TAPE BLISTERS FOLLOWING HIP SURGERY

A PROSPECTIVE, RANDOMIZED STUDY OF TWO TYPES OF TAPE

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Background: Tape blisters after hip surgery can be a source of postoperative morbidity and can increase patient discomfort. The purpose of this prospective study was to compare two different types of tape to determine whether the type of tape influences the rate of blister formation.

Methods: Ninety-nine patients (100 hips) were enrolled in the study. Patients were randomized into one of two treatment groups: one treated with a nonstretchable silk tape and one treated with a perforated, stretchable cloth tape. After surgery, the assigned tape was applied over the postoperative dressing with care not to produce skin tension. At the first dressing change, the presence or absence of blisters was recorded as were the number, size, location, and type of any blisters. The presence or absence of tape blisters was recorded at the time of each subsequent dressing change.

Results: A tape blister developed on twenty-five hips in twenty-five patients. The risk of a blister developing was 41% (twenty of forty-nine patients) when the nonstretchable silk tape was used and 10% (five of fifty patients) when the perforated cloth tape was used (relative risk = 4.08, 95% confidence interval = 1.53 to 10.87, p = 0.005). We found no association between formation of tape blisters and the age or gender of the patient, number of medical comorbidities, smoking history, results of nutritional assessment, or type of surgery.

Conclusions: The prevalence of tape blisters was significantly lower when perforated cloth tape was used than it was when nonstretchable silk tape was used.

Level of Evidence: Therapeutic study, Level I-1a (randomized controlled trial [significant difference]). See Instructions to Authors for a complete description of levels of evidence.

Injuries related to the use of adhesives around surgical wounds remain a clinical dilemma. Tape blisters can be a source of postoperative morbidity and are a substantial quality assurance issue. The causes of tape blisters have been related to the creation of shear forces at the dermal-epidermal junction in association with a compromised vascular supply to the dermis in the postoperative setting[1,2]. Few studies have documented the prevalence of tape injuries after surgical intervention, and we are aware of only one prospective study on the effectiveness of preventive measures in decreasing the prevalence of postoperative tape blisters[2].

The purposes of the current prospective study were to (1) determine the prevalence of tape blisters after surgery about the hip and (2) compare two different types of tape to determine whether the type of tape can influence the rate of tape-blister formation. Our null hypothesis was that the type of tape used following hip surgery does not affect the development of blisters.

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Materials and Methods

This study was approved by our institutional review board. All patients who underwent surgery about the hip in our hospital system were considered eligible for inclusion in the study. After providing informed consent, patients were randomized by a computer-generated random-number series into one of two treatment groups: one treated with a nonstretchable silk tape (Curasilk; Kendall, Mansfield, Massachusetts) and the other treated with a perforated, stretchable cloth tape (Hypafix; Smith and Nephew, Memphis, Tennessee). These two types of tape were chosen for study because they are both commonly used at our institution to secure postoperative dressings.

Between December 2001 and May 2002, 100 hips in ninety-nine patients were enrolled in the study. The demographic data and surgical procedures are shown in the Appen-

TABLE I Estimated Relative Risks of Tape-Blister Formation According to Type of Treatment and Patient Characteristics as Demonstrated by Univariate Analysis (N = 99)

	Blister	No Blister	Row Total	Risk	Estimated Univariate Relative Risk*	95% Confidence Interval	P Value
All patients	25	74	99	25%	—	—	—
Tape					4.08	1.53-10.87	0.005
Silk	20	29	49	41%			
Cloth	5	45	50	10%			
Surgical procedure					0.73	0.34-1.61	0.441
Fracture repair	13	46	59	22%			
Reconstruction	12	28	40	30%			
Anesthesia					0.46	0.18-1.15	0.095
General	6	35	41	15%			
Regional	19	39	58	33%			
Gender					0.93	0.42-2.08	0.868
Female	15	46	61	25%			
Male	10	28	38	26%			
Race					0.52	0.20-1.39	0.195
Nonwhite	5	27	32	16%			
White	20	47	67	30%			
Age					1.21	0.53-2.73	0.654
≥65 yr	16	43	59	27%			
18-64 yr	9	31	40	23%			
Comorbidities					0.83	0.31-2.21	0.708
≥1	20	62	82	24%			
0	5	12	17	29%			
Smoking history							
Current smoker	4	14	18	22%	0.88	0.30-2.57	0.812
Former smoker	4	17	21	19%	0.72	0.25-2.12	0.555
Never smoked	17	43	60	28%	1.00	—	—
Nutritional status					1.11	0.65-1.91	0.703
Depressed	11	22	33	33%			
Not depressed	2	14	16	13%			

*Estimated using Poisson regression.

dix. The randomization procedure produced treatment groups with approximately equivalent characteristics with regard to age, gender, race, smoking, comorbidities, duration of surgery, type of anesthesia, and type of surgical procedure.

At the completion of surgery, the assigned tape was applied over the postoperative dressing. To do this, the appropriate length of tape was removed from the roll, stuck to the dressing, and then applied to the patient's skin. The tape was applied, with the hip in extension, along the longitudinal axis of the limb with care taken not to create tensile forces. Another piece of the tape was placed on a remote body site to determine whether the patient had an allergic reaction to the tape.

The patients were prospectively followed throughout their hospital stay. They were all treated with a similar postoperative protocol consisting of forty-eight hours of prophylactic antibiotics, thromboprophylaxis, and mobilization out of bed on the first or second postoperative day. The postoperative dressing was first changed on the third postoperative day unless wound drainage necessitated that it be changed earlier. At the first dressing change, the presence or absence of blisters was recorded as were the number, size, location, and type of any blisters (filled with blood or clear fluid and with the blister roof intact or disrupted).

All subsequent dressing changes were performed, with use of the assigned type of tape, in the manner similar to that used at the completion of the surgery. The reason for additional dressing changes was recorded as was the total number of dressing changes needed for each patient. The presence or absence of blisters was recorded at the time of each dressing change. All surgical wounds were visually inspected by one of

the two senior authors (K.J.K. or K.A.E.). Blisters were treated daily with 1% silver sulfadiazine cream (Kendall) until re-epithelialization occurred.

Demographic information was collected during hospitalization and included patient age, gender, race, medical history, medication use, smoking history, type of surgery, and history of tape allergy. A nutritional assessment was performed at one of the hospitals and included a lymphocyte count and measurement of the albumin level. Any previous hip surgery as well as the type of anesthesia and the surgical duration was recorded.

Statistical Methods

The principal analysis of this study was a comparison of the risk of the development of tape blisters between patients randomized to be treated with a nonstretchable silk tape and those randomized to be treated with a perforated cloth tape. Risk was calculated as the proportion of enrolled subjects with tape blisters divided by the total number of patients enrolled in the study. Separate risks were calculated for each treatment group (silk tape and cloth tape). We calculated relative risks by forming a ratio of the risks, with the risk for the silk-tape group as the numerator and the risk for the cloth-tape group as the denominator. A relative risk of >1 indicated that the proportion of patients with tape blisters in the silk-tape group was larger than that in the cloth-tape group.

We estimated relative risks, confidence intervals, and p values using a form of the generalized linear model, substituting the log of the risk ratio as the link function and assuming that the residuals from the maximum likelihood fitting procedure followed a Poisson distribution. This method produces regression coefficients that, after exponentiation, can be interpreted as relative risks[3].

We included a number of variables in a multivariate model to assess whether tape type was associated with an increased risk of blister formation independent of other, possibly predictive factors. Secondary factors included patient age (up to sixty-five years of age and older than sixty-five), gender, race (white or nonwhite), medical comorbidities (none compared with one or more), smoking history, nutritional status (nourished or malnourished), type of surgery (fracture repair or reconstruction), and type of anesthesia (general or regional). The criterion for significance was set as alpha = 0.05 for all analyses.

We calculated that, with 100 incisions, we would have 80% power to demonstrate that a reduction of 10% from a baseline blister rate of 40% would be significant with alpha = 0.05.

An intent-to-treat approach to the analysis was used. However, there were no reports of patients removing tapes or otherwise altering the treatment to which they had been assigned.

Results

The outcome with regard to the development of tape blisters was recorded for all ninety-nine patients. A tape blister developed on twenty-five hips in twenty-five patients (25%). The rate of blister formation was 41% (twenty of forty-nine patients) when the nonstretchable silk tape was used and 10% (five of fifty patients) when the perforated cloth tape was used (relative risk = 4.08, confidence interval = 1.53 to 10.87, p = 0.005). No other factors (age, gender, race, smoking history, nutritional status, number of comorbidities, anesthesia type, or type of surgical procedure) were significantly associated with the risk of a tape blister developing (Table I).

Use of the nonstretchable silk tape remained associated with an increased risk of blister formation after adjustment for patient age, gender, race, number of medical comorbidities, smoking history, nutritional assessment, type of anesthesia, and type of surgery (Table II). Nutritional status was not analyzed further because only patients at one hospital (forty-nine patients with fifty involved hips) had albumin and total lymphocyte values recorded. No other factors were significantly associated with the risk of a tape blister developing.

Ninety-five of the 100 hips had the first dressing change on the third postoperative day. Eleven (44%) of the twenty-five hips with a blister had it at the time of the first dressing change. Fifteen (60%) of the patients had a single blister, and ten (40%) had multiple blisters (range, two to five). Thirty-

TABLE II Adjusted Relative Risk of Tape-Blister Formation as Demonstrated by Multivariate Analysis (N = 99)

	Adjusted Relative Risk*	95% Confidence Interval	P Value
Silk tape	4.30	1.50-12.37	0.007
Fracture repair	0.42	0.14-1.31	0.137
General anesthesia	0.52	0.17-1.56	0.245
Female	0.64	0.21-1.89	0.415
Nonwhite race	0.54	0.18-1.64	0.277
Age of ≥65 yr	1.61	0.44-5.95	0.474
≥1 comorbidities	0.53	0.18-1.59	0.259
Current smoker	1.00	0.18-5.52	0.996
Former smoker	0.80	0.23-2.82	0.733

*Estimated using multivariate Poisson regression.

five blisters (78%) were filled with clear fluid, and all except four had an intact roof. No patient had a reaction to either type of tape at the control site. There were no postoperative wound infections during hospitalization. At the time of the latest follow-up, patients who had a clear-fluid-filled blister had no evidence of permanent sequelae from the blister. However, blood-filled blisters were associated with permanent skin scarring and/or discoloration.

Discussion

In this study, a tape blister developed after surgery around the hip in twenty-five (25%) of ninety-nine patients. We were able to significantly reduce the prevalence of tape blisters from 41% (twenty of forty-nine patients) to 10% (five of fifty patients) by simply using perforated stretchable cloth tape instead of nonstretchable silk tape in the postoperative period. Adhesive tapes cause external stresses applied tangential to the skin surface[1]. Routine postoperative swelling may exacerbate those stresses. Tape that is resistant to stretch, such as silk tape, contributes to blister formation as a result of increased forces at the ends of the tape[4,5].

Although tape blisters are a pervasive clinical problem, we are aware of only two prior studies comparing different methods to reduce the prevalence of such blisters around the hip. Milne et al. performed a prospective study comparing the ability of three methods to prevent blister formation under the taped portion of postoperative hip surgical dressings[2]. In that study, the dressing was taped directly to the skin, taped to a hydrocolloid barrier (DuoDERM; ConvaTec, Princeton, New Jersey), or taped to a nonhydrocolloid barrier (Stomahesive; ConvaTec)[2]. Tape blisters formed on 34% (seventeen) of the fifty hips in the control group, on 14% (eight) of the fifty-eight hips treated with the nonhydrocolloid barrier, and on none of the hips treated with the hydrocolloid barrier. Hahn et al. performed a retrospective study comparing use of tape (eighty-nine patients) with use of a compressive spica Ace wrap bandage (273 patients) after hip surgery[6]. The type of tape was not reported. Blisters developed in thirteen (15%) of the eighty-nine patients treated with a taped dressing and in four (1%) of the 273 patients treated with a compressive spica Ace wrap dressing.

In conclusion, we found an overall rate of tape-blister formation of 25% after surgery around the hip. We were able to significantly reduce the prevalence of tape blisters by simply altering the type of tape from a nonstretchable silk tape to a perforated stretchable cloth tape. On the basis of this study, we rejected our null hypothesis and have stopped using nonstretchable silk tape to secure postoperative dressings.

Appendix

(eA) Tables showing pertinent clinical characteristics of the patients and details about the operations that were performed are available with the electronic versions of this article, on our web site at www.jbjs.org (go to the article citation and click on "Supplementary Material") and on our quarterly CD-ROM (call our subscription department, at 781-449-9780, to order the CD-ROM). ■

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References

1. **Comaish JS.** Epidermal fatigue as a cause of friction blisters. *Lancet.* 1973; 1:81-3.
2. **Milne CT, Barrere CC, McLaughlin T, Moore A.** Surgical hip dressings: a comparison of taping methods. *Orthop Nurs.* 1999;18:37-42.
3. **Breslow NE, Day NE.** *Statistical methods in cancer research.* Volume 2, The design and analysis of cohort studies. Lyon: International Agency for Research on Cancer; 1987.
4. **Rodeheaver GT, McLane M, West L, Edlich RF.** Evaluation of surgical tapes for wound closure. *J Surg Res.* 1985;39:251-7.
5. **Moy RL, Quan MB.** An evaluation of wound closure tapes. *J Dermatol Surg Oncol.* 1990;16:721-3.
6. **Hahn GJ, Grant D, Bartke C, McCartin J, Carn RM.** Wound complications after hip surgery using a tapeless compressive support. *Orthop Nurs.* 1999; 18:43-9.