First aid treatment for friction blisters: “walking into the right direction?”

Janssen L, Allard NAE, ten Haaf DSM, Romburgh CPP van, Eijsvogels TMH, Hopman MTE

Author list:
Lando Janssen, MD *
Neeltje AE Allard, MD *
Dominique SM ten Haaf, MSc *
Cees PP van Romburgh, MA †
Thijs MH Eijsvogels, PhD *#
Maria TM Hopman, MD, PhD *

* Radboud University Nijmegen Medical Centre (RUNMC), Department of Physiology, Nijmegen, the Netherlands
† The Netherlands Red Cross, The Hague, the Netherlands
# Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, Liverpool, United Kingdom.

Corresponding author:

Lando Janssen, MD
Department of Physiology (286)
Radboud University Nijmegen Medical Center (RUNMC)
Geert Grooteplein Zuid 30, 6525 GA Nijmegen
The Netherlands
Fax number: 0031243540535
Telephone number: 0031614552947
Email: Lando.Janssen@Radboudumc.nl

No author has conflict of interest related to this work.

Acknowledgments

We recognize the International Nijmegen 4DM Organization and The Netherlands Red Cross for their assistance. We especially thank Han Pelster and Henk Lulf of the Netherlands Red Cross for their contributions during the 4DM. We would like to thank dr. Joseph Hamati for his critical reading of this paper and valuable comments for improving the manuscript

Word count abstract: 250
Word count manuscript: 2968

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 two 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 yrs., 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 one 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 min; SD=21.6 min) in the wide area fixation dressing group compared to the adhesive tape group (43.4 min; SD=25.5 min; p=0.02). Furthermore, the wide area fixation dressing group demonstrated a significantly higher drop-out rate (11.7% *versus* 4.0%, p=0.048), delayed blister healing (51.9% *versus* 35.3%, p=0.02) and a trend towards lower satisfaction (p=0.054) when compared to the adhesive tape group.

Conclusions: Wide area fixation dressing decreased time of treatment application by 2 minutes (4.5%) when compared to adhesive tape. However, due to lower effectiveness and a trend towards lower satisfaction, we do not recommend the use of wide area fixation dressing over adhesive tape, in routine first aid treatment for friction blisters.

Keywords: exercise, walking, acute care, foot injuries, treatment outcome

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 the majority of friction blisters remain uncomplicated,

105 infections can occur (4, 5) with the risk of developing cellulitis or sepsis (6, 7). Furthermore,
106 in an attempt to avoid walking on the painful blisters an antalgic gait pattern occurs which
107 may lead to other exercise-related injuries, such as overuse injuries of the knee (8). Blister
108 treatment aims to reduce pain, facilitate healing of the skin and neutralize infection, and
109 prevent blister recurrence.
110 During the annual Nijmegen Four Day Marches (4DM), the world's largest multi-day walking
111 event with daily distances ranging from 30-50 km, the need for treatment of friction blisters
112 is very high. In prior years of the 4DM, the number of participants requiring at least a single
113 blister treatment varied between 4000 and 5000, accounting for ~10% of the total number
114 of walkers (9). Ever since 1954, blister treatment during the 4DM has been performed using
115 adhesive tape, however evidence for this treatment is based on only one study (5). Though
116 taping has been found to be an effective treatment (5), it is time consuming which can lead
117 to long waiting lines and disruption of the walking rhythm of the participants. Anecdotal
118 evidence suggests that the use of wide area fixation dressing may decrease time of
119 treatment application by approximately 10%. However, its effectiveness in the treatment of
120 friction blisters is unknown.
121
122 To date, only limited research has been conducted to examine different treatment regimens
123 for friction blisters (4, 5). Most studies that examined friction blisters have been performed
124 within the military (2, 6, 8) or in athletes (1, 10), with a high homogeneity for age and
125 physical activity levels and with a primary focus on prevention of blisters. Consequently, the
126 purpose of the current study was to prospectively compare the efficacy of fixation dressing
127 versus adhesive tape in first aid treatment of friction blisters. These two methods of
128 treatment were evaluated based upon 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 since it can be applied in one 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.

Methods

We performed an observational study during the 99th 4DM. Participants who walked either 30, 40 or 50 km per day 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) via 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 prior to 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 in order 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 (LJ and NA) 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 0-10 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. In order to determine the effect of type of blister treatment on experienced pain, we compared the pre- to post-treatment 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 two groups: rapid healing (<2 weeks) and delayed healing (≥2 weeks).

178

179 Assessment of satisfaction

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

186

187 Treatment

188 All participants of the 4DM with blisters requiring professional treatment were treated with
189 either fixation dressing (Fixomull Stretch, BSN medical GmbH & Co KG, Hamburg, Germany)
190 or adhesive tape (Leukoplast, BSN medical GmbH & Co KG, Hamburg, Germany). The fixation
191 dressing is a stretchable, non-woven dressing, which can be applied in one piece, whereas
192 the high tensile strength adhesive tape is applied in several overlapping strips (Figure 1).
193 Both materials are suitable for use on the entire foot, including heel, forefoot and toes. The
194 costs for fixation dressing and adhesive tape are similar (approximately $1,90/€1,80 per
195 foot). The treatment materials were applied by volunteers of the Netherlands Red Cross.
196 Although the level of expertise differed between the volunteers ranging from basic to
197 advanced, all volunteers finished a blister treatment training and were found qualified by
198 instructors to apply either fixation dressing or adhesive tape. Participants were randomly
199 allocated to a caregiver using standard treatment with adhesive tape or fixation dressing
200 without any pre-selection. Since adhesive tape is the standard blister treatment during the
201 4DM, more volunteers were trained to apply adhesive tape when compared to fixation

dressing, resulting in a ratio of 3:1 between the treatment groups. Prior to applying the fixation dressing or adhesive tape, pre-treatment 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's t-tests and Wilcoxon rank sum test were performed to compare data between the adhesive tape and fixation dressing group for continuous variables when data was normally and non-parametrically distributed, respectively. For comparison of categorical variables Pearson χ^2 test was used or Fisher's 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 yrs., 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 due to invalid treatment application times). Average time of treatment application in the fixation dressing group was lower (41.5 min; SD=21.6 min) compared to the adhesive tape group (43.4 min; SD=25.5 min; p=0.02; Figure

225 3). In addition, time of treatment application was calculated for the different parts of the
226 foot (toes, forefoot and heel) separately. Time of treatment application for toe blisters was
227 not different between the fixation dressing and adhesive tape group (34.1 min; SD=16.8 min
228 vs. 35.2 min; SD=22.0 min, respectively; p=0.52). For forefoot and heel blisters, time of
229 treatment application was lower in the fixation dressing group compared to the adhesive
230 tape group (27.1 min; SD=13.8 min vs. 32.9 min; SD= 23.2 min; p=0.001 and 27.0 min;
231 SD=11.4 min vs. 32.0 min; SD=18.4 min; p=<0.001, respectively).
232
233 Follow-up measurements
234 A subgroup of 254 subjects (8.7% of total study population; Figure 2) was included to assess
235 effectiveness and satisfaction. Within this subgroup, the average age (p=0.62), gender
236 (p=0.95) and walking distance (p=0.08) were comparable to the overall study population.
237 Furthermore, age, gender and BMI did not differ across the fixation dressing (n=118) and
238 adhesive tape group (n=136; Table 1). Foot disorders such as pes planus/pes cavus and toe
239 joint deformities were reported in 18% of the fixation dressing group and 17% of the
240 adhesive tape group. Mean training distance in the previous year was 571 km (SD=568 km)
241 in the fixation dressing group and 631 km (SD=663 km) in the adhesive tape group and did
242 not differ (p=0.46). The majority of the subjects wore walking shoes that were broken in
243 (84% and 83% in the fixation dressing group and adhesive tape group, respectively).
244 Furthermore, no differences were found between the groups in the number of blisters (3.1;
245 SD=2.0; Table 1) and the prevalence of denuded and blood blisters. Loss to follow-up ranged
246 from 11% to 39% and did not differ between the fixation dressing and adhesive tape group.
247

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 *versus* -0.56; SD=2.68; Table 2). No differences were found between the fixation dressing and adhesive tape group in the proportion of subjects that used over-the-counter analgesics during the 4DM (32.8% *versus* 40.2%; p=0.24). A significantly higher drop-out rate in the 4DM was observed in the fixation dressing group as compared to the adhesive tape group (11.7% *versus* 4.0%, respectively, p=0.048).

Blister healing, infection, additional medical treatment

Delayed healing was reported more frequently in the fixation dressing group (51.9%) as compared to the adhesive tape group (35.3%; p=0.02; Figure 4). The number of subjects in which blisters were complicated by an infection was similar in the fixation dressing and adhesive tape group (11.1% *versus* 16.5%, respectively). Furthermore, no difference was found between the fixation dressing and adhesive tape group in the number of subjects who required additional medical blister treatment (6.5% *versus* 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 and51.7% in favor of adhesive tape (p=0.80).

Discussion

The aim of the present study was to compare fixation dressing and adhesive tape in the treatment for 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: 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 towards lower satisfaction as compared to 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 savings of 2 minutes per treatment when compared to treatment with adhesive tape.. Although this reduction in time of treatment application (4.5%) may seem 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, pre-treatment (i.e. degreasing, disinfecting, lancing and draining) and applying 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 utilized for comparison. In this study a reduction in time of treatment application was achieved by

intervening in the last stage of the treatment, i.e. applying covering material. Additional studies are required to examine whether further time savings may be achieved by shortening other treatment stages, such as the pre-treatment.

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. Since no differences in potential confounders were found between the adhesive tape and fixation dressing group at baseline (i.e. age, gender, medical history, foot disorders, training distance, use of over-the-counter analgesics, shoe type and number and type of blisters), the higher drop-out rate appears to be the direct consequence of the use of fixation dressing. By including a follow-up period of one 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 of additional medical treatments compared to the adhesive tape group. A study by Roos and van Setten (5) is the only published literature that previously examined effectiveness of blister treatment. They measured effectiveness of adhesive tape compared to gauze (during the 4DM of 1953) by assessing infection, blister recurrence and newly formed blisters 24 hours post treatment. They concluded that the adhesive tape group was superior in all measures; however, since no follow-up period was included the study 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 van Setten 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, since 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 to 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 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. Due to 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 two treatment strategies. Although our data demonstrates 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 one 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 (i.e. running). Furthermore, the self-reported nature of our effectiveness measurements may lead to recall bias. However, previous studies have demonstrated reasonable agreement between self- and medical record report 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 group. Therefore, this did not impact our findings.

Conclusion

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 towards lower satisfaction was observed in the fixation dressing group. Consequently, despite the significant time savings, we do not recommend the use of fixation dressing in routine first aid treatment for friction blisters . In conclusion, our data supports the use of adhesive tape as the treatment of choice for friction blisters sustained from (prolonged) walking exercise.

References

1. Brennan FH, Jr. Managing blisters in competitive athletes. Current sports medicine reports. 2002;1(6):319-22.

2. Knapik JJ, Reynolds KL, Duplantis KL, et al. Friction blisters. Pathophysiology, prevention and treatment. Sports Med. 1995;20(3):136-47.

3. Naylor PFD. EXPERIMENTAL FRICTION BLISTERS. British Journal of Dermatology. 1955;67(10):327-42.

4. Cortese TA, Jr., Fukuyama K, Epstein W, et al. Treatment of friction blisters. An experimental study. Archives of dermatology. 1968;97(6):717-21.

5. Roos J, Setten van PH. De behandeling van wandelblaren. Dutch Journal of Medicine. 1954;98:1988-92.

6. Hoeffler DF. Friction blisters and cellulitis in a navy recruit population. Military medicine. 1975;140(5):333-7.

7. Taylor CM, Riordan FA, Graham C. New football boots and toxic shock syndrome. Bmj. 2006;332(7554):1376-8.

8. Van Tiggelen D, Wickes S, Coorevits P, et al. Sock systems to prevent foot blisters and the impact on overuse injuries of the knee joint. Military medicine. 2009;174(2):183-9.

9. RedCross. Rode Kruis behandelde 12.000 blaren Vierdaagse: The Netherlands Red Cross; 2014 [cited 2014 19-07-2014]. Available from: http://www.rodekruis.nl/actueel/nieuws/rode-kruis-behandelde-12000-blaren-vierdaagse?gclid=CjwKEAjw_7y4BRDykp3Hjqyt_y0SJACome3TLuQ90LLLa2qGu8k9weWzC5ETWkzXnohe7n_InqMbthoCzOrw_wcB.

10. Lipman GS, Sharp LJ, Christensen M, et al. Paper Tape Prevents Foot Blisters: A Randomized Prevention Trial Assessing Paper Tape in Endurance Distances II (Pre-TAPED II). Clinical journal of sport medicine : official journal of the Canadian Academy of Sport Medicine. 2016.

11. Wiler JL, Bolandifar E, Griffey RT, et al. An emergency department patient flow model based on queueing theory principles. Academic emergency medicine : official journal of the Society for Academic Emergency Medicine. 2013;20(9):939-46.

12. Doyle C, Lennox L, Bell D. A systematic review of evidence on the links between patient experience and clinical safety and effectiveness. BMJ Open. 2013;3(1).

13. Eijsvogels T. Physiological demands of prolonged exercise: Science of the Nijmegen Four Days Marches: Radboud University Nijmegen Medical Centre; 2011.

14. Okura Y, Urban LH, Mahoney DW, et al. Agreement between self-report questionnaires and medical record data was substantial for diabetes, hypertension, myocardial infarction and stroke but not for heart failure. Journal of clinical epidemiology. 2004;57(10):1096-103.

15. Bush TL, Miller SR, Golden AL, et al. Self-report and medical record report agreement of selected medical conditions in the elderly. American journal of public health. 1989;79(11):1554-6.

16. Hansen H, Schafer I, Schon G, et al. Agreement between self-reported and general practitioner-reported chronic conditions among multimorbid patients in primary care - results of the MultiCare Cohort Study. BMC family practice. 2014;15:39.

17. Kristman V, Manno M, Cote P. Loss to follow-up in cohort studies: how much is too much? European journal of epidemiology. 2004;19(8):751-60.

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

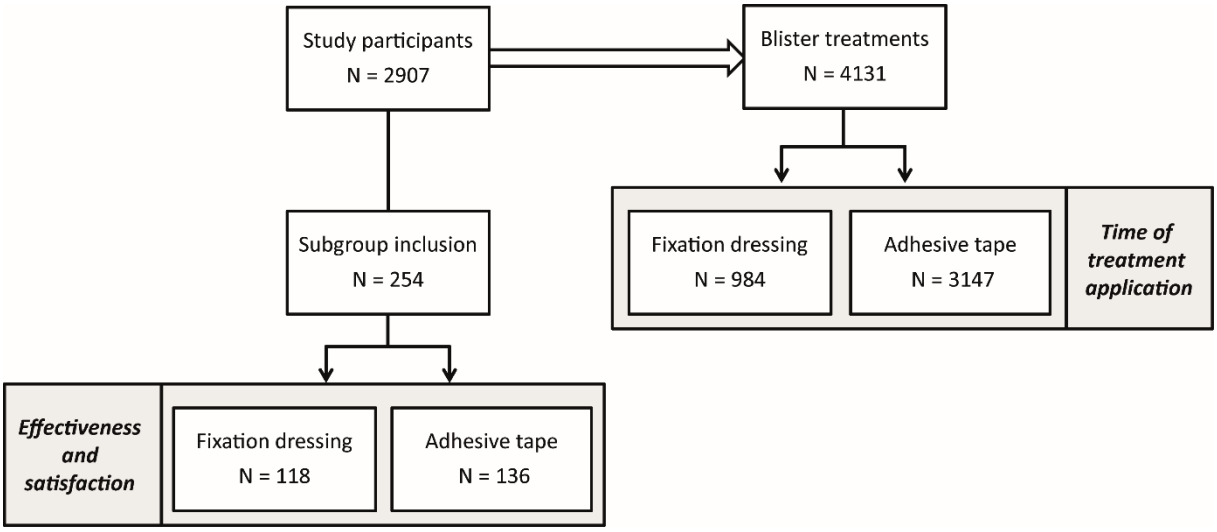
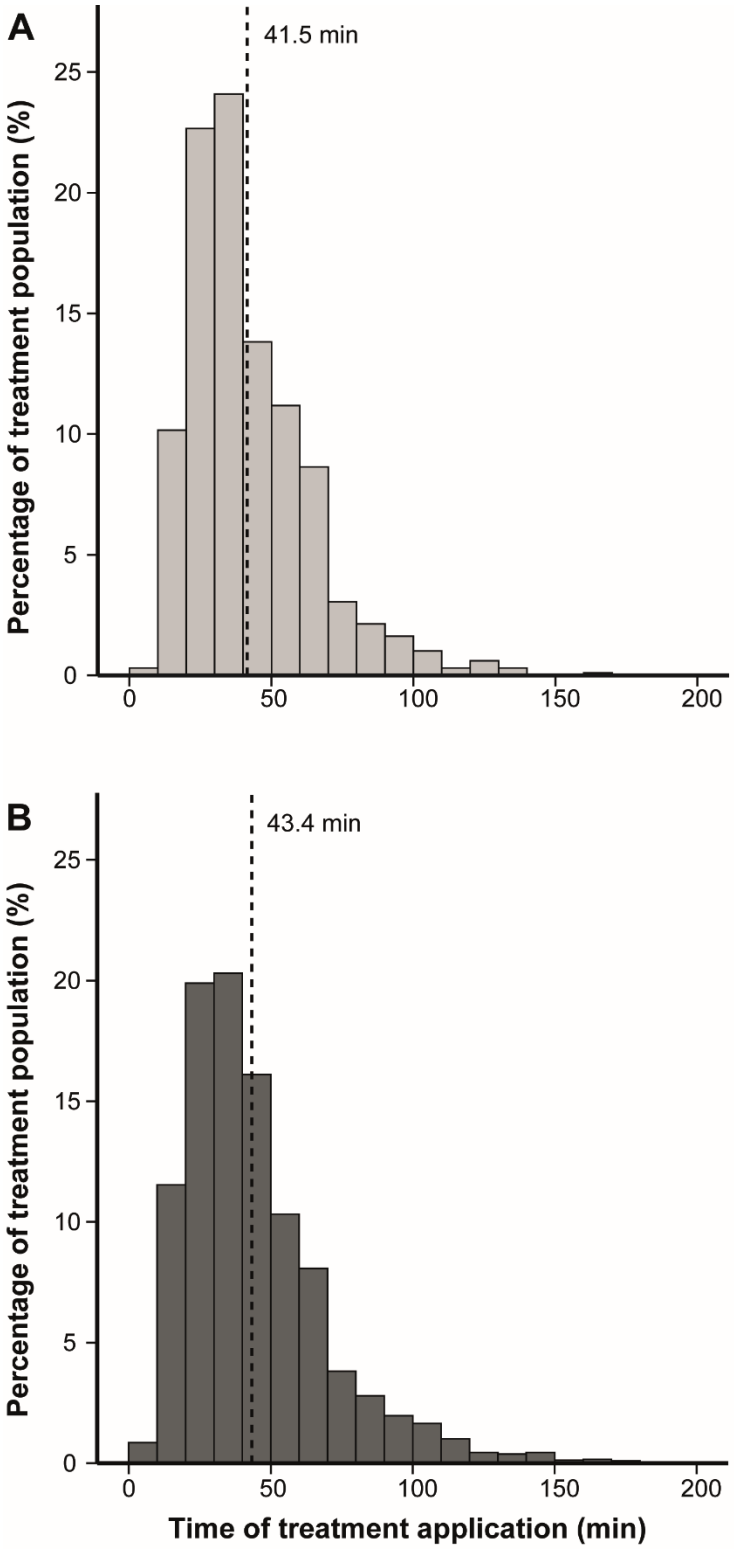


Figure 2. *Flow chart of the study population and measurements performed. In short, time of treatment application was assessed in 2907 participants with 4131 friction blisters. Furthermore, the effectiveness and satisfaction of the treatment were assessed in 254 participants during 3 follow-up measurements: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



429

430 **Figure 3.** *Percentage distribution of the time of treatment application of (A) fixation dressing*

431 *(n=984) and (B) adhesive tape (n=3147). The dashed lines represent the average time of*

432 *treatment application of fixation dressing (41.5 min) and adhesive tape (43.4 min) and show*

433 *a significant time saving of 2 minutes (4.5%; p=0.02).*

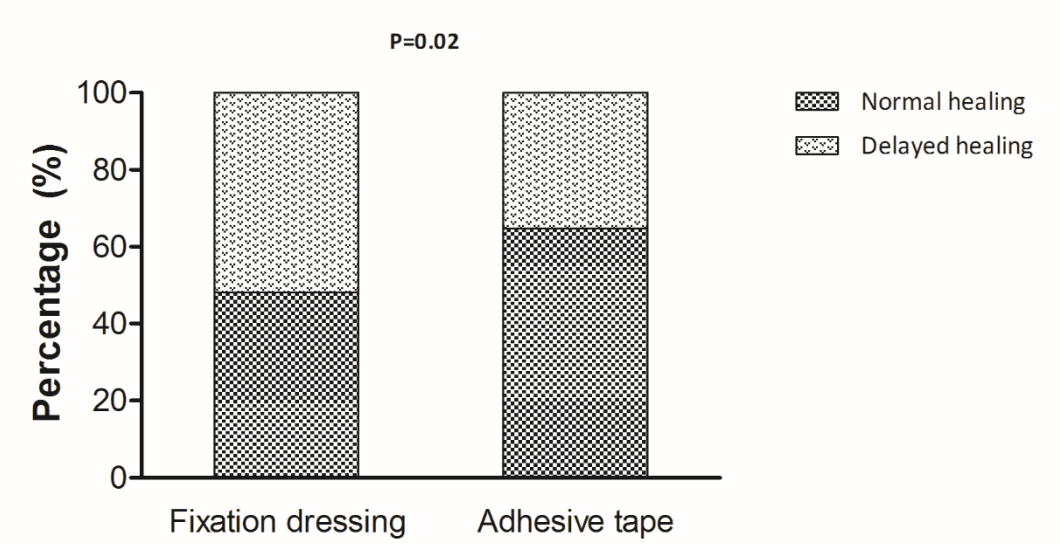


Figure 4. *Delayed healing (≥2 weeks) was reported significantly more often in the fixation dressing group as compared to the tape group (52% versus 35%, respectively, p=0.02).*

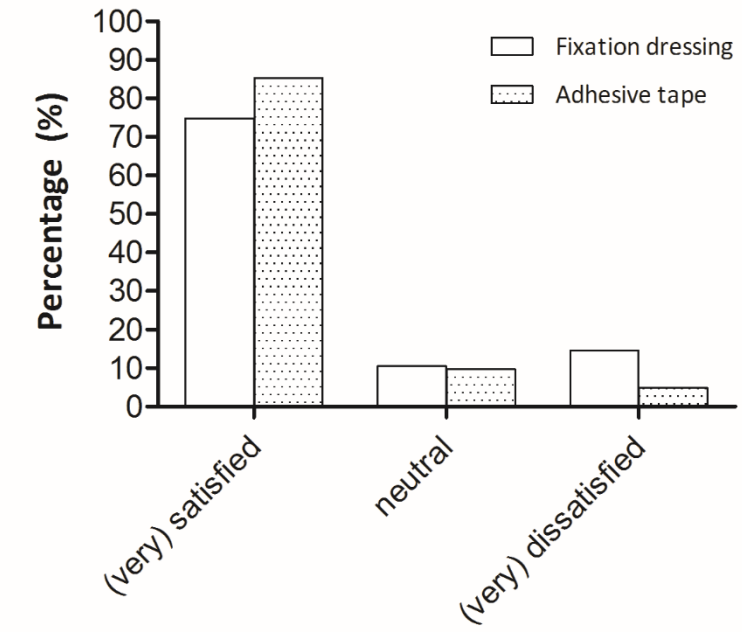


Figure 5. *A trend towards lower satisfaction was found in the fixation dressing group as compared to the adhesive tape group; 75.4% in the fixation dressing group was (very) satisfied with the material versus 85.3% in the adhesive tape group, whereas 14.6% and 4.9%*

442 *were (very) dissatisfied with the material in the fixation dressing and adhesive tape group,*

443 *respectively (p=0.054).*

444

Table 1. Subject characteristics

Characteristics	Fixation dressing (n=136)	Tape (n=118)	P-value
Age, years	43 (14)	45 (14)	0.38
Male gender	55.9%	54.2%	0.79
Caucasian	96.3%	96.6%	0.36
BMI, kg/m2	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/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 into	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 4DM			0.48
30 km/day	5.9%	9.3%	
40 km/day	52.2%	46.6%	
50 km/day	41.9%	44.1%	
Blisters			
Number of 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

445 Values are presented as means (SD) or as percentages, indicated by %. There were no significant differences
446 between the fixation dressing and the tape group.

Table 2. Time of treatment application and effectiveness of fixation dressing and adhesive tape

Variable	Fixation dressing	Adhesive tape	P-value
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

447 * Statistically significant difference

448