

Treatment and outcomes of rectus diastasis in post-bariatric patients and postpartum women – a systematic review

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Summary

Background: Rectus diastasis is an increasing condition determining both cosmetic and functional disability that mostly affects post-bariatric patients and postpartum women. The goal of this study is to provide an updated review of open surgical techniques used for rectus diastasis repair during an abdominoplasty in these two subgroups, their comparative efficacy and eventual differences in the outcomes. **Evaluation of the topic:** In accordance with Systematic Reviews and Meta-Analyses guidelines, the Pubmed, EMBASE, MEDLINE, the Cochrane and Scholar databases were searched for articles from 2004 to 2024. A total of 47 studies were analysed. Among these, 5 were about one specific subgroup. The plication was done most with permanent sutures. In case of hernia, a repair with mesh was performed with at least > 1 cm of diastasis. There was no statistically significant difference in surgical complication and recurrence rates between post-bariatric and postpartum patients ($P \geq 0.05$ and $P \geq 0.05$, respectively). **Conclusions:** In general, surgical repair of rectus diastasis appears to be efficient but there is no evidence or unanimity about one method over another. Moreover, the quality and the number of studies treating the two categories of patients separately in literature so far is too low. Despite the plication of the rectus muscle during surgical abdominoplasty in association with an eventual herniorrhaphy as principal treatment is known, there is a lack of defined guidelines regarding the correct approach taking into consideration the pathophysiological differences of the two subgroups. Therefore, further prospective studies are necessary in this area to improve the quality of data and reduce the bias.

Key words

diastasis recti – systematic review – wall reconstruction – post-bariatric – post-pregnancy

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Introduction

Rectus diastasis (RD) is a clinical condition with a high prevalence worldwide. The definition currently accepted by most authors describes RD as a widening of the linea alba beyond 2 cm, accompanied by thinning of this structure [1–3].

This condition results in a protruding abdomen, which leads to both aesthetic concerns and significant functional disability for the patient, affecting the entire abdominal wall. This disability primarily predisposes patients to the development of hernias, lower back pain, and reduced trunk muscle strength [4–6].

The two main patient groups affected are post-bariatric patients and postpartum women.

The diagnosis of diastasis recti is mostly clinically made using the "finger width" method, which manually assesses the distance between the medial margins of the two rectus muscles. Alternatively, more in-depth diagnostic methods such as ultrasound or CT can be used [1].

In the early stages, treatment of the condition takes place through non-surgical approaches such as physiotherapy or training programs aimed at strengthening the abdominal wall; in the more advanced stages, invasive open or laparoscopic surgical methods are used.

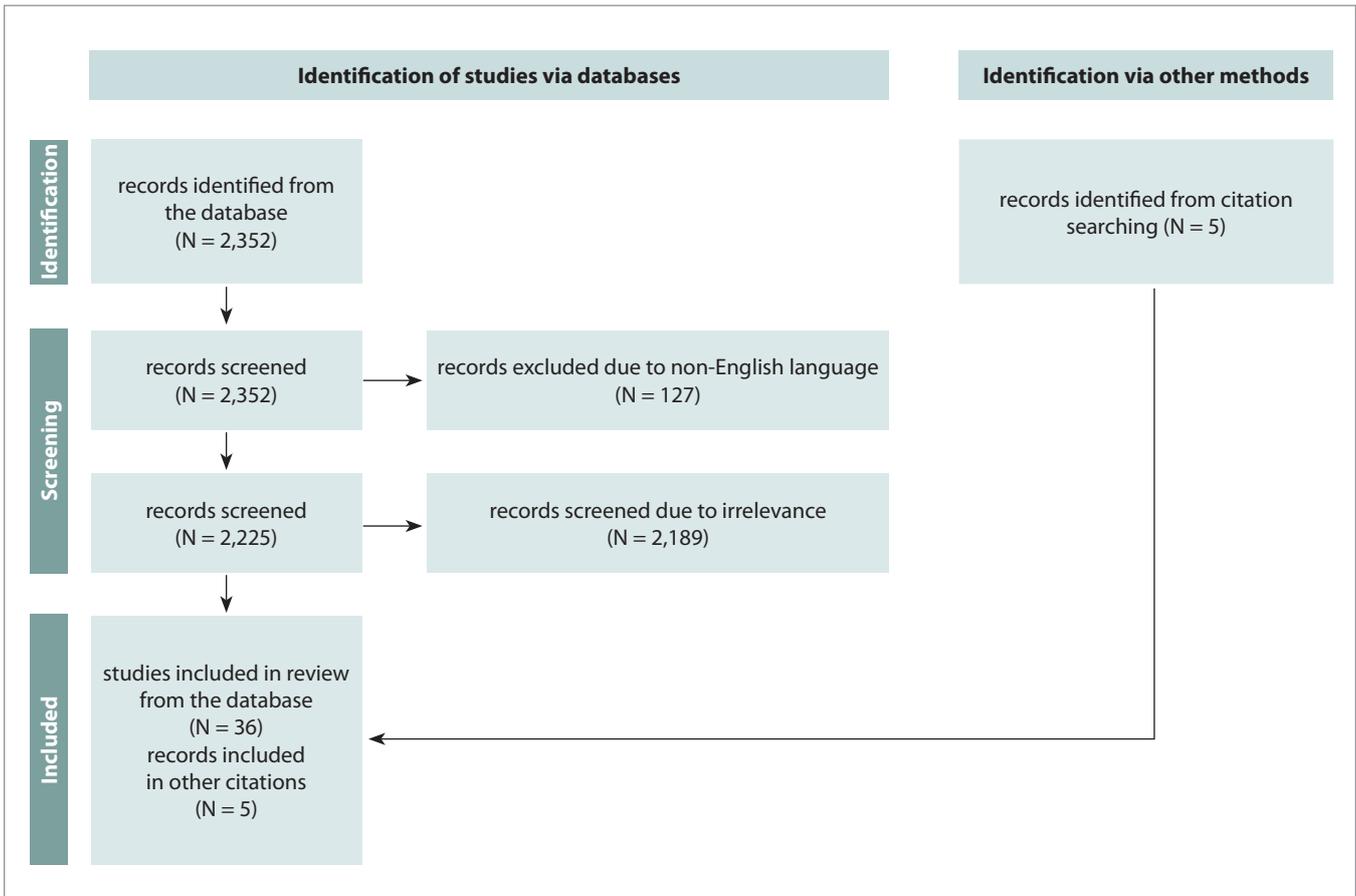
Most existing studies consider a wall defect > 5 cm as the appropriate indication for a surgical approach [6]. However,

currently, there is no unanimity on a tailor-made approach for each type of patient suffering from the diastasis of rectal muscles.

The aim of this study is to perform an updated review of the last 20 years in the treatment of the diastasis of rectal muscles in conjunction with an abdominoplasty, to evaluate any existing differences in the surgical treatment of postpartum and post-bariatric diastasis recti and, finally, to evaluate any existing differences in the management of female and male patients.

Evaluation of the topic Methods

The research was conducted on PubMed, Google Scholar and Cochrane li-



Scheme 1. A flowchart.

brary according to the 2009 Prisma statement, using the following words:

((("RectusAbdominis/surgery"[Mesh]) OR (Rectus muscle)) OR (Abdominal muscle)) OR (Abdominal wall*)) AND ((("Diastasis, Muscle/surgery"[Mesh]) OR (Abdominal diastasis)) OR (abdominal separation)).

The bibliographies of all articles were consulted to search for any other eligible articles not included in the algorithm's search results. The articles were selected by two independent physicians according to the following inclusion criteria: comprehensive English-language articles published from 2004 to 2024 regarding surgical techniques for the treatment of diastasis recti, conducted on patients over 18 years of age. In the event of disagreement on the selection of an article according to the eligibility criteria, two other reviewers were consulted.

Non-English articles, animal studies and letters to editors were excluded. In addition, articles dealing with conservative techniques for the treatment and prevention of diastasis recti, articles dealing with hernia repair techniques that do not have a midline defect and articles dealing with "complex" reconstruction of the abdominal wall were excluded. Finally, articles that talk about the repair of the defect through laparoscopic surgical techniques have been excluded. The data extracted from the articles concern the title, year and name of the author, number of patients included, and number of articles included, type of diastasis (post-pregnancy or post-bariatric), technique used, materials used, recurrence rate and complications.

Efforts were made to minimize potential biases. Data analysis for each individual article was conducted through a comprehensive review of the text and

extraction of relevant information from the presented tables. When the patient category, falling within one of the two study-specific groups, was not explicitly stated, this was documented accordingly in the study tables. Additionally, the results of the selected articles were reported both in the tables and summarized in a few lines within the text.

2,352 articles emerged from the research. After skimming according to the PRISMA statement and after eliminating duplicates, 37 articles were selected (Scheme 1). Five articles have been selected from the bibliography of the research articles as they are considered related to the purpose of the review.

Of the selected articles, 15 are reviews. Tab. 1 shows the data extrapolated from the reviews as type of surgical technique and suture / suture material / suture size used in the correction of diastasis recti: nine reviews analyze studies with open

Tab. 1. Analysis of the reviews.

Ref No.	Type of article	Author	Year	No. of articles	No. of patients	Type of surgery	Type of suture
5	review	E. H. Mommers	2017	20	1,591	3 open, 1 study with mesh, 2 with plication	NS
4	review	J. Akram	2013	28	3,725	15 open	NS
22	review	M. L. Jessen	2021	61	3,531	46 open	13 single layer, 16 double layer, 2 single and double layer, 22 not absorbable, 2 slowly absorbed, 5 absorbable
25	review	F. X. Nahas	2019	22	2,184	NS	13 nylon, 5 PDO, 1 polyester, 3 NS
23	review	A. Olsson	2021	10	780	7 open	5 absorbable, 3 not absorbable 1 NS
32	review	L. Van Kerckhoven	2021	24	931 (920 women, 11 men)	7 retrospective studies, 17 prospective studies	761 plication and 170 mesh, 355 absorbable and 406 not absorbable, 366 one layer, 395 two layers
30	review	J. E. Cheesborough	2014	NS	32	32 plication and mesh	NS
28	review	H. ElHawary	2019	24	1,253	31 open	18 not absorbable, 11 absorbable
27	review	H. ElHawary	2021	28	453	10 open	NS
24	review	M. L. Jessen	2019	NS	7	7 open	3 not absorbable vs. absorbable suture
29	review	J. Gormley	2020	7	497	7 with plication, 3/7 abdominoplasty, 2/7 mesh	NS
2	review	M. Y. Nahabedian	2018	NS	NS	NS	2-0 nylon suture, two layers vs. continuous 2-0 nylon suture
26	review	M. Radhakrishnan and K. Ramamurthy	2022	77	NS	NS	NS
31	review	M. Cavalli	2021	13	12 studies on women, 1 on men	NS	NS
3	review	S. W. Nienhuijs	2021	95	NS	NS	NS

NS – not stated, PDO – polydioxanone

technique, seven reviews analyze characteristics of suture material and type of plication (single layer or multilayer), three reviews analyze the differences between men and women, and one is an analysis conducted on cadavers.

Tab. 2 shows, on the other hand, the data extrapolated from all the other

types of studies (case report, retrospective, control case and guidelines) comparing the type and number of patients, the type of incision and the technique used in an open approach, the suture materials and the suturing technique and, finally, if mentioned, episodes of recurrence and/or complications.

Two of these articles are guidelines that recommend a double-layer plication if the RD is < 1 cm, while if the defect is > 1 cm they also recommend the application of mesh [1,6].

Dumanian and Moradian talk about the use of mesh in moderate and severe diastasis in both men and women, dem-

Tab. 2. Analysis of articles.

Ref. No.	Type of article	Author	Year	No. of patients	Type of surgery	Incision	Type of suture	Suture technique	Complications or recurrence
1	guidelines	P. Hernández-Granados	2021	NS	RD with no hernia = plication, RD with hernia > 1 cm = plication + mesh	NS	NS	NS	NS
6	guidelines	A. Carlstedt	2021	84 primiparous 300 postpartum	plication	midline or transverse in the lower half of abdomen	NS	double-row suture	NS
7	RCT	G. A. Dumanian	2021	56; 40 women and 16 men	plication + mesh if RD > 5 cm	semilunar line	0-polypropylene	NS	3 superficial infections, 1 recurrence
8	case report	W. Ha	2016	2	plication	initial incision around umbilicus, then semilunar line	1-0 vycril 1-0 prolene	longitudinal "figure of 8" followed by interlocking towards midline	NS
9	case report	R. Touminen	2024	46 women postpartum	lateral plication	semilunar line (bispinoiliac)	0 nonreabsorbable polyfilament.	NS	low
11	case report	D. El Israwi	2023		mini-abdominoplasty	semilunar line (bispinoiliac)	PDO absorbable monofilament	continued suture above and below umbilicus	NS
12	case report	D. J. Perry	2021	82	abdominoplasty and "corset" contour	semilunar line (bispinoiliac)	NS	NS	none reported
10	retrospective	G. G. Nervil	2023	44 postpartum	abdominoplasty	bispinoiliac	PDO absorbable monofilament	single running plication of anterior rectus fascia	few
13	retrospective	V. Bucaria	2021	718 postpartum	dermal auto-mesh in retro-muscular layer	bispinoiliac	polyglycolic acid 0-0, polyester 2-0	interrupted suture and reinforce	none
14	case control	P. Verissimo	2019	31 postpartum	conventional abdominoplasty	bispinoiliac	0 monofilament nylon	triangular mattress suture vs. continuous suture	NS

NS – not stated, PDO – polydioxanone, RCT – randomized control trial, RD – rectus diastasis

Tab. 2 – continuing. Analysis of articles.

Ref. No.	Type of article	Author	Year	No. of patients	Type of surgery	Incision	Type of suture	Suture technique	Complications or recurrence
15	RCT	L. J. Gama	2017	30 postpartum	conventional abdominoplasty	bispinoiliac	2-0 monofilament nylon vs. barbed non-absorbable	control: double layer with nylon I: single layer with nylon II: barbed non-absorbable running suture	3 recurrences in group II
16	case report	F. X. Nahas	2004	2 postpartum with RD recurrence	posterior rectus sheath plication in patients with rectus insertion congenital malformation	paramedian incision	2-0 nylon	interrupted suture	none
17	case control	O. Mestak	2010	44 postpartum, 7 hernias, 10 nulliparous (control)	conventional abdominoplasty	bispinoiliac	0 Ethicon PDO	NS	NS
34	case report	S. Uzair	2013	1 post-partum	conventional abdominoplasty with plication and mesh	bispinoiliac	non-absorbable	NS	NS
18	retrospective	F. X. Nahas	2005	20 postpartum	conventional abdominoplasty with plication of anterior sheath of the rectus	bispinoiliac	2-0 nylon suture	two layers: first with interrupted buried stitches, second with continuous suture	1 seroma
19	case report	K. M. Gallus	2016	1 postpartum	conventional abdominoplasty	bispinoiliac	2-0 prolene 1 polydioxanone	first layer: figure of 8 mattress sutures, second layer: running looped	none
20	retrospective	A. Rosen	2011	34 women	conventional abdominoplasty	bispinoiliac	2 or 0 absorbable PDO vs. barbed	double layer closure	barbed suture: 2 minor seromas, 1 infected hematoma, absorbable: 1 seroma
21	retrospective	G. Köhler	2015	231	hernia repair (< 2 cm), if with RD and mesh	NS	non-absorbable	NS	7 hematoma/seroma, 6 wound infections, 38 recurrences

NS – not stated, PDO – polydioxanone, RCT – randomized control trial, RD – rectus diastasis

onstrating that the best suture is trans-fascial and close to the semilunar line [7].

In their case report on two Korean women, Ha et al. show a multiple longitudinal plication approach of the abdominal wall with absorbable thread [8].

Tuominen et al. describe the experience with hydrodissection and epidural anesthesia for lateral plication modification of abdominoplasty to restore abdominal wall firmness [9].

El Israwi and Watfa explain a modified mini-abdominoplasty [11], while Perry and Driscoll reinforce the plication with an autograft taken from the removed adipose-skin flap calling the technique "corset contour" [12].

Nervil et al. argue as using a single running plication of the anterior rectus fascia with a slowly absorbable suture gives a fair cosmetic result, excellent effect on symptoms, few complications and high levels of patient satisfaction [10].

Bucaria and Boccuzzi offer an alternative to mesh with a dermal graft which is easy to handle, has demonstrated comparable tensile strength to alloplastic mesh and is available in abdominoplasty or mini abdominoplasty from the excised skin [13].

Veríssimo et al. show how the use of triangular mattress sutures significantly reduces the length of the aponeurosis of the rectus muscle [14].

Gama et al. state at the end of his randomised study that the repair of single-layer straights with non-absorbable thread is much faster and with efficiency comparable to the classic technique [15].

Nahas et al. bring a correction of the technique by plicating the posterior sheaths of the rectus after their advancement in patients who have recurrence because they have a congenital mutation of the muscle insertion [16].

In their case-control study, Mestak et al. conclude by saying that the rectus sheath plication using absorbable sutures in patients with the diastasis of rectal muscles is a reliable method that maintains the long-term stability of the

abdominal wall. The same conclusion is reached by Nahas et al. in their retrospective study [17,18].

In their case report, Gallus et al. demonstrate how plication surgery is not only aesthetic but also functional, so much so that postpartum women with RD can be enrolled in the US Navy [19].

Rosen and Hartman conclude his retrospective study by stating that long-acting absorbable barbed or smooth sutures appear to be equally effective in maintaining rectus diastasis repair [20].

Finally, with their retrospective study on the treatment of RD in conjunction with hernia, Köhler et al. say that patients with rectus diastasis and absorbable sutures have a tenfold higher risk for recurrence compared to those without rectus diastasis and nonabsorbable sutures [21].

Definition of outcomes

The first outcome of the study concerns the evaluation of the different existing open techniques for the treatment of diastasis recti and the comparison of these in terms of material used, complications and recurrence rate.

The second outcome aims to analyze whether there are differences in terms of anatomical characteristics of diastasis in post-bariatric and postpartum patients and any differences in surgical treatment.

Diastasis recti is a common condition in post-bariatric patients and post-pregnancy patients. Surgical management takes over when a conservative approach is not possible. There are several classifications available in the literature, but there is not unequivocally recognized one.

Diastasis recti can be classified by patient characteristics: T1 (post-pregnancy) and T2 (for adiposity); by size of the defect in D1 (between 2 and 3 cm), D2 (between 3 and 5 cm) and D3 (> 5 cm); finally for the concomitant presence of hernia (H1) or absence (H0) [1]. A further classification is the Nahas classifi-

cation which identifies four types of diastasis aesthetics: type A, post-pregnancy DRAM (diastasis of rectus abdominis muscle); type B, DRAM and lateral and infraumbilical aponeurosis laxity; type C, congenital lateral insertion of the rectus abdominis muscles; and type D, DRAM combined with a poor waist circumference [4,5]. Other classifications are the Beer and the Rath [2,4].

Mostly, RD is acquired with central/visceral obesity and pregnancy being the two main etiological factors of its incidence [22]. The congenital forms caused by autosomal dominant transmissions are due to syndromes that involve alterations in the quality of collagen present in the body, associating, in these cases, with joint aneurysms and laxity, as in Ehler-Danlos syndrome [3]. A not uncommon malformation of the insertion of the rectus on the lateral costal margin has also been reported, causing post-treatment relapsing diastasis, which requires plication of the posterior sheaths of the rectus after their advancement, to obtain a definitive resolution of the diastasis [16].

The use of surgery makes it possible to eliminate the distance between the rectus muscles and restore the continuity of the abdominal wall. Rectus plication is the most widely used surgical technique and is often performed at the same time as a tummy tuck, to improve the aesthetic result of the abdomen and improve the patient's quality of life.

Surgical technique

When a conservative approach is not possible, the surgical technique represents a valid alternative in improving the symptoms associated with diastasis recti such as lower back pain, urinary incontinence and quality of life [23,24]. The surgical technique available for DR is rectus plication and if there is a concomitant hernia, a combined diastasis and hernia repair technique is used. Plication of the anterior wall of the rectus is the main technique currently used. It

consists of pinching the anterior abdominal wall and in most cases is conducted vertically and allows the attenuated linea alba to be delineated [2]. Some studies suggest horizontal, curved, fusiform or H-shaped techniques in the external oblique aponeurosis during plication [25]. In patients with significant anterior rectus sheath laxity, lateral plication on both sides can also be performed to further improve and firm the abdominal contour [2]. In the case of concomitant hernias, for defects < 1 cm the direct plication is sufficient for the correction of the defect, for higher values the use of a mesh is necessary [1].

The plication of the rectus can take place in the open technique, laparoscopic or a combination of the above. The open approach, defined as "according to Pitanguy", is the most widely used in plastic surgery and consists of a transverse suprapubic incision that joins the two iliac spines. The lifting of the abdominal flap with an upper base allows the visualization of the linea alba and the rectus muscles. Other types of incisions are also possible, such as supraumbilical incisions, used when there are coexisting conditions such as nephrectomy or hernia [7,24,26]. There is also the left suprapubic incision extended 2–3 cm upwards and the median incision extending from the xiphoid process to the pubic area, which is useful when choosing to perform an inverted T abdominoplasty [24,26]. The open technique compared to the laparoscopic technique offers better visualization of the linea alba and the possibility of removing excess skin. However, it is still associated with a higher rate of complications, greater postoperative pain, and larger scarring [27].

A study reports a differentiation of techniques based on sex, preferring the Pitanguy technique in females and the vertical one in males [7].

Plication can be conducted with interrupted suture, interrupted mattress suture or continuous suture [22]. The interrupted suture technique has always

been the most common and one of the first to be developed, but it is associated with longer operative times than the continuous one. In addition, plication can be performed with or without mesh reinforcement depending on whether there is a concomitant hernia.

Triangular mattress techniques have been developed to contain the epigastric bulge that was seen in some patients treated with detached sutures.

Plication can be conducted in a single layer or in several layers with a combination or not of detached or continuous suture. The times in the mentioned technique are up to 50% shorter than in the multi-layer technique without having any consequences in tension and resistance over time [15]. Although there are no differences in terms of recurrence in the use of the single-layer or double-layer technique, it appears that the double-layer technique is associated with a lower number of complications [28].

The suture can be absorbable, slowly absorbable or non-absorbable. Some studies comparing the use of notched monofilament with absorbable non-serated monofilament show a higher recurrence rate in the former case, probably related to the muscle tearing effect that occurs in the passage of the thread into the muscle during plication [25]. This material can also cause more frequent post-operative complications such as seroma and hematoma [20]. Hassan et al. also report a case of diastasis recti conducted with a paper clip, considering it fast in execution and effective in holding [28].

The most used suture as absorbable suture is polyglactin 910 and polydioxanone while the most frequent non-absorbable sutures are polyamide, polypropylene, and polyester [25].

Case-control studies show that even an absorbable suture such as ethicon polydioxanone 2-0 can give stable results in the long term [17].

There are no differences in terms of recurrence between a non-absorbable

and a absorbable suture material [24,28]; however, the literature shows that often a non-absorbable suture can generate a greater inflammatory effect, greater palpability in the postoperative period and is associated with a greater persistence of postoperative pain along the midline [25]. In addition, an absorbable thread can facilitate the recurrence of periumbilical and epigastric hernias along with other factors such as obesity and wound infections [21].

The choice of wire size must consider the fact that the knot is tightened the greater the diameter of the wire itself. Therefore, sutures that are too thin tend to tear the aponeurosis and this is the main cause of recurrence of diastasis recti. Thus, choosing a suture thread size ranging from 0 to 2-0 tends to be the most appropriate choice. However, it should be considered that sutures that are too large can lead to the development of granulomas, so these characteristics should be considered when choosing the thread size. There is no evidence to support the use of antibiotic-soaked threads in reducing infection rates in the correction of diastasis recti [25].

Finally, from the current literature, it is not clear whether the plication of the rectus is able to increase abdominal strength as existing studies do not consider the different severity of the diastasis. It can be agreed that rectus plication contributes in terms of improving abdominal function but not muscle strength. It would seem that in the case of a hernia, mesh reinforcement contributes to both trunk reinforcement and abdominal wall functionality [29].

Some authors have questioned the duration of plication alone, suggesting as an alternative a reinforcement with mesh in the submuscular plane.

This technique would seem to be safer in patients who have had a 100% recurrence of musculoaponeurotic laxity at one year after surgery, especially multiparous women with severe abdominal wall laxity [30].

Vertical abdominoplasty allows for greater waist shrinkage and more adequate removal of excess fat from the epigastric region, as well as the creation of a new navel [30]. Therefore, the choice of the type of surgical technique should consider the type of myoaponeurotic deformity according to the Nahas classification [4].

Moreover, Perry and Driscoll suggest an alternative surgical technique called "autodermic corset" performed through the aid of an autograft taken from the abdominal panniculus normally removed and inserted under tension between the semilunar lines as a corset, to reduce the recurrence of RD and abdominal hernias [12].

Complications

The surgical complications related to the plication of the rectus, whether performed with the laparoscopic technique or with the open technique, are many: infections, sensory disturbances, flap necrosis, seroma formation, local wound complications and recurrence [2,4,22]. Common complications include seroma, wound dehiscence, and minor bleeding episodes [27,29]. There is no evidence of difference in terms of complications or recurrences from the comparison of the use of various techniques [22,28]. In addition, significant diastasis recti can contribute to the loss of abdominal function and not allow an adequate Valsalva maneuver [30].

The aspect that most worries patients is post-operative pain. Studies in the literature comparing postoperative pain in the various techniques show that there are minimal differences. However, it must be considered that the analysis of pain in the various studies currently present takes place in a non-standardized way. On the contrary, however, it is possible to conclude that in most cases the use of mild analgesics is sufficient to contain post-operative pain [22].

Finally, it must be borne in mind never to perform too stringent plications in

order not to compromise the patient's ventilation [25].

From the current literature there is no difference in terms of postoperative complications between the above-mentioned techniques, therefore it is not possible at present to identify a superiority of one technique over another [5,22,28].

Etiological differences

There are not enough studies to highlight the differences between men and women, but it is commonly believed that the pathophysiology underlying the process is different in the two sexes.

In post-pregnancy DRAM, collagen remodeling induced by the hormone relaxin during pregnancy seems to play a predominant role by directly stimulating matrix metalloproteases [3,5]. The viscoelastic properties of collagen allow the linea alba to increase its length when subjected to prolonged mechanical stress, as occurs in the case of a constant increase in intra-abdominal pressure. The progressive growth of the fetus inside the uterus together with hormonal changes (increased secretion of relaxin, progesterone and estrogen) in the connective tissue, creates a physiological enlargement between the rectus, which can cause diastasis during pregnancy [31].

The midline conjunction weakens as the components of the extracellular matrix change due to the altered progesterone-estradiol balance and corticosterone release [3].

In most cases, this phenomenon regresses spontaneously after pregnancy, restoring, albeit partially, the continuity of the abdominal wall. Small or highly trained women, as well as those with twin pregnancies, are more at risk [3]. In these, an incidence of diastasis emerged in 66% of cases during the third trimester of gestation and in 33% during the postpartum period [22]. Current data report that one in three women still experience the presence of this midline separation one year after childbirth [3,23,31].

Currently, a statistically significant incidence relative to the age of pregnant women does not seem to emerge, although a slight prevalence in young women has been emphasized in several reviews [31]. Therefore, based on these considerations, surgery in postpartum women should be considered from six to twelve months after delivery, as in some patients it tends to resolve spontaneously [24]. According to other studies, the waiting time before surgery is 2 years [6]. Therefore, pregnancy is confirmed as a risk factor for the development of diastasis and increases with the number of pregnancies. Caesarean section is a risk factor only in the case of a second pregnancy [31].

The increase in intraabdominal pressure caused by increased weight and BMI explains how diastasis recti is a prevalent condition even in obese people. The increase in visceral fat, characteristically male, in fact, leads to an accumulation of adipose tissue in the mesentery and in the greater omentum, associated with a marked loss of muscle thus generating pressure on the rectus muscles, which together with the reduction of collagen in the linea alba above the navel in severely obese patients, causes a separation, explaining the onset of this condition in patients with high BMI [31]. Male diastasis rectus develops more frequently because of increased intra-abdominal fat volume, especially in the supraumbilical region, and occurs from the fifth to the sixth decade of life [30].

Finally, diabetes mellitus appears to be an additional risk factor associated with generalized sarcopenia [31].

Recent cadaveric studies have also shown a structural difference in the linea alba between male and female individuals, showing a predisposition to diastasis in the former. In nulliparous females, compared to males, a greater amount of transverse collagen fibers was found, both in the upper (hypogastric) and in the middle (infra-umbilical) portion, while no differences were found in

the lower segment. This disparity translates into a different aponeurotic thickness between the two sexes, both at rest and in the curl-up position [31]. In women, the fiber levels of the linea alba are twice that of a man [3].

In humans, the genetic component seems to have a greater weight [5]. Some authors believe that the male abdominal wall is more rigid, explaining the higher percentage of cases of diastasis and concomitant hernia in this sex [30].

Conclusions

Considering the current literature and the quality of the studies present, there is insufficient evidence to support the choice of one surgical technique over another (plication vs mesh) nor the recurrence rate in the case of absorbable or non-absorbable sutures. There is a greater recurrence for the use of absorbable sutures, but further studies are needed.

Therefore, the choice of the type of surgical approach and the type of suture to be used remains a decision of the surgeon based on his preferences and skills. The choice of technique also considers the patient's characteristics such as the presence of excess skin or the presence of a concomitant hernia.

The current literature considers the surgical approach a safe and adequate choice for the treatment of diastasis recti especially when combined with excess abdominal skin or in the presence of a concomitant hernia. The conservative approach should only be considered if there is no serious functional impediment or when the patient decides not to undergo surgery. Furthermore, our review did not bring to light different surgical indications depending on the etiology or sex of the patient. It is now common opinion that the basic pathophysiology differs in different conditions. Therefore, subsequent studies should highlight these differences and seek the best surgical approach for each underlying condition.

Limits

The limitations of this study relate to the linguistic bias for the exclusion of non-English articles that may have been relevant to the purpose of the review. In addition, many studies do not report adequate information about the technique used or the characteristics of the suture threads. In addition, many studies do not specify patient characteristics such as gender, BMI, and pregnancies. Moreover, not every study is public, so it has not been possible to include some papers in this review. Finally, the quality of prospective studies is often very low and with a limited number of patients.

Roles of authors

All authors have been actively involved in the planning, preparation, analysis and interpretation of the findings, enactment and processing of the article with the same contribution.

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