ISSN: 2572-3235

Almat'hami et al. Int J Radiol Imaging Technol 2024, 10:126
DOI: 10.23937/2572-3235.1510126
Volume 10 | Issue 2
Open Access

International Journal of
Radiology and Imaging Technology

RETROSPECTIVE STUDY

Lateral Abdominal Wall Muscles Injection with Botulinum Toxin for Easier Repair of Complex Abdominal Wall Hernia

Abdulaziz Almat'hami, MD[1*], Abdulrahman Almutairi, MD[2], Faisal Al Ahmari, MD[1], Hatim Al Obaidi, MD[1], Sultan Al Ammari, MD[1], Abdulwahed Al Ruhaimi, MD[1], Othman AlShehre, MD[1], Hassan AlShehri, MD[1], Mohammed Alshulayyil, MD[3], Mohammed Alqahtani, MD[4], Abdullah AlMalki, BSc[5], Ali Alshehri, BSc[5], Taghreed Al-Ajaji, MD[6], Feras Alsannaa, MD[6] and Talal Alkuhaimi, MD[1]

[1]*Interventional Radiology Department, Prince Sultan Military Medical City, Riyadh, Saudi Arabia*

[2]*Radiology Department, King Fahad Specialized Hospital, Tabuk, Ministry of Health, Tabuk, Saudi Arabia*

[3]*Radiology Department, Imam Abdulrahman Al Faisal Hospital, Ministry of Health, Riyadh, Saudi Arabia*

[4]*Radiology and Medical Imaging, Armed Force Hospital South Region (AFHSR), Khamis Mushait, Saudi Arabia*

[5]*Interventional Radiology Department, Prince Sultan Military Medical City, Riyadh, Saudi Arabia*

[6]*General Surgery Department, Prince Sultan Military Medical City, Riyadh, Saudi Arabia*

***Corresponding author:** *Abdulaziz Almat'hami, MD, Interventional Radiology Department, Prince Sultan Military Medical City, Riyadh, Saudi Arabia*

Abstract

Complex abdominal wall hernias pose a difficult problem due to their higher rates of morbidity and recurrence. Using botulinum toxin injections as a potential treatment to stretch the patients' muscles and promote primary fascial closure has been suggested. This study focuses on the effectiveness of preoperative botulinum toxin injections for patients with complicated abdominal wall hernias.

Methodology: This retrospective study included patients with complex abdominal wall hernias who received preoperative botulinum toxin injections between January 2021 and October 2023. The study examined variables such as age, gender, size of the hernia defects, without and loss of domain and muscle length. The data were analysed through comparative analysis and paired t-tests.

Results: This study included 11 patients with an average age of 51.38 ± 11.56 years. The average size of the fascial gap decreased notably after receiving injections of botulinum toxin. There was also a statistically significant reduction in the loss of domain post-injection. Primary fascial closure was successfully attained in 10 participants, with no significant adverse effects.

Conclusion: Utilizing botulinum toxin injection prior to surgery in patients with complex abdominal wall hernias proves to be a reliable and successful method in alleviating muscle tension and ensuring proper fascia closure. While the effectiveness of preoperative Botox injection in repairing complex abdominal wall hernias cannot be definitively determined without a control group, further comprehensive studies with extended follow-up periods and control groups are essential to validate the findings of this study.

Introduction

Complex abdominal wall hernias pose a formidable surgical challenge due to muscular tension and lateral retraction, especially in the context of open abdomen care [1,2]. Repairing those hernias can be made even more difficult by large defects, loss of domain, and infection [3]. One way to improve surgical outcomes is to reduce the strain on the abdominal wall muscles during repair [4]. In the case of complicated repairs, some experts have proposed using Botulinum Toxin Type A (BTA) as a viable method for easing muscle tension and enhancing surgical results [5-7].

Botulinum toxin type A, also known as BTA, is a neurotoxin that can cause paralysis in specific

Citation: Almat'hami A, Almutairi A, Al Ahmari F, Al Obaidi H, Al Ammari S, et al. (2024) Lateral Abdominal Wall Muscles Injection with Botulinum Toxin for Easier Repair of Complex Abdominal Wall Hernia. Int J Radiol Imaging Technol 10:126. doi.org/10.23937/2572-3235.1510126

Accepted: October 24, 2024; **Published:** October 26, 2024

muscles by blocking the release of acetylcholine at the neuromuscular junction [8]. It has been shown to reduce muscle tension and improve the results of various surgical procedures in fields such as urology, plastic surgery, and cosmetic rejuvenation [9]. In complex abdominal wall hernia repair, BTA can help reduce strain in the abdominal wall muscles, this helps to simplify the closure of the fascia and decrease the chances of hernial recurrence [10].

In the minimally invasive process of BTA injection, small amounts of the toxin are injected directly into the muscles of the lateral abdominal wall [9]. This treatment usually takes less than 30 minutes and can be done with local anaesthesia or minor sedation. BTA injections generally result in minimal side effects, such as mild soreness or bruising at the injection site [11]. Literature indicates that using BTA before complex abdominal wall hernia surgery has shown promising results in several trials [12,13]. A retrospective analysis found that BTA treatment before abdominal wall hernia repair benefited patients with large hernia defects and loss of domain. It reduced the tension required during closure and furthermore, decreased the size of the hernia defect, due to the paralysis of the lateral muscles [14,15].

Research has indicated that using BTA on the lateral abdominal muscles can decrease their thickness and increase their length for patients undergoing open abdomen therapy. Additionally, BTA may raise the volume of the intra-abdominal cavity, relax muscles, and help bring the fascial borders closer without causing tension. This is crucial for successfully achieving primary fascial closure during major ventral hernia surgery. Before undergoing Abdominal Wall Reconstruction (AWR), receiving BTA injections is safe and linked to high rates of fascial closure and low recurrence rates in patients with large ventral hernias [16-18]. New studies indicate that US-guided Component Separation Surgery (CCS) has achieved a technical success rate of 100%, and patients have undergone surgical closure within a mean of 34.1 days (ranging from 14 to 48 days) [19]. However, there is limited research on the use of BTA as a neoadjuvant for surgical reconstruction of major abdominal wall abnormalities. Therefore, this retrospective study seeks to assess the efficiency and safety of preoperative BTA injection for repairing complex abdominal wall hernias.

Methodology

Study design

This research involved revision of electronic medical records for patients with complicated abdominal wall hernias who were given botulinum toxin injections before undergoing abdominal surgery between January 2021 and October 2023. The study took place at the Interventional Radiology Department in Prince Sultan Military Medical City, Riyadh, Saudi Arabia.

Inclusion criteria

The study encompassed all patients who had intricate abdominal wall hernias and underwent preoperative botulinum toxin injection, followed by abdominal surgery for a transverse hernia defect exceeding 100 mm, as well as loss of domain hernias.

Data collection

Data were collected from electronic medical records; this includes demographic data, medical/surgical history, together with details of the botulinum toxin injection and abdominal surgery. The primary outcome was overall reduction in the transverse hernia defect size as well as the loss of domain reduction after the botulinum toxin injection. The secondary outcomes included surgical outcomes, such as successful fascial closure and -if any- hernial recurrence.

Data analysis

Categorical variables such as gender, age group, and Case of abdominal defect were represented as frequencies and percentages. Continuous variables like age, pre- and post-procedure fascial defect, loss of domain, and muscle length were expressed as Mean ± SD. The Kolmogorov-Smirnov test was utilized to verify the assumption of normal distribution. In the case of biased data, a nonparametric test was employed. The paired sample t-test was used to assess the mean significant difference between the pre- and post-procedure features. Meanwhile, an independent sample t-test was utilized to determine the mean significant difference between gender and age in relation to Botox features. All data were entered and analysed using the SPSS 25 Statistics Package (SPSS Inc., Chicago, Illinois, USA).

Ethical considerations

Since this was a review of past electronic medical records, there was no requirement for informed consent. Approval for the study was granted by the Institutional Review Board at Prince Sultan Military Medical City.

Results

The study examined 11 patients who had complex abdominal wall hernias and received pre-surgical botulinum toxin injections.

Table 1 details the patients' demographic and clinical characteristics, indicating that 54.5% of the patients' abdominal defects resulted from post-surgical complications, and most of them were male (64%).

The descriptive analysis in Table 2 shows that the average patient age was 51.38 ± 11.56 years, with an average fascial defect size before procedure of 13.14 ± 4.58 cm. After the procedure, the average fascial defect size decreased to 11.84 ± 4.07 cm. The mean loss of domain before the procedure was 18.46 ± 11.96%, while

the mean domain loss after the procedure was 13.90 ± 7.21%. The mean muscle length was 33.91 ± 6.38 cm prior to the procedure, compared to 39.29 ± 6.08 cm post-procedure.

Furthermore, Table 3 reveals that there was a statistically significant reduction in the transverse hernia defect and loss of domain following Botox injections (p 0.05). However, the size of the fascial defect did not show significant change post-surgery (p = 0.094).

Table 1: Demographic and clinical characteristics of patients (n = 11).

Variables		n (n%)
Gender	Male	7 (63.6%)
	Female	4 (36.4%)
Age group	< 60	5 (45%)
	≥ 60	6 (55%)
Case of abdominal defect	Cancer	3 (27.3%)
	Post-surgical	6 (54.5%)
	Trauma	2 (18.2%)

Note: All Categorical data were presented as frequency (%) while continuous data were presented as Mean ± SD

The comparison analysis in Table 4 shows that male and female patients did not significantly differ in terms of fascial defect size, loss of domain, or muscle length. Similarly, Table 5 demonstrates that age did not have a significant impact on the size of the fascial defect (p > 0.05), although younger patients experienced less loss of domain compared to the older patients (p 0.05).

Discussion

The aim of the present study was to evaluate the effectiveness of botulinum toxin injections before surgery in individuals with complex abdominal wall hernias. The study demonstrated a noteworthy reduction in the size of the hernia defect and loss of domain after the Botox injection, affirming the conclusion that Botox injection was advantageous in relieving muscular tension and achieving primary fascial closure (Figure 1). These findings align with previous research indicating the positive impact of Botox injections on patients with complex abdominal wall hernias by alleviating muscular tension and facilitating primary fascial closure [20,21].

After receiving a Botox injection, there was a notable decrease in the size of the transverse hernia defect, as

Table 2: Descriptive analysis of the study variables.

Variables	Minimum	Maximum	Mean ± SD
Age (years)	28.00	66.00	51.38 ± 11.56
The pre-procedure fascial defect (cm)	5.70	20.60	13.14 ± 4.58
The Post-procedure fascial defect (cm)	5.60	17.60	11.84 ± 4.07
Pre-procedure loss of domain (%)	5.00	44.00	18.46 ± 11.96
Post-procedure loss of domain (%)	4.20	25.00	13.90 ± 7.21
The Pre-procedure muscles length (cm)	22.00	41.50	33.91 ± 6.38
The post-procedure muscles length in cm	28.90	48.60	39.29 ± 6.08

Table 3: Pre and post-analysis of botox features.

Variables		Mean ± SD	MD [95% CI]	P-value
Pair 1	The pre-procedure fascial defect (cm)	13.14 ± 4.58	1.30 [-2.93 - 2.89]	0.094
	The post-procedure fascial defect (cm)	11.84 ± 4.07		
Pair 2	Pre-procedure loss of domain (%)	18.46 ± 11.96	4.55 [-2.56 - 11.67]	0.174
	Post-procedure loss of domain (%)	13.9 ± 7.21		
Pair 3	The pre-procedure muscles length (cm)	33.91 ± 6.38	5.37 [-7.89 - (-2.85)]	0.001*
	The post-procedure muscles length in cm	39.29 ± 6.08		

Note: All continuous data were presented as Mean ± SD; *shows that P-value is significant at P < 0.05.

Table 4: Comparative analysis between gender and botox features.

Variables	Description	Gender		P-value
		Male	Female	
The Pre-procedure fascial defect (cm)	Mean ± SD	14.7 ± 3.82	8.45 ± 3.89	0.208
The Post-procedure fascial defect (cm)	Mean ± SD	12.93 ± 3.73	8.55 ± 4.17	0.346
Pre-procedure loss of domain (%)	Mean ± SD	19.11 ± 13.44	16.5 ± 9.33	0.784
Post-procedure loss of domain (%)	Mean ± SD	14.89 ± 8.14	10.95 ± 3.04	0.362
The pre-procedure muscles length (cm)	Mean ± SD	36.52 ± 4.21	26.1 ± 5.8	0.199
The post-procedure muscles length in cm	Mean ± SD	41.87 ± 4.12	31.55 ± 3.75	0.087

Table 5: Comparative analysis for gender and botox features.

Variables	Description	Age Group		P -value
		< 60	≥ 60	
The pre-procedure fascial defect (cm)	Mean ± SD	14.6 ± 4.71	11.68 ± 4.58	0.408
The post-procedure fascial defect (cm)	Mean ± SD	12.7 ± 4.07	10.98 ± 4.48	0.590
Pre-procedure loss of domain (%)	Mean ± SD	25.01 ± 13.5	11.91 ± 6.09	0.149
Post-procedure loss of domain (%)	Mean ± SD	19.38 ± 5.55	8.43 ± 3.21	0.020*
The pre-procedure muscles length (cm)	Mean ± SD	35.93 ± 4.46	31.9 ± 8.02	0.423
The post-procedure muscles length in (cm)	Mean ± SD	40.98 ± 6.28	37.6 ± 6.25	0.475

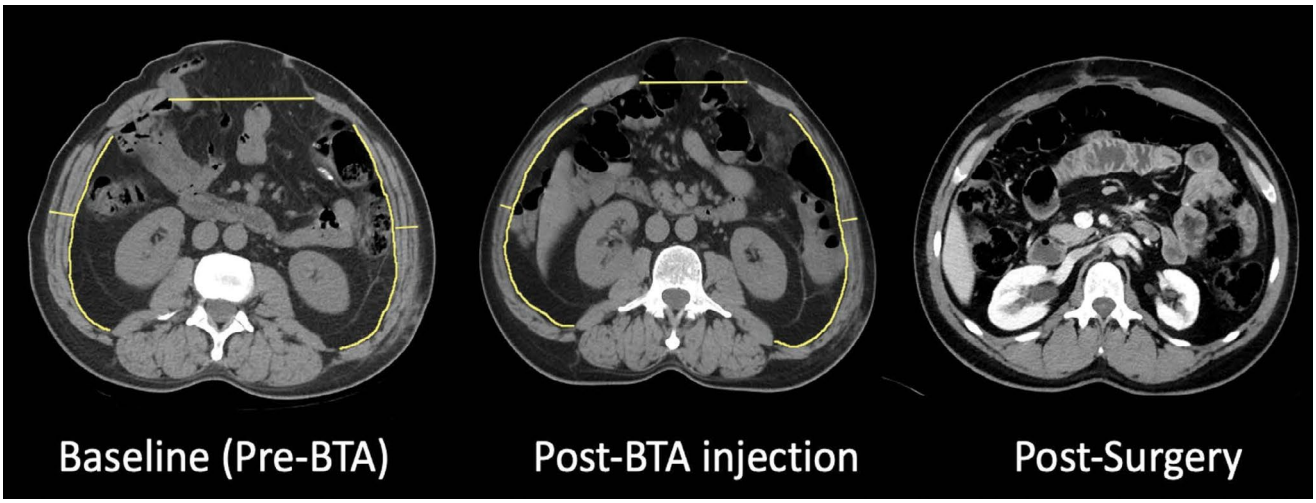

Figure 1: Preoperative axial CT comparison image of baseline (pre-BTA) and post-BTA treatment, demonstrating the elongation and thinning of the lateral abdominal oblique muscles, as well as the reduction in defect width after BTA treatment. The final post-surgical CT scan is shown as well.

indicated by statistical significance (p 0.001). The mean transverse hernia defect measurement decreased from 147.0 ± 3.82 mm before the injection to 129.4 ± 37.3 mm after. The reduction in muscle tension and the muscle lengthening post-Botox injection could be attributed to the shrinkage of the transverse hernia defect. Botox injections work by temporarily paralyzing muscles through preventing the release of acetylcholine [22].

Following the Botox injection, there was a statistically meaningful reduction in the loss of domain (p 0.05). Complex abdominal wall hernia repair is complicated by the loss of domain. This refers to the herniation of intra-abdominal contents into the hernia sac, leading to an increase in intra-abdominal pressure, which is responsible for the loss of abdominal domain [3]. The reduction of muscle tension after receiving a Botox injection may contribute to the decrease in abdominal protrusion by allowing the contents of the abdomen to return to their original position within the abdominal cavity, thereby restoring the abdominal domain [23].

The size of the fascial opening did not demonstrate a noteworthy change before and after the procedure, with a p-value of 0.094. The lack of a significant decrease in the fascial defect size may be attributed to the Botox injection's indirect impact on reducing muscular tension, thereby indirectly promoting primary fascial closure by alleviating pressure on the fascial margins [24,25]. Following the Botox injection, all patients underwent abdominal wall reconstruction, resulting in primary fascial closure in 10 individuals (90.9%).

The most effective method for treating complex abdominal wall hernias is the primary closure of the fascia [26]. The significant success of primary fascial closure seen in the present study can be attributed to the Botox injection's ability to reduce muscle tension, thereby promoting the alignment of the fascial edges and reducing the stress placed on them [27].

The average follow-up was 18.3 ± 9.2 months, with no recurrence of hernias were reported during this period. Hernia recurrence is a major concern in the repair of complex abdominal wall hernias, with documented rates ranging from 10% to 50% in the literature [28,29]. The potential role of Botox injections in reducing muscle tension and aiding in the primary closure of the fascia may account for the absence of hernia recurrence in the present study, ultimately reducing the risk of hernia recurrence [30].

The abdominal surgery and Botox injection did not cause any notable adverse effects. A few people experienced slight discomfort and bruising around the injection areas, but these side effects resolved quickly.

This aligns with previous studies suggesting that Botox injections are safe for individuals with complex abdominal wall hernias [11,20]. The use of Botox injection is a low-risk, minimally invasive procedure that can be performed under local anaesthesia [6].

Conclusion

The findings of this study indicate that using Botox injections before surgery are a safe and effective method for treating patients with complex abdominal wall hernias by relaxing their muscles and achieving primary fascial closure. However, it is important to acknowledge certain limitations of the study. This was a retrospective study that was conducted at a single site, which limits the generalizability. Moreover, it is difficult to draw definitive conclusions about the effectiveness of preoperative Botox injection for complex abdominal wall hernia repair without a control group. It is necessary for larger studies with longer follow-up periods and control groups to validate the results of the current study.

References

1. Piccoli M, Agresta F, Attinà GM, Amabile D, Marchi D, et al. (2019) "Complex abdominal wall" management: Evidence-based guidelines of the Italian consensus conference. Updates Surg 71: 255-272.
2. Wilson KL, Davis MK, Rosser JC (2012) A traumatic abdominal wall hernia repair: A laparoscopic approach. JSLS 16: 287-291.
3. Parker SG, Halligan S, Blackburn S, Plumb AAO, Archer L, et al. (2019) What exactly is meant by "loss of domain" for ventral hernia? Systematic review of definitions. World J Surg 43: 396-404.
4. Lien SC, Hu Y, Wollstein A, Franz MG, Patel SP, et al. (2015) Contraction of abdominal wall muscles influences size and occurrence of incisional hernia. Surgery 158: 278-288.
5. Tang FX, Ma N, Huang E, Ma T, Liu CX, et al. (2022) Botulinum toxin a facilitated laparoscopic repair of complex ventral hernia. Front Surg 8: 803023.
6. Soltanizadeh S, Helgstrand F, Jorgensen LN (2017) Botulinum toxin A as an adjunct to abdominal wall reconstruction for incisional hernia. Plast Reconstr Surg Glob Open 5: e1358.
7. Deerenberg EB, Shao JM, Elhage SA, Lopez R, Ayuso SA, et al. (2021) Preoperative botulinum toxin A injection in complex abdominal wall reconstruction- a propensity-scored matched study. Am J Surg 222: 638-642.
8. Wheeler A, Smith HS (2013) Botulinum toxins: Mechanisms of action, antinociception and clinical applications. Toxicology 306: 124-146.
9. Frost G, Finlayson H, Saeidiborojeni S, Lagnau P, Reebye R (2021) Perioperative botulinum toxin injections to enhance surgical outcomes in patients with spasticity: Preoperative, intraoperative, and postoperative case reports. Arch Rehabil Res Clin Transl 3: 100101.
10. Jacombs A, Elstner K, Rodriguez-Acevedo O, Read JW, Ho-Shon K, et al. (2022) Seven years of preoperative BTA abdominal wall preparation and the macquarie system for surgical management of complex ventral hernia. Hernia 26: 109-121.
11. Whitehead-Clarke T, Windsor A (2021) The use of botulinum toxin in complex hernia surgery: Achieving a sense of closure. Front Surg 8: 753889.
12. Hijji T, Al Shammari A, Al Hammad A, Al Khalefah G, Hashem F, et al. (2019) Incisional hernia repair with plication and utilization of botox injections: First case report from Saudi Arabia for a 19-year-old female. Clin Case Reports 7: 311-315.
13. Timmer AS, Claessen JJM, Atema JJ, Rutten MVH, Hompes R, et al. (2021) A systematic review and meta-analysis of technical aspects and clinical outcomes of botulinum toxin prior to abdominal wall reconstruction. Hernia 25: 1413-1425.
14. Muysoms FE, Miserez M, Berrevoet F, Campanelli G, Champault GG, et al. (2009) Classification of primary and incisional abdominal wall hernias. Hernia 13: 407-414.
15. Passot G, Villeneuve L, Sabbagh C, Renard Y, Regimbeau JM, et al. (2016) Definition of giant ventral hernias: Development of standardization through a practice survey. Int J Surg 28: 136-140.
16. Ibarra-Hurtado TR, Nuño-Guzmán CM, Echeagaray-Herrera JE, Robles-Vélez E, de Jesús González-Jaime J (2009) Use of botulinum toxin type A before abdominal wall hernia reconstruction. World J Surg 33: 2553-2556.
17. Ibarra-Hurtado TR, Nuño-Guzmán CM, Miranda-Díaz AG, Troyo-Sanromán R, Navarro-Ibarra R, et al. (2014) Effect of botulinum toxin type A in lateral abdominal wall muscles thickness and length of patients with midline incisional hernia secondary to open abdomen management. Hernia 18: 647-652.
18. Catalán-Garza V, Peña-Soria MJ, Sáez-Carlin P, Cabeza-Gómez JJ, García-Fernández A, et al. (2020) Long-term results of botulinum toxin type A in complex abdominal wall repair and review of the literature. Updates Surg 72: 1201-1206.
19. Deerenberg EB, Elhage SA, Shao JM, Lopez R, Raible RJ, et al. (2021) The effects of preoperative botulinum toxin A injection on abdominal wall reconstruction. J Surg Res 260: 251-258.
20. Seretis F, Chrysikos D, Samolis A, Troupis T (2021) Botulinum toxin in the surgical treatment of complex abdominal hernias: A surgical anatomy approach, current evidence and outcomes. In Vivo 35: 1913-1920.
21. Kurumety S, Walker A, Samet J, Grant T, Dumanian GA, et al. (2021) Ultrasound-guided lateral abdominal wall botulinum toxin injection before ventral hernia repair. J Ultrasound Med 40: 2019-2030.
22. Satriyasa BK (2019) Botulinum toxin (Botox) A for reducing the appearance of facial wrinkles: A literature review of clinical use and pharmacological aspect. Clin Cosmet Investig Dermatol 12: 223-228.
23. Sauerland S, Walgenbach M, Habermalz B, Seiler CM, Miserez M (2011) Laparoscopic versus open surgical techniques for ventral or incisional hernia repair. Cochrane Database Syst Rev 16: CD007781.
24. Laurens JR, Foster A, Hardley A (2021) Closing difficult laparostomies with the aid of botulinum toxin A: An audit of 12 cases. Cureus 13: e14066.
25. Pirazzini M, Rossetto O, Eleopra R, Montecucco C (2017) Botulinum neurotoxins: Biology, pharmacology, and toxicology. Pharmacol Rev 69: 200-235.

26. Deerenberg EB, Henriksen NA, Antoniou GA, Antoniou SA, Bramer WM, et al. (2022) Updated guideline for closure of abdominal wall incisions from the European and American hernia societies. Br J Surg 109: 1239-1250.

27. Novitsky YW, Elliott HL, Orenstein SB, Rosen MJ (2012) Transversus abdominis muscle release: A novel approach to posterior component separation during complex abdominal wall reconstruction. Am J Surg 204: 709-716.

28. Luijendijk RW, Hop WC, van den Tol MP, de Lange DC, Braaksma MM, et al. (2000) A Comparison of suture repair with mesh repair for incisional hernia. N Engl J Med 343: 392-398.

29. Köckerling F (2019) Recurrent incisional hernia repair-An overview. Front Surg 6: 26.

30. Weissler JM, Lanni MA, Tecce MG, Carney MJ, Shubinets V, et al. (2017) Chemical component separation: a systematic review and meta-analysis of botulinum toxin for management of ventral hernia. J Plast Surg Hand Surg 51: 366-374.