First-Aid Treatment for Friction Blisters: "Walking Into the Right Direction?"

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Abstract

Objective: Blisters are common foot injuries during and after prolonged walking. However, the best treatment remains unclear. The aim of the study was to compare the effect of 2 different friction blister treatment regimens, wide area fixation dressing versus adhesive tape. **Design:** A prospective observational cohort study. **Setting:** The 2015 Nijmegen Four Days Marches in the Netherlands. **Participants:** A total of 2907 participants (45 ± 16 years, 52% men) were included and received 4131 blister treatments. **Interventions:** Blisters were treated with either a wide area fixation dressing or adhesive tape. **Main Outcome Measures:** Time of treatment application was our primary outcome. In addition, effectiveness and satisfaction were evaluated in a subgroup (n = 254). During a 1-month follow-up period, blister healing, infection and the need for additional medical treatment were assessed in the subgroup. **Results:** Time of treatment application was lower (41.5 minutes; SD = 21.6 minutes) in the wide area fixation dressing group compared with the adhesive tape group (43.4 minutes; SD = 25.5 minutes; $P = 0.02$). Furthermore, the wide area fixation dressing group demonstrated a significantly higher drop-out rate (11.7% vs 4.0%, $P = 0.048$), delayed blister healing (51.9% vs 35.3%, $P = 0.02$), and a trend toward lower satisfaction ($P = 0.054$) when compared with the adhesive tape group. **Conclusions:** Wide area fixation dressing decreased time of treatment application by 2 minutes (4.5%) when compared with adhesive tape. However, because of lower effectiveness and a trend toward lower satisfaction, we do not recommend the use of wide area fixation dressing over adhesive tape in routine first-aid treatment for friction blisters.

Key Words: exercise, walking, acute care, foot injuries, treatment outcome

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INTRODUCTION

Friction blisters frequently occur during prolonged exercise and often result in exercise cessation.[1] These intraepidermal blisters are the result of trauma-induced separation within the epidermis.[2,3] Although most friction blisters remain uncomplicated, infections can occur[4,5] with the risk of developing cellulitis or sepsis.[6,7] Furthermore, in an attempt to avoid walking on the painful blisters an antalgic gait pattern occurs which may lead to other exercise-related injuries, such as overuse injuries of the knee.[8] Blister treatment aims to reduce pain, facilitate healing of the skin and neutralize infection, and prevent blister recurrence.

During the annual Nijmegen Four Days Marches (4DM), the world's largest multiday walking event with daily distances ranging from 30 to 50 km, the need for treatment of friction blisters is very high. In previous years of the 4DM, the number of participants requiring at least a single blister treatment varied between 4000 and 5000, accounting for ~10% of the total number of walkers.[9] Ever since 1954, blister treatment during the 4DM has been performed using adhesive tape; however, evidence for this treatment is based on only one study.[5] Although taping has been found to be an effective treatment,[5] it is time consuming which can lead to long waiting lines and disruption of the walking rhythm of the participants. Anecdotal evidence suggests that the use of wide area fixation dressing may decrease time of treatment application by approximately 10%. However, its effectiveness in the treatment of friction blisters is unknown.

To date, only limited research has been conducted to examine different treatment regimens for friction blisters.[4,5] Most studies that examined friction blisters have been performed within the military[2,6,8] or in athletes,[1,10] with a high homogeneity for age and physical activity levels and with a primary focus on prevention of blisters. Consequently, the purpose of this study was to prospectively compare the efficacy of fixation dressing versus adhesive tape in first-aid treatment of friction blisters. These 2 methods of treatment were evaluated based on time of treatment application, effectiveness, and material satisfaction in a large group of participants of the 4DM. We hypothesize that treatment with fixation dressing will lead to a reduction in time of treatment application because it can be applied in 1 piece, whereas adhesive tape has to be applied in an overlapping manner (Figure 1). In addition, we expect to find no differences in effectiveness and satisfaction between the treatments. To the best of our knowledge, this is the first study to include a follow-up period to evaluate blister healing when comparing treatments with different blister-covering materials.

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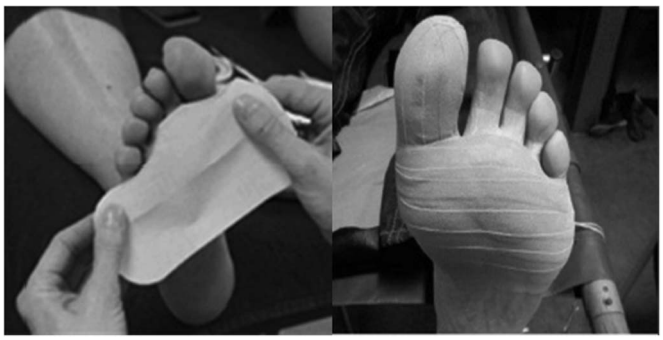

Figure 1. An example of the 2 types of blister treatment that were assessed in this study: fixation dressing (left) versus adhesive tape (right).

METHODS

We performed an observational study during the 99th 4DM. Participants who walked 30, 40, or 50 km/d and required blister treatment at treatment centers of the Red Cross were eligible to participate. Time of treatment application was assessed in the whole study cohort (Figure 2). Subsequently, a subgroup of participants (≥18 years) was approached for assessment of treatment effectiveness and satisfaction (Figure 2) by telephone interviews and online questionnaires. Participants who dropped out before they received blister treatment were excluded in subgroup analyses. Written informed consent was obtained from each participant before enrollment. This study was conducted in line with the Declaration of Helsinki.

Time of Treatment Application

Participants' badges containing a unique walking number were scanned at the beginning and at the end of the blister treatment to evaluate time of treatment application. For each treatment, caregivers filled out a blister registration form with information on the number and localization of blisters and the type of blister treatment. All these forms were scanned into a database at the end of the day. Treatments from 5 to 180 minutes were eligible for data analysis; treatments outside this range were deemed unrepresentative of typical blister treatment and excluded.

Demographics

Two members (L.J. and N.A.E.A.) of the research team randomly recruited a subgroup of walkers for participation in the follow-up study. They managed to include 254 participants for the follow-up measurements. One of the research members included only walkers who were treated with fixation dressing, whereas the other included only walkers in the adhesive tape group. Both members included approximately the same number of walkers, resulting in a subgroup treatment ratio of near 1:1. The subgroup was asked to fill out a questionnaire during their treatment containing items regarding demographic characteristics, medical history, foot and shoe type, training, treatment preference, pain intensity score on a 0 to 10 numeric rating scale, and the use of over-the-counter analgesics.

Assessment of Treatment Effectiveness

The subgroup was contacted by telephone at the end of the day of enrollment (follow-up 1) to obtain pain intensity scores after treatment and drop-out rate. To determine the effect of type of blister treatment on experienced pain, we compared the pretreatment to posttreatment change (Δ) in pain intensity score between fixation dressing and adhesive tape on each walking day. All included subjects were contacted by telephone again at the end of the 4DM to assess drop-out rate (follow-up 2). One month after the 4DM subjects were invited to complete an online questionnaire (follow-up 3) to evaluate blister healing, the occurrence of infection, and the need for additional medical blister treatment. Blister healing was classified into 2 groups: rapid healing (<2 weeks) and delayed healing (≥2 weeks).

Assessment of Satisfaction

Treatment satisfaction was assessed at the end of the enrollment day (follow-up 1), at the end of the 4DM (follow-up 2), and 1 month after the 4DM (follow-up 3) using a 5-point Likert scale (1 = very satisfied, 2 = satisfied, 3 = neutral, 4 = dissatisfied, and 5 = very dissatisfied). The average satisfaction score was calculated over the 3 follow-up measurements. To compare differences in satisfaction between both treatment methods, we pooled very satisfied or satisfied and very dissatisfied or dissatisfied scores.

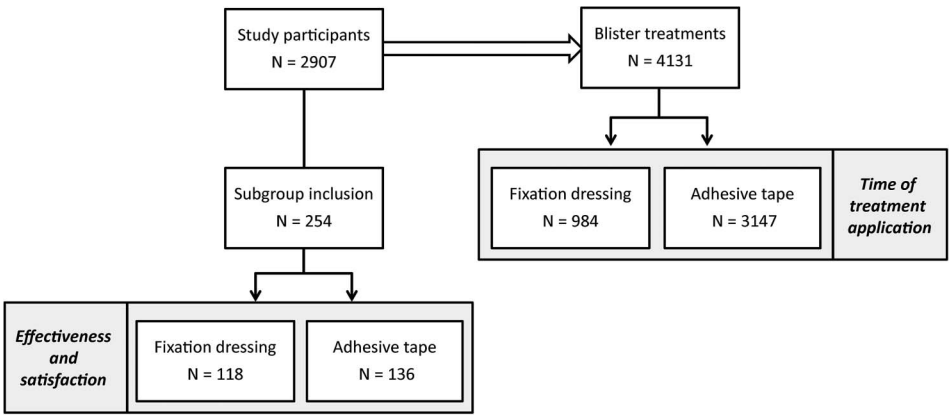

Figure 2. Flow chart of the study population and measurements performed. In short, time of treatment application was assessed in 2907 participants with 4131 friction blisters. Furthermore, the effectiveness and satisfaction of the treatment were assessed in 254 participants during 3 follow-up measurements: (1) after the day of inclusion, (2) after finishing the 4DM, and (3) 1 month after finishing the 4DM.

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Treatment

All participants of the 4DM with blisters requiring professional treatment were treated with either fixation dressing (Fixomull Stretch; BSN medical GmbH & Co KG, Hamburg, Germany) or adhesive tape (Leukoplast; BSN medical GmbH & Co KG). The fixation dressing is a stretchable, nonwoven dressing, which can be applied in 1 piece, whereas the high tensile strength adhesive tape is applied in several overlapping strips (Figure 1). Both materials are suitable for use on the entire foot, including heel, forefoot, and toes. The costs for fixation dressing and adhesive tape are similar (approximately $1.90/€1.80 per foot). The treatment materials were applied by volunteers of the Netherlands Red Cross. Although the level of expertise differed between the volunteers, ranging from basic to advanced, all volunteers finished a blister treatment training and were found qualified by instructors to apply either fixation dressing or adhesive tape. Participants were randomly allocated to a caregiver using standard treatment with adhesive tape or fixation dressing without any preselection. Because adhesive tape is the standard blister treatment during the 4DM, more volunteers were trained to apply adhesive tape when compared with fixation dressing, resulting in a ratio of 3:1 between the treatment groups. Before applying the fixation dressing or adhesive tape, pretreatment was carried out by degreasing, disinfecting, lancing, and draining all blisters.

Statistical Analysis

To evaluate the effectiveness and satisfaction of both treatment methods, all subjects who completed at least one of the follow-up measurements were included. Student *t* tests and Wilcoxon rank sum test were performed to compare data between the adhesive tape and fixation dressing groups for continuous variables when data were normally and nonparametrically distributed, respectively. For comparison of categorical variables, Pearson χ^2 test was used, or Fisher exact test if observations were <10. All data analyses were performed with Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, Version 22.0; IBM Corp, Armonk, New York). Statistical significance was set at a P value < 0.05.

RESULTS

Time of Treatment Application

A total of 2907 participants (45 ± 16 years, 52% men) were included in the study, and they received 4131 blister treatments with fixation dressing (n = 984) or adhesive tape (n = 3147), accounting for 97.1% of all treatments performed with fixation dressing and adhesive tape during the 4DM (122 treatments excluded because of invalid treatment application times). Average time of treatment application in the fixation dressing group was lower (41.5 minutes; SD = 21.6 minutes) compared with the adhesive tape group (43.4 minutes; SD = 25.5 minutes; P = 0.02; Figure 3). In addition, time of treatment application was calculated for the different parts of the foot (toes, forefoot, and heel) separately. Time of treatment application for toe blisters was not different between the fixation dressing and adhesive tape groups (34.1 minutes; SD = 16.8 vs 35.2 minutes; SD = 22.0 minutes, respectively; P = 0.52). For forefoot and heel blisters, time of treatment application was lower in the fixation dressing group compared with the adhesive tape group (27.1 minutes; SD = 13.8 vs 32.9 minutes; SD = 23.2 minutes; P = 0.001 and 27.0 minutes; SD = 11.4 vs 32.0 minutes; SD = 18.4 minutes; $P \leq 0.001$, respectively).

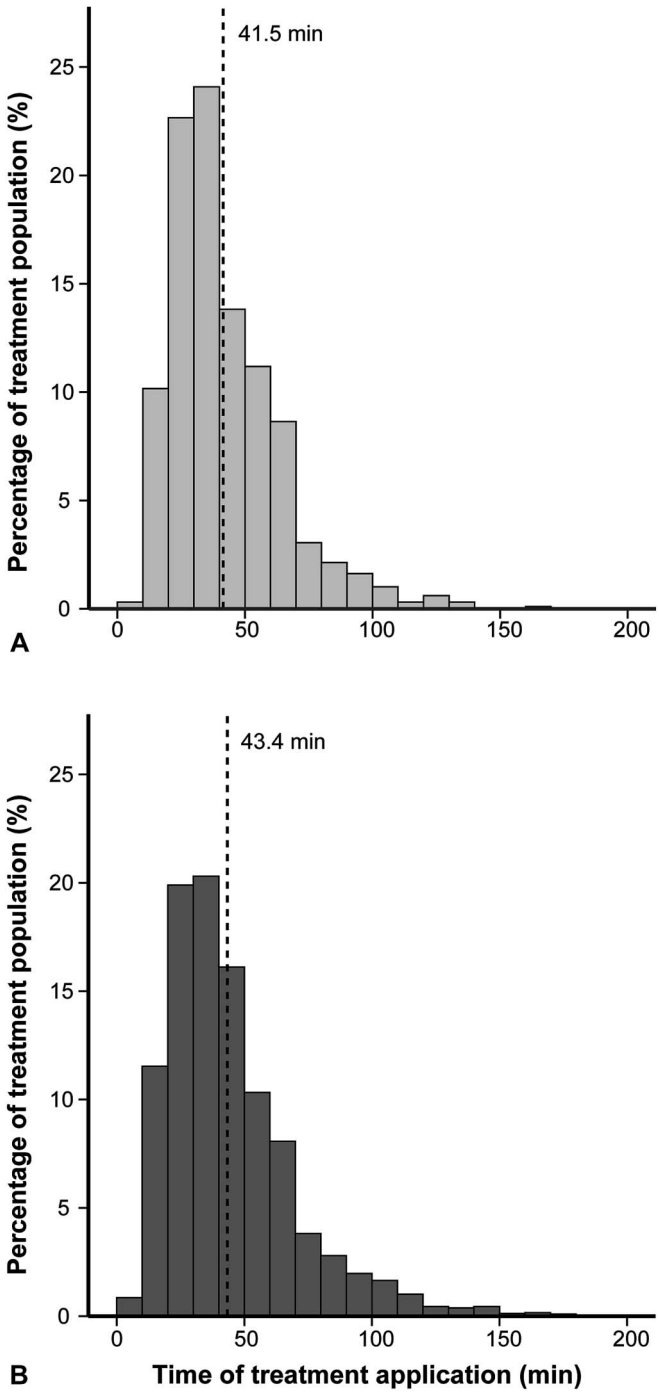

Figure 3. Percentage distribution of the time of treatment application of (A) fixation dressing (n = 984) and (B) adhesive tape (n = 3147). The dashed lines represent the average time of treatment application of fixation dressing (41.5 minutes) and adhesive tape (43.4 minutes) and show a significant time saving of 2 minutes (4.5%; P = 0.02).

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Follow-up Measurements

A subgroup of 254 subjects (8.7% of total study population; Figure 2) was included to assess effectiveness and satisfaction. Within this subgroup, the average age ($P = 0.62$), sex ($P = 0.95$), and walking distance ($P = 0.08$) were comparable with those of the overall study population. Furthermore, age, sex, and body mass index did not differ across the fixation dressing (n = 118) and adhesive tape groups (n = 136; Table 1). Foot disorders such as pes planus or pes cavus and toe joint deformities were reported in 18% of the fixation dressing group and 17% of the adhesive tape group. Mean training distance in the previous year was 571 km (SD = 568 km) in the fixation dressing group and 631 km (SD = 663 km) in the adhesive tape group and did not differ ($P = 0.46$). Most of the subjects wore walking shoes that were broken in (84% and 83% in the fixation dressing group and adhesive tape group, respectively). Furthermore, no differences were found between the groups in the number of blisters (3.1; SD = 2.0; Table 1) and the prevalence of denuded and blood blisters. Loss to follow-up ranged from 11% to 39% and did not differ between the fixation dressing and adhesive tape groups.

TABLE 1. Subject Characteristics

Characteristics	Fixation Dressing (n = 136)	Tape (n = 118)	*P*
Age, yrs	43 (14)	45 (14)	0.38
Male sex, %	55.9	54.2	0.79
White, %	96.3	96.6	0.36
BMI, kg/m^2	25.1 (3.2)	25.4 (3.7)	0.45
Medical history, %			
Diabetes	8.8	3.6	0.10
Hypertension	8.9	4.6	0.16
Dyslipidemia	5.7	4.0	0.54
Current smoker	18.1	15.9	0.62
Foot disorders, %			
Pes planus or pes cavus	13.6	12.5	0.80
Toe joint deformities	4.8	4.5	0.90
Training distance, km	571 (568)	631 (663)	0.46
Use of over-the-counter analgesics, %	32.8	40.2	0.24
Type of shoes, %			0.67
Walking shoes, broken in	84.3	83.2	
Walking shoes, new	5.5	7.1	
Running shoes	3.9	4.4	
Sneakers	2.4	3.5	
Walking distance during the 4DM km/d, %			0.48
30	5.9	9.3	
40	52.2	46.6	
50	41.9	44.1	
Blisters			
No. blisters	3.1 (2.0)	3.1 (1.9)	0.98
Presence of denuded blisters, %	15.4	21.2	0.24
Presence of blood blisters, %	11.0	5.1	0.90

BMI, body mass index.
Values are presented as mean values (SD) or as percentages, indicated by percentage.
There were no significant differences between the fixation dressing and the tape groups.

Pain Score and Drop Out

A similar decrease in pain intensity score was observed in the fixation dressing versus the adhesive tape group (−0.80; SD = 2.08 vs −0.56; SD = 2.68; Table 2). No differences were found between the fixation dressing and adhesive tape groups in the proportion of subjects who used over-the-counter analgesics during the 4DM (32.8% vs 40.2%; $P = 0.24$). A significantly higher drop-out rate in the 4DM was observed in the fixation dressing group as compared with the adhesive tape group (11.7% vs 4.0%, respectively, $P = 0.048$).

Blister Healing, Infection, and Additional Medical Treatment

Delayed healing was reported more frequently in the fixation dressing group (51.9%) as compared with the adhesive tape group (35.3%; $P = 0.02$; Figure 4). The number of subjects in who blisters were complicated by an infection was similar in the fixation dressing and adhesive tape groups (11.1% vs 16.5%, respectively). Furthermore, no difference was found between the fixation dressing and adhesive tape groups in the number of subjects who required additional medical blister treatment (6.5% vs 11.8%, respectively).

Satisfaction

In the fixation dressing group, 75.4% and 14.6% were (very) satisfied and (very) dissatisfied with the material, respectively, versus 85.3% and 4.9% in the adhesive tape group ($P = 0.054$; Figure 5). Subjects who were treated on multiple walking days and received treatment with both fixation dressing and adhesive tape (N = 67) were also asked to indicate a preference for either material. A total of 60 subjects (90%) reported a preference, with 48.3% in favor of fixation dressing and 51.7% in favor of adhesive tape ($P = 0.80$).

DISCUSSION

The aim of this study was to compare fixation dressing and adhesive tape in the treatment of friction blisters with a specific emphasis on time of treatment application, effectiveness, and satisfaction. The major findings were that treatment with fixation dressing resulted in the following: (1) a significant time reduction; (2) higher drop-out rates and delayed blister healing; (3) no differences in pain intensity score, infection, and additional medical treatments; and (4) a trend toward lower satisfaction, as compared with treatment with adhesive tape. These findings indicate that treatment with fixation dressing is inferior to adhesive tape in treating friction blisters.

Time of Treatment Application

Treatment of friction blisters with fixation dressing led to an average time saving of 2 minutes per treatment when compared with treatment with adhesive tape. Although this reduction in time of treatment application (4.5%) may seem

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TABLE 2. Time of Treatment Application and Effectiveness of Fixation Dressing and Adhesive Tape

Variable	Fixation Dressing	Adhesive Tape	*P*
Treatment duration, min (SD)	41.5 (21.6)	43.4 (25.5)	0.02*
Δ pain score (SD)	−0.80 (2.08)	−0.56 (2.68)	0.53
Drop out, %	11.7	4.0	0.048*
Delayed healing, %	51.9	35.3	0.02*
Infection, %	11.1	16.5	0.28
Additional medical treatment, %	6.5	11.8	0.20
Satisfied with material, %	75	85.3	0.054

** Statistically significant difference.*

small for an individual treatment, it may actually result in a substantial decrease in waiting time during walking events where a large number of treatments are given simultaneously.[11] Furthermore, when interpreting time of treatment application, we need to take into account that the vast majority of the subjects in our study had multiple blisters. Moreover, we measured the total time of treatment application, including inspection, pretreatment (ie, degreasing, disinfecting, lancing, and draining), and application of the covering material (fixation dressing or adhesive tape). To the best of our knowledge, there are no other published studies reporting time of treatment application of friction blisters or similar skin defects that could be used for comparison. In this study, a reduction in time of treatment application was achieved by intervening in the last stage of the treatment, that is, application of the covering material. Additional studies are required to examine whether further time saving may be achieved by shortening other treatment stages, such as the pretreatment.

Treatment Effectiveness

During the 4DM, we found a significantly higher drop-out rate in the fixation dressing group and no differences in pain intensity scores between the groups. Because no differences in potential confounders were found between the adhesive tape and fixation dressing groups at baseline (ie, age, sex, medical history, foot disorders, training distance, use of

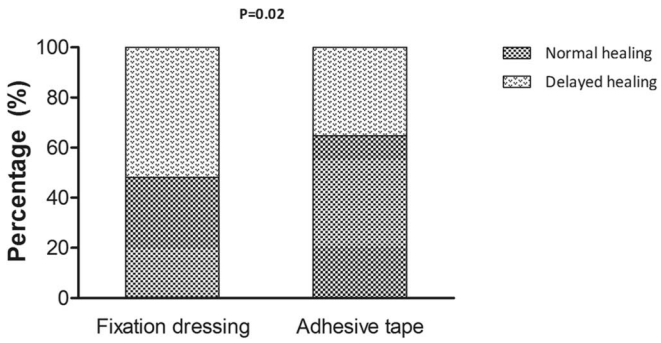

Figure 4. Delayed healing (≥2 weeks) was reported significantly more often in the fixation dressing group as compared with the tape group (52% vs 35%, respectively, $P = 0.02$).

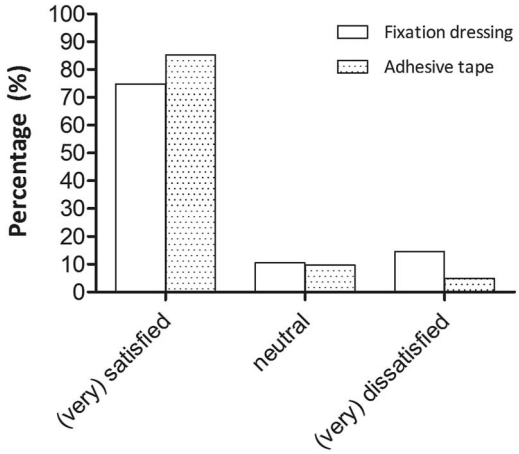

Figure 5. A trend toward lower satisfaction was found in the fixation dressing group as compared with the adhesive tape group; 75.4% in the fixation dressing group was (very) satisfied with the material versus 85.3% in the adhesive tape group, whereas 14.6% and 4.9% were (very) dissatisfied with the material in the fixation dressing and adhesive tape groups, respectively ($P = 0.054$).

over-the-counter analgesics, shoe type and number, and type of blisters), the higher drop-out rate seems to be the direct consequence of the use of fixation dressing. By including a follow-up period of 1 month, we were able to detect delayed blister healing in the fixation dressing group with no difference in either the infection rate or the need for additional medical treatments, compared with the adhesive tape group. A study by Roos and Setten van[5] is the only published literature that previously examined effectiveness of blister treatment. They measured effectiveness of adhesive tape compared with gauze (during the 4DM of 1953) by assessing infection, blister recurrence, and newly formed blisters 24 hours after treatment. They concluded that the adhesive tape group was superior in all measures; however, because no follow-up period was included the study, it was unable to evaluate blister healing, delayed infection, and the need for additional medical treatment. This might explain the difference in infection rate after treatment with adhesive tape, which was 0.3% according to Roos and Setten van and 16.5% in our study. Recently, Lipman et al[10] found that the use of tape in prevention of friction blisters led to a significant reduction in blister formation of 40%. However, as this study focused on a different exercise duration and intensity, these results may not be extrapolated to participants of long-distance walking marches. When all factors are accounted for, adhesive tape has shown to be the most effective way to treat friction blisters.

Satisfaction

Assessment of treatment satisfaction is especially relevant because positive associations between satisfaction and clinical outcomes have been found across a wide range of diseases and symptoms, including pain perception.[12] This is the first study, to our knowledge, to report satisfaction with blister-covering material. We found a trend of higher satisfaction in the adhesive tape group in comparison with the fixation dressing group ($P = 0.054$). Although treatment time for adhesive tape was longer, follow-up data revealed a better outcome over time. This may have

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contributed to the higher satisfaction in the adhesive tape group versus the fixation dressing group.

Clinical Relevance

The reduction in time of treatment application with fixation dressing is relevant for large groups during marching events and, to a lesser extent, for individual treatments. Because of the increasing popularity of long-distance walking events over the last decades,[13] rapid and effective treatment for friction blisters is necessary, and our study provides novel information on 2 treatment strategies. Although our data demonstrate that treatment with fixation dressing is a time-saving method for friction blisters, we also found a significantly higher drop-out rate and delayed blister healing in the fixation dressing group. These findings strongly suggest a preference for the use of adhesive tape as a first-aid treatment for friction blisters.

Limitations

The strengths of this study include the large population, its unique and prospective study design, and the 1-month follow-up period. Despite these strengths, a number of limitations should also be taken into account. We observed the optimal blister treatment for walking exercise only, so our results may not be applicable to other types of (endurance) exercise (ie, running). Furthermore, the self-reported nature of our effectiveness measurements may lead to recall bias. However, previous studies have demonstrated reasonable agreement between self-record and medical-record reports of medical conditions.[14–16] Furthermore, anonymity was ensured by asking subjects to only fill out their walking number instead of identifying information, and thus, social desirability bias was reduced. Loss to follow-up was modest (11%-39%)[17] and equal in the fixation dressing and adhesive tape groups. Therefore, this did not impact our findings.

CONCLUSIONS

Treatment with fixation dressing leads to a small but significant reduction in time of treatment application. Nevertheless, a higher drop-out rate and delayed blister healing (>2 weeks) were observed in the fixation dressing group in comparison with the adhesive tape group. Furthermore, a trend toward lower satisfaction was observed in the fixation dressing group. Consequently, despite the significant time saving, we do not recommend the use of fixation dressing in routine first-aid treatment for friction blisters. In conclusion, our data support the use of adhesive tape as the treatment of choice for friction blisters sustained from (prolonged) walking exercise.

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