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Kinesiotaping in the emergency department: The effect of kinesiotaping on acute pain due to uncomplicated traumatic injury of the shoulder or chest wall. A pilot study.

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ABSTRACT

Introduction: Traumatic injuries of the shoulder or chest wall are commonly treated in the Emergency Department (ED). A complementary treatment is kinesiotaping, an elastic tape often used to treat musculoskeletal dysfunction and pain. However, the added pain-reducing effect of kinesiotape in comparison to standard conservative treatment is unknown. The aim of this study was to determine the effect of kinesiotaping on pain relief compared to standard treatment with pain medication and immobilization in patients with uncomplicated traumatic injury of the shoulder or chest wall in the ED.

Method: A pilot randomized controlled trial (RCT) was conducted in the ED of a teaching hospital in the Netherlands from January 2021 until the end of March 2021. Patients diagnosed with uncomplicated isolated rib fractures, rib contusions, clavicle fracture, disruption of the AC joint and fracture of the proximal humerus were assigned to two treatment groups. The control group received the standard treatment with oral analgesics (acetaminophen q6h 1000 mg and NSAID (according to prescription) and if shoulder injury also a sling. The intervention group received kinesiotaping in addition to the same standard treatment. Pain intensity was measured with 0–10 Numeric Rating Scale (NRS) just before treatment (T1) and after 15 min (T2). On day 4 both groups were assessed with NRS in a follow up phone call (T3).

Results: A total of 251 patients presented with traumatic injury of the shoulder or chest wall in the study period, 85 patients were approached to participate and 2 of them were excluded. The remaining 83 were randomly allocated to kinesiotaping (n = 40) or control group (n = 43), 57 of them completed the study and had sufficient data for complete analysis In both groups, pain intensity after 15 min and 4 days significantly reduced compared with baseline. Regarding the reduction of pain intensity on day 4, kinesiotaping was significantly superior compared to the control group with a difference in pain reduction of 2.45 compared with 0.88 in control group ($p = 0.018$).

Conclusion: Compared to standard treatment alone, kinesiotaping combined with standard care appears to be more effective in terms of acute pain reduction in patients with uncomplicated traumatic injury of the shoulder or chest wall. Further research is recommended.

1. Introduction

Fractures of the ribs, clavicle, proximal humerus and disruption of the acromioclavicular (AC) joint are commonly treated injuries in the Emergency Department (ED) [1,2]. The main symptom of these injuries is intense pain, which increases when moving the affected body part. A decreased range of motion, breathing capacity and power to cough are known consequences of this pain. In addition, discomfort in breathing may result in atelectasis, decreased lung compliance, hypoxemia and respiratory distress [3]. Inadequately treated acute pain is known to delay recovery and increase the risk of developing chronic pain [4].

The most common conservative treatment of fractures is immobilization and oral analgesics. However, due to practical reasons it is not possible to cast the injuries described above. Therefore, conservative

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treatment with oral analgesics (and a sling in shoulder injuries) is the only non-invasive conservative treatment option [5]. Unfortunately, this may not provide adequate analgesia for every patient [2,3].

Previous research and best practices present the option of kinesiotaping (KT). KT could be an addition to the standard analgesic care. KT is a drug-free elastic therapeutic tape used for treating various musculoskeletal injury, pain and dysfunction. The exact working mechanism of kinesiotape is unclear. Research suggests kinesiotape supports injured muscles and joints, improves fascia function and position and increases segmental stability. In addition, it may activate blood and lymph flow by lifting the skin and decrease pain by reducing nociceptive stimulation [2-13]. Researchers also claimed significant symptom relief, comfort and stability of the involved joint. Patients also reported these advantages [6-10]. In other studies, kinesiotaping has been successful for low back pain during pregnancy [11], rib fractures [2,12], other musculoskeletal injuries especially in sports medicine [13] and shoulder pain with no fracture [9,10]. There is no earlier research found on the effect of kinesiotaping in pain due to acute traumatic injury of the shoulder in emergency departments. However, anecdotal feedback and experience has suggested the hypothesis that kinesiotaping of the shoulder or chest wall could reduce acute pain within minutes.

The aim of this study was to determine the effectiveness of kinesiotaping on pain in patients with traumatic injury of the shoulder or chest wall.

2. Patients and methods

2.1. Study design

A prospective randomized controlled trial (RCT) was conducted in an ED of a teaching hospital in The Netherlands between January 4 and March 31, 2021.

The study was approved by the local institutional review board and regional medical ethics committee. All patients provided written informed consent prior to participation in the study.

2.2. Selection of participants

Adult patients diagnosed with acute traumatic injury of the shoulder and chest wall were included in this trial. This included the diagnoses of rib fracture, rib contusion, disruption of the AC joint and fracture of the clavicle or proximal humerus. Inclusion and exclusion criteria are defined in Table 1.

Patients were included at any time of day by the attending emergency physician or resident, nurse practitioner, nurse or plaster technician (in training). They explained the study protocol vocally to the patient. Also, a printed information leaflet was handed out to illustrate this. A protocol transcript for patient explanation was available for providers. When informed consent was obtained, randomization by sealed blank envelops followed. After opening the envelope, even numbered patients were included in the intervention group and odd numbers were assigned to the control group.

Table 1
Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Patients >18 years old	Patients <18 years old
Rib fracture on chest x-ray or CT	Incapacitated patients
Rib contusion (clinical diagnosis)	3 or more rib fractures
Disruption of acromioclavicular (AC) joint	Hospitalization
Fracture of the clavicle	Fracture of rib number 1–3
Proximal humeral fracture	Presence of haemo- or pneumothorax with indication for a chest tube
	Hemodynamic instability
	Endotracheal intubation indication
	Loss of consciousness (GCS <15)
	Required surgical treatment
	Tape allergy
	No Dutch or English language

2.3. Interventions and methods of measurements

The control group received the standard treatment with oral analgesics. A sling was added if the diagnosis was shoulder injury. This control group was compared with the same treatment combined with kinesiotaping (intervention group).

The oral treatment was given when the patient entered the ED. The oral analgesics were acetaminophen 1000 mg and Naproxen 500 mg by protocol (unless contraindicated). This combined oral therapy is known for its pain reducing effect in 90 min for patients with acute musculoskeletal injuries in the ED [9]. If the patient was already treated with oral analgesics by self-care or paramedics, the time of administration was noted. Patients could decline oral analgesics.

Pain intensity was assessed with 0–10 Numeric (Pain) Rating Scale (NRS) [10]. NRS is comparable on validity and reliability with VAS and is validated to use by phone [10–22]. In accordance with previous research [2], the pain score was assessed before the treatment with kinesiotaping (T1), after 15 min (T2) and on day 4 (T3). The control group was assessed in the same moments as the intervention group.

After finishing all ED procedures, the level of pain intensity was noted (T1) and kinesiotaping was applied by a nurse, nurse practitioner or a plaster technician. The pain score was reassessed after 15 min (T2) and on day 4 in a follow-up phone call (T3). On day 4, the research team checked if the tape was still attached to the body by asking the patient if they removed the tape.

To ensure uniformity and quality in applying technique, instructional videos (supplement A) were made and distributed by personal education and email. These instructional videos were also included in the hospital protocol index. All health care professionals responsible for applying the tape (n = 139) were already familiar with the applying tape techniques due to their normal skills and training. Extra hands-on training sessions were offered by experienced plaster technicians if needed. The health care professional, responsible for the patient who participated in the study, applied the tape on the patient. Applying the tape takes a few minutes. Examples of the applying techniques are presented in Fig. 1.

2.4. Statistical analysis

Since this was a pilot study, no power analysis was calculated. The choice for convenience sampling was made on the recommendation of experts. The reason for this recommendation was the limited time of 3 months during the COVID-19 epidemic. A total of 30 participants per group was found feasible, based on patient flow in history.

Descriptive statistics of the characteristic variables were reported as mean and standard deviation (SD). Despite non-parametric tests, means and SD were chosen to facilitate comparison with previous research. To compare differences in groups Mann-Whitney *U* test was performed. Wilcoxon test was used to compare periods. To demonstrate clinically relevance Cohens' d was used. According to NRS-standard [15], a reduction of 2 points in the 1–10-point NRS-scale is recognized as a clinically relevant decrease. In all analyses, a p value <0.05 was considered significant. Because of the choice for means with non-parametric tests, there was no confidence interval calculated.

3. Results

In the study period 251 patients presented to the ED with rib fracture, rib contusion, clavicle fracture, disruption of the AC joint or proximal humeral fracture. A total of 85 patients were approached and included to participate. The remaining 166 patients were not approached for the study due to departmental logistics (e.g. excessive

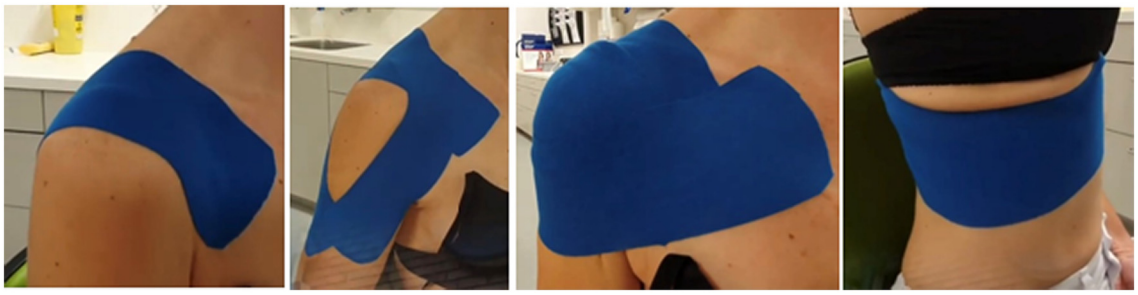

Fig. 1. Examples of applied kinesiotaping.
Legend: Applied KT on 1. Disruption of the AC joint; 2. Fracture of the clavicle; 3. Proximal humeral fracture; 4. rib fracture or contusion. For full view of the applying techniques, link to the instructional videos (supplement A).

patient volume or understaffing) . Two of the 85 patients were excluded because they did not meet the inclusion criteria after all. The remaining 83 were randomly assigned to kinesiotaping (n = 40) and to the control group (n = 43). A total of 26 patients were excluded during the process due to several reasons, presented in Fig. 2. If data was missing, the patient was excluded for that time of measurement. The final statistical analysis was performed on 57 patients: control group 29 and intervention group 28. The inclusion process is presented in the consort diagram in Fig. 2.

There were no baseline differences between the two groups in terms of age, gender, diagnosis, pain intensity and use of oral analgesics. On day 4, there was also no significant difference between the groups in terms of use of oral analgesics (Table 2).

In both groups, a significant reduction in pain was observed when comparing T1 (baseline) with T2 (15 min) (intervention group $p = 0.006$; control group $p = 0.02$). On T3 (day 4) both groups also demonstrated a significant difference in pain reduction, compared with baseline (T1) ($p \leq 0.001$, $p = 0.014$). Kinesiotaping (intervention group) was significantly superior to the control group regarding the reduction in pain intensity ($p = 0.018$) with a mean decrease of NRS 2.44 based on a mean pain level of 2.86 in the intervention group compared to a mean pain level of 4.74 in control group (Tables 3, 4 and 5). Cohens effect size was $d = 0.9$.

Further analysis on the lost in follow-up group showed no significant difference based in age ($p = 0.167$), gender ($p = 0.28$), diagnosis ($p = 0.155$) and NRS at T0 ($p = 0.183$), T1 ($p = 0.265$) and T2 ($p = 0.505$).

4. Discussion

Patients with traumatic injury of the shoulder or chest wall seem to experience a statistically significant difference in pain reduction after 15 min and on day 4 whether they received kinesiotaping or not. Kinesiotaping was significantly superior to standard care. In both groups there was no significant difference found in the use of oral analgesics. Therefore, this factor may be discounted. The significant difference is also clinically relevant with a high effect size on day 4.

To our knowledge this is the first study to examine the reduction of pain by applying kinesiotape in patients with a fracture of the clavicle, disruption of the AC joint and proximal humeral fracture in ED. The results are consistent with the study reported by Akça et al. (2020) who investigated the effect of kinesiotaping in rib fractures. In both studies a significant difference in pain intensity by using kinesiotaping is shown. The results of Akça et al. demonstrate a bigger difference in pain decrease than the present study. Kaplan et al. (2016) reported similar findings by using kinesiotaping with pregnant patients with low back pain. However, Mostafavifar (2016) found kinesiotaping immediately reduced the pain in cervical spine after whiplash with no long-term effects. The present study shows decrease of pain intensity with and without the use of kinesiotaping so the natural healing progress of pain could have an effect on the pain reduction as well. All studies used their own protocol, and all applied the tape with their own techniques. This could be a reason for the differences in pain intensity in these studies. Further research is recommended to understand the differences of the known studies, the influence of natural progress of pain and the choice of technique applied.

Earlier studies did not claim any disadvantages or difficulties when using the KT. The only suggested difficulty might be the removal of the tape and anecdotally, some surgeons claim a higher risk of infection due to the removal of the tape. There is no hard evidence for this claim found in literature, as is for skin reactions, allergies or skin lesions. The most recent study of Akça et al. (2020) showed no adverse effect after 4 days of kinesiotaping [2]. Many different manufacturers claim the tape is hypoallergenic and latex free. In the current study, no patient experienced any adverse effects. Because this was not a part of the research question, it was not included in the results.

The internal validity is guaranteed with randomizing, a valid method of measurement, similar application, measurement techniques and procedures. A transcript was also used for follow-up (supplement B). However, the test effect threatens this internal validity because the participants could remember their own previously pain intensity levels. The external validity is threatened by the possibility of bias of the act of measurement, as the results could have changed because the participants could be sensitive for the treatment with kinesiotape. The placebo effect cannot be ruled out as well. The possible thought of the support of the affected body part could distort the experience of pain. It still is an unresolved question if it is clinically relevant if a decrease of pain is due to the tape or placebo effect. Further research with a placebo-group is recommended.

Furthermore, the generalizability of this intervention depends on the training of health care professionals. The skill of applying the tape is quick and easy to learn by instructions of a skilled health care professional or an instructional video (Fig. 1 and supplement A).

The loss of patients on follow-up was reasonably high. Further analysis on the lost in follow-up group might help understand if this group was lost due to high or low pain intensity levels. These analyses showed no significant difference in age, gender, diagnosis and NRS in all the times of measurement so these characteristics are probably no reason for loss to follow-up. The internal validity is thereby not threated.

4.1. Limitations

In this study, patients with four different diagnoses were included as a combined group. Evidently, kinesiotaping will cause significant difference in pain relief in the total group. The individual effect of kinesiotaping on the subgroups is not known. The results may not be generalizable as all subgroups have their own signs and symptoms in pain intensity and prognosis. Because of the limited time of inclusion (3 months) and the decrease of ED patients with traumatic injuries due to the COVID-19 pandemic, the sample size is too limited to discriminate the data of the subgroups. Because of this limited time and

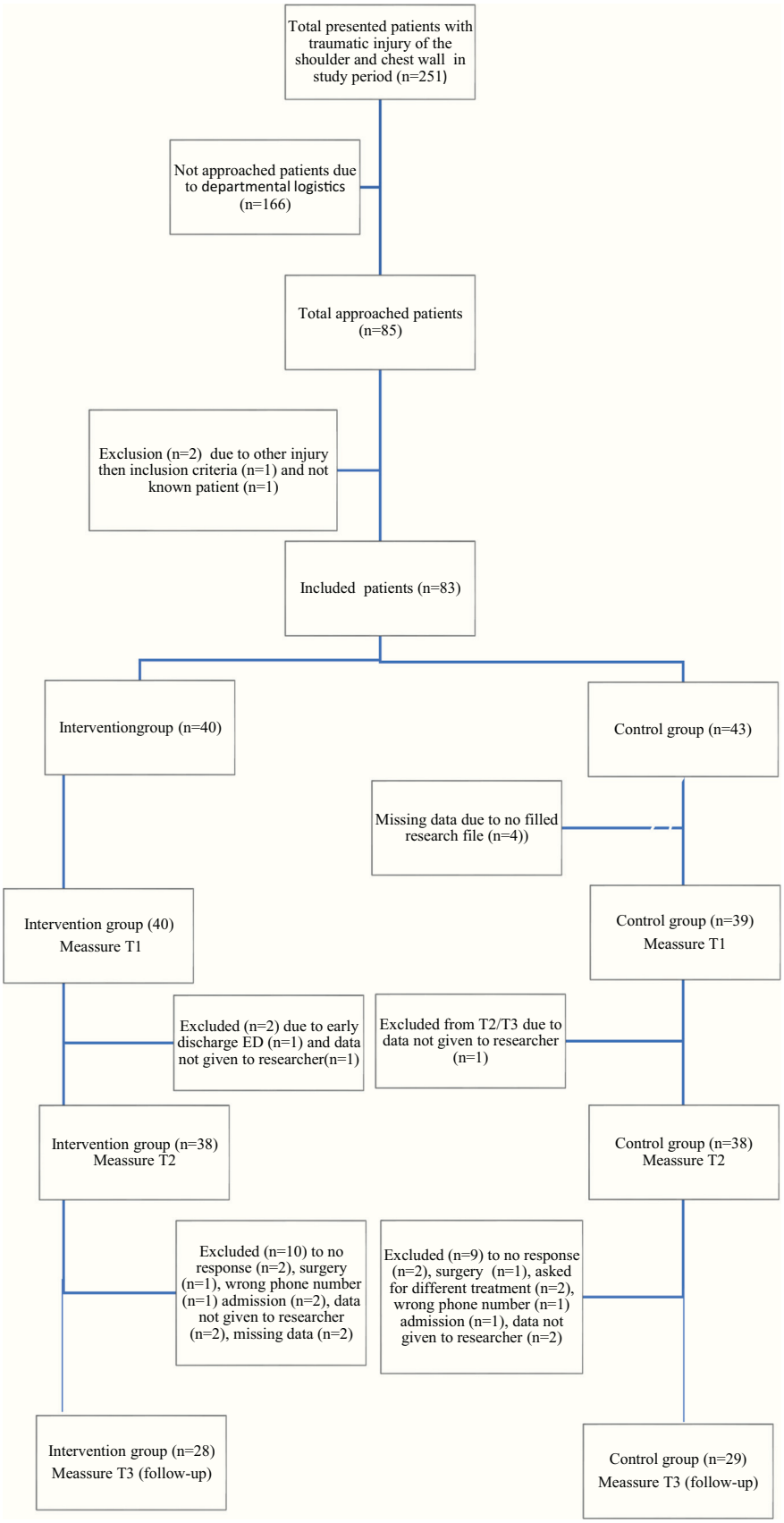

Fig. 2. Consort diagram.

Table 2
Characteristics of participants.

	Intervention group (n = 40)	Control group (n = 43)	P-value[a]
Age (years); mean (SD)	56.38 (15.893)	50,70 (17,656)	0.129[c]
Gender (n, %total)			0.726[b]
- M	18 (21.7%)	21 (25.3%)	
- F	22 (26.5%)	22 (26.5%)	
Diagnosis (n, %total)			0.501[b]
- Rib fracture	1 (1.2%)	4 (4.8%)	
- Rib contusion	5 (6%)	4 (4.8%)	
- Fracture clavicle	8 (9.6%)	9 (10.8%)	
- Dislocation AC joint	5 (6%)	2 (2.4%)	
- Proximal humeral fracture	21 (25.3%)	24 (28.9%)	
Pain intensity entering ED T0 (NRS); Mean (SD)	5.49 (3.023)	5.36 (3164)	0.982[d]
Oral analgesic given on ED (n, %group)	24 (60%)*	23 (53.5%)*	0.621[b]
Oral analgesic necessary on day 4 (n, %total)	26 (41%)	29 (46%)	0.421[d]
Kind of oral analgesic on day 4 (n, %group)			
- Acetaminophen	23 (27.7%)	24 (28.9%)	0.440[b]
- NSAID	11 (13.3%)	13 (15.7%)	0.784[b]
- Opioids	4 (2.4%)	7 (8.4%)	0.701[b]

Legend: SD: standard deviation, n: number, ED: Emergency Department, NRS: Numeric Rating Scale, NSAID: Non Steroidal Anti-Inflammatory Drug, [a]p-value: statistic significant if P < 0,05, [b]Pearson Chi-Square [c]unpaired t-test [d]Mann Whitney U test *none of the patients received oral analgesics by selfcare prior to arrival in the ED.

Table 3
Mean level of pain intensity (NRS).

	Intervention group kinesiotaping	Control group	p-value
NRS (T1) mean (SD)	5.16 (2507)	5.4 (2729)	p = 0.580[a]
NRS after 15 min (T2) mean (SD)	4.47 (2.50)	5 (2.579)	p = 0.519[a]
NRS day 4 (T3) mean (SD)	2.86 (2.722)	4.74 (2669)	**p = 0.023[a]**

Legend: NRS: pain intensity score according to Numeric Rating Scale, SD: Standard Deviation, p: p-value, statistic significant if P < 0,05, T1: 1st measure time NRS after finishing all procedures in ED, T2: 2nd measure time: 15 min after T1, T3: 3th measure time on day 4. [a]Mann Whitney U test.

decrease of patients, the power of this study is one of the big limitations. The calculated patient flow was based on the patient flow in history instead of a power analysis. This calculated patient flow was not reached in the three months' time available for the study. The likely reason for this is the number of patients in loss to follow-up and due to COVID-19, which generally reduced the numbers of patients on the ED. This results in the desired number of 30 patients in each group was not met, which has its effect on the power of this pilot study. A study with more included patients in separate groups of diagnosis could give more insight in the effect of kinesiotaping in pain in general and in each group. Further research could gain understanding to connect the treatment with the individual diagnoses. Unlike in the current study, a power analysis is recommended. Also, this study did not take into

Table 4
Mean difference decrease pain intensity (NRS) with change in time within own group.

	Intervention group (mean NRS, SD, p)	Control group (mean NRS, SD, p)
T0 vs. T2	0.9091 (2.14) p = 0.014[a]	0.7586 (1.90) p = 0.005[a]
T1 vs. T2	0.7237 (1.82) p = 0.006[a]	0.4861 (1.93) p = 0.020[a]
T1 vs. T3	2.4464 (2.79) p ≤0.001[a]	0.8846 (1.68) p = 0.014[a]

Legend: NRS: pain intensity score according to Numeric Rating Scale, SD: Standard Deviation, p: p-value, statistic significant if P < 0,05, T0: measure time 0 NRS entering ED, T1: 1st measure time NRS after finishing all procedures in ED, T2: 2nd measure time: 15 min after T1, T3: 3rd measure time on day 4. [a]Wilcoxon Signed Range test.

Table 5
Mean difference decrease pain intensity (NRS) with change in time between 2 groups.

	Mean difference decrease pain intensity between intervention group and control group	p-value
T0 vs. T2	NRS 0.1505	p = 0.682[a]
T1 vs. T2	NRS 0.2376	p = 0.430[a]
T1 vs. T3	NRS 1.5618	**p = 0.018[a]**

Legend: NRS: pain intensity score according to Numeric Rating Scale, p: p-value, statistic significant if P < 0,05, T0: measure time 0 NRS entering ED, T1: 1st measure time NRS after finishing all procedures in ED, T2: 2nd measure time: 15 min after T1, T3: 3rd measure time on day 4, [a] Mann Whitney U test.

account confounders other than those mentioned above. A patient's body mass index and medical comorbidities are factors that impact a patient's pain and were not accounted for in this study. Also, one of the limitations is the choice for using means to compare with previous research and calculate effect size, even when non-parametric tests have been used. The consequence of this choice is that no confidence intervals have been calculated.

As this pilot study was an exploratory search for possible differences and thereby an indication for follow-up research the results need to be confirmed in a larger RCT with correction for multiple testing.

5. Conclusion

When compared to standard treatment alone, combined kinesiotaping and standard care appears to be more effective in terms of pain reduction. Kinesiotaping could be used in clinical practice as an additional treatment method to decrease pain intensity in known painful fractures.

Further research is recommended with a larger sampling group and a placebo group to explore the effect in the individual subgroups and to find out the impact of possible placebo effect and insight in possible side effects. In addition, further research on the effect of kinesiotaping in comfort and patient satisfaction and cost benefit analysis is needed.

Credit authorship contribution statement

M.E. Bakker: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **V.J.J. Bon:** Writing – review & editing, Supervision, Investigation. **B.P.M. Huybrechts:** Writing – review & editing, Supervision, Investigation. **S. Scott:** Writing – review & editing. **M. Zwartsenburg:** Writing – review & editing, Supervision. **J.C. Goslings:** Writing – review & editing.

Declaration of Competing Interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajem.2022.05.057.

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