

Surgical repair of rectus diastasis

Reparación quirúrgica de la diástasis de rectos

Rosa Ferreira* , Osmar Cuenca** , Eduardo González Miltos*** , Nelson Martínez*** , Jesús Ferreira*** , Jorge Ruíz Díaz**** , Richard Fretes***** , Diosnel Alonso***** , Luján Giménez***** 

Universidad Nacional de Asunción. Medical Science Department. Second Chair of Surgical Clinic.
San Lorenzo, Paraguay.

ABSTRACT

Introduction: Diastasis of the rectus abdominis muscles is a common condition, especially in women, and is frequently associated with midline hernias. **Objective:** to describe the outcomes of the techniques used for its treatment in a university surgical service. **Materials and methods:** a retrospective, observational, descriptive, cross-sectional study was conducted between March 2024 and February 2025 at the Second Chair of Surgical Clinic. Twenty-four patients diagnosed with rectus diastasis were included. The variables analyzed were age, sex, diagnostic methods, defect size, associated hernias, surgical techniques, parietal repair, and outcomes. **Results:** females predominated (84%), with a mean age of 45 years. Diagnosis was clinical in all cases, and computed tomography was used for preoperative measurement. The mean defect size was 5.5 cm. In 20 patients, abdominal wall hernias were associated, mainly incisional hernias. Onlay mesh techniques, either alone or combined with abdominoplasty, were the most commonly used approaches. Parietal repair was performed more frequently using the onlay technique. Two postoperative complications (8.3%) were recorded, with no mortality. **Conclusion:** repair of rectus diastasis by midline plication associated with abdominoplasty and polypropylene mesh showed favorable outcomes and a low complication rate in this series.

Keywords: *Diastasis recti, Incisional hernia, Abdominoplasty, Polypropylene mesh, Abdominal wall repair.*

RESUMEN

Introducción: La diástasis de los rectos abdominales es una afección frecuente, sobre todo en mujeres, y suele asociarse a hernias de la línea media. **Objetivo:** describir los resultados de las técnicas utilizadas para su tratamiento en un servicio universitario. **Materiales y métodos:** estudio retrospectivo, observacional, descriptivo y de corte transversal, realizado entre marzo de 2024 y febrero de 2025 en la II Cátedra de Clínica Quirúrgica. Se incluyeron 24 pacientes con diagnóstico de diástasis de rectos; se analizaron edad, sexo, métodos diagnósticos, tamaño del defecto, hernias asociadas, técnicas quirúrgicas, reparación parietal y evolución. **Resultados:** predominó el sexo femenino (84%), con edad promedio de 45 años. El diagnóstico fue clínico en todos los casos y la tomografía se utilizó para la medición preoperatoria. El defecto tuvo un tamaño promedio de 5,5 cm.

En 20 pacientes se asociaron hernias de la pared abdominal, principalmente incisionales. Predominaron las técnicas con malla onlay, solas o combinadas con abdominoplastia. La reparación parietal se realizó con mayor frecuencia mediante técnica onlay. Se registraron dos complicaciones posoperatorias (8,3%), sin mortalidad. **Conclusión:** la reparación mediante plicatura de la línea media, asociada a abdominoplastia y malla de polipropileno, mostró resultados favorables y baja tasa de complicaciones en esta serie.

Palabras claves: *Diástasis de los rectos abdominales, Hernia incisional, Abdominoplastia, Malla de polipropileno, Reparación de pared abdominal.*

INTRODUCTION

Diastasis of the rectus muscles (DR) is defined as the abnormal separation of the rectus abdominis muscles along their midline. DR is considered present when the linea alba exceeds 2 cm in width. This measurement remains controversial, since bulging of the linea alba between the rectus muscles may occur even with a smaller width, or may not manifest with a greater separation, as the laxity of the linea alba depends more on its thickness than on its width.⁽¹⁾

The normal distance between the rectus abdominis muscles at the level of the xiphoid process is 1.5 cm, in the supraumbilical region 2.2 cm, and in the infraumbilical region 1.6 cm, varying according to the author or the age of the patient.^(2,3)

It is a frequent clinical entity; the female population is the most affected, within the third trimester of pregnancy and the puerperium, with a prevalence of 30–70%, persisting in 15% of patients, especially in multiparous women.^(4,5,6) It is usually associated with midline hernias, with a reported frequency of 45% in umbilical hernia; followed by epigastric and incisional hernias.⁽⁷⁾

There are several classifications of DR, aiming to reach consensus on the lesion and its triggering and risk factors. Ranney classifies according to the degree of separation of the rectus muscles, as follows: mild when the diastasis is less than 3 cm, moderate from 3 to 5 cm, and severe when greater than 5 cm.^(8,9) Currently, the EHS publishes this classification⁽¹⁰⁾. (Fig. 1)

* Room Chief. Second Chair of Surgical Clinic. FMC-UNA.

** Chief of Service. Second Chair of Surgical Clinic. FMC-UNA.

*** Attending Doctor of Emergency Services. FMC-UNA.

**** Chief of Residents. Second Chair of Surgical Clinic. FMC-UNA.

***** Resident. Second Chair of Surgical Clinic. FMC-UNA.

Corresponding author: Rosa Ferreira - email: rferreirapedezoli@gmail.com

Received: 05/01/2026 - Revised: 12/02/2026 - Accepted: 10/03/2026

Revisor: Esteban Daniel Mendoza  Hospital of Surgical Specialties Ingavi – Instituto de Previsión Social.

Review process: Double-blind peer review.

Editor: Eduardo González Miltos  Universidad Nacional de Asunción; San Lorenzo, Paraguay

 This is an open access article published under a Creative Commons License

T Type	D Inter-rectus distance	H Concomitant umbilical and/or epigastric hernia
T1 = after pregnancy	D1 = >2–3 cm	H0 = without H1 = present
T2 = with adiposity	D2 = >3–5 cm	
	D3 = >5 cm	

Figure 1. DR classification, according to the EHS.

The diagnosis is clinical, accompanied by imaging studies; generally, during anamnesis, the patient reports a sensation of heaviness and an abdominal mass in the epigastrium. The defect can be palpated in the physical examination, depending on the degree of obesity of the patient. Imaging is the most precise way to diagnose in order to classify DRA and plan the surgical approach. Computed tomography (CT) or magnetic resonance imaging (MRI) measure the distance between the rectus muscles and the width of the linea alba.^(10,11)

The most frequently used repair is abdominoplasty or mini abdominoplasty associated with a periumbilical incision or a fleur de lis approach;^(12,13) however, there is no consensus on which technique is ideal.

Endoscopic, preaponeurotic, or preperitoneal approaches are also reported, which allow repair of the parietal defect with the placement of a reinforcing prosthesis, thereby reducing recurrence.⁽¹⁴⁾

The objective of this study is to describe the results of the techniques used for the treatment of DR.

MATERIAL AND METHOD

Retrospective, observational, descriptive, cross sectional study, with non probabilistic sampling, including patients of both sexes with DR. The techniques employed for treatment and the concomitance with abdominal wall hernias were analyzed from March 2024 to February 2025, at the Second Chair of Surgical Clinic.

Data collection was carried out through the review of medical records and the preparation of a questionnaire to gather information on the study variables (age, sex, diagnostic methods, defect size, types of midline hernias, DR surgical techniques, parietal repair, evolution) to be investigated in this work. All principles of ethics and confidentiality were respected.

RESULTS

24 patients were included: 4 were male (16%) and 20 were female (84%).

Average age was 45 (20 – 70 years old).

Clinical evaluation was the diagnostic method in 100% of the cases; in addition, Computed Axial Tomography was used to measure the defects. The average defect size was 5.5 cm (range: 3 – 8).

Concomitance with incisional hernias was frequently observed.

Table 1. Types of abdominal wall hernias associated with DR (n:20)

Type of hernia	Patients	Frequency
Umbilical hernia	8	33,3%
Epigastric hernia	2	8,3%
Incisional hernia	10	41,6%

Source: IICCQ Archive FCM UNA

Table 2. Surgical techniques employed (n:20)

Techniques	Patients	Frequency
Midline plication with sublay mesh	2	8,3%
Midline plication with onlay mesh and abdominoplasty	10	41,6%
Midline plication with sublay mesh and abdominoplasty	3	12,5%
Midline plication with mesh, through REPA endoscopic handling	3	12,5%
Milos	2	8,3%
Midline plication with onlay mesh	4	16,8%

Source: IICCQ Archive FCM UNA

Table 3. Parietal repair (n:20)

Type of hernia	Rives technique	Onlay technique
Umbilical hernia	2	6
Epigastric hernia	0	2
Incisional hernia	3	7

Source: IICCQ Archive FCM UNA

Table II shows a clear predominance of onlay mesh techniques, either alone or associated with abdominoplasty, suggesting that this was the most frequently used approach in the series. In turn, Table III reflects that parietal repair was performed more often using the onlay technique than the Rives technique, especially in cases of incisional and umbilical hernia.

Complications occurred in two (8.3%) patients: surgical site infection and skin necrosis, which were resolved with targeted antibiotic therapy, debridement, and advancement flap. No deaths were recorded.

DISCUSSION

Diastasis can be congenital or acquired. In congenital diastasis, cases have been reported that are associated with hypoplasia of the abdominal musculature, such as Cantrell's pentalogy, Beckwith Wiedemann syndrome, Opitz syndrome, or Prune Belly syndrome. There are also cases of DR without association with one of these syndromes due to defects in the maturation of the abdominal wall. They have a higher incidence in premature newborns.^(1,2)

In acquired diastasis, two profiles are distinguished in adults: 1) young woman after pregnancy, and 2) middle-aged obese men.^(1,3,5)

The incidence is much higher in women than in men, according to the literature, a finding that coincides with this study, which confirmed 84% in the female sex. These findings are consistent with what was described by Cavalli et al. and Benjamin et al., who report a higher prevalence of rectus diastasis in women, especially associated with pregnancy and the puerperium.^(1,6)

Acquired DR is secondary to the weakening of the abdominal wall tissues due to separation and laxity of the abdominal wall muscles and fascia, associated with increased intra abdominal pressure, as in the case of patients with pregnancy, obesity, and previous abdominal surgeries. Several authors, including Baumann and Butler, have also highlighted the close relationship between rectus diastasis and the occurrence of midline hernias,

as well as the impact of their simultaneous repair in reducing recurrences.^(7,8,9)

With respect to risk factors, several publications reveal that during pregnancy the prevalence of diastasis at week 35 is 100%; six months after delivery, 39%. The majority of the patients in this study had a previous pregnancy as antecedent.⁽¹⁰⁾

Obesity can give rise to DR, as well as alterations in collagen metabolism; connective tissue weakness, as in some cases of patients with aortic aneurysm and certain diseases derived from collagen disorders (Bechterew, Marfan, Ehlers Danlos).^(1,7)

For patient preparation, the size of the defect is very important, which can be verified with tomography. This helps to plan the surgical strategy, determine the type of approach, confirm the existence of primary or incisional hernias, and assess the need to accompany the procedure with resection of excess dermocutaneous tissue.^(10,11,12)

In this study, a considerable percentage of incisional hernias was observed, differing from other works that report a 45% frequency of umbilical hernias.⁽⁷⁾

The technique most frequently used was abdominoplasty with placement of a polypropylene prosthesis, due to the characteristics of the patients in whom there was a need for resection of excess skin. Plications with mesh placement were performed in patients who refused treatment by endoscopic or open video assisted surgery, in which treatment schemes are proposed according to the size of the DR and whether or not it is accompanied by a hernia. These results are comparable to those described by Bellido Luque et al., who report good outcomes with minimally invasive approaches in the repair of rectus diastasis associated with midline hernias.^(13,14,15)

According to management guidelines, the endoscopic approach is advisable, except when abdominoplasty is required; therefore, in certain patients, endoscopic REPA^(16,17) (Pre Aponeurotic Endoscopic Repair) surgery described by Juárez was chosen. The indication for video assisted open MILOS surgery, proposed by Reinhold and collaborators^(18,19) (Mini or Less Open Sublay), places the mesh in a preperitoneal or retromuscular position with the aid of a modified 10 mm lens or

laparoscope. It is indicated in patients with DR less than 3 cm, obese men with umbilical hernia, and was also used according to the patients in this study.

In this study, an 8.3% complication rate was reported in an open repair, with infection and necrosis. According to several studies, recurrence rates vary from 0% to 40% incidence, with no significant differences between groups using different plication techniques of the linea alba and with highly variable follow up periods (from 6 to 64 months).^(18,19)

Other, less frequent complications include hematomas (between 0% and 7%), seroma (between 0% and 30%), and wound infection (between 0% and 18%), which were not observed in this study.⁽¹⁹⁾

The most frequent complication with the endoscopic approach is the appearance of seroma, with an incidence between 3% and 27%. In the series presented, no complications occurred with the endoscopic approach, although the population numbers are small.⁽¹⁹⁾

Surgical treatment of DR, based on the application of a therapeutic algorithm and the appropriate selection of technique according to patient characteristics, allows good outcomes to be achieved.

CONCLUSION

The repair of rectus diastasis through midline plication associated with abdominoplasty and placement of a polypropylene mesh showed favorable results and a low complication rate in our series.

CONFLICT OF INTERESTS

The authors declare that they have no conflicts of interest related to the preparation and publication of this work.

AUTHOR'S CONTRIBUTION

Nelson Martínez and Eduardo González participated in the methodological conception and study design. The other authors collaborated in data collection and manuscript writing. All authors reviewed and approved the final version of the article.

REFERENCES

- Zorraquino González A. Guía clínica de la diástasis de los músculos rectos del abdomen y pequeños defectos de la línea alba. Rev Hispanoam Hernia. 2021;9(2):118-125.
- Beer GM, Schuster A, Seifert B, et al. The Normal Width of the Linea Alba in Nulliparous Women; Clin Anat. 2009;22:706-11. DOI: 10.1002/ca.20836
- Juárez-Muas DM. Preaponeurotic endoscopic repair (REPA) of diastasis recti associated or not to midline hernias. Surg Endosc. 2019; 33: 1777-1782. doi: 10.1007/s00464-018-6450-3.
- Benjamin DR, van de Water ATM, Peiris CL. Effects of exercise on diastasis of the rectus abdominis muscle in the antenatal and postnatal periods: A systematic review. Physiotherapy. 2014;100(1):1-8. DOI: 10.1016/j.physio.2013.08.005 Bezada-Murray JA. Técnica quirúrgica para reparar la diástasis de recto
- Nahabedian M, Brooks DC. Rectus abdominis diastasis. UpToDate. 2018-01-26. Available in: [https://www.uptodate.com/contents/rectus-abdominis-diastasis#:~:text=Rectus%20abdominis%20diastasis%20\(RAD;%20diastasis%20recti](https://www.uptodate.com/contents/rectus-abdominis-diastasis#:~:text=Rectus%20abdominis%20diastasis%20(RAD;%20diastasis%20recti)
- Awad E, Mobark A, Zidan AA, Hamada HA, Shousha T. Effect of progressive prone plank exercise program on diastasis of rectus abdominis muscle in postpartum women: a randomized controlled trial. J Human Sport Exercise. 2021; 16: S395-S403. doi: 10.14198/jhse.2021.16.Proc2.24-
- Baumann DP, Butler CE. Diastasis recti and primary midline ventral hernia: the plastic surgery approach. Hernia. 2019; 23: 1017-1018. doi: 10.1007/s10029-019-02055-y.
- Fiori F, Ferrara F, Gobatti D, Gentile D, Stella M. Surgical treatment of diastasis recti: the importance of an overall view of the problem. Hernia. 2021; 25: 871-882. doi: 10.1007/s10029-020-02252-0.
- Cavalli M, Aiolfi A, Bruni PG, Manfredini L, Lombardo F, Bonfanti MT, Campanelli G. Prevalence and risk factors for diastasis recti abdominis: a review and proposal of a new anatomical variation. Hernia. 2021; 25: 883-890. doi: 10.1007/s10029-021-02468-8.
- P Hernández-Granados, NA Henriksen, F Berrevoet, D Cuccurullo, M López-Cano, S Nienhuijs, D Ross, A Montgomery, Directrices de la Sociedad Europea de Hernia sobre el tratamiento de la diástasis del recto, British Journal of Surgery .2021;108(10):1189-1191. <https://doi.org/10.1093/bjs/znab128>
- Campanelli, G. Ventral hernia and diastasis recti. Is there a consensus? Hernia. 2021; 25: 823-823. doi: 10.1007/s10029-021-02471-z.
- Tung RC, Towfigh S. Diagnostic techniques for diastasis recti. Hernia. 2021; 25: 915-919. doi: 10.1007/s10029-021-02469-7.
- Kulhanek J, Mestak O. Treatment of umbilical hernia and recti muscles diastasis without a periumbilical incision. Hernia. 2013; 17: 527-530. doi: 10.1007/s10029-013-1047-1.
- Cervelli V, Grimaldi M, Gentile P, Araco A, Colicchia GM, Gravante G. Miniabdominoplasty for the treatment of aesthetic defects after Pfannenstiel incisions. Scand J Plast Reconstr Surg Hand Surg. 2008; 42: 96-100. doi: 10.1080/02844310801924175.
- Bellido-Luque J, Bellido-Luque A, Valdivia J, Suarez-Gráu JM, Gomez-Menchero J, García-Moreno J, et al. Totally endoscopic surgery on diastasis recti associated with midline hernias. The advantages of a minimally invasive approach. Prospective cohort study. Hernia. 2015; 19: 493-501. doi: 10.1007/s10029-014-1300-2.
- Juárez DM. Preaponeurotic endoscopic repair (REPA) of diastasis recti associated or not to midline hernias. Surg Endosc. 2019;33:1777-82. DOI: 10.1007/s00464-018-6450-3
- Juárez DM, Palmisano E, Pou G, et al. Reparación endoscópica preaponeurótica (REPA) como tratamiento de la diástasis de los músculos rectos asociada o no a hernias de la línea media. Estudio multicéntrico. Rev Hispanoam Hernia. 2019;7:59-65. Keshwani N, Mathur S, McLean L. Relati
- Reinhold W, Köckerling F, Bittner R, et al. Classification of Rectus Diastasis-A Proposal by the German Hernia Society (DHG) and the International Endohernia Society (IEHS). Front Surg. 2019;6:1. DOI: 10.3389/fsurg.2019.00001
- Reinhold W, Schroeder M, Berger C, et al. Mini-or Less-open Sublay Operation (MILOS): A New Minimally Invasive Technique for the Extraperitoneal Mesh Repair at Hernias of Incision. Ann Surg. 2019;269:748- 55. DOI: 10.1097/SLA.0000000000002661

Bioerix S.A. | Insumos de precisión para el cuidado de la vida.

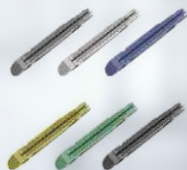
Cirugía



Especializados en dispositivos de sutura mecánica y grapador quirúrgico.



Grapadora quirúrgica lineal Endrive™



Cirugía



Lapiz para electro bisturí.



Placa neutro para paciente.



Cardiología



- Válvulas cardíacas
- Tubo valvulado
- Endoprotesis
- Sellador quirúrgico
- Prótesis híbrida



Endoscopia



Elevando el estándar de la endoscopia



EVIS X1

Es el sistema de endoscopia más avanzado de Olympus.

Cirugía



LUFT 5 Ventilador pulmonar de alta complejidad.



1625 ++ Máquina de anestesia.



PR5 TT Ventilador adaptativo con sistema de turbina.

