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Incisional hernia repair by fascial component separation: results in 128 cases and evolution of technique

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Incisional hernia;
Ventral hernia;
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Abstract

BACKGROUND: Most ventral incisional hernias are repaired using 1 of 2 principal techniques: (1) prosthetic repair (open or laparoscopic) and (2) primary reconstruction by fascial component separation. Primary midline restoration provides physiological advantages, and avoidance of mesh may reduce complications. This report describes 128 cases of incisional hernia repair by fascial release. Evolution of the technique produced modifications and fewer complications.

METHODS: Fascial component separation was performed either by "classic" technique (broad skin flaps) in group 1 and by "perforator preservation" (fascial release through separate inferolateral incisions) in group 2.

RESULTS: Mortality was .75% (1/128). Major complications occurred in 7 patients (5.5%). Total recurrence rate is 16% (21/128) with major recurrences in 9.3% (12/128). Both groups were statistically equivalent in demographics, comorbidities, and recurrences. Group 1 had significantly higher rates of skin necrosis ($P < .001$) and chronic pain ($P = .003$).

CONCLUSIONS: Fascial component separation can provide satisfactory results in uncomplicated incisional hernias, but skin necrosis is prohibitive without perforator preservation.

Abdominal incisions ultimately result in hernias in as many as 20% of cases. This complication is thought to occur early in the postoperative period, although the hernia may not become apparent for many years.[1] Considering the large number of laparatomies performed, the magnitude of this problem is obvious. High recurrence and complication rates in many published series confirm that surgery for repair of incisional hernia will remain a challenge for the foreseeable future.

In the classic 1973 paper, Jean Rives stated, "The problem which we must solve is not just a simple problem of technique."[2] Indeed, there still is no unique surgical solution to the problem, and prevention is elusive.[3] The particular abdominal defect as well as the health and lifestyle of the patient are important considerations, and the goals of repair are not always the same. The elderly sedentary patient may not require a dynamically functioning abdominal wall, as would a more active person. Diabetes, obesity, steroids, ascites, and pulmonary disease are harbingers of postoperative complications and may mandate the simplest approach, even if this leads to a theoretically less desirable result.

Prosthetic repairs have become the procedures of choice in many surgical practices. In its simplest form ("inlay" or "bridging" of the defect) the operation is not technically challenging. Tension is not an issue, and the hernial defect disappears. But prosthetic meshes carry their own set of problems, infection and visceral erosion being most prominent among them. Furthermore, the bridging mesh may separate with time, and acellular dermis as a replacement for

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prosthetic material does not seem to have fulfilled its earlier promise.[4,5] The failed bridging repair will enlarge even more because of the vector forces of the contracting oblique muscles, which have lost their insertion point on the linea alba. The more technically complex submuscular, extraperitoneal mesh implant, popularized primarily by French surgeons, has produced good results in experienced hands, although it is not without complication risk.[6,7]

Laparoscopic repair of incisional hernias has gained immense popularity, and excellent results have been reported in large series.[8,9] Whether this is the best technique for the average hernia in the average patient, however, may still be questioned. Laparoscopic repair can be effective in preventing incarceration and further enlargement of a defect, but the cosmetic and physiological results may not be ideal. The early fear of erosion complications with intraperitoneal mesh does not seem to have materialized, presumably because of improvements in prosthetic materials.

Fascial component separation, initially described by Ramirez et al, offers theoretical physiological advantages for repair of abdominal wall defects.[10] Mesh with its attendant complication risk is avoided; the contracting lateral abdominal musculature is physically reattached to its insertion point on the linea alba, and the intra-abdominal pressure is restored, preventing later diaphragmatic dysfunction. Results of this operation have not been uniform, however, perhaps because of different patient characteristics or owing to modifications of the technique itself.

All operations evolve in the hands of the surgeons performing them, and this one is no exception. A single surgeon's experience with fascial component separation is hereby presented, along with lessons learned.

Materials and Methods

Abdominal fascial component separation was utilized to repair incisional hernias in 128 patients. All procedures were performed by a single surgeon in private practice. No trauma patients were treated during this period, and there were no instances of extensive acute tissue loss. No patients with stomas or enterocutaneous fistulas are included. Patient demographics are summarized in Table 1. A standardized method for measuring hernial defects is lacking. For uniformity, beginning about half way through this series, defect measurements were done under anesthesia and after clearing of attenuated tissue. The long and short axes of the defect were measured, and the defect was calculated as the area of an ellipse (*formula*: $\pi *$ long axis $*$ short axis/4). Where the defect was cribriform or where multiple defects existed, the total defect was used for this calculation. Follow-up protocol consisted of yearly outpatient visits or postcard questionnaire. At the time of this report, 79 of 128 patients were available for evaluation. Average length of follow-up is 38 months (median 30, range 8–161).

Table 1 Patient demographics

	Group 1*	Group 2†	*P*
Age (y)			
Mean/median	67/68	67/68	.342
Range	29–84	42–91	
Sex (M/F)	25/38	29/36	.572
BMI (kg/m^2 mean/median)	29/29	28/27	.020
ASA (mean/median)	2.5/3	2.7/3	.190
Defect size (cm^2, mean/median)	121/99	132/95	.374
Prior repair (no. of patients)	20	19	.757
Mesh	34	4	<.001
Comorbidities (frequencies)			
Atrial fibrillation	7	3	.171
Cardiac arrhythmia, other	5	3	.438
Cardiomyopathy	3	1	.295
Chronic renal failure	2	1	.541
Cirrhosis	0	1	.323
Connective tissue disease	1	2	.578
Coronary artery disease	6	4	.478
COPD	9	8	.742
Cystic fibrosis	1	0	.308
Diabetes	11	10	.751
Hepatitis	2	0	.148
Hypertension	24	19	.288
Immunodeficiency	0	2	.161
Leukemia	2	0	.148
Morbid obesity	0	6	.014
Obstructive sleep apnea	1	6	.057
Seizure disorder	0	1	.323
Valvular heart disease	4	3	.666

BMI = body mass index; ASA = American Society of Anesthesiologists physical status; COPD = chronic obstructive pulmonary disease.
*Group 1: classic, wide skin flaps.
†Group 2: perforator preservation technique.

Surgical technique

All operations were performed under general anesthesia with preoperative antibiotic administration, bladder catheterization, sequential leg compression devices, and nasogastric intubation if indicated by intraoperative findings. Standard perioperative anticoagulant protocols have been followed recently according to risk assessment for deep venous thrombosis. Two variations of the surgical technique were utilized in the study group.

Group 1 is comprised of 63 patients who underwent a modification of the "classic" component separation technique (Fig. 1) with creation of broad skin flaps. (Extrafascial mesh was also used in 54% [34/63] of these patients.) This technique, which is no longer preferred by the author, has been described in earlier publications.[11,12] Midline scar excision followed by extensive skin flap mobilization is accomplished, the lateral border of the rectus muscle is located, and at a point 1 cm lateral to the rectus, the external oblique aponeurosis and muscle are divided from the inguinal region to the costal margin. Lateral dissection deep to the external oblique allows creation of a "sliding myofascial flap" consisting of internal oblique and transversus muscles. Cephalad to the costal margin, where the rib cage protects

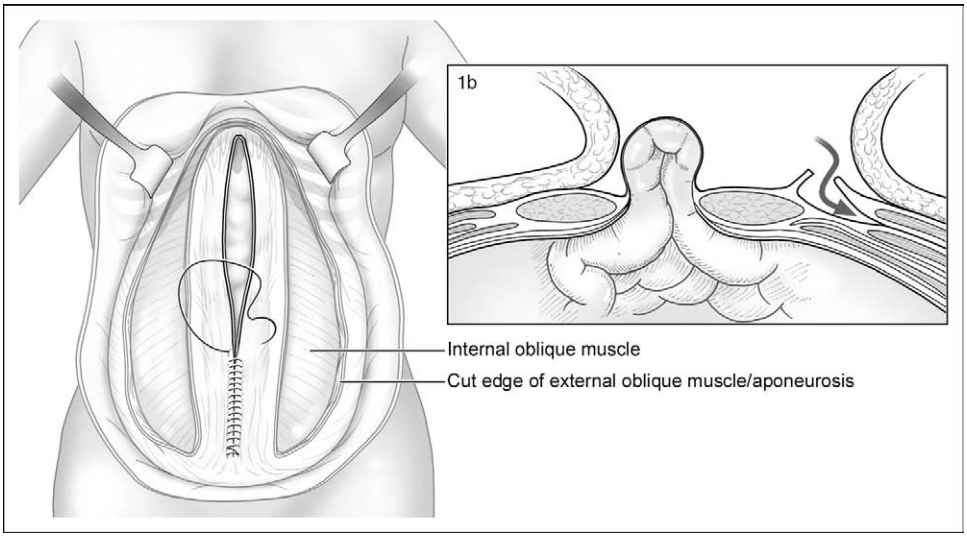

Figure 1 Classic components separation technique, with broad skin flaps and external oblique release. (1b) Cross-sectional view.

against herniation, the lateral border of the rectus may be released to allow these muscles to be mobilized from the chest wall and apposed in the midline to "fill" the epigastrium. Attenuated tissue around the hernia is resected, and the posterior rectus sheath, (cephalad to the semicircular line of Douglas) may also be incised longitudinally, if additional mobilization is desirable. The midline is then closed with a single layer of heavy monofilament suture, as a "mass closure" technique. Questionably, viable skin is resected, often including the umbilicus, and subcutaneous suction drains are placed. The skin is usually closed with staples.

Group 2 consists of the more recent 65 patients who had minimal or no skin flaps raised, the "perforator preservation" technique (Fig. 2). In these cases the fascial separation is done through separate inguinal incisions with balloon dissection (AutoSuture PDB 1,000, Covidien, Norwalk, CT). After incising the external oblique aponeurosis (as in a standard inguinal hernia repair) the balloon dissector is passed deep to the external oblique aponeurosis, advanced cephalad, and inflated. The lateral border of the rectus muscle acts as an anatomical barrier and forces the balloon to expand laterally, creating the necessary space. With headlamp illumination and a narrow retractor, a sponge forceps completes the fascial separation. Ultrasonic shears (Harmonic Ace, Ethicon Endosurgery, Cincinnati, OH) are then used to incise the elevated external oblique aponeurosis and the muscular portion found more cephalad. The deeper muscle layers are pressed posteriorly with a sponge forceps to avoid injury as the external layer is divided. With persistence, fascial release and dissection can often be accomplished up to the costal margin. In some cases the cephalic portion of the release must be done later through the epigastric skin flaps, extending the musculofascial incision that was begun in the inguinal region. After the

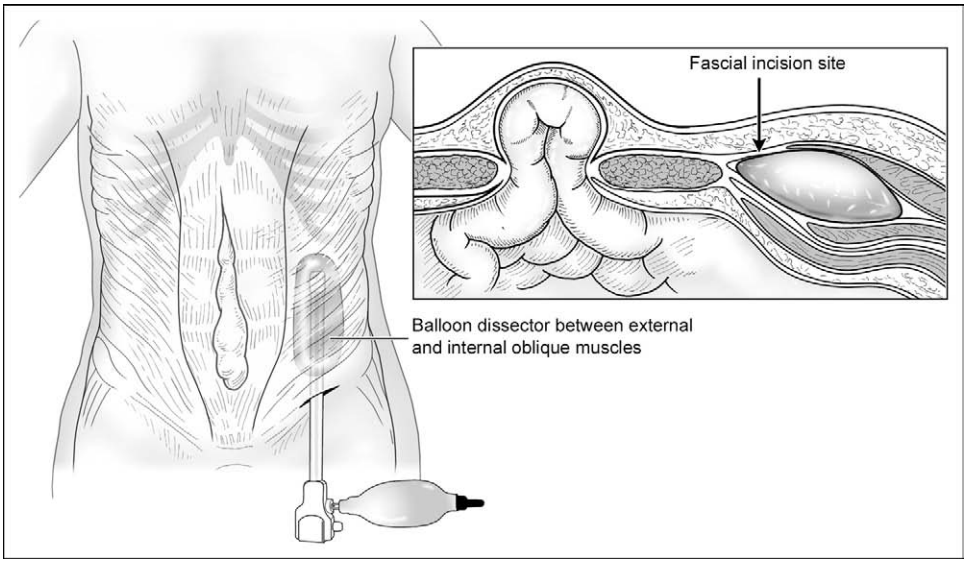

Figure 2 Perforator preservation technique for components separation, using balloon dissector.

fascial release has been done bilaterally, the midline scar is excised and minimal skin flaps are raised to free the hernia sac, thus preserving the periumbilical perforator vessels. The supraumbilical-epigastric skin flaps are then elevated as with the "classic" technique; the rectus muscles on the chest wall are mobilized; the posterior rectus sheath is incised from within the midline incision, and the attenuated tissue is resected. Midline closure is done as described for the "classic" technique (group 1). Drains are seldom used. Postoperative management is routine with intensive care unit monitoring when appropriate. Patient-controlled narcotic analgesia and early ambulation are standard, and intensive pulmonary support is stressed. Antibiotics are not given after 24 hours unless there are specific indications for such use.

Statistical analysis

Statistical analyses were performed using SPSS 17.0 (SPSS, Inc, Chicago, IL). Statistical tests included: Pearson χ^2 for all comparisons of frequencies between groups; Spearman correlation; independent-samples *t* tests for comparison of means when the distributions of the samples were normal; and Mann–Whitney *U* tests for comparisons of medians when the sample distributions were not normal. Prior to analyses were established that *P* values of less than .05 were to be considered statistically significant.

Table 2 Postoperative results and complications

	Group 1* (n = 63)	Group 2† (n = 65)	*P*
Complications (no.)			
Adynamic ileus	7	9	.640
Atelectasis	6	3	.277
Chronic pain	8	0	.003
Death	0	1	.315
Pneumonia	3	2	.623
Postoperative bleeding	1	0	.308
Respiratory failure—ventilator	2	3	.674
Skin necrosis/ debridement	16	0	<.001
Urinary retention	1	2	.578
Urinary tract infection	2	4	.425
Wound infection	2	2	.975
Pleural effusion	2	1	.541
Recurrences (no.)			
Recurrence, major	6	6	.977
Recurrence, minor or suspected	6	3	.278
Reoperation for recurrence	4	5	.766
Recurrence after reoperation	0	1	.323
Time to recurrence (mo), mean/median	25/12	17/17	.780

*Group 1: classic, wide skin flaps.
†Group 2: Perforator preservation technique.

Results

The total recurrence rate is 16% (21/128). Major central incisional failures occurred in 12 patients, 2 of these being seen only in the epigastrium. Two of the major recurrences occurred in patients with multiple previous incisions. Lateral herniation, presumably related to the fascial separation itself, was noted in 2 patients. Major recurrences were therefore seen in 9% (12/128). Nine patients have either minor diastasis or minimal central defects. (These are defined as palpable defects less than 2 cm in diameter without protrusion or symptoms.) Smaller or suspected recurrences are therefore present in 7% (9/128).

Two large recurrences were reoperated upon with a successful result, using additional fascial separation techniques, including posterior rectus release, which had not been done at the original operation. One patient was reoperated upon but suffered a prompt second recurrence after early postoperative heavy lifting. Of the lateral recurrences, 1 underwent a successful primary tissue repair, and 1 patient required prosthetic repair. One patient with a recurrence in an adjacent subcostal incision underwent a successful laparoscopic repair. One of the patients with "minimal" recurrence underwent successful primary repair.

Results and complications are summarized in Table 2. There was no difference in hernia recurrence between the 2 groups and no significant difference in complications except for skin necrosis and pain. However, these 2 complications constitute a striking difference in the results of the 2 techniques. Significant skin necrosis occurred in 25% (16/63) of patients in group 1, but in no patient in group 2 (0/65); $P < .001$. Chronic or prolonged discomfort was noted in 13% (8/63) patients from group 1. All patients with chronic pain had extrafascial mesh placed. No patients from group 2 had this complication; $P = .003$. The occurrence of chronic pain was not correlated with the date of surgery for group 1 ($P = .264$); this suggests that the incidence of chronic pain was not simply the result of a "learning curve." All patients with skin necrosis required debridement on subsequent office visits, and 1 required a skin graft. Two patients required mechanical ventilation postoperatively. One patient returned to the operating room on the day of surgery for control of bleeding. One patient developed an abscess requiring drainage. One patient had multiple organ failure secondary to preexisting cirrhosis with postoperative hepatic decompensation and accounts for the only death in the series. Three patients in group 2 developed lateral hematomas, which resolved spontaneously. Four patients had defects that could not be closed without prosthetic material, despite extensive fascial release. Three of these patients had massive defects, measuring 501 cm^2, 551 cm^2, and 973 cm^2, respectively. One of these 4 patients presented with a recurrent hernia involving both the midline and the costal

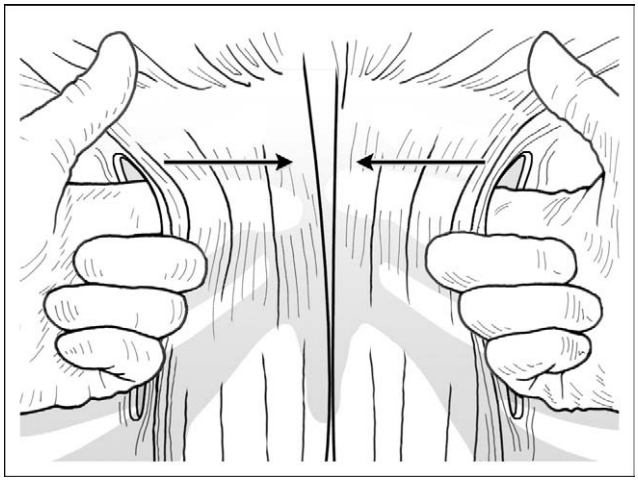

Figure 3 Mobilization of rectus muscles cephalad to costal margin.

margin. Fascial component separation alone was therefore not possible for 3% (4/128) of patients in this study.

Comments

Acceptable results for incisional hernia repairs continue to be reported with a variety of techniques. Fascial component separation restores a close approximation of the original anatomy and physiology. The loss of external oblique function does not seem to be important, although the potential weakness thus created has been reinforced with mesh by some surgeons in cases done by the classic wide skin flap method. Reinforcement of this area is not feasible with the currently preferred "perforator preservation" technique, and 2 hernias did, in fact, occur in the lateral release area. This complication is presumably secondary to injury to the deep musculature during the fascial release, a technical error.

The principles of a successful abdominal wall reconstruction have been well defined.[13] The most important of these may be restoration of the linea alba, since this structure represents the insertion site for all of the lateral abdominal musculature, the oblique or "flat" muscles inserting on the linea alba through the rectus sheath. Proponents of prosthetic repair believe this insertion is achieved "through" the mesh, without true tissue approximation in the midline. Many reports of prosthetic techniques state that actual midline tissue approximation is accomplished "when possible," but precise numbers are usually lacking. Certainly, the excellent results of extraperitoneal mesh reinforcement of groin defects, based on Stoppa's work, are well documented. It may be misleading, however, to extrapolate the results of "patch repairing" a relatively static inguinal defect to the same technique for the more dynamic mid and upper abdominal wall.

Although many surgeons have adopted Ramirez's general principles in performing fascial component separation operations, there are 2 important technical details found in his original and subsequent reports that are not always addressed. These supplemental maneuvers have developed into an integral part of the repair technique described in this report.

Mobilization of the pectoral muscles over the costal margin was described in Ramirez's original paper as a "rectopectoralis" flap, preserving the continuity of the pectoralis muscle with the rectus and their contiguous overlying fascia. In this series, a modification of this maneuver was used. Detachment of the lateral aspect of the rectus muscle was done cephalad to the costal margin, so the rectus muscles could be mobilized and brought together in the midline, thus "filling" the often weak or herniated epigastrium (Fig. 3). Since the rib cage provides a solid posterior support, there is no risk of herniation with this maneuver, as there would be if this were done caudal to the costal margin. Lateral fascial release, so effective for the central abdominal wall, has no effect in the epigastrium because of the costal arch, and the epigastrium is a notoriously difficult area for repair of hernias, for example, following sternotomy. This chest wall rectus mobilization technique was not utilized earlier in the series, likely accounting for 2 of the major recurrences reported.

Ramirez et al also stressed the importance of release or mobilization of the rectus muscle by incision of the posterior rectus sheath (Fig. 4). Obviously, this only applies to the portion of the rectus muscle cephalad to the semicircular line of Douglas (arcuate line). Shestak et al reported that this maneuver adds 2 cm of mobilization.[14] Ramirez and Girotto recommended this maneuver as the first step in fascial component separation, the second step being the better-known lateral external oblique release.[15] Illustrations may show the posterior rectus sheath being incised without opening the peritoneum, which is not always possible. Incision of both peritoneum and posterior sheath is the technique used in this report. No adverse effects have been noted from the peritoneal defect thus created.

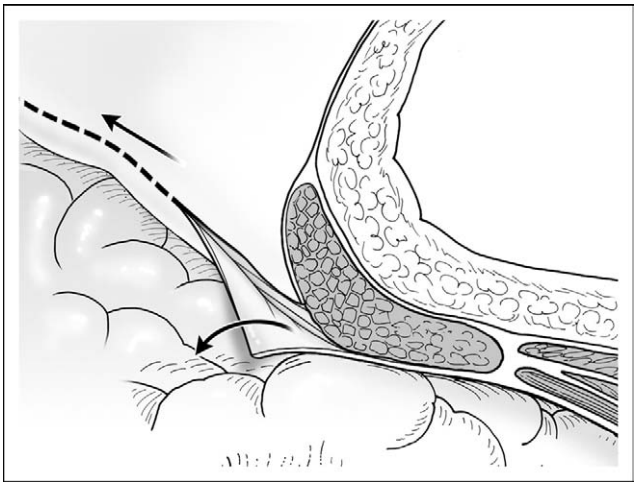

Figure 4 Incision of posterior rectus sheath for rectus muscle mobilization.

The weak point of the classic fascial component separation technique, in group 1 of this series, as in others, is the disturbingly high incidence of skin necrosis. Saulas and Dumanian described tunneling around the periumbilical perforators and then completing the lateral release in the standard way.[16] They reported a significant decrease in skin necrosis with this technique. The tunneling may be tedious, however, and produces skeletonization of the fragile vessels, putting them at risk of disruption by retraction of the abdominal wall as the operation progresses. Maas et al reported approaching the component separation through a separate incision to avoid a stoma, and others have described variations of lateral incision placement.[17] Maas and others and have also reported techniques for accomplishing the separation endoscopically.[18,19] The bilateral inguinal approach described in this report was found to provide very satisfactory and expeditious release with standard instrumentation. In cases where the musculofascial section cannot be carried far enough cephalad through the inguinal incision, it may be completed through the upper skin flaps. A sponge forceps inserted from the inguinal incision below will mark the site from which the lateral musculofascial incision is to be continued. (Thanks to blood supply from the intercostal vessels, wide skin flaps may be created cephalad to the periumbilical perforators without risk of skin necrosis.)

Analysis of the failures in this series has obviously led to modifications in technique. Patients with defects involving multiple incisions are not good candidates for this method. Some additional nontechnical points are now also stressed. Preoperative weight loss is strongly advised when appropriate, and referral to physicians with interest in this area may be considered. Postoperatively, patients are cautioned to avoid abdominal stress for at least 6 months and to avoid weight gain. If abdominal exercises are desirable, only isometric ones are advised during the first 12 months after repair. Firm scientific support is admittedly lacking for these instructions.

Management of recurrences must be individualized. Some of these patients may be salvaged by other modifications of fascial release, such as Chevrel's anterior fascial overlap procedure, a modification of the operation described by Welti and Eudel and known in the United States as the "open book" procedure.[20–22] Others may be best served by laparoscopic repair or by open mesh techniques.

The modified fascial components separation repair of incisional hernia as currently performed produces satisfactory results with minimal morbidity. When successful, it provides a dynamic and physiologically functional abdominal wall. The technique is based on 4 steps:

1. Lateral fascial release by inguinal incision, balloon dissection and external oblique section.
2. Rectus mobilization over the chest wall for epigastric closure.
3. Posterior rectus sheath incision and release.
4. Abdominal wall reconstruction by primary midline closure.

This method is an acceptable technique for the repair of uncomplicated midline incisional hernias in suitable patients, but long-term recurrence rates are unknown. Success in primary repair of abdominal hernias depends on the ultimate strength and elasticity of the healed abdominal wall, properties that do not lend themselves to precise measurement.

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