Subdorsal Flaps in Dorsal Preservation

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KEYWORDS

• Preservation rhinoplasty • Dorsal preservation • Rhinoplasty • Septoplasty • Subdorsal

KEY POINTS

- Subdorsal septal flaps used in dorsal preservation rhinoplasty include the intermediate septal strip, modified subdorsal strip method, Z-flap, and the Tetris concept.
- Subdorsal flap techniques are similar in using carefully designed septal cuts to excise and/or mobilize a dorsal cartilaginous segment for dorsal flexion and lowering.
- Existing outcomes data suggests satisfactory results from each subdorsal septal flap technique, although comparative data are limited.

INTRODUCTION

Dorsal preservation rhinoplasty (DPR) techniques date back to the 19th century with work by otolaryngologists Joseph Lincoln Goodale and Oliver Ames Lothrop, parallel to hump resection techniques described by J. Joseph.[1–3] However, DPR has grown in popularity among rhinoplasty surgeons in the last 5 to 6 years.[4,5] Fundamentals to dorsal preservation ideology are medial keystone preservation and osseocartilaginous continuity. The process requires both 1. disarticulation of the external bony vault from adjacent attachments and 2. resection and mobilization of the septum. Regarding septal resection, a high subdorsal strip resection was originally described and is utilized by many. This has undergone evolution with a variety of modified approaches to the septum, typically classified by the location of septal cartilage excision: subdorsal, mid-septal, or inferior septal (also termed high, intermediate, and low excision technique) (**Fig. 1**). The purpose of this work is to review and highlight the existing descriptions and evidence for various septal approaches employed in DPR, with particular attention to subdorsal flaps.

DISCUSSION

Septal Anatomy in Dorsal Preservation Rhinoplasty

A review of the anatomy of the septum and its relationship with surrounding nasal structures facilitates understanding of the mechanisms and potential benefits of various septal approaches in DPR. The septum is composed of bony (perpendicular plate of the ethmoid bone and vomer) and cartilaginous (quadrangular cartilage) portions. The cartilaginous portion of the septum does not terminate at the level of the rhinion (the dorsal bony-cartilaginous junction); instead, it extends posteriorly underneath the nasal bones. This most cranial cartilaginous-bony junction has been coined the Ethmoidal (E), Keystone (K), or Junctional (J) point. The distance from the rhinion to the ethmoidal point varies, and distances of 4 to 11 mm have been reported. Therefore, a dorsal hump overlies largely cartilaginous septum. In fact, it has been reported that 97% of dorsal humps lie caudal to the ethmoidal point. This anatomic relationship permits descent of both the bony and cartilaginous dorsum following resection of the

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Abbreviations	
sASR	anterior septal reconstruction
DPR	dorsal preservation rhinoplasty
LD	*let-down*
MSSM	modified subdorsal strip method
PD	*push-down*
SPQR	Simplified Preservation Quick Rhinoplasty

cartilaginous septum.[6–10] This anatomy is key to the mechanism of dorsal reduction associated with the subdorsal flaps discussed in this review.

Subdorsal Strip Resection

Goodale first described correction of a dorsal hump with what is now known as the *push-down* (PD) technique for bony vault management. He utilized endonasal root and lateral osteotomies, along with dorsal cartilaginous septal wedge resection, to lower the entire bony-cartilaginous complex as a single unit into the nasal cavity medial to the maxilla.[1,2] Lothrop described what is now known as *let-down* (LD) technique in which wedge resections of the nasal bones were added to allow the bony vault to rest on the maxilla.[3] Both of these methods involve resecting the immediate subdorsal septal cartilage to permit dorsal reduction.

The excision of high septal cartilage has also been advocated by recent preservation experts including Saban and Gola.[1–3,5,11–13] Using this method, appropriate hump elimination is thought to be technically simpler and easier to visualize, and allows the option to abandon preservation, open the middle vault, and convert to a structural approach.[14] This is because all septal cuts are made in the most superior subdorsal aspect of the cartilaginous septum, leaving the remaining septum intact with adequate subdorsal cartilage for traditional L-strut septoplasty and grafting if needed.

Beyond Subdorsal Strip Resection

Expanding on immediate subdorsal resection, several other approaches to the septum in preservation rhinoplasty have been proposed. Cottle described a low septal resection with disarticulation of the cartilaginous septum from the ethmoid plate and resection of immediate subdorsal ethmoid bone.[15–17] This method may be helpful in repositioning anterior septal deviations, as the entire cartilaginous septum is disarticulated and re-anchored to the maxillary crest.[18] Finocchi developed a modification of the Cottle technique coined *Simplified Preservation Quick Rhinoplasty*, or SPQR. Hallmarks of this technique include a *swinging-door* septoplasty with a vertical incision in the septum beneath the highest dorsal point, excision of a low cartilaginous septal strip, PD or LD osteotomies, and repositioning of the septum in the midline. This technique is particularly useful for to address a straight axis deviation and high septal deviations using a dorsal preservation approach.[19,20] One drawback of these techniques is the lack of septal cartilage available for harvest. In addition, inherent to the Cottle and SPQR techniques is keystone disruption beneath an intact dorsum, which may cause apprehension, though it remains a powerful method for septal repositioning.

Several variations of intermediate septal cartilage resection between the immediate subdorsal and inferior septum have been described. These include: Ishida mid-septal resection, Neves Tetris Concept, most modified subdorsal strip method (MSSM), and Kovacevic Z-flap.[21–31] Because a more generous portion of the subdorsal cartilage remains, these methods facilitate ease in anchoring the lowered dorsum to more inferior septal cartilage with suture. This stabilizes the dorsum in a lower position and allows for dorsal flexion, and may limit risk of middle vault deformity from scar contracture.[27] All of these maneuvers include partial upper lateral cartilage release from beneath the nasal bones while preserving keystone attachments (**Fig. 2**). This facilitates

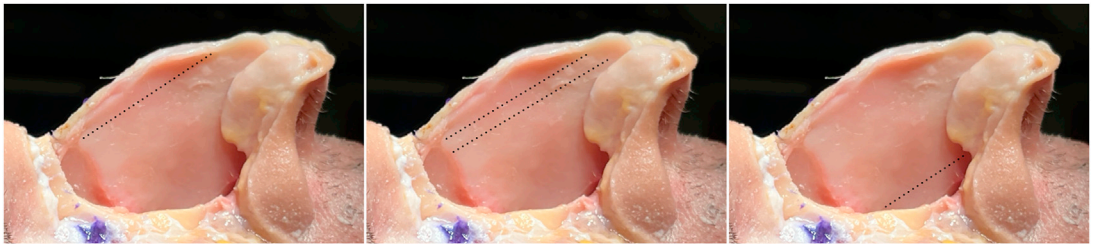

Fig. 1. Approximate location of excised septal cartilage in high, intermediate and low septal excision techniques. Dotted black lines indicate the location of septal cuts in each technique.

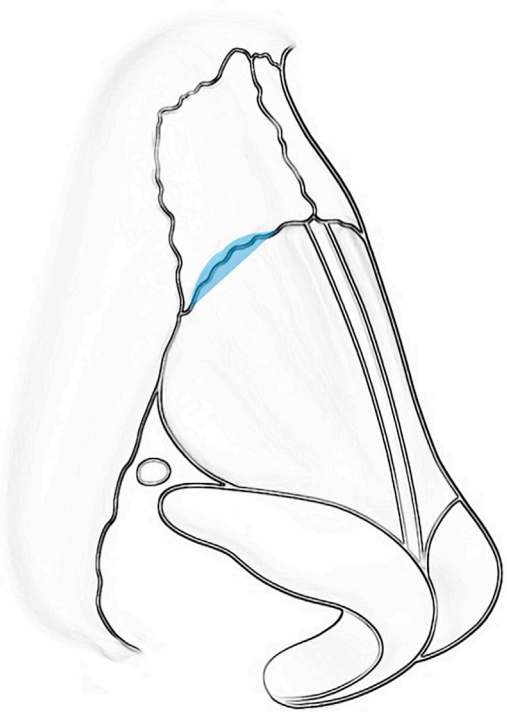

Fig. 2. Ballerina Maneuver. A partial release of the upper lateral cartilage from beneath the nasal bones (*blue*) while preserving medial keystone attachments facilitates the dorsal lowering and releases spring-like tension on the dorsum as it descends into the new, reduced position.

dorsal lowering and releases spring-like tension on the dorsum as it descends into the new, reduced position. This upper lateral cartilage release has also been termed the "ballerina maneuver".[32] Each of these septal approaches may accompany PD or LD DPR and are described here.

Ishida mid-septal resection

J. Ishida described a mid-septal, or *intermediate*, strip excision in which a rectangular segment of cartilage parallel to the dorsum is resected.[33] This segment extends from the caudal septum to the bony-cartilaginous junction. It is best placed in an area of septal deviation in order to excise/correct the deviation, or 3 to 4 mm below the dorsum if the septum is straight.[34] The remaining subdorsal strut may be sutured into its new flexed and reduced position, lateral osteotomies performed to allow descent of the nasal bones, and the bony hump removed down to the level of the new cartilaginous dorsum.

In his original publication describing mid-septal strip excision, Ishida reports satisfactory outcomes in 120 patients. One patient exhibited recurrence of axis deviation, 3 had a broad dorsum after 6 months, and 15% had hump recurrence. He notes that the width of the excised septal strip can be difficult to estimate and postulated that miscalculation of this led to cases of hump recurrence. The most optimal results were in patients with *delicate structures* including thin and fair skin, a small to medium size hump, and a narrow dorsum. Ishida describes the advantages of DPR with intermediate septal strip excision in a patient with this anatomy, advocating for its ability to create a natural-appearing middle third and avoid hump overcorrection, saddle nose deformity, and inverted-V deformity.[33]

In a later publication from L. Ishida, a modification to this technique, in which the bony cap is preserved and lowered independently of the nasal bones, is described. In this modification, keystone osteotomies are performed to isolate the bony cap and maintain its continuity with the cartilaginous dorsum. The bony cap may then be lowered with the cartilaginous hump, and lateral/medial osteotomies performed to lower and narrow the nasal bones. This best preserves the dorsal aesthetic lines and prevents surface irregularities of the bony dorsum, and may be applied to a larger hump and wider dorsum due to isolation of the bony cap from the remainder of the independently-addressed nasal bones.[34]

The Ishida mid-septal excision is commonly accepted as one of the first modifications to the classically described immediate subdorsal resection and low septal resection. This method preserves a subdorsal strut of cartilage and paved the way for several additional subdorsal approaches to the septum in DPR, which are reviewed as follows.

Neves tetris concept

Neves initially described an intermediate subdorsal septal resection approach in which a strip of intermediate subdorsal septal cartilage and bone is resected from the caudal septum superiorly to the transverse osteotomy site, parallel to the dorsum. A remnant 5 to 8 mm of subdorsal cartilage beneath the upper lateral cartilages remains to allow suture fixation. A vertical cut extending from this up to the rhinion is made to permit dorsal flexion and suturing of the preserved subdorsal cartilage to the inferior septum.[26]

Evolving from this is Neves' Tetris concept, in which a rectangular *tetris block* of cartilage below the rhinion is cut, flexed, and sutured to the anterior and inferior septum in 2 locations (**Fig. 3**). First, relative to the dorsum, 2 perpendicular cuts and 1 parallel cut are made to create the tetris block. The block is 5 to 8 mm tall and extends from the caudal border of the upper lateral cartilages (ULCs) to the

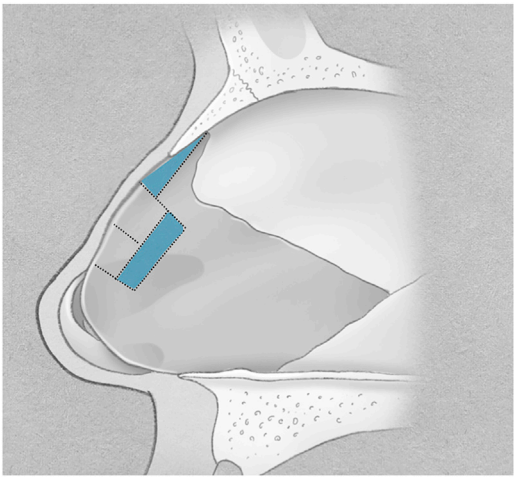

Fig. 3. Tetris concept: A subdorsal rectangle of septal cartilage is excised (*blue area*) beneath the subdorsal flap—the *Tetris block*. The Tetris block may be flexed and re-secured to the remaining septum. A vertical cut may be made to split the Tetris block and allow adequate flexion.

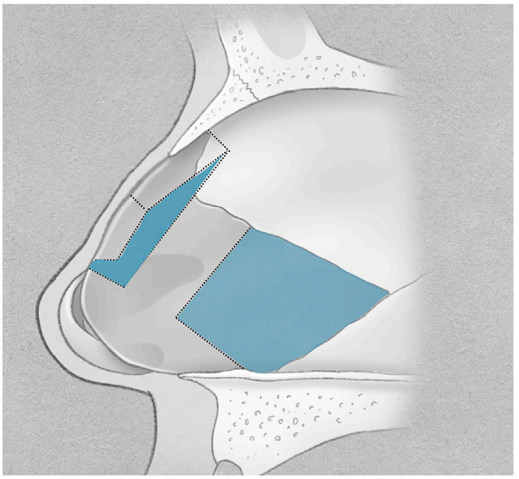

Fig. 4. Modified subdorsal strip method: A subdorsal cartilaginous septal cut is made parallel to the dorsum and extended caudally toward but not violating the caudal septum. A rectangle of septal cartilage is excised inferior to this initial cut (*superior blue region*), and at least 1 vertical cut is made in the subdorsal flap beneath the highest point of the cartilaginous hump to allow appropriate flexion. The subdorsal flap is re-secured to the septum with suture. Inferior septal cartilage may be excised if deviated or for grafting (*inferior blue region*).

highest point of the hump. A triangular section of ethmoid bone is resected from the tetris block to the transverse osteotomy site to allow dorsal flexion. A trapezoid-shaped section of septal cartilage just beneath the tetris block, as well as a triangular section of cartilage along the caudal aspect of the block, is excised to allow the tetris block to flex and be secured to the remaining septum without overlap. If needed, the caudal septum may be trimmed to align with the new dorsal height.[26]

If additional dorsal reduction is desired after the aforementioned steps, 1 or more vertical cuts in the tetris block can be made to create additional flexion points and further lower the dorsum. This is termed as the *split Tetris concept*, a modification of the prior Vitruvian split method in which the caudal strut of cartilage was not entirely preserved (Neves 2020). In a slightly deviated nose, Neves describes eliminating the trapezoid and triangular excisions of inferior and caudal cartilage, respectively, and allowing the tetris block to overlap the septum to correct the deviation.[22,25,26] The use of a subdorsal flap, relative to an immediate subdorsal resection, allows this ability to correct and effectively stabilize the deviated dorsum into a more midline position.

Most modified subdorsal strip method

The MSSM also involves an intermediate subdorsal cartilage resection with preservation of a 3 to 5 mm subdorsal strut of cartilage (**Fig. 4**).[24] In this method, a cartilaginous cut is made parallel to the dorsum, extending from the bony-cartilaginous junction toward the caudal septum. Septal resection is not extended into the caudal septum, leaving a 1 to 1.5 cm caudal septal strut. At the peak of the dorsal hump, 1 to 2 vertical incisions are made into the subdorsal cartilage extending to the dorsum, allowing flexion and hump reduction. Anterior to the segment of preserved subdorsal cartilage, a vertical segment of the remaining cartilage may be resected to permit adequate dorsal flexion and anterior rotation. If septal ethmoid bone is thin, a longitudinal cut is made in lieu of a triangular excision of ethmoid bone to allow for bony septal overlap with dorsal flexion. This method helps limit overdisplacement of the pyramid into the nasal vault, though is preferred only if ethmoid bone is thin and resultant overlap does not cause an axis deviation. Inferior portions of septum can be removed if deviated or for grafting. If the ethmoid point is posterior enough, no bony work is required on the perpendicular plate of the ethmoid (PPE). This is more common in younger patients. The caudal septum may be trimmed or left in its native position.[21,23,24]

This method has also been employed successfully alongside anterior septal reconstruction (ASR) in cases of severe caudal septal deviation. The deviated portion of caudal septum is resected, and the ASR graft is stabilized to the subdorsal strut of cartilage that remains attached to the overlying dorsum and keystone region. The ASR graft

Fig. 5. Asymmetric let down technique: Pre-photos and 12-month post photos are shown of correction in rightward deviation of the pyramid and tip on front view. Patient underwent asymmetric let down procedure with 5 mm bony resection on the left, Piezoelectric rasping of the bony cap, underlay articulated rim grafts, cranial tip sutures, and tongue-in-groove.

may be secured to the maxillary crest with suture or a miniplate if there is no suitable groove in the maxillary crest. Similar to the Tetris method, given the control afforded by a subdorsal flap, the MSSM method can be used to overlap septum and thereby correct a straight axis deviation of the nose (**Fig. 5**).[21,23,24]

Kovacevic Z-flap

Kovacevic describes a subdorsal flap termed as the *Z-flap* (**Fig. 6**). A transcutaneous needle is inserted at the K-Area (the dorsal bony-cartilaginous junction and often the highest point of the dorsal hump) and viewed endonasally between the septum and upper lateral cartilage. A cut is made in the septal cartilage 8 to 10 mm below the dorsum and carried upward to the dorsal junction. A second cut is then made from the inferior aspect of the first cut toward the W-point at an angle of approximately 30°. This creates a triangular segment of subdorsal cartilage that may be flexed and secured with suture after the bony subdorsal cut is completed to mobilize the nasal pyramid. In a straight nose, overlap of the septal Z-flap on one side may create an axis deviation. The overlapping cartilage may be carefully thinned to minimize this effect prior to securing with suture.[30]

This method has been modified in cases of caudal septal fracture and a dorsal hump, termed the *modified septal extension-grafted Cottle technique*. A larger Z-flap is carried to the inferior

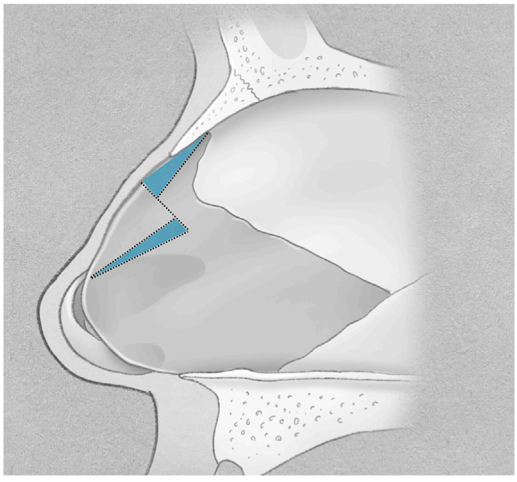

Fig. 6. Z-flap technique: A cut is made in the septal cartilage 8 to 10 mm below the dorsum and carried upward to the dorsal junction. A second cut is then made from the inferior aspect of the first cut toward the W-point at an angle of approximately 30°. This creates a triangular segment of subdorsal cartilage that may be flexed and secured with suture after blue shaded areas are excised.

septum, the septum is mobilized and pulled caudally and inferiorly, and the redundant caudal-fractured cartilage is trimmed. This cartilage may be repurposed as a septal extension graft to re-establish adequate projection, and the neo-caudal septum is sutured to the maxillary crest.[30]

Outcomes of Intermediate Subdorsal Septal Approaches

There are few studies reporting outcomes from subdorsal septal flaps in DPR. In particular, there are very few studies that compare outcomes between subdorsal flap techniques. The existing literature suggests favorable functional and aesthetic outcomes for each method and will be summarized as follows.

Modified subdorsal strip method

Patel and colleagues showed improvement in functional (SCHNOS-O, VAS-F) and aesthetic (SCHNOS-C, VAS-C) scores in patients who underwent DPR with LD technique and MSSM. Both aesthetic and functional improvements were comparable to those of a matched cohort of patients who underwent structural rhinoplasty. Cosmetic visual analog scale scores were greater in the DPR group at short-term follow-up, though this difference was not significant at long-term follow-up.[35] In addition, a recent 84-patient randomized controlled trial studying DPR with MSSM versus conventional dorsal hump reduction with spreader grafts showed similar postoperative aesthetic and functional outcomes at 1 year. There was no difference in incidence of residual hump between the groups. The average residual hump in the study's DPR group was 0.05 mm, which was observed in only 4 patients, and only 1 required revision.[36] Pre-operative and post-operative photos of patients who underwent DPR with MSSM are displayed in **Figs. 7** and **8**.

Tetris concept

In one of the first publications describing the Tetris concept, Neves and colleagues demonstrate excellent aesthetic outcomes from DPR cases in which this subdorsal flap was used.[26] In a review of 78 dorsal preservation cases in which a Tetris or split Tetris flap was used, Neves and colleagues demonstrated subjectively favorable aesthetic and functional outcomes.[37] No objective outcome data are available on DPR in which the Tetris concept is utilized.

Z-flap

In Kovacevic's publication describing the Z-flap technique, he reports a 2-year experience with no complications from this technique, and a lower

Fig. 7. DPR with MSSM. Pre- and 3-year postoperative images of a patient who underwent let-down DPR with MSSM, underlay articulated rim grafts, septal extension graft with lateral crural tensioning, and re-attachment of Pitanguy ligament. DPR, dorsal preservation rhinoplasty; MSSM, modified subdorsal strip method.

Fig. 8. DPR with MSSM. Pre- and 8-month postoperative images of a patient who underwent let-down DPR with MSSM, cranial tip sutures and tongue-in-groove. DPR, dorsal preservation rhinoplasty; MSSM, modified subdorsal strip method.

Fig. 9. DPR with Z-flap. Pre- and 5-month postoperative images of a patient who underwent let-down DPR with Z-flap, septal extension graft, cranial tip sutures, alar spanning stitch, tongue-in-groove, and morselized septal cartilage supratip onlay graft. DPR, dorsal preservation rhinoplasty; MSSM, modified subdorsal strip method.

revision rate due to hump recurrence or radix step deformity.[30]

Toriumi published his experience with his first 20 preservation rhinoplasty cases, and in a majority of these he used a Z-flap technique.[14] In his experience, Toriumi claims that the Z-flap serves as an excellent *handle* to maintain the dorsal hump in a reduced position, as well as correct the axis of a deviated nose by securing the flap to the contralateral side of the cartilaginous septum in the reduced position. Objective outcome data are not included in this case series. Pre-operative and post-operative photos of a patient who underwent DPR with Z-flap are displayed in **Fig. 9**.

Comparing subdorsal methods

There are few studies comparing various subdorsal septal flap methods using patient-reported outcome measures (PROMs). In a recent publication, Sosanky published outcomes of the MSSM versus subdorsal Z-flap in 52 patients who underwent LD DPR. There was no significant difference in NOSE, SNOT-22, SCHNOS, or ESS scores up to 1 year after surgery, and overall scores for each of these metrics improved postoperatively in the study cohort.[38]

Barrera retrospectively compared outcomes following LD DPR with MSSM versus Z-flap septal approaches in 71 patients. There was no significant difference in aesthetic and functional PROMs (NOSE, SCHNOS, ESS, and SNOT-22) between the 2 groups at several post-operative intervals up to 12 months. Both groups demonstrated improvement in all functional and aesthetic metrics, with the greatest improvement in aesthetic scores. Complications were few and included residual hump in 2 patients, axis deviation in 1 patient, and tip deviation in 1 patient.[39]

SUMMARY

DPR is classically characterized by subdorsal septal manipulation and PD or LD osteotomies to mobilize the nasal pyramid and reduce a dorsal hump, with preservation of the dorsal keystone to avoid a need for middle vault reconstruction. A variety of approaches to the septum have been employed, from the original immediate subdorsal strip excision of Goodale and Lothrop to the more recent subdorsal flap techniques including MSSM, Z-flap, intermediate septal strip, and Tetris concept. All of these subdorsal flap techniques are similar in using carefully designed septal cuts to excise and/or mobilize a dorsal cartilaginous segment for dorsal flexion and lowering, with suture stabilization to prevent hump recurrence. The growing body of outcomes data suggest satisfactory and comparable results from each of these septal approaches.

CLINICS CARE POINTS

- Subdorsal septal flaps used in DPR include MSSM, Z-flap, intermediate septal strip, and Tetris concept.
- Subdorsal flap techniques are similar in using carefully designed septal cuts to excise and/or mobilize a dorsal cartilaginous segment for dorsal flexion and lowering.
- Existing outcomes data suggest satisfactory and comparable results from each subdorsal septal flap technique.

DISCLOSURES

The authors have neither relevant disclosures, funding sources nor conflicts of interest.

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