

# Improvement in Back Pain Following Abdominoplasty: Results of a 10-Year, Single-Surgeon Series

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### Abstract

**Background:** Few studies have examined the impact of abdominoplasty on chronic back pain.

**Objectives:** The aim of this study was to test our hypothesis that patients undergoing abdominoplasty with anterior abdominal wall plication will show significant improvements in back pain and physical function compared with those without plication.

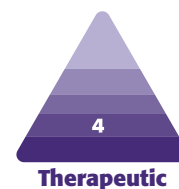
**Methods:** We utilized Current Procedural Terminology (CPT) codes to identify patients who underwent abdominoplasty with the senior author over a 10-year period. The Oswestry Disability Index (ODI) and the RAND 36-Item Short-Form Health Survey (SF-36) were administered. All patients indicating preoperative back pain were reviewed.

**Results:** Of 338 patients, 143 surveys (42.3%) were returned; 51 patients (35.7%; n = 28 aesthetic, n = 23 massive weight loss) reported preoperative back pain on the ODI. Paired *t* tests compared overall and strata-specific changes in ODI and SF-36 pre- and postsurgery. Multivariable linear regression models were fitted to model relations between scores and plication, adjusting for presurgery scores and patient variables. There were significant improvements in overall patient cohort in ODI (−15.14), SF-36 physical function (19.92), and pain (17.42) ( $P < 0.001$ ), as well as when patients were stratified by plication status. However, outcomes between those with plication and those without were not significantly different.

**Conclusions:** Abdominoplasty with and without anterior abdominal wall plication significantly improves ODI and SF-36 scores relating to physical function and pain, in both aesthetic and massive weight loss patients. Outcomes did not differ based on plication status. All patients with preoperative back pain showed improvement regardless of operation performed, suggesting that abdominoplasty with or without abdominal wall plication improves chronic back pain in this patient population.

### Level of Evidence: 4

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Back pain is one of the most common and physically debilitating conditions in the United States, reported to affect an estimated 84% of adults at some point within their lifetime.<sup>1</sup> Given the frequency of this complaint, it comes as no surprise that the fiscal impact of back pain on the healthcare system is quoted as upwards of US\$20 billion annually.<sup>1,2</sup> Female gender is a known risk factor for the development

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of chronic lumbar pain, and studies have shown that this may be partially attributable to diastasis recti, separation of the rectus muscles at the midline, a condition that commonly arises with pregnancy or obesity.<sup>3</sup> These physiologic states strain the abdominal wall, weakening the connection between the rectus sheath and the lateral abdominal wall musculature. As many as 15% of women who become pregnant can develop a resultant postpartum diastasis, and although this condition may improve or resolve spontaneously, 39% of these women have symptoms persisting beyond the immediate postpartum period.<sup>4</sup> Diastasis has been shown to limit core strength and functional ability, due to the reduction in stability of the trunk caused by the abnormal length and position of the abdominal wall musculature.<sup>5</sup> Models have been developed to examine the role a functionally tight abdominal wall plays in reducing tension on the spinal musculature and intervertebral joints, and stabilizing the spine.<sup>6-10</sup>

Given this proven anatomic relationship, several studies have correlated the correction of diastasis with the alleviation of chronic back pain, a result which has been attributed to the spinal stabilization that occurs after plication.<sup>4,5,11-13</sup> Other studies have demonstrated similar improvements in abdominal strength and functional status following abdominoplasty without plication of the abdominal wall, suggesting perhaps that shifting the center of gravity through tissue resection alone can significantly improve postural stability.<sup>14,15</sup> This becomes an important question as plication of the abdominal wall is not without risk. Increasing the intra-abdominal pressure with plication may increase the risk of venous thromboembolism and pulmonary embolus and can restrict lung volumes which may lead to increased risk of postoperative pneumonia. Fabio Nahas, a pioneer of abdominoplasty, questions whether rectus plication is necessary to improve spinal stability, or if simply removing excess abdominal tissue alone can improve persistent back pain without subjecting patients to the increased risks of anterior abdominal wall plication.<sup>16</sup>

To our knowledge, there exists no comparative study examining the effect of abdominoplasty with and without anterior abdominal wall plication on chronic back pain and physical function. Given the biomechanical models and clinical evidence that exists in support of spinal stabilization that results when the abdominal wall is tightened, we hypothesize that patients who undergo abdominoplasty with anterior abdominal wall plication will show significant improvements in back pain and resultant physical function compared with those who undergo abdominoplasty without plication.

## METHODS

This retrospective study utilized validated questionnaires to assess back pain and quality-of-life measures in patients who were identified by CPT code as having undergone

abdominoplasty with or without anterior abdominal wall plication performed by the senior author (J.S.) over a 10-year period (April 2007-March 2017). This work was approved by the Health Sciences Institutional Review Board (IRB) of the University of Wisconsin, Madison. Informed consent was obtained from all patients who participated in the study. The surveys were distributed by the study coordinator (C.S.) initially by mail, and a second round of surveys was sent electronically via an institutional survey creation system approved by the IRB. The surveys were linked to the patient record by an encoded number that allowed for anonymity during survey completion. The study coordinator (C.S.) had access to the encoding document that linked survey number to patient name and medical record number, in compliance with the Health Insurance Portability and Accountability Act. The study subjects were aesthetic and massive weight loss patients, both male and female. Informed consent was obtained prior to participation. A single patient who reported conflicting results to the individual surveys indicating that her symptoms of pain had both improved and worsened postoperatively was excluded from the results. Notably, this patient identified complaints unrelated to the survey questions that likely precluded the accurate reporting of postoperative symptoms and resulted in conflicting results. As a result of her conflicting survey responses, removal of this patient from the data set did not change the outcomes of this study, and therefore we do not believe this to be a source of inadvertent bias.

The Oswestry Disability Index (ODI) and the RAND 36-Item Short-Form Health Survey (SF-36) were administered to all patients who indicated that they suffered from any degree of chronic back pain preoperatively (Appendices A and B, respectively). An additional 10-question survey was included to query patients for surgery-specific information, and any attempted management of their back pain preoperatively (Appendix C). There was also a section for freehand comments to capture any information patients might feel relevant that was not adequately queried in the previous questions. The questionnaires were administered by mail or by electronically mailed link through Qualtrics (QualtricsXM, Seattle, WA) online survey creation software. Patients completed questionnaires during a 1-year period between August 2017 through August 2018.

Following data collection, chart review was completed, and the following patient information was collected: age, sex, body mass index (BMI, kg/m<sup>2</sup>) at time of surgery, indication for surgery and surgical procedure performed, preoperative weight loss, parity, prior abdominal and spinal surgical history, and presence of abdominal hernia. Presence of documented back pain in the electronic medical record, physician visits, and provider documentation of treatments attempted for this problem were also recorded. The surgeon's preoperative and intraoperative documentation of skin laxity, muscle laxity, and presence of diastasis and hernia was also recorded.

**Table 1.** Oswestry Disability Index Scoring

0%-20% minimal disability	The patient can cope with most living activities. Usually no treatment is indicated apart from advice on lifting and sitting.
20%-40% moderate disability	The patient experiences more pain and difficulty with sitting, lifting, and standing. Travel and social life are more difficult and they may be disabled from work. Personal care, sexual activity, and sleeping are not grossly affected and the patient can usually be managed by conservative means.
40%-60% severe disability	Pain remains the main problem in this group but activities of daily living are affected. These patients require a detailed investigation
60%-80% crippled	Back pain impinges on all aspects of the patient's life. Positive intervention is required.
80%-100% bed-bound	These patients are either bed-bound or exaggerating their symptoms.

### Oswestry Disability Index and RAND 36-Item Short-Form Health Survey

The ODI, considered the gold standard of low-back functional outcome tools, was used to query back pain.<sup>17</sup> This 10-question survey measures a patient's functional disability on a converted percentage scale ranging from no disability (0%) to bed-bound (100%) (Table 1). The minimum clinically important difference with a 90% confidence interval has been reported to be 10%.<sup>17</sup>

The SF-36 examines 8 areas of quality of life related to health: physical function, role of limitations due to physical health, role of limitations due to emotional problems, energy/fatigue, emotional well-being, social functioning, pain, and general health.<sup>18-20</sup> This form is scored by averaging individual items into scales ranging from 0 to 100 with a higher score representing a more favorable state of health on each scale. These 8 sections can be combined to produce a Physical Component Summary (PCS) and a Mental Component Summary (MCS).<sup>20</sup> This questionnaire is therefore uniquely suited to the abdominoplasty patient population as it recognizes the impact of this surgery on physical and psychological aspects of health and how these dimensions influence overall functional status.<sup>18</sup> The categories of physical function and pain (Table 2) were chosen for further analysis because these questions were directly related to the outcomes of interest.

## RESULTS

Through review of records, 338 patients were identified by CPT code as meeting inclusion criteria. Of these 338 patients, 143 surveys (42.3%) were returned; 51 patients (35.7%; n = 28 aesthetic, n = 23 massive weight loss) reported preoperative back pain of any severity on the ODI. The 51 patients reporting preoperative back pain comprised 3 males and 48 females, with an average BMI of 26.0 kg/m<sup>2</sup> (range, 19.8-37.4 kg/m<sup>2</sup>) for the aesthetic patients, and 35.7 kg/m<sup>2</sup> (range, 28.6-48.5 kg/m<sup>2</sup>) for the massive weight loss patients.

**Table 2.** RAND SF-36 Questions and Scoring

RAND SF-36 physical function questions and scoring	
Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	
Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	
Lifting or carrying groceries	
Climbing several flights of stairs	
Climbing one flight of stairs	
Bending, kneeling, or stooping	
Walking more than a mile	
Walking several blocks	
Walking one block	
Bathing or dressing yourself	
Score: 1, limited a lot; 2, limited a little; 3, not limited at all	
RAND SF-36 pain questions and scoring	
How much bodily pain have you had during the past 4 weeks?	
Score: 1, None; 2, Very mild; 3, Mild; 4, Moderate; 5, Severe; 6, Very severe	
During the past 4 weeks, how much did back pain interfere with your normal work (including both work outside the home and housework)?	
Score: 1, not at all; 2, a little bit; 3, moderately; 4, quite a bit; 5, extremely	

SF-36, 36-Item Short-Form Health Survey.

The average patient age for all patients was 48 years (range, 31-68 years).

### Demographic Data

Demographics and surgical details of patients who indicated back pain preoperatively are shown in Table 3. Pre- and postoperative ODI and SF-36 pain and physical function scores are shown in Table 4. The impact of plication status on ODI and SF-36 scores is shown in Table 5.

**Table 3.** Patient Demographics

Demographic	Aesthetic	Massive weight loss
Patients (n)	28 (55%)	23 (45%)
Average age, years (range)	46 (31-68)	49 (33-67)
Sex	28 female	20 female
	0 male	3 male
Average BMI, kg/m <sup>2</sup>	26.0 (19.8-37.4)	35.7 (28.6-48.5)
Children (n)	25 (86%)	13 (65%)
Plication (n)	8 midline	3 midline
	6 oblique	2 oblique
	8 combined	0 combined
	6 none	18 none
Prior surgery (n)	22 (76%)	21 (91%)

BMI, body mass index.

## Surgical Technique

The senior author (J.S.) routinely performs a midline, single-layer, continuous monofilament plication for rectus diastasis if present intraoperatively. This type of plication has been shown to be efficient and effective for prevention of recurrence, and requires less operative time than a 2-layer plication.<sup>21,22</sup> Plication is performed both superior and inferior to the umbilicus. Following midline plication, the laxity of the anterior abdominal wall is reassessed, and if unacceptable laxity remains only then will oblique plication of the lateral abdominal wall be performed. The decision to perform midline and oblique plication is fully dependent on intraoperative assessment of the abdominal wall.

## Data Analysis

Multivariable linear regression models were fitted to model the relationships between scores and plication, adjusting for presurgery survey score and other patient variables. Paired *t* tests were used to compare overall and strata-specific changes in ODI and SF-36 pre- and postsurgery (Table 4). There were significant improvements in the overall patient cohort in ODI (−15.14), SF-36 physical function (19.92), and SF-36 pain (17.42) ( $P < 0.001$ ), as well as when patients were stratified by plication status. Notably, multivariable linear regression analysis did not demonstrate significant association of plication (midline, oblique, or combined), on ODI or SF-36 scores of physical function or pain (Table 5). Preoperative exam findings of skin laxity, muscle laxity, prior abdominal surgical history, and BMI

were also not correlated with significant differences in the outcomes we examined in this study. Furthermore, we did not see a difference in outcomes when the data were stratified into aesthetic and massive weight loss patient groups. Contrary to our hypothesis, all patients who indicated preoperative back pain of any severity showed significant improvement in ODI and SF-36 scores postoperatively, regardless of preoperative characteristics or operation performed. When we examined the impact of plication on these outcome measures, there was no significant association between plication (midline, oblique, or combined) and more dramatic improvement in outcomes than achieved when abdominoplasty was performed without plication.

## DISCUSSION

Several studies have demonstrated improved spinal stabilization and resultant relief of chronic back pain, and improvement in other quality-of-life metrics following abdominoplasty with rectus plication.<sup>3,5,11-13</sup> In contrast, 1 case report demonstrates improvement in back pain and other functional improvements following abdominoplasty without plication.<sup>15</sup> A single study shows no significant difference in trunk muscle endurance or physical function between patients randomly allocated to undergo abdominoplasty with or without plication, irrespective of diastasis width.<sup>14</sup> Patients in both cohorts showed increased abdominal muscle endurance postoperatively, regardless of plication status.<sup>14</sup> Given the significant increase in operative time and risks associated with abdominal wall plication compared with abdominoplasty without plication, the primary goal of this study was to further delineate differences in outcomes that may exist between the 2 groups.

Several studies have examined functional and radiographic changes in the spine after abdominoplasty with rectus plication in patients with diastasis. Initially, these changes were credited to the wide abdominal rectus plication (WARP) abdominoplasty, which involved an aggressive plication that brought the rectus muscles through a 90° rotation at the midline.<sup>5,11,12</sup> Diastasis was thought to decrease efficiency of the abdominal wall musculature, thus predisposing patients with chronic back pain to failure of conservative management and orthopedic interventions that do not address the abdominal wall.<sup>11</sup> After WARP abdominoplasty, patients reported significant relief of chronic back pain, had improved intervertebral space height on MRI, and significant gains in torque strength of the core compared with preoperative values.<sup>4,5,11,12</sup> These early reports concluded that significant tightening of the lateral abdominal musculature and the subsequent increase in intra-abdominal pressure was necessary to improve spinal stabilization and reduce back pain.<sup>4,5,11,12</sup> More recently, studies have demonstrated similar clinical

**Table 4.** Back Pain and Functional Scores

Survey	Mean	Minimum	Maximum	P	t
ODI					
Preoperative	27.7	2	70		
Postoperative	12.6	0	48	<0.001	-15.14
SF-36 Pain					
Preoperative	52.7	0	100		
Postoperative	70.1	0	100	<0.001	17.42
SF-36 physical functioning					
Preoperative	57.8	5	100		
Postoperative	77.7	5	100	<0.001	21.67

ODI, Oswestry Disability Index; SF-36, 36-Item Short-Form Health Survey.

**Table 5.** Impact of Plication Status on Back Pain and Functional Scores

Patient group	ODI	SF-36 pain	SF-36 physical functioning
All	-15.14	17.42	19.92
Plication	-13.71	14.11	17.04
No plication	-16.67	21.67	23.62

ODI, Oswestry Disability Index; SF-36, 36-Item Short-Form Health Survey. All P values significant at <0.05.

and radiographic improvements in patients undergoing abdominoplasty with limited rectus plication.<sup>3,13</sup> A recent prospective, multicenter study showed improvement in both chronic back pain and urinary incontinence following abdominoplasty with a variety of different limited plication techniques in postpartum females.<sup>13</sup> Contrary to earlier studies, current literature suggests that a limited plication can improve vertebral angles and relieve pressure on the spine, while avoiding the potential complications of abdominoplasty with wide plication previously described.<sup>3,5</sup>

These studies were performed under the assumption that the rectus abdominis muscle and sheath contribute to lumbar spinal stability as a result of the anatomic connection between the 2 structures, and that alteration of the anterior abdominal wall through plication is necessary for functional improvement. However, a recent trial randomizing abdominoplasty candidates with skin excess (with/without diastasis of any width) to abdominoplasty with or without plication demonstrated overall improvement in trunk muscle function, lung function, and self-assessed physical function in both groups, yet no significant differences in improvement between the 2 groups.<sup>14</sup> A single

case report has shown improvements in chronic back pain and postural stability following simple panniculectomy, without plication of the abdominal wall.<sup>15</sup> Such outcomes suggest that perhaps factors beyond plication, such as the weight of tissue resected and resultant biomechanical changes, play a role in the overall improvement experienced by these patients.<sup>14,15</sup>

Abdominal wall laxity and diastasis have been implicated as risk factors in the development of lumbar pain. The indirect connection between the linea alba and the lumbodorsal fascia through the lateral abdominal wall musculature helps to explain why this is the case.<sup>11,12</sup> Plication of the abdominal wall optimizes the muscles on their length-tension curves, increasing the ability to generate force and stabilize the spine.<sup>5</sup> Given these biomechanical factors, we hypothesized that we would see significantly improved ODI and SF-36 scores in those patients who underwent anterior abdominal wall plication compared with those who did not. However, our results demonstrated that all patients, regardless of plication status, showed improvements in ODI and SF-36 scores of physical function and pain. Furthermore, there was no significant difference in outcomes when patients were stratified by plication status, suggesting that within this patient population plication may not be an absolute necessity to see improvements with respect to back pain and physical function specifically. We acknowledge that plication is typically indicated for repair of abdominal wall laxity and resultant cosmetic outcome. Increased abdominal pressure from tissue excision and tightening, as well as anterior abdominal weight reduction, are the mechanisms by which abdominoplasty without plication can improve lumbar pain. Our results expand upon the results of Wilhelmsson et al<sup>14</sup> who demonstrated no difference in trunk muscle function resulting from plication of any width.

Although interventions that increase intra-abdominal pressure have been shown to improve spinal stabilization, the amount of pressure that is needed to see a benefit is unclear.<sup>6,23,24</sup> In fact, one study found no correlation between plication width and intra-abdominal pressure changes, suggesting that even a slight adjustment in the abdominal biomechanics can be beneficial.<sup>24</sup> This adjustment could come from the reduction in abdominal tissue alone, as excess abdominal tissue shifts the center of gravity anteriorly and places an abnormal strain on the spinal column.<sup>3</sup> As little as 10 pounds (4.5 kg) of anterior abdominal weight gain can result in 100 pounds of additional strain on the lumbar disks.<sup>11</sup> Therefore, it is possible that the changes that arise from tissue and skin resection alone, combined with the increased intra-abdominal pressure resulting from postoperative pain, a flexed posture, and compressive binder, may explain our results.<sup>24</sup>

A secondary goal of this study was to identify preoperative characteristics that may help to predict who may benefit from abdominoplasty as a treatment option for chronic lumbar pain. No specific patient characteristics were identified as significant predictors of improvement in this cohort. All patients who reported preoperative back pain, regardless of their preoperative characteristics or operation performed, experienced a reduction in back pain postoperatively.

This study is not without limitations. Most importantly, it was retrospective in nature and patients were asked to report symptoms both before and after surgery. There is likely an element of recall bias encountered due to the nature of the study and when the surveys were completed. Additionally, although the survey response rate was actually quite high (42.3%), the number of patients indicating preoperative back pain who were included for review was relatively low at  $n = 51$ . There may exist differences in outcomes amongst patient groups that we were unable to recognize due to low patient volume. A large-volume, prospective study randomly allocating patients into plication and nonplication groups with surveys completed pre- and postoperatively would be the ideal situation. This is obviously difficult given the clinical indication to perform a plication for the best cosmetic outcome for patients with lax abdominal wall musculature.

Regardless of the limitations of this study, our results suggest that the biomechanical effect of plication on the spine is not the only factor responsible for alleviating chronic back pain in this patient population, and that reduction of excess tissue alone does play a significant role in altering the forces acting on the lumbar spine. Our results align with and expand upon prior work showing improvement in patients regardless of plication status.<sup>14</sup> Further studies with larger patient numbers will be required to identify preoperative characteristics that may indicate whether a plication might

improve outcomes. The results of this study are encouraging; abdominoplasty regardless of plication status has a significant positive impact on specific validated outcome measures that examine the functional limitations of chronic back pain in this patient population. This impact on chronic pain and quality of life has significant implications for the management of back pain in patients with abdominal wall laxity and excess abdominal tissue, especially considering that up to 70% of patients who undergo spine surgery for back pain continue to have pain postoperatively.<sup>25</sup> In this select patient population, abdominoplasty both with and without anterior abdominal wall plication may be an acceptable treatment for chronic back pain. Furthermore, in patients with chronic back pain who may not be candidates for a plication or perhaps do not have diastasis, our results suggest that abdominoplasty alone has the potential to alleviate pain and improve physical function.

## CONCLUSIONS

Abdominoplasty both with and without anterior abdominal wall plication has a positive outcome on chronic back pain and resultant quality of life as evidenced by significant improvements in ODI and SF-36 scores in categories of physical function and pain, in both aesthetic and massive weight loss patients. In this single-surgeon series, we did not see a significant difference in outcomes based on plication status or patient-specific preoperative characteristics. These results suggest that both an increase in abdominal pressure and a reduction of anterior abdominal weight can alter the biomechanics of the trunk musculature, and both of these factors play important roles in spinal stabilization. Furthermore, a significant reduction in back pain and resultant functional improvement is not limited to a certain subset of patients. Together, these biomechanical changes can alleviate chronic back pain in patients with abdominal wall laxity and excess anterior abdominal tissue, adding to the literature which suggests that abdominoplasty with or without anterior abdominal wall plication may be an acceptable treatment option for chronic back pain in this patient population.

## Supplementary Material

This article contains supplementary material located online at [www.aestheticsurgeryjournal.com](http://www.aestheticsurgeryjournal.com).

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