outcomes including the frequency of changing the dressing, pain due to dressing change, patient satisfaction, wound site infections, and formation of blisters were compared between groups retrospectively. This study was approved by the ethics committee of the Institute.

Surgical Procedure

Zimmer NexGen, Legacy Posterior-Stabilized Prosthesis was applied to all patients under regional anesthesia and without tourniquet application. Access to the knee was through a midline incision and medial parapatellar incision. Patellar component was not changed in any

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patient. Operation site was closed with interrupted sutures. Hemovac drain was used routinely, and was removed at the 24th hour of surgery. Staples were used for skin closure.

Following completion of the surgery, povidone iodine was applied on the site, and either conventional gauze or Aquacel Ag® Surgical Dressing (ConvaTec Inc., Greensboro, North Carolina, USA) was applied on the wound. Jones bandage was applied in all patients, and was removed at the 24th hour of surgery to start active-passive movements. Patients were mobilized on the next day using a walker.

Gauze dressings were changed if more than 50% of it was stained. Aquacel Ag® dressings were changed if there is a leakage out from the dressing. Other reasons for changing the dressings were severe painful itching, and progression of blisters.

Medications

Preoperative antibiotic prophylaxis was initiated 24 hours prior to the operation; 1 gr cefazolin sodium IV at 8 hour intervals. Same analgesic procedure was applied to all patients. Patient controlled analgesia (PCA) device was used for tramadol infusion, and 50 mg of dexketoprofen IV was applied 2 times a day, if needed. In order to prevent excess hemorrhage, 1 gr of tranexamic acid was administered intravenously after the surgery. Additionally, 4000 U subcutaneous enoxaparin was initiated 6 hours after the surgery, and continued for 3 weeks for thromboembolism prophylaxis.

Measures

Demographic characteristics including age, sex, body-mass index (BMI), presence of chronic pain, and ASA category, and clinical parameters including frequency of dressing change, pain due to dressing change, patient satisfaction from dressing change, wound site infections, and progression of blisters were evaluated until removal of the sutures. Pain was assessed using a visual analogue scale (VAS) ranging from 1 to 10, in which 1 refers to no pain and 10 refers to excruciating pain. Patient satisfaction was evaluated on a 4 point scale; 1: perfect, 2: good, 3: moderate, and 4: bad.

Statistical Analysis

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Descriptive statistics were expressed as mean, standard deviation, and median (Q1-Q3) where appropriate for numerical variables and as frequencies (%) for categorical variables. Comparisons between study groups were performed with Mann-Whitney U test, Student-t test, and chi-square test for non-normally and normally distributed numerical data, and categorical data, respectively. Statistical significance was defined as a p value <0.05. The PASW 18 (SPSS Inc., Chicago, IL, USA) software was used for the analysis.

Results

A total of 274 patients were included in the analysis. The conventional gauze and the Aquacel Ag® dressing groups included 135 and 139 patients, respectively. Gender distribution was similar in both groups (p=0.380), but mean age was higher in the Aquacel Ag® group (67.6±7.6 years vs. 65.4±5.7 years; p=0.006). There was no significant difference in anthropometric measurements between the groups. General characteristics of the patients are summarized in Table 1.

Clinical characteristics of the patients are presented in Table 2. Accordingly, patients in both study groups were similar regarding ASA category (p=0.640), presence of diabetes (p=0.860), hypertension (p=0.770), and atherosclerotic heart disease (p=0.770). Blister formation was similar in the two study groups (p=0.770); 12 patients (8.9%) in the conventional dressing group, and 11 patients (7.9%) in the Aquacel Ag® group. Likewise, development of superficial infections were similar in both conventional dressings and Aquacel®l dressing groups (p=0.500), and was observed in 5 (3.7%) and 3 (2.2%) patients , respectively.

The duration of hospital stay (p<0.001), and number of dressing change (p<0.001) were significantly higher in the conventional gauze dressing group. Patient satisfaction from the dressings were significantly higher in the Aquacel Ag® group (p<0.001). Accordingly, 26 patients (18.7%) found the dressing perfect in the Aquacel Ag® group, but none in the gauze dressing group. Moreover, 8 patients (5.9%) in the conventional dressing group were not satisfied with the dressing by any means (graded their satisfaction as bad), while none of the patients in the Aquacel Ag® group found the dressing bad. Pain scores during dressing change were also significantly lower in the Aquacel Ag® group (p<0.001), and, the number of patients

who could take a shower during the first three days of surgery was significantly higher in the Aquacel Ag® group ($p<0.001$).

Discussion

TKA surgeries are performed in high numbers in orthopedic practice. Favorable outcomes in these operations are closely associated with the excellence in application of surgical procedures as well as the postoperative wound care . Patient satisfaction, decreased pain during postoperative care, decreased duration of hospital stay, and prevention of subsequent infections are the key parameters determining the successful outcomes in TKA operations. These favorable outcomes are also associated with decreased costs in patient management, and multidisciplinary protocols are being developed in clinical settings to achieve these aims (12, 13). The Aquacel Ag® Ag Surgical Dressing is being widely used for optimal wound care in the postoperative period due to its favorable properties. This study evaluated the outcomes of patients who were applied Aquacel Ag® Ag dressing in comparison to those who were applied conventional gauze dressing, and the results of the analysis revealed that Aquacel Ag® dressing was superior to classical dressing regarding both clinical outcomes and patient satisfaction.

The Aquacel Ag® Ag is a highly hydrophilic surgical dressing consisting 100% sodium carboxymethylcellulose without any active ingredient, and can absorb significantly high amounts of fluid without losing its integrity. It can absorb exudate from the wound, and keeps the surrounding skin exudate-free. Moreover, it provides a clear, warm, and moist environment at the surgical site to facilitate optimal and enhanced wound healing (11).

Several studies have evaluated the efficiency of Aquacel Ag® dressing for wound care in arthroplasty surgeries. Cai et al. (6) who investigated whether Aquacel Ag® decreases the rate of periprosthetic joint infection after total joint arthroplasties reported the incidence of acute infections as 0.44% in the Aquacel Ag® group and 1.7% in the standard gauze dressing group, and the authors reported that Aquacel Ag® dressing significantly decreases the incidence of acute periprosthetic joint infections in total joint arthroplasty. Similar results were reported by Grosso et al. (14), who showed a four-fold decrease in periprosthetic joint infections in the Aquacel Ag® group in comparison to standard sterile dressing in total joint arthroplasty.

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Another study by Hopper et al. (7) evaluated the outcomes after knee or hip arthroplasty, and reported that wear time, number of dressing change, discharge times, and progression of blisters were significantly lower in patients in the Aquacel Ag® dressing group when compared to those in the traditional dressing group. Similar favorable outcomes including decreased surgical site infections and improved patient satisfaction with Aquacel Ag® were reported in a study by Kuo et al. (15), who evaluated wound complications and surgical site infections after minimally invasive total knee arthroplasty surgeries. Another study by Langlois et al. (4) compared the conventional gauze-based versus absorbing hydrofibre dressings in primary total hip or knee arthroplasties, and reported that application of Aquacel Ag® dressings resulted in overall improvement in patient satisfaction, as well as improved comfort of the medical staff after these procedures. Several other studies also reported similar favorable outcomes of Aquacel Ag® (5, 16).

The favorable outcomes observed in our study were in accordance with the literature. Patients in the Aquacel Ag® group had decreased duration of hospital stay, lower number of dressing changes, increased satisfaction, and decreased pain during dressing change. Paddock et al. (17) also found that Aquacel Ag® reduces hospital stay and as a consequence reduces the cost overallTheir study was on pediatric burns, the current study demonstrated that these dressings can also reduces the hospital stay in relatively fast track operations. Also, the number of patients who were able to take a shower in the postoperative 3 days was significantly higher in the Aquacel Ag® group. These favorable outcomes were significantly associated with enhanced wound healing, and increased postoperative satisfaction rates as well as improved quality of life. The cost of the silver impregnated dressings are higher than standard dressings when considering individually. The silver impregnated dressings are shown to decrease postoperative complications including serious infections, which eventually reduce the healthcare costs (16). Although not evaluated in our study, postoperative complications, particularly postoperative infections that may necessitate revision surgeries, are significantly associated with costs, which is a significant parameter for the healthcare systems. When the high number of these surgeries

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is considered, the overall cost of these two products needs to be studied independently. Aquacel Ag®

Conclusion

The results of this study showed that Aquacel Ag® Ag Surgical Dressing significantly improves patient outcomes after TKA surgeries by decreasing postoperative complications, and enhancing patient satisfaction.

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Table 1. General characteristics of the patients

	Conventional gauze dressing group (n=135)	**Aquacel Ag® dressing group (n=139)**	**p**
Sex, n (%)			0.38
Female	120 (88.9)	116 (85.3)	
Male	15 (11.1)	20 (14.7)	
Age (years), mean±SD	65.4±5.7	67.6±7.6	0.006
Height (cm), mean±SD	159.1±3.9	158.4±4.0	0.35
Body weight (kg), mean±SD	76.9±7.0	76.3±6.9	0.68
BMI (kg/m2), mean±SD	30.4±3.1	30.5±3.3	0.84

BMI, Body mass index; SD, Standard deviation

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Table 2. Clinical characteristics of the patients

	Conventional gauze dressing group (n=135)	Aquacel Ag® dressing group (n=139)	p
ASA grade, n (%)			0.64
1	11 (8.1)	10 (7.2)	
2	46 (34.1)	55 (39.6)	
3	78 (57.8)	74 (53.2)	
Chronic diseases, comorbidity, n (%)			
Diabetes	16 (32.0)	21 (30.4)	0.86
Hypertension	43 (86.0)	58 (84.1)	0.77
Atherosclerotic heart disease	7 (14.0)	11 (15.9)	0.77
Blister formation, n (%)	12 (8.9)	11 (7.9)	0.77
Superficial infection, n (%)	5 (3.7)	3 (2.2)	0.50
Duration of hospital stay (days), median (Q1-Q3)	3 (3-4)	3 (2-3)	<0.001
Number of dressing change, median (Q1-Q3)	4 (4-5)	2 (2-2)	<0.001
Satisfaction score, median (Q1-Q3)	2 (2-3)	2 (2-2)	<0.001
Perfect, n (%)	-	26 (18.7)	
Good, n (%)	82 (60.7)	90 (64.7)	
Moderate, n (%)	45 (33.3)	23 (16.5)	
Bad, n (%)	8 (5.9)	-	
Pain at dressing change (VAS score), median (Q1-Q3)	4 (4-5)	2 (2-3)	<0.001
Ability to take a shower during the first 3 days of surgery, n (%)	19 (14.1)	60 (43.2)	<0.001

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ASA, American Society of Anesthesiologists; VAS, Visual Analogue Scale

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