

Abdominal binders may reduce pain and improve physical function after major abdominal surgery – a systematic review

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ABSTRACT

INTRODUCTION: Evidence for the effect of post-operative abdominal binders on post-operative pain, seroma formation, physical function, pulmonary function and increased intra-abdominal pressure among patients after surgery remains largely un-investigated.

METHODS: A systematic review was conducted. The PubMed, EMBASE and Cochrane databases were searched for studies on the use of abdominal binders after abdominal surgery or abdominoplasty. All types of clinical studies were included. Two independent assessors evaluated the scientific quality of the studies. The primary outcomes were pain, seroma formation and physical function.

RESULTS: A total of 50 publications were identified; 42 publications were excluded leaving eight publications counting a total of 578 patients for analysis. Generally, the scientific quality of the studies was poor. Use of abdominal binder revealed a non-significant tendency to reduce seroma formation after laparoscopic ventral herniotomy and a non-significant reduction in pain. Physical function was improved, whereas evidence supports a beneficial effect on psychological distress after open abdominal surgery. Evidence also supports that intra-abdominal pressure increases with the use of abdominal binders. Reduction of pulmonary function during use of abdominal binders has not been revealed.

CONCLUSION: Abdominal binders reduce post-operative psychological distress, but their effect on post-operative pain after laparotomy and seroma formation after ventral hernia repair remains unclear. Due to the sparse evidence and poor quality of the literature, solid conclusions may be difficult to make, and procedure-specific, high-quality randomised clinical trials are warranted.

Abdominal elastic binders (trusses, girdles, abdominal belts, longuette, etc.) [1-3] are often used routinely after laparotomy and ventral hernia repair. An abdominal binder is a wide belt that surrounds the abdomen and supports the incision [1]. The desirable effects include, among others, pain relief, reduced risk of seroma formation, improved respiratory function and postural stability. Nevertheless, the use of abdominal binders is based on vague or no evidence. Moreover, the clinical effects

of abdominal binders have been challenged due to a potential risk of post-operative pulmonary complications [2] and deep venous thrombosis after surgery due to increased intra-abdominal pressure [4, 5]. Also, abdominal binders have been criticised for being uncomfortable and hot to wear and for impinging the breast line in females [6]. On the positive side, documentation from a few studies implies that abdominal binders diminish post-operative pain, seroma formation, psychological distress and post-operative discomfort [2, 7-9]. Abdominal binders have also been indicated to enhance mobilisation, protect the patient's wound and thereby aid in coughing and promote deep breathing [10].

This systematic review was undertaken to analyse the evidence for clinical effects of routine use of abdominal binders after laparotomy, laparoscopic surgical procedures and abdominoplasty. The main outcomes were effects on post-operative pain, prevention of seroma formation, physical function and psychological distress. We also registered adverse effects on intra-abdominal pressure, decreased pulmonary function, deep venous thrombosis and general patients complaints related to the use of abdominal binders. We did not aim to investigate patients using abdominal binders after cardio-thoracic or spinal surgery.

METHODS

The literature search (1966 to July 2013) was performed according to the guidelines recommended by Preferred Reporting Items of Systematic reviews and Meta-Analyses (PRISMA) [11] (Figure 1). The PubMed, EMBASE, Cochrane, and Cinahl (articles on nursing) databases were scrutinised for relevant data. The search strategy included a combination of the following terms and/or medical subject headings (MeSH): "seroma"(MeSH), "pain"(MeSH), "vital capacity"(MeSH), "pulmonar*", "respirat*", "abdominal binder", "trusses"(MeSH), "ostomy belt", "support belt", "abdominal compression", "abdominal support", "corset", "longuette", "abdominal surgery", "hernia" and "post-operative". Publications were screened according to title and abstract. Furthermore, full-text publications were obtained when inclusion criteria could not be determined from the title or

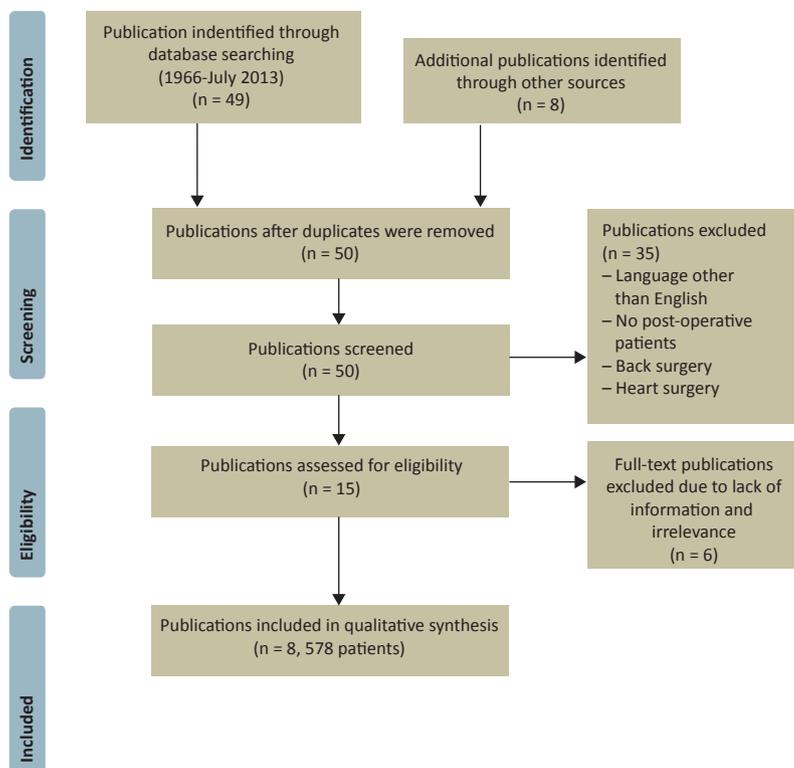
SYSTEMATIC REVIEW

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FIGURE 1

The systematic literature search strategy according to Liberati et al [11].



abstract. Only written publications in English language were included. Studies were excluded if they did not include post-operative patients (for instance healthy persons in experimental settings) and if the discipline was other than abdominal surgery, such as heart and spine surgery [12, 13]. Also, studies reported only by abstracts were excluded. Due to the shortage of literature, it was decided that RCTs, prospective, retrospective as well as case studies including five or more patients should be included in the analysis. Reference lists of publications were revised manually to identify publications not retrieved by the electronic search. Finally, commercial producers of abdominal binders were contacted to cross check for references. Randomised controlled trials (RCT) were evaluated for scientific quality according to Slim et al's 11-item scoring system [14]. Thus, randomised trials were assessed questioning whether the trial stated an aim, an adequate control group, an account for the selection process and randomisation technique, etc. Each item was scored 0 (not reported), 1 (inadequately reported), or 2 (adequately reported). According to the score, the trials were placed in category A (score 20-22), category B (score 17-19) or category C (16 or less). Non-comparative non-randomised trials were evaluated according to Slim et al [15] whose framework consists of


FACTBOX

Abdominal binders may reduce early post-operative pain after laparotomy.

More studies are needed to establish current indications that prophylactic use of abdominal binders reduces seroma after ventral hernia repair.

Abdominal binders can be used without compromising pulmonary function.

eight items. The ideal score was 16. Non-comparative trials were likewise categorised into ideal quality = score 12-16, moderate quality = 6-11, and poor quality = 0-5. RCT and comparative or non-comparative non-randomised trials were evaluated by two independent assessors (the first and last author). Consensus was achieved through discussion.

RESULTS

The search profile is shown in Figure 1. We identified 50 articles and excluded 42 publications from the analysis due to the predetermined criteria. Thus, the analysis included eight publications with a total of 578 patients (four RCT) [1-3, 16], two prospective studies [5, 17] and two retrospective studies [8, 18]. The type of surgical procedure is listed in **Table 1**. Of these studies, two were in patients undergoing ventral hernia repair [8, 18], five in patients undergoing laparotomy and major abdominal procedures [1-3, 16, 17], and one study investigated patients after abdominoplasty [5]. None of the RCTs included ventral hernia surgery. The trials were predominantly of poor quality and none of the studies were of ideal quality (Table 1).

Pain

Three RCTs (binders versus no binders the initial 1-5 post-operative days) [1-3] (n = 75, n = 54 and n = 50, respectively) investigated the effects on post-operative pain after major abdominal surgery when patients were out of bed (Table 1). In two of the RCTs [1, 2], pre- and post-operative pain scores were compared. These RCTs [1-3] found no significant analgesic effect in the binder groups compared with the non-binder group, although there was a non-significant trend towards pain relief in the binder group in two of the RCTs [1, 2]. In a small sequential, prospective, controlled study (patients being their own controls) [17] (n = 16) conducted in patients after open major upper abdominal surgery, patients reported non-significantly less pain when wearing an abdominal binder than when wearing no binder. The binder was applied approximately ten minutes a day.

In summary, and due to the sparse literature, solid conclusions may be difficult to make. There is weak,

non-significant evidence to support that abdominal binders reduce early post-operative pain after laparotomy.

Seroma formation

No RCTs have investigated the effect of using abdominal binders per se versus no abdominal binders in patients undergoing ventral hernia repair. The effect of abdominal binders on prevention of seroma formation was, however, indirectly investigated in two studies (one post-hoc re-analysis (n = 146) [18], one retrospective controlled study (n = 202) [8]) (Table 1). One study [18] was based on a re-analysis of an earlier randomised study [19] after open (n = 86) or laparoscopic (n = 60) incisional hernia repair. The post-hoc analysis reported that seroma formation was independent of duration of abdominal belt wearing time (32-40 days, no specific information provided). Thus, patients with seromas wore binders just as long as patients without seromas. Another retrospective study conducted in patients after laparoscopic ventral (primary and incisional) herniotomy (n = 202) [8] reported that the number of patients with seroma formation was significantly reduced from 32% to 18% when abdominal binders were used for 7-10 days

(the authors provided no detailed information) compared with historical patients using no abdominal binders. Seroma formation was registered by clinical examination.

In summary, there is weak evidence to support prophylactic use of abdominal binders to prevent seroma formation after open or laparoscopic ventral (primary and incisional) hernia repair.

Physical function

Physical function (defined as distance after a 6-minute walk or as the patient's ability to mobilise (non-validated mobilisation scale) [1, 3] was investigated in two RCTs after laparotomy (binders versus no binders) (Table 1). Abdominal binders were worn for 5 days when out of bed [1] or as "much as possible" [3]). In the first study, 75 patients performed a 6-min walk [1] pre-operatively and on post-operative day and 5. The walking distance was significantly longer on post-operative day 5 in the binder group than in the no binder group. In another RCT [3] (Table 1), the authors found no significant intergroup difference in the capability of mobilisation on post-operative day 1-5.

In summary, abdominal binders may improve phys-



TABLE 1

Studies on abdominal binders after surgical treatment [11].

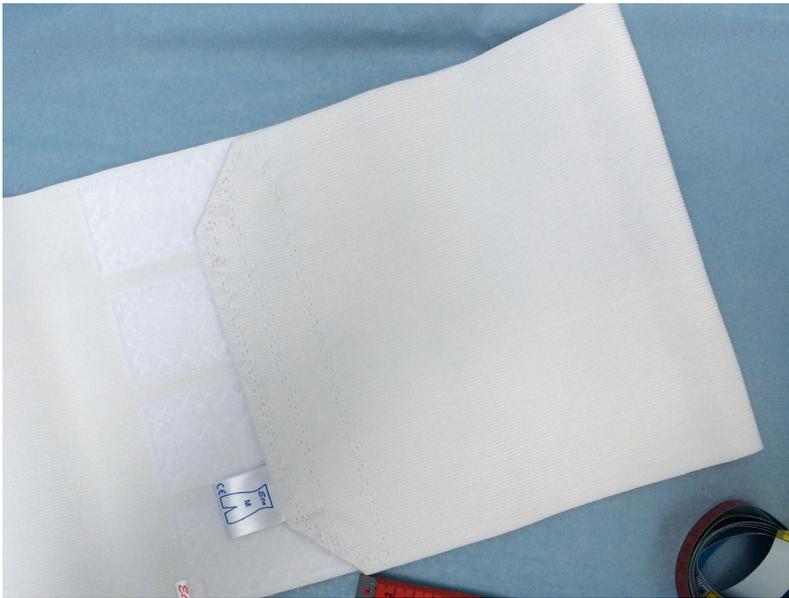
Reference	Type of surgical procedure	Design	Patients, n	Quality assessment, category ^a [14, 15]	Type of binder	Binder use	Pain	Physical function	Pulmonary function	Seroma formation	Perceived distress ^b
<i>Cheifetz et al, 2010</i> [1]	Open major abdominal surgery (Whipple's procedure, colectomy, abdominoperineal resection, splenectomy, pancreatectomy)	RCT	75	B	Elastic binder	When out of bed first 5 days	↓	↓	→	–	↓
<i>Larson et al, 2009</i> [2]	Midline laparotomy	RCT	54	C	NA	3 days	→	–	→	–	–
<i>Olsen et al, 2009</i> [3]	Major upper abdominal surgery (pancreas, gastrectomy, miscellaneous upper gastrointestinal surgery)	RCT	50	C	Elastic binder with Velcro lining (Dale)	As much as possible first 5 days	→	→	→	–	–
<i>Ali & Khan, 1983</i> [16]	Open cholecystectomy	RCT	23	C	Elastic binder with Velcro lining (Dale)	NA	–	–	↓	–	–
<i>Huang et al, 2007</i> [5]	Abdominoplasty	P	12	B	NA	Intermittent	–	–	–	–	–
<i>Daniel & Matheson, 1969</i> [17]	Major upper abdominal surgery, laparotomy	P	16	C	Cough-Lok belt	Intermittent	↓	–	→	–	↓
<i>Chowbey et al, 2000</i> [8]	Laparoscopic ventral hernia repair	R	202	C	NA	Continuously first 7 days	–	–	–	↓	–
<i>Kaafarani et al, 2009</i> [18]	Laparoscopic and open ventral incisional herniotomy	R	146	B	NA	First 33-41 days	–	–	–	→	–

– = no data; ↓ = significantly beneficial effect of abdominal binders; → = no significant effect between abdominal binders and no-abdominal binders group.

NA = not applicable; P = prospective study; R = retrospective study; RCT = randomised controlled study.

a) A: score 20-22, B: score 17-19, C: ≤ score 16.

b) The patient's perception of the occurrence of symptoms, and concerns and responses due to these symptoms.



Abdominal binder and tape measure to determine size.

ical function after major abdominal surgery but more studies are needed before final conclusions can be drawn.

Post-operative psychological distress

Post-operative psychological distress defined as the patient's emotional response to the occurrence of any kind of negative post-operative symptoms [20] was studied on post-operative day 1-5 in an RCT (n = 75) [1] (Table 1). Patients undergoing open major abdominal surgery were assessed using a validated scoring system. In the binder group, distress scores remained unchanged compared with pre-operative levels, whereas the distress scores were significantly increased on all post-operative days in the non-binder group. In another prospective controlled study (n = 16) [17], patients reported less distress when coughing on post-operative day 1-3 using abdominal binders compared with coughing when not wearing abdominal binders, although this was not quantified.

In summary, evidence supports the use of abdominal binders to reduce psychological distress during the first 5 days after open major abdominal operations.

Pulmonary function

Five studies (four RCTs [1-3, 16] and one prospective controlled study [17]) investigated pulmonary function after open major abdominal surgery (Table 1). One RCT [16] (n = 23) reported that vital capacity was significantly improved in the abdominal binder group compared with the no binder group, although there was no significant effect on peak expiratory flow. Information on duration of abdominal binder wearing was not provided. This positive finding was, however, contradicted by three

larger and more recent RCTs [1-3] (n = 75, n = 54, and n = 50, respectively). Abdominal binders were worn for 3-5 days (when out of bed, no further information was provided). In the latter studies [1-3] but not in the first [16], patients were actively encouraged to ambulate early guided by a physiotherapist. However, only one [2] of these studies included measurements from static spirometry, whereas the other two [1, 3] only published data from dynamic spirometry. Thus, comparison with improvement of vital capacity [16] is difficult.

In summary, there is no evidence to support that abdominal binders either reduce or improve post-operative pulmonary function.

Intra-abdominal pressure

A small prospective study in 12 patients undergoing abdominoplasty [5] revealed a significant increase in intra-abdominal (intravesical pressure) from 2.63 to 4.55 mmHg using abdominal binders compared with no use.

In summary, weak evidence supports that abdominal binders increase intra-abdominal pressure, but clinical implications remain unknown.

DISCUSSION

The present analysis found that abdominal binders may reduce post-operative pain after laparotomy and may prevent seroma formation after ventral hernia repair, but the evidence is weak. The lack of convincing evidence may be due to only minor clinical effect of the abdominal binders or lack of well-designed studies with sufficient quality and power.

A possible analgesic effect from the use of abdominal binders after abdominal surgery is of major interest. However, the fact is that studies within this field define their outcomes using different scales and definitions which makes comparison very difficult. The visual analogue scale is commonly used for measuring pain, which is also the case for three of the RCTs [1-3] included in this systematic review, but not for the last prospective study [17] where pain was not quantified. Moreover, the amount of analgesics and in what situation pain is recorded were not specified, which produces varying results.

Post-operative seroma formation is a common complication following ventral hernia repair after open and laparoscopic procedures and will appear in almost all patients if diagnosed by ultrasound [21]. The formation of seroma can either be assessed routinely or only when it becomes symptomatic, and it can be diagnosed using ultrasound or by clinical examination. The risk of symptomatic seroma formation after open ventral hernia repair may range from 1% to 33% [22-25], whereas the risk after laparoscopic hernia repair ranges from 2% to 36% [23-25]. Since the risk for seroma formation is

linked to foreign body implantation (i.e. mesh) and wide subcutaneous or subfascial dissections, evaluation of the effect of binders must be made in such surgical procedures. The present analysis found no beneficial effect of abdominal binders on the risk of seroma formation. However, the effect of abdominal binder on seroma formation was studied only indirectly (see above). The post-hoc analysis of a RCT [18] was made between laparoscopic versus open ventral incisional herniotomy, whereas the use of a binder was registered as a secondary variable regardless of the method to which the patient was assigned. Consequently, it is impossible to conclude whether there would have been even more patients with seroma formation if an abdominal binder had not been used. The retrospective study [8], which found a significant reduction in seroma formation, had a high risk of bias because of the possible learning curve for the surgeon (operation time descending from 90 to 50 minutes) which may affect seroma formation. Experimental studies have suggested that abdominal binders generate a pressure gradient to drive fluid across a mesh, and thereby reduce seroma formation [7], why it would be interesting if these results could be reproduced in a RCT.

The literature on pulmonary function and abdominal binders is of poor to moderate quality. The more recent studies showed that abdominal binders could neither promote nor restrict pulmonary function. Evaluation of post-operative pulmonary function must include both static and dynamic spirometry. Consequently, no significant differences were identified for dynamic spirometry, which was investigated in all four RCTs [1-3, 16]. Only two of these studies [2, 16] included static spirometry, of which one [16] found an improvement of vital capacity in the binder group, whereas the other [2] did not. However, that study is historic (1983) and surgical technique and perioperative care have changed, which may influence the results compared with the more recent studies [1-3].

The study on intraabdominal pressure [5] showed a correlation between abdominal binders and higher intra-abdominal pressure. A higher intra-abdominal pressure has previously been associated with an increased risk for deep venous thrombosis [4]. Major abdominal surgery is a risk factor for venous thromboembolism *per se* [26] which raises concerns for the use of abdominal binders after laparotomy. On the other hand, the literature supports that abdominal binders may facilitate early post-operative mobilisation, which is important to avoid thromboembolic complications [26] although the literature is not conclusive [1, 3]. The probably elevated intra-abdominal pressure should therefore be weighed against early mobilisation that reduces complications, convalescence and fatigue [27].

Our systematic review has several limitations. The number of studies included was small. Studies were heterogeneous (different surgical procedure, outcomes, analgesic treatment, etc.), often of poor quality and often underpowered. Of the eight studies, only half were RCTs, and of poor to moderate quality. Furthermore, these RCTs suffered from a high proportion of drop-outs which hampers any final conclusions. All publications were included regardless of the publication date, why some may be of historical interest. The search was limited to English-language publications, why some publications might not have been taken into account. In addition, none of the studies were single-blinded.

Future studies should be well-designed, procedure-specific, with a single-blinded and randomised design. Studies should focus on the ability of abdominal binders to reduce pain and seroma formation, assist mobilisation and physical function and reduce discomfort and psychological distress. Since ventral hernia repair is a frequently conducted surgical procedure and seroma formation and pain are the most frequent reasons for post-operative complaints as well as for readmission, more studies using abdominal binders should be conducted within this field [28, 29]. Abdominal binders should be fitted individually to patients and the period of time patients wear the binder shall be noted to ensure reliable results.

CONCLUSION

For practical reasons, the present analysis is inconclusive regarding the effect of abdominal binder on seroma formation after ventral herniotomy. There is weak evidence for a positive effect on pain, physical function and psychological distress when abdominal binders are used after major abdominal surgery. Evidence also supports that abdominal binders can be used without compromising pulmonary function.

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