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# Comparison of the Aquacel Ag Surgical Dressing vs Standard Dressing in the Treatment of the Wound Site Infection and Patient Comfort in Total Knee Arthroplasty

Mutlu Akdoğan <sup>1</sup>, Halis Atıl Atilla <sup>1</sup>

## ABSTRACT

**Objective:** The present study aimed to evaluate the effects of the Aquacel Ag surgical dressing on wound site infections and patient comfort in total knee arthroplasty (TKA).

**Materials and Methods:** The study included a total of 274 patients diagnosed with primary gonarthrosis, who underwent TKA at our clinic during 2016 and 2017. The Aquacel Ag surgical dressing was applied in 139 patients (Group 1), and a 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 the groups retrospectively.

**Results:** The formation of blisters ( $p=0.770$ ) and superficial infections ( $p=0.500$ ) were similar in both groups. The duration of hospital stay ( $p<0.001$ ) and the number of dressing changes ( $p<0.001$ ) were significantly higher in the 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 3 days following surgery was significantly higher in the Aquacel Ag group ( $p<0.001$ ).

**Conclusion:** The results of the present study showed that the Aquacel Ag surgical dressing significantly improved patient outcomes after the TKA surgery 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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Department of Orthopedics and Traumatology, University of Health Sciences Dışkapı Yıldırım Beyazıt Training and Research Hospital, Ankara, Turkey

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### Correspondence

Halis Atıl Atilla,  
Department of Orthopedics and Traumatology, University of Health Sciences Dışkapı Yıldırım Beyazıt Training and Research Hospital, Ankara, Turkey  
Phone: +90 535 676 48 48  
e-mail:  
dratilatilla@hotmail.com

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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 procedures are not without complications, and the wound site complications such as delayed healing, blister formation, or prolonged drainage, were reported in approximately 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 for the moist environment at the wound site. Also, exudates contain several other components, such as 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 health care costs. It has been reported that the 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 (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 provide moist environment and are 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 it should be cost-effective when a 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 it 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 transforms into a gel and provides a moist environment around the wound site to enhance the healing process.

Apart from the clinical benefits, patient satisfaction is also critical for evaluating the efficiency of Aquacel Ag. 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 patients diagnosed with primary gonarthrosis, who 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, patients 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 underwent the 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 a chronic skin disease, and 4 were excluded due to varicose veins. Of the remaining patients, the Aquacel Ag surgical dressing was applied in 139 patients (Group 1), and a conventional gauze sponge was applied in 135 patients (Group 2). The Aquacel Ag surgical dressing was applied to consecutive patients during a limited period of time in 2017 upon availability of the product in the clinic. A standard gauze dressing was 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 the groups retrospectively. This study was approved by the ethics committee of the institute.

### Surgical Procedure

The Zimmer NexGen, Legacy Posterior-Stabilized Prosthesis was applied to all patients under regional anesthesia and without tourniquet application. The knee was accessed via a midline incision and medial parapatellar incision. The patellar component was not changed in any patient. The surgical site was closed with interrupted sutures. A Hemovac drain was used routinely, and it was removed at the 24<sup>th</sup> hour of surgery. Staples were used for skin closure.

Following completion of the surgery, povidone iodine was applied on the site, and either a conventional gauze or the Aquacel Ag surgical dressing (ConvaTec Inc., Greensboro, North Carolina, USA) was applied on the wound. The Jones bandage was applied in all patients, and it was removed at the 24<sup>th</sup> hour from 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 them was stained. The Aquacel Ag dressing was changed if there was a leakage observed. 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 applied intravenously (IV) at 8-hour intervals. Same analgesic procedure was applied to all patients. A patient-controlled analgesia (PCA) device was used for tramadol infusion, and 50 mg of dexketoprofen IV was applied 2

**Table 1.** General characteristics of the patients

	<b>Conventional gauze dressing group (n=135)</b>	<b>Aquacel Ag® dressing group (n=139)</b>	<b>p</b>
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/m <sup>2</sup> ), mean±SD	30.4±3.1	30.5±3.3	0.84

BMI: Body mass index; SD: Standard deviation

times a day, if needed. To prevent excessive hemorrhage, 1 gr of tranexamic acid was administered intravenously after the surgery. In addition, 4000 U of subcutaneous enoxaparin was initiated 6 hours after the surgery, and continued for 3 weeks for thromboembolism prophylaxis.

### Measures

Demographic characteristics including age, gender, body mass index (BMI), the presence of chronic pain, and ASA category, and clinical parameters including the frequency of dressing change, pain due to dressing change, patient satisfaction regarding 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, where 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

Descriptive statistics were expressed as the mean, standard deviation, and median (Q1–Q3), where appropriate for numerical variables, and as frequencies (%) for categorical variables. Comparisons between study groups were performed using the Mann–Whitney U test, Student's t-test, and chi-squared 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. The gender distribution was similar in both groups (p=0.380), but the 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 the ASA category (p=0.640), presence of diabetes (p=0.860), hyper-

**Table 2.** Clinical characteristics of the patients

	Conventional gauze dressing group (n=135)		Aquacel Ag® dressing group (n=139)		p
	n	%	n	%	
ASA grade					
1	11	8.1	10	7.2	0.64
2	46	34.1	55	39.6	
3	78	57.8	74	53.2	
Chronic diseases, comorbidity					
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	12	8.9	11	7.9	0.77
Superficial infection	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	–	–	26	18.7	
Good	82	60.7	90	64.7	
Moderate	45	33.3	23	16.5	
Bad	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	19	14.1	60	43.2	<0.001

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

tension ( $p=0.770$ ), 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 was similar in both conventional dressings and Aquacel Ag dressing groups ( $p=0.500$ ), and it was observed in 5 (3.7%) and 3 (2.2%) patients, respectively.

The duration of hospital stay ( $p<0.001$ ) and the number of dressing changes ( $p<0.001$ ) were significantly higher in the conventional gauze dressing group. Patient satisfaction with the dressings was 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 (i.e., graded their satisfaction as bad), while none of the patients in the Aquacel Ag group found the dressing to be 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 3 days of surgery was significantly higher in the Aquacel Ag group ( $p<0.001$ ).

## DISCUSSION

The TKA surgery is frequently performed in orthopedic practice. Favorable outcomes in these procedures 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 procedures. 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 surgical dressing is widely used in optimal wound care during the postoperative period due to its favorable properties. This study evaluated the outcomes of patients who were applied the Aquacel Ag dressing in comparison to those who were applied a conventional gauze dressing, and the results of the analysis revealed that the Aquacel Ag dressing was superior to classical dressing regarding both clinical outcomes and patient satisfaction.

The Aquacel Ag is a highly hydrophilic surgical dressing consisting of 100% sodium carboxymethylcellulose without any active ingredient, and it can absorb significantly high amounts of fluid without losing its integrity. It can absorb exudate from the wound, keeping 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 the Aquacel Ag dressing for wound care in arthroplasty. Cai et al. (6) who inves-

tigated whether Aquacel Ag decreased 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 the Aquacel Ag dressing significantly decreased 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. Another study by Hopper et al. (7) evaluated the outcomes after knee or hip arthroplasty and reported that the 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 TKA procedures. Another study by Langlois et al. (4) compared the conventional gauze-based versus absorbing hydrofibre dressings in primary total hip or knee arthroplasties, and they reported that the application of the Aquacel Ag dressing resulted in an overall improvement in patient satisfaction, as well as improved comfort of the medical staff after these procedures. Several other studies 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 a 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 overall cost. Their study was on pediatric burns, and the current study demonstrated that these dressings can also reduce the hospital stay in relatively fast-track operations. Also, the number of patients 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 is higher than the cost of standard dressings when considered individually. The silver impregnated dressings are shown to decrease postoperative complications, including serious infections, which eventually reduce the health care costs (16).

Although not evaluated in our study, postoperative complications, particularly postoperative infections that may necessitate revision surgeries, are significantly associated with increased costs, which is a significant parameter for the health care systems. When the high number of these surgeries is considered, the overall cost of these two products needs to be studied independently.

## CONCLUSION

The results of this study showed that the Aquacel Ag surgical dressing significantly improved patient outcomes after TKA surgeries by decreasing postoperative complications and enhancing patient satisfaction.

**Ethics Committee Approval:** The University of Health Sciences Dışkapı Yıldırım Beyazıt Training and Research Hospital, Clinical Research Ethics Committee granted approval for this study (date: 02.04.2018, number: 48/01).

**Informed Consent:** Written informed consent was obtained from patients who participated in this study.

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept – MA, HAA; Design – MA, HAA; Supervision – MA; Resource – MA, HAA; Materials – MA, HAA; Data Collection and/or Processing – MA; Analysis and/or Interpretation – MA, HAA; Literature Search – HAA; Writing – MA, HAA; Critical Reviews – MA, HAA.

**Conflict of Interest:** The authors have no conflict of interest to declare.

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