A New Indication for Barbed Threads: Static Reanimation of the Paralyzed Face

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Purpose: The objective of this study was to present the authors' experience in static facial reanimation using a straightforward incisionless procedure adapted from techniques commonly used for performing minimally invasive facelifts.

Materials and Methods: Seventeen patients were treated by static suspension using barbed sutures and all resulting changes were reviewed. The technique used for suture placement is described in detail, as are the author's tips for achieving the best esthetic and functional results. All patients had preoperative indication for physiotherapy and rehabilitation procedures (local massage and mirror therapy). Facial nerve function was evaluated using the Arianna Disease Scale.

Results: The cosmetic outcome improved in all cases, with marked amelioration of the preoperative facial asymmetry. Oral competence was enhanced by elevating the oral commissure and reinforcing the cheek, and amelioration of symptoms related to lagophthalmos was achieved through increased support and decreased pull on the inferior eyelid. The addition of physiotherapy with specific rehabilitation exercises before the surgical intervention increased the success rate.

Conclusion: This technique proved to be a good alternative to other static reanimation procedures because of its straightforward technique, availability, good outcomes, low complication rate, and ability to perform minor adjustments and corrections at any time.

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The static facial expression in facial paralysis triggers patterns associated with negative emotions from downward orientation of the oral commissure and the sagging, tired appearance of the eyes, with accentuation of the inferior orbital rim contour. This abnormal facial appearance adversely affects these patients' social interactions with others.[1] The functional disturbances linked with facial paralysis are even more socially debilitating, impeding normal public outings because of unpleasant features, such as saliva leakage.[2] The quality of life of these patients is considerably improved using straightforward facial reanimation procedures, in addition to physiotherapy and other rehabilitation procedures before surgery.

Static procedures for reconstructing the paralyzed face are periodically revised and refined to achieve maximum benefits with minimum discomfort and complications. From surgical procedures targeted at specific anatomic areas to minimally invasive facial slings, botulinum toxin, and combined techniques,

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the procedures involved in static reanimation are constantly inspired by and adapted from facial rejuvenation techniques.

In recent years, a new category of surgical threads (ie, barbed threads) has gained increased popularity in minimally invasive facelifts. Although extensively used in plastic surgery, to the authors' knowledge, no studies have been published thus far on the effectiveness of these barbed threads in the static rehabilitation of facial paralysis.

Materials and Methods

The study is a systematic review and therefore was exempt from institutional review board approval. The authors followed the guidelines of the Declaration of Helsinki during the entire research process.

PATIENTS

After conducting a retrospective review, 17 patients met the inclusionary criteria and were selected for this study. All 17 patients (6 women and 11 men; 29 to 82 yr old) were treated by closed percutaneous static facial reanimation using barbed sutures. The inclusion criteria for patient selection were the presence of facial nerve paralysis, other associated factors that would contraindicate more complex methods of facial reanimation (advanced age, presence of comorbidities), and the refusal of patients to undergo further complex open surgery or general anesthesia.

Facial nerve paralysis was the result of parotidectomy in 9 cases, post-traumatic injury in 3, and resection of acoustic neuromas in 5. The average time from paralysis onset to the correction procedure was 1 to 19 months. Of the selected patients, 2 underwent previous attempts of restoring facial symmetry by static or dynamic procedures. In 9 cases, a gold plate insertion in the upper eyelid also was performed.

Preoperative therapeutic ultrasound applied locally and massage of the paralyzed area were performed to support the surgical intervention.[3] Preoperative mirror therapy was performed in all patients. Clinical assessment of the facial paralysis was performed using the Arianna Disease Scale.[4]

The authors used commercially available self-retaining monofilament polydioxanone (PDO) 2-0 double-cog threads (Prime PDO LIFTING, BS Medical, Luxembourg) that are commonly used for facelifts. The barbed thread comes inside an insertion needle and therefore placement is simple and quick. The authors used threads of different lengths, according to the area of insertion and the desired effect. The needle size was 23 gauge in all cases, and the length was 38 mm for the frontal area and 50, 60, or 90 mm for the cheek region. The incisionless static reanimation procedure that uses barbed threads is described below in detail.

TECHNIQUE

The first step involves assessing the symmetry points corresponding to the level of the contralateral oral commissure, the location of the nasolabial fold, the position of the maximal volume of the cheek, and the maximum convexity point of the brow arch (Fig 1). This enables appropriate planning for the desired lift. Because there is always some tissue droop after the procedure, it is advisable to perform some overcorrection.

The anchorage points are marked at the level of the anatomic structures that are to be lifted (Fig 2). Anchorage or grasping points are those points located at the inferior end of the thread, where the lift of the tissue begins. Starting from the anchorage points in an upward direction, the weight of the lifted tissue is redistributed along the thread through the existing barbs until reaching the superior end of the thread. For best results, anatomic landmarks can be used to identify the anchorage points in the prolapsed tissues.

The authors prefer following the curved line of the nasolabial fold, from the superior and lateral aspects of

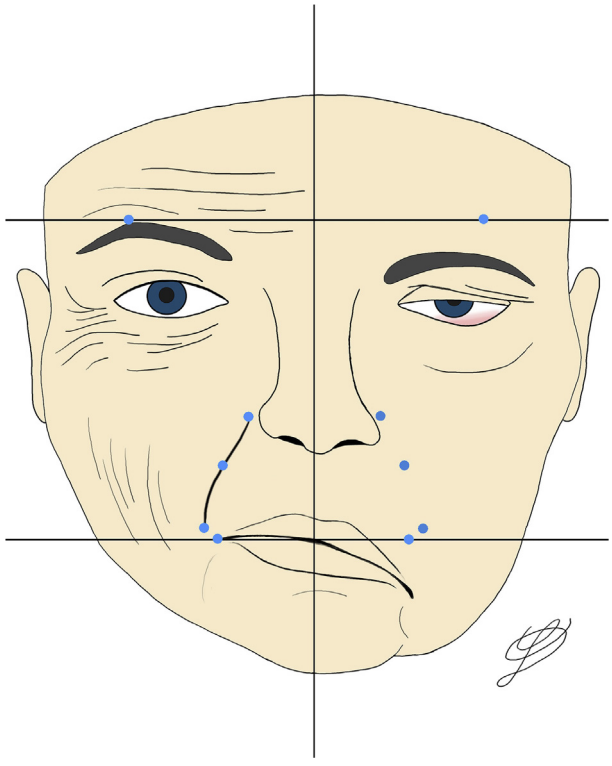

FIGURE 1. Illustration of facial asymmetry caused by left facial nerve paralysis. Symmetry points (*blue dots*) represent the desired level of tissue lift on the left side.

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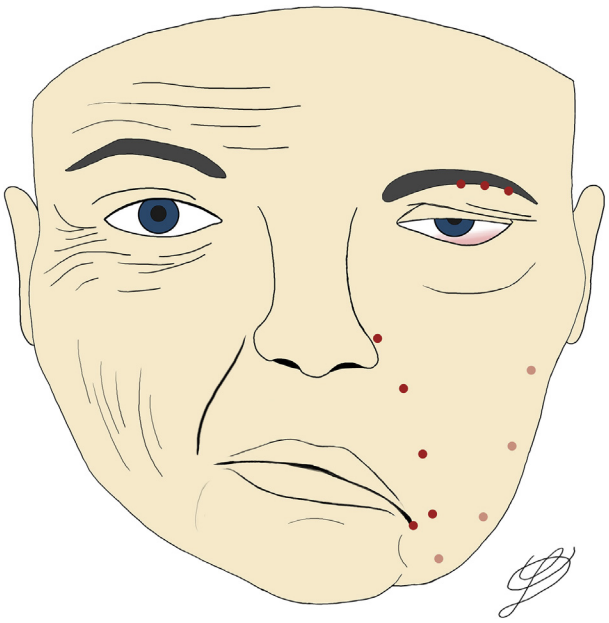

FIGURE 2. Illustration of facial asymmetry caused by left facial nerve paralysis. Anchorage points (*red dots*) are entry points used in all situations. Additional anchorage points (*pink dots*) can be used to improve results.

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the ala nasi toward the external aspect of the modiolus. Two to 3 anchorage points are needed at this level.

The modiolus is a key anchorage point for achieving an appropriate lift of the lip corner. This anatomic point is found slightly lateral to and upward from the oral commissure. The distance can be approximated by palpating the contralateral side during function. If using 1 or 2 threads at this level, the anchorage obtained will allow a very efficient pullup of the tissues without deforming the upper lip.

The authors obtained the best results by using 1 thread for the modiolus, a second thread slightly lateral to the previous thread, passed more superficially to create a dimple, and 2 additional threads also passed superficially at one third and two thirds of the nasolabial fold to shape it.

In patients with facial nerve paralysis, the transition from the inferior cheek region to the chin becomes apparent by the formation of a fold induced by the ptosis of the more mobile cheek soft tissues over the more adherent chin region. This fold also becomes apparent in elderly people and is noticed as a downward line from the oral commissure toward the mandible. One or 2 anchorage points are usually needed to grasp these tissues.

The appropriate height of the brow is determined by identifying the location of the maximum convexity of the brow arch and lifting this point to reach the same level as on the contralateral side. This maximum convexity is commonly located between the internal two thirds and external one third of the brow and is usually more accentuated in women. At least 1 additional thread is needed external from the previous one to achieve symmetry. The lift is designed to be smaller for the exterior thread and start slightly more inferiorly following the arch. The grasping points are located inside the eyebrow.

After marking the grasping points, the vector lines should be decided and marked (Fig 3). In the cheek region, most forces are directed obliquely toward the temporal area. Some vertical threads also can be inserted to support the weight of the cheek and redistribute the tissues more evenly in a net-like pattern, achieving a symmetric appearance of the maximum volume of the cheek. Progressively shorter threads or threads inserted consecutively at different levels, in a "ladder," are needed in the cheek area for even distribution and natural results. On the forehead, the vector lines are directed vertically.

Local anesthesia of deeper tissues is not needed for insertion. EMLA cream (lidocaine and prilocaine) can be used for the skin and light sedation is commonly added by oral administration. Then, the threads are inserted at different depths, depending on the desired

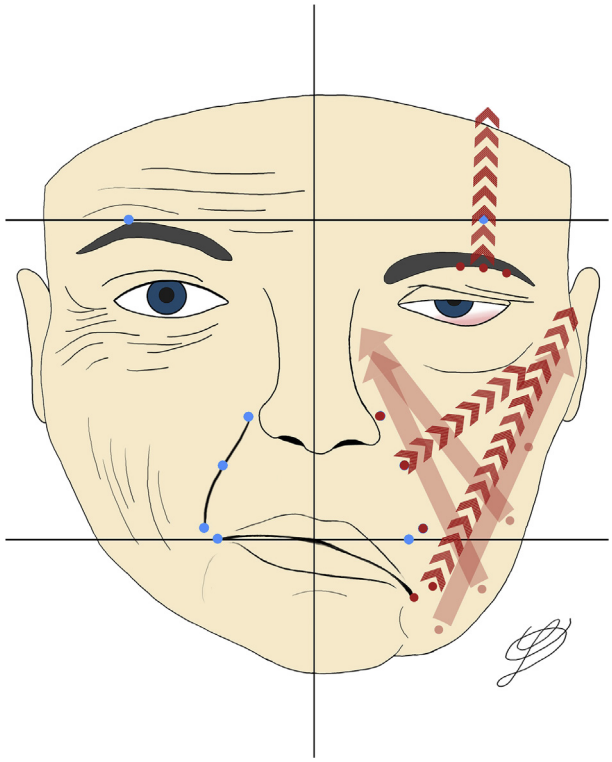

FIGURE 3. Illustration of facial asymmetry caused by left facial nerve paralysis. The location and direction of the vector lines for thread insertion correspond to the main anchorage points (*red dots*) and additional anchorage points (*pink dots*).

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result. For support and adequate lift, most threads should be inserted at the level of the superficial muscular aponeurotic system, because this fascial structure is more reliable for anchorage and mobile in rapport with the underlying structures. When redistribution of the skin is needed in a specific area, the threads can be inserted more superficially. For the specific case of the nasolabial fold, the threads can be "misused" by purposefully creating a dimple at the exit point to re-create the crease by several dimples.

The threads are passed starting at the inferior aspect and exiting at the superior one, while uplifting and supporting the tissues with the nondominant hand, in the direction of the thread insertion. The direction is usually oblique from the nasolabial fold and from the oral commissure toward the temporal area and vertical from the brow toward the hairline. Slight variations can be made, depending on the desired result. Additional and more vertical threads in the cheek area can help reinforce and stabilize the oblique threads, creating a net-like pattern.

On average 6 to 10 threads are needed for static facial reanimation. This depends on the specifics of each case, the number of facial nerve branches involved, the constitution of the patient, and the patient's main complaints.

None of the patients included in this study had any contraindications for preoperative physiotherapy and rehabilitation procedures, which consisted of ultrasound at 0.6 W/cm^2 for 3 minutes in the paralyzed area and massage for correct anatomic drainage of the facial area. Before the intervention, the patients practiced mirror therapy for the usual face movements (facial expression and mastication) 2 or 3 times per day for approximately 10 minutes. The mirror therapy induced self-confidence for the surgical intervention in all patients. Surgery, physiotherapy, and rehabilitation were valuable additions for a good success rate from a psychological point of view.

Results

Facial appearance improved in all cases to a satisfactory degree and the effect was noticeable immediately after the procedure (Figs 4-9). No important edema developed as a result and bruising was minimal. A small droop in the tissues was noticed in the first week after the procedure. However, this had been anticipated by performing overcorrection at the time of the surgery. Small adjustments were added in the

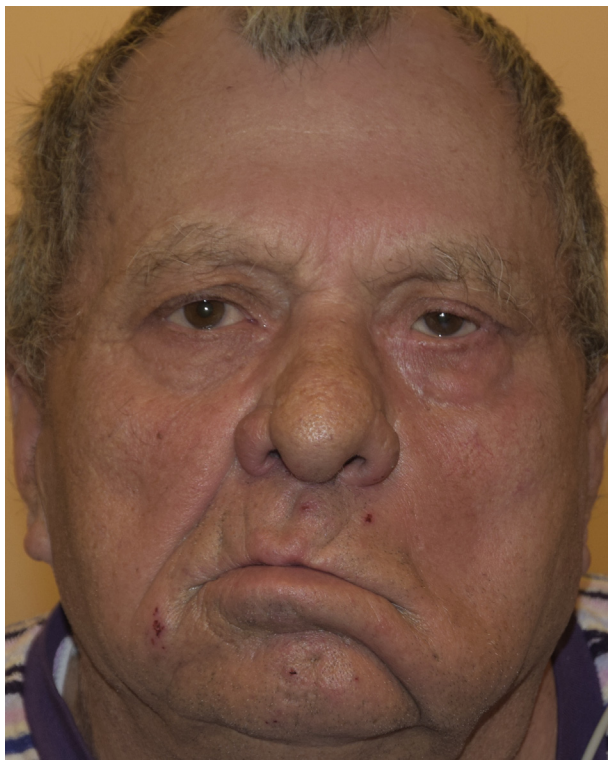

FIGURE 4. Patient with left facial nerve paralysis after surgery for acoustic neuroma displaying typical facial asymmetry signs, with ptosis of the oral commissure, lagophthalmos, and the disappearance of normal skin creases.

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FIGURE 5. Postoperative view at 7 days showing considerable improvement of facial symmetry and increased muscular tonicity on the affected side.

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FIGURE 6. Frontal view of a patient with left facial nerve paralysis after surgery for a malignant parotid gland tumor displaying the usual signs of facial asymmetry: superior palpebral ptosis, ectropion, depressed oral commissure, disappearance of the normal skin creases, including the nasolabial fold, and sunken aspect of the cheek with pulling on the inferior eyelid.

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FIGURE 7. Frontal view of patient after suspension using barbed sutures showing improved facial symmetry with lifting of the superior eyelid and the brow, lifted left oral commissure, restored volume of the left cheek with less pull on the inferior eyelid, and improved aspect of the left nasolabial fold.

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early postoperative period in 3 cases, according to the feedback received from the patients.

There were further functional improvements regarding oral competence during function and at rest and regarding ectropion and lagophthalmos. Additional gold plate insertion in the upper eyelid was performed in 9 patients. Diction also improved after the increased tonus of the cheek area.

Subsequent thread insertions for maintaining the results were performed on average every 6 months. There were no recorded cases of infections or thread extrusion.

Discussion

The advantages of barbed threads for the suspension of paralyzed tissues in open procedures, by anchorage to the temporal fascia, have been highlighted in several publications.[5,6] The authors describe a different way of addressing this issue using commercially available barbed threads in a short percutaneous incisionless procedure. In the authors' experience, barbed threads have proved useful in rendering static procedures even more straightforward and with good results when used appropriately.

Facial paralysis of any etiology can benefit from the straightfoward insertion of barbed sutures, whenever it is established that a dynamic functional reconstruction cannot be performed safely. For example, patients undergoing resections of extended parotid malignancies can benefit most from routine static procedures, because the resulting defects involving several anatomic layers and the lack of local vessels and soft tissues would make a dynamic reconstruction extremely challenging.[7]

Because self-retaining barbed sutures are usually indicated in performing facelifts for mild aging,[8] extreme asymmetry and ptosis of the soft tissues from seventh nerve paralysis might seem an unlikely indication. However, in the authors' experience, the results are favorable, and this good outcome seems paradoxically related to the lack of facial movements.

Concerns regarding restricting facial mobility after the surgery are not an issue in facial paralysis. This contributes to the good results by not modifying the initial position of the threads, which will be further reinforced by the formation of fibrous tissue around the suture.

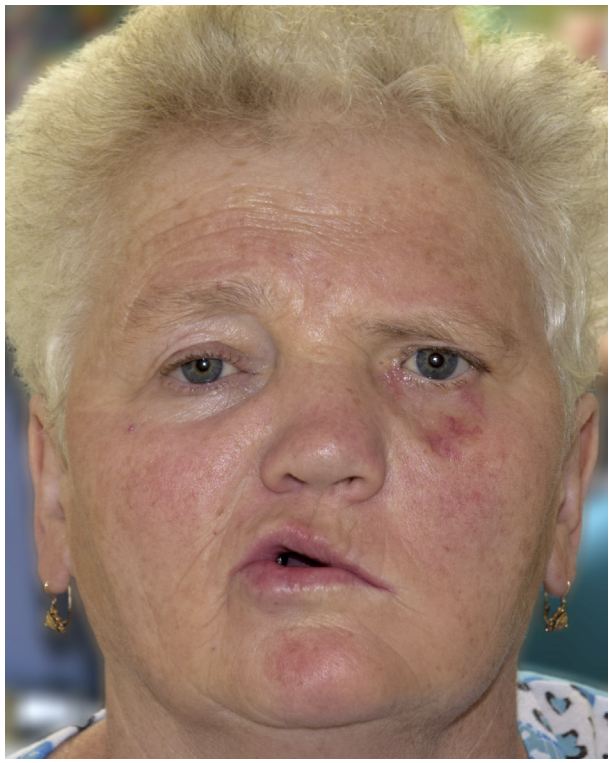

FIGURE 8. Facial asymmetry during function from left facial nerve paralysis after surgery for a malignant parotid gland tumor.

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FIGURE 9. Postoperative frontal view of patient during function after suspension using barbed sutures showing marked improvement in perioral symmetry and dynamics.

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In addition, long-standing paralysis leads to muscle atrophy. Together with the decrease of adipose tissue occurring normally with advancing age or the loss of soft tissues that are removed surgically, this will lead to a lack of volume and therefore decreased weight of the tissues to be suspended. A decreased weight will result in less traction along the thread and more stable results. In certain situations, when the weight of the tissue is increased because of constitutional features or the presence of a free flap reconstruction, results can be improved by increasing the number of threads used for additional support and volume distribution.

In oncologic patients with facial paralysis, the main aim is to restore facial symmetry. Therefore, the amount of facial lift needed is just enough to overcome tissue ptosis without the need to address skin excess, because the aim is not to provide a younger look, but to achieve a symmetric appearance. In such instances, contrary to making these patients look younger, symmetry is achieved by re-creating the lines created by advancing age, such is the nasolabial fold.

One important problem is caused by the decreased tonus of the cheek muscles after denervation, which leads to the "fall" of the oral commissure. The functional consequences consist of phonation disturbances but most importantly of eating impairments because of inefficient containment and coordination of the cheek and lip area during mastication and deglutition.[9] In consequence, drooling appears and, between meals, the food remains in the inferior oral vestibule within the "bags" created by the decreased muscular tonus.

Reinforcing the cheek by upward traction will eliminate the pocket formed in the inferior vestibule and will help maintain tension during mastication, and lifting the corner of the mouth will impede food and saliva leakage from the oral cavity.

Bringing the bulge of the cheek to the initial position also will restore the normal contours of the region, the malar prominence, and the submalar slope, but more importantly it will decrease the pull on the lower eyelid and therefore decrease the degree of ectropion.[10] By increasing the volume of the zygomatic region, additional support is provided for the inferior eyelid and at the same time traction on the eyelid is decreased, with positive outcomes regarding lagophthalmos. Subsequent procedures addressing this functional impairment should be evaluated after performing the mid-facelift. Gold plate insertion in the superior eyelid is an effective and straightforward operation that can be used to complete the static barbed thread reanimation procedure.

In repositioning the cheek and in restoring facial symmetry, the nasolabial fold needs to be addressed as a key area. Although anatomically defined as a distinct structure, the nasolabial crease is not apparent in the paralyzed face. Studies have determined the presence of muscle fibers in the structure of the crease and its surroundings, explaining the disappearance of the fold in seventh nerve paralysis.[11] Because the formation of the nasolabial fold is related to the act of smiling, the movement of the lip elevator muscles and the positioning of the cheek soft tissues and of the oral commissure, there is a natural need to reposition all involved structures to restore the crease.[12] In the absence of facial movement, there is a supplementary need for mechanical means of redefining the fold using suspension threads within the crease outline.

After gradual resorption of the PDO threads (6 to 8 months), collagen synthesis is continuously stimulated, leading to the formation of scar tissue that will further contribute to the retraction and maintenance of the tissues in the desired position. Studies have shown that the strength of the suture decreases as the formation of the fibrous tissue adjacent to it advances.[13] Over time, the scars soften and the effect of the threads diminishes. Therefore, there is a need for additional insertion of barbed sutures. The ease of the procedure allows this not to be a real issue, because the technique is readily reproducible at any time. In anticipation of this gradual loosening, reinsertion should be scheduled and performed before there is a marked decrease of the previously obtained results.

By using physiotherapy rehabilitation procedures preoperatively, the self-confidence of each patient can be increased in achieving normal facial expression and mastication, with as few side effects as possible.

No matter the etiology of facial paralysis (after parotidectomy, trauma, or surgery for acoustic neuroma), reanimation using barbed threads offers similar results to other static reanimation techniques, with the advantage of an even more straightforward, incisionless procedure that can be repeated and completed as many times as necessary to refine the results, with minimal risks and in a short operating time. Facial symmetry and functionality in oral competence, diction, and mastication, and ectropion and lagophthalmos are improved with this technique.

The described procedure can be performed under local anesthesia and in short sessions, rendering favorable, reproducible results that help restore the social life of patients with facial paralysis. Considering the straightforward nature of this procedure, it can become an attainable alternative to previously used and more time-consuming open surgery static reanimation techniques. Performing preoperative mirror therapy for facial expression and mastication increased the success rate. From the point of view of rehabilitation, the indication of this new surgical procedure can be extended to other types of facial paralysis (after stroke, cranial traumatisms).

The minimally invasive technique, the recent availability of the suspension materials, low complication rate, and good overall results recommend this technique for the static treatment of facial nerve paralysis.

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