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External abdominal support after laparotomy: amechanistic and clinical perspective on fascial stress and wound dehiscence

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ABSTRACT

Abdominal binders are widely used after abdominal surgery, despite inconsistent evidence regarding their clinical effectiveness. Their role in preventing wound complications, particularly fascial dehiscence, remains unclear. This study aims to evaluate the potential role of external abdominal support as a mechanical load-sharing strategy after laparotomy, with emphasis on critically ill patients. Available evidence indicates that abdominal supports may improve postoperative comfort and facilitate early mobilization, although their impact on wound-related complications remains inconclusive. Mechanistic studies consistently demonstrate substantial differences between device types: elastic binders exhibit high extensibility with limited control of abdominal wall dynamics, whereas semi-rigid supports provide greater circumferential stability and reduced deformation under physiologically relevant loading conditions. These differences may influence the ability of external support to modulate mechanical stress acting on the healing fascia.

KEY WORDS: Abdominal binder, fascial stress, laparotomy, postoperative care, wound dehiscence.

INTRODUCTION

Laparotomy remains a common surgical approach in both elective and emergency settings and is associated with a substantial risk of postoperative complications. Among these, wound dehiscence (Fig. 1) represents one of the most serious adverse events, often leading to reoperation, prolonged hospitalization, and increased mortality [1-4]. The integrity of the abdominal wall after surgery depends on a complex interplay between tissue healing and mechanical forces acting on the fascial closure [5].

Abdominal binders are frequently prescribed after abdominal surgery with the aim of improving patient comfort, reducing pain, and facilitating early mobilization [6-11]. Despite their widespread use, clinical evidence supporting their effectiveness remains inconsistent, and current guidelines do not provide clear recommendations regarding their routine application [1-4].Importantly, most studies have evaluated abdominal binders as a homogeneous intervention, without considering differences in their mechanical properties [12]. Recent evidence suggests that devices commonly grouped under the same term may exhibit fundamentally different behavior under physiologically relevant conditions (Fig. 2). This raises the question of whether the lack of demonstrated clinical benefit may be related to inappropriate device selection rather than true inefficacy.In critically ill patients, additional factors such as mechanical ventilation, coughing, and increased intra-abdominal pressure further amplify mechanical stress acting on the healing fascia [13–15]. In this context, external abdominal support may represent a simple and underexplored strategy to reduce fascial load and improve postoperative stability.

Figure 1. Wound dehiscence with evisceration on postoperative day 7 following right nephrectomy. This case illustrates complete failure of fascial closure under postoperative mechanical stress. The patient was admitted to the emergency department prior to surgical intervention. White arrows indicate the full extent of the wound from the upper to the lower pole. Black arrows indicate distended, congested small bowel with visible serosal surface injury.

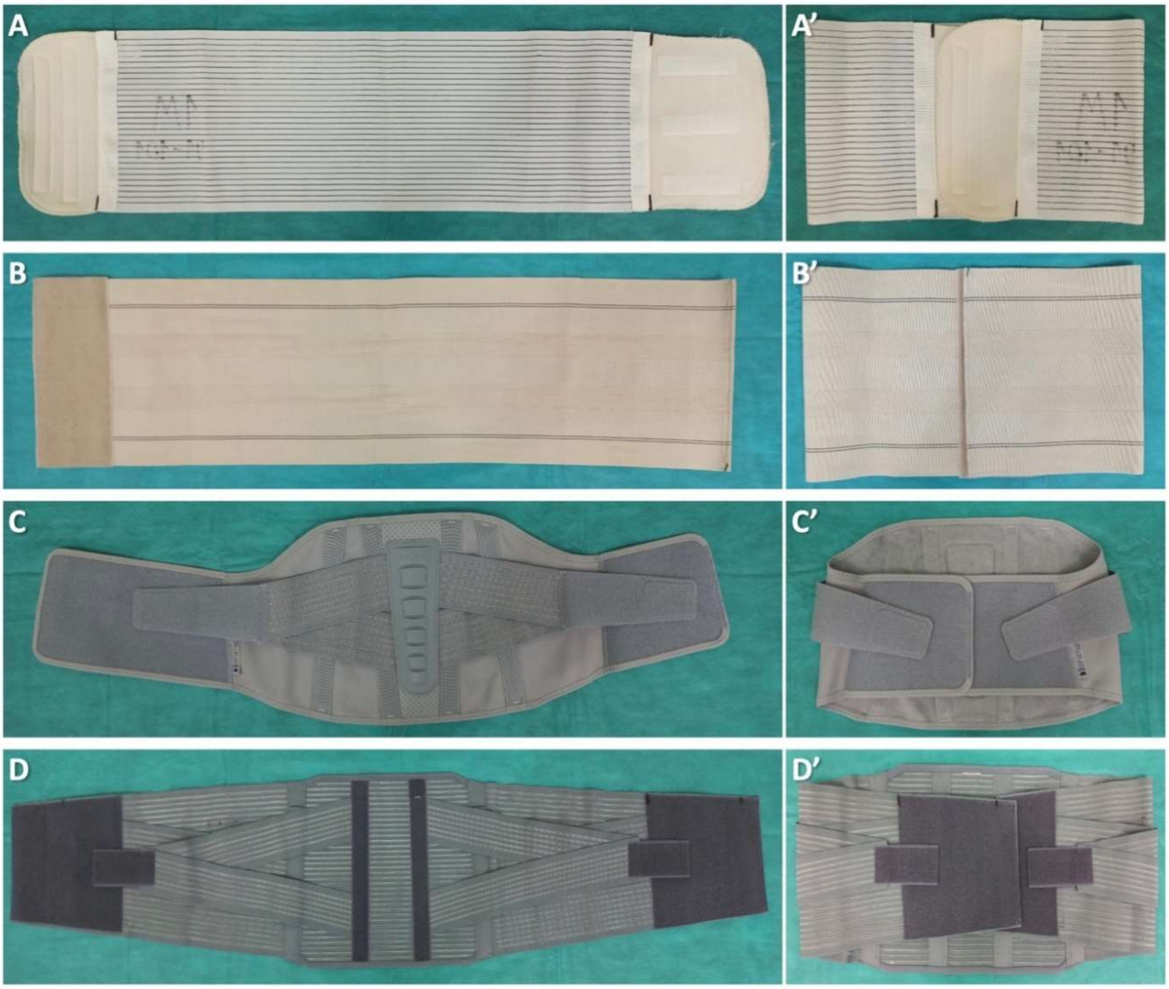

Figure 2. Commonly used elastic abdominal binders (A, B) and semi-rigid lumbar corsets (C, D). Left panels show the devices in the fully extended configuration, while right panels present the supports after fastening.

The aim of this study is to provide a mechanistic and clinical perspective on the role of abdominal supports after laparotomy, with particular emphasis on their potential to reduce fascial stress and prevent wound dehiscence. Therefore, an updated synthesis of the literature integrating the biomechanical properties of abdominal supports with their potential clinical implications is warranted.

REVIEW METHODOLOGY

A narrative review of the literature was performed using PubMed, Scopus, and Google Scholar databases. The search included studies published between 2000 and 2025 using combinations of the following keywords: “abdominal binder”, “laparotomy”, “wound dehiscence”, “abdominal wall”, “postoperative support”, “lumbo-sacral corset” and “intra-abdominal pressure”. The term “lumbosacral corset” was included to capture studies on semi-rigid external supports with relevant biomechanical properties, which may provide insights into abdominal wall stabilization despite being primarily used in spinal indications.

Randomized controlled trials, observational studies, meta-analyses, and relevant mechanistic studies were included. Particular attention was given to studies evaluating the mechanical behavior of abdominal supports and their effects on abdominal wall dynamics and respiratory function [5-12]. In addition, previously published mechanistic and clinical data regarding abdominal supports were integrated to provide a comprehensive framework linking device properties with potential clinical effects. Study selection for integration of mechanistic and clinical data was based on relevance to the biomechanical behavior of abdominal supports and their potential clinical implications.

Priority was given to studies providing quantitative, experimental, or physiologically grounded data on device mechanics, abdominal wall dynamics, intra-abdominal pressure, and clinically relevant outcomes.Exclusion criteria included non-English publications, animal studies, case reports without relevant mechanistic or clinical insight, and studies not directly related to abdominal support or its biomechanical or clinical implications.

LITERATURE REVIEW

Pathophysiology of Wound Dehiscence

Wound dehiscence following laparotomy is a multifactorial process resulting from the imbalance between tissue healing capacity and mechanical stress acting on the fascial closure [5,16]. In the early postoperative period, fascial strength is limited, and the suture line represents the weakest point of the abdominal wall.Mechanical factors play a crucial role in this process. Sudden increases in intra-abdominal pressure during coughing, straining, or mobilization generate significant tensile forces acting on the fascial edges [13-15]. Repeated exposure to these forces may lead to progressive suture pull-through, tissue failure, and eventual wound separation [5].In critically ill patients, this risk is further amplified by systemic factors such as sepsis, malnutrition, and impaired tissue perfusion, as well as mechanical factors including mechanical ventilation and frequent episodes of elevated intra-abdominal pressure [17,18]. These patients are therefore particularly vulnerable to wound complications.Understanding the mechanical environment of the healing abdominal wall is essential for identifying potential strategies aimed at reducing stress along the suture line and improving wound stability.

Mechanical Perspective: Role of External Support

External abdominal support may act as a load-sharing system, redistributing forces acting on the abdominal wall and reducing peak stress at the fascial suture line [19]. However, the effectiveness of this mechanism is likely dependent on the mechanical properties of the applied device.Recent mechanistic studies have demonstrated that commonly used elastic abdominal binders exhibit substantial elongation within the range of forces applied by patients, resulting in limited ability to control dynamic abdominal circumference. In contrast, semi-rigid supports show significantly reduced elongation and achieve a stable load–length relationship at relatively low forces, providing more effective circumferential stabilization of the abdominal wall [20].

Importantly, increased mechanical stability does not appear to compromise basic respiratory parameters, suggesting that more rigid external supports may be safely used in the postoperative setting [21].These findings indicate that abdominal supports differ substantially in their mechanical behavior across device types, which may have important implications for their clinical effectiveness.

Clinical Evidence

Clinical studies evaluating abdominal binders have primarily focused on patient-centered outcomes such as pain, comfort, and mobilization. Several studies and meta-analyses have reported reduced postoperative pain and improved early mobilization in patients using abdominal supports [6,7]. However, these analyses do not stratify outcomes according to device type or mechanical properties. Experimental data demonstrate that elastic binders and semi-rigid supports differ substantially in their mechanical behavior under physiologically relevant loading conditions, which may influence their clinical effects [11-13].

However, evidence regarding their impact on wound-related complications, including surgical site infection, incisional hernia, and wound dehiscence, remains inconclusive [1]. Current guidelines do not recommend routine use of abdominal binders due to insufficient high-quality evidence.Importantly, previous studies have rarely differentiated between types of abdominal supports. The inclusion of mechanically heterogeneous devices within the same intervention group may obscure potential benefits of more effective supports [19].Recent clinical observations indicate that patients often prefer devices providing greater perceived stability, even when associated with increased tightness. Semi-rigid supports have been associated with higher patient acceptance and confidence in abdominal wall protection, without deterioration in perceived health status [14].These findings suggest that perceived and actual mechanical stabilization may play an important role in patient recovery and adherence to postoperative recommendations.

Why Previous Studies Failed

The lack of consistent evidence supporting the clinical effectiveness of abdominal binders may be explained by several methodological limitations. First, most studies do not differentiate between device types, despite substantial differences in their mechanical properties [22]. Elastic binders with high extensibility may provide minimal stabilization, whereas semi-rigid supports may offer significantly greater mechanical control. Second, there is a lack of standardization regarding device application, including tightening force, duration of use, and patient selection [7–10]. Without consistent application protocols, it is difficult to assess true clinical effects. Third, few studies have evaluated mechanistic endpoints such as abdominal wall dynamics or stress distribution [23], limiting understanding of how these devices interact with the healing abdominal wall. Finally, clinically relevant endpoints such as wound dehiscence have rarely been investigated, particularly in high-risk populations such as critically ill patients [24,25]. These limitations highlight the need for a more mechanistically informed and device-specific approach to evaluating abdominal supports.

Implications for Critical Care

In this context, “critically ill patients” refers to individuals at high risk of postoperative complications, including those requiring intensive care unit admission, mechanical ventilation, or presenting with conditions associated with increased intra-abdominal pressure and impaired tissue healing. Patients requiring intensive care after laparotomy represent a population at particularly high risk of wound complications. Mechanical ventilation, frequent coughing, and elevated intra-abdominal pressure expose the healing abdominal wall to repeated and often extreme mechanical stress [26,27].

External abdominal support may provide an additional layer of stabilization, particularly during periods of increased abdominal pressure. By limiting excessive abdominal wall expansion, appropriately selected supports may reduce peak stress acting on the fascial closure [28].However, the use of abdominal supports in critically ill patients requires careful consideration. Excessive compression may impair respiratory mechanics or increase intra-abdominal pressure, particularly in patients with compromised pulmonary function [29,30].

Therefore, individualized selection of abdominal supports based on mechanical properties and patient-specific factors is essential. Semi-rigid supports that provide effective stabilization without excessive restriction may offer the most favorable balance between benefit and risk. It should be emphasized that the considerations presented for critically ill patients are largely extrapolated from studies conducted in general surgical populations, as direct evidence in ICU settings remains limited. These conclusions should therefore be interpreted with caution and viewed as hypothesis-generating rather than definitive clinical recommendations.

Future Directions

Future research should focus on standardized evaluation of abdominal supports with clearly defined mechanical characteristics [30–33]. Randomized controlled trials should incorporate device-specific analysis and include clinically relevant endpoints such as wound dehiscence and incisional hernia formation [34,35]. Integration of biomechanical measurements, including abdominal wall dynamics and intra-abdominal pressure, may provide valuable insight into the mechanisms underlying potential clinical effects [13].

Standardized evaluation should include objective assessment of device application, such as measurement of tightening force or interface pressure, along with clearly defined protocols regarding duration of use, patient positioning, and conditions of application, including respiratory assessment. Development of such standardized clinical protocols may improve both comparability of studies and translation into clinical practice. Additionally, the development of adjustable or sensor-based abdominal supports may allow for personalized optimization of compression and stabilization, particularly in high-risk patients.

CONCLUSIONS

Abdominal supports are widely used in postoperative care despite limited and inconsistent evidence regarding their effectiveness. Emerging data suggest that their potential benefits may depend largely on their mechanical properties rather than their general classification.External abdominal support may represent a simple and low-cost strategy to reduce mechanical stress acting on the healing fascia after laparotomy, particularly in critically ill patients. However, elastic and highly extensible binders may provide insufficient stabilization, whereas semi-rigid supports may offer more effective mechanical control. Well-designed studies focusing on mechanically characterized devices and clinically relevant outcomes are needed to determine the true role of abdominal supports in preventing wound complications.While these considerations may be particularly relevant in critically ill patients, the underlying principles are applicable to a broader population undergoing abdominal surgery.

SUPPLEMENTARY INFORMATION

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Conflicts of Interest: *KM has received payments for organizing workshops and lectures for Medtronic, Olympus, TZMO, BBraun, Corza Medical and BD (Bard) and conducting educational activities. PM declare that she has no conflict of interest.*

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