

Joy C. Sy, MD<sup>1</sup>  
Josephine Grace Rojo Tan, MD<sup>2</sup>  
Eduard M. Alfanta, MD, MPH<sup>1,3</sup>  
Eduardo C. Yap, MD<sup>1,4,5</sup>

<sup>1</sup>Department of Otorhinolaryngology  
Head and Neck Surgery  
East Avenue Medical Center

<sup>2</sup>Department of Surgery  
Cebu Institute of Medicine

<sup>3</sup>Department of Otolaryngology-Head and Neck Surgery  
Asian Hospital and Medical Center

<sup>4</sup>Department of ENT  
Metropolitan Medical Center

<sup>5</sup>Belo Medical Group

Correspondence: Dr. Eduard M. Alfanta  
Department of Otorhinolaryngology  
Head and Neck Surgery  
East Avenue Medical Center  
Diliman, Quezon City 1100  
Philippines  
Phone: +63 939 933 8273  
Email: doctor.alfanta@gmail.com

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# Safety Outcome of Yap Technique in Structural Rhinoplasty with PCL Mesh as Unilateral Extended Spreader Graft and End-to-End Septal Extension Graft: A Four-Year Single Surgeon Experience

## ABSTRACT

**Objective:** To look at the outcomes of a single surgeon's experience using Yap Technique in utilizing PCL mesh for nasal tip support from August 2018 to July 2022 with a follow-up of six months to four years.

### Methods:

**Design:** Retrospective Case Series  
**Setting:** Private Outpatient Surgical Centers  
**Participants:** 697 patients

**Results:** From a total of 1,404 cases performed from August 2018 to July 2022, PCL mesh was used in 697 cases (49.6 %). There were 74 males and 623 females with ages ranging from 15-63 (mean age 28). Out of the 697, there were no cases reported to have extrusion or hemorrhage requiring revision surgery within the 6 month to 4 year post-operative period. There were two cases of caudal strut deviation needing minor procedure of submucous resection at 6 months and 1-year post-operative period, respectively. Only one case developed bleeding and significant deviation requiring removal of PCL mesh because of trauma at around 1-year post-operative period.

**Conclusion:** The index surgeon's 4-year experience with PCL mesh as tip support in structural rhinoplasty using Yap technique resulted in generally favorable outcomes with only 1 reported complication needing removal.

**Keywords:** polycaprolactone; PCL mesh; structural rhinoplasty; extended spreader graft; septal extension graft; septoplasty; deviated septum

**Structural rhinoplasty** for Asian noses usually entails reconstruction of the bony and cartilaginous support to achieve an aesthetically improved look with adequate airflow.<sup>1</sup> Autologous cartilage grafts coming from the septum, concha and rib are common graft materials, but inherent autologous graft characteristics and surgeon preference may lead to



choosing a synthetic graft. Recent scientific advancements led to the popularity of human tissue replacement grafts like silicone, expanded polytetrafluoroethylene (e-PTFE) and porous polyethylene, as well as non-synthetic products like processed homografts and xenografts.<sup>2</sup> One of the newer materials available as graft in rhinoplasty is synthetic polycaprolactone (PCL) mesh.<sup>2</sup>

Polycaprolactone mesh was first introduced in Asia in 2018.<sup>2</sup> It is a Food and Drug Administration (FDA)-approved bioresorbable material that can be conformed into different shapes and is utilized for scaffold development while also being relatively cheaper.<sup>3</sup> These features make it popular for septorhinoplasty as it provides structural support while serving as a scaffold for tissue regeneration.<sup>2</sup> As a scaffold material, it is a polymer that has the ability to integrate with other synthetic and natural polymers making it an ideal material for scaffold fabrication.<sup>3</sup> In addition, it has favorable properties that include biocompatibility, low immunogenicity and optimal degradation.<sup>3</sup> It is slowly absorbed within 2 years, acting as a mesh support that provides strength in the early stage. In the later process of degradation, it absorbs and adopts the qualities of the surrounding tissue cells contributing to tissue strength.<sup>2</sup>

The utilization of PCL in septorhinoplasty mainly depends on the structure of the septum with indications in the use of the material include small and weak septum as seen in most Southeast Asian noses.<sup>2</sup> Southeast Asian noses are typically small with the harvested septum being likewise small.<sup>1,4</sup> When the need for additional cartilage grafts arises, ear cartilage may be used but it provides small volume or may be too soft as support graft.<sup>2,5</sup> Costal cartilage can be used as well but the tedious work involved in harvesting limits its widespread use not to mention the unfavorable situation of another (distant) harvest site. In these situations, allogenic grafts such as PCL mesh may be utilized instead. There are mixed outcomes as to the safety of its use including the immediate and delayed complications. A number of rhinoplasty surgeons reported complications with PCL mesh use such as infection, mucosal ulceration and extrusion. However, these outcomes cannot be generalized as the techniques used vary between surgeons.

This study aims to eliminate those variables by looking into a single surgeon experience on the use of PCL mesh for structural rhinoplasty using Yap Technique from 2018 to 2022 with a follow-up of six months to 4 years.

## METHODS

With East Avenue Medical Center Institutional Review Board approval (EAMC IRB 2023-65), this retrospective series of patients who underwent primary rhinoplasty using PCL mesh was conducted in private outpatient surgical centers of the Belo Medical Group. All surgical rhinoplasties were performed by the senior author (ECY). The

study was undertaken to evaluate the safety of using PCL mesh as tip support using Yap technique in open structural rhinoplasty.

Records of patients were included if they underwent primary structural rhinoplasty performed by the index surgeon, had PCL mesh incorporated into the procedure, and had documented post-operative follow-up within the study period. Patients were excluded if they underwent revision rhinoplasty (secondary cases), received rib grafts for structural support, or were lost to follow-up before six months post-surgery.

A quantitative analysis of patients who underwent primary rhinoplasty using PCL mesh was performed. A chart review was done on records of all patients who underwent structural rhinoplasty under a single index surgeon from the period of August 2018 to July 2022 including the follow-up period from six months to four years post-surgery. A data collection form was used and the following variables were collected: 1) total number of rhinoplasty surgeries; 2) total number of rhinoplasty surgeries using PCL Mesh; 3) type of techniques used (Yap's technique vs. other); 4) number of patients with complications; 5) types of complications; 6) number of patients without complications; 7) management of complications; and 8) other pertinent information on patients with complications.

## Surgical Procedure: Yap Technique- PCL as unilateral extended spreader graft (ESG) and end-to-end septal extension graft (SEG)

All procedures were performed through an open rhinoplasty approach. The decision to use PCL mesh was made intra-operatively with indications that included soft cartilage, soft struts after cartilage harvest and septal deviation.

The technique involved harvest of the central septal cartilage leaving a 10-12mm dorsal and caudal strut. A PCL mesh was placed unilaterally as an extended spreader graft (ESG). The caudal margins of ESG should not extend beyond the cephalic margin of medial crura. After placement of the PCL as ESG, a contralateral extended caudal strut batten graft using harvested septal cartilage was placed. (*Figure 1*) Subsequently, an end-to-end septal extension graft (SEG) was designed using PCL mesh, ensuring that the caudal margin of the PCL SEG did not extend beyond the caudal margin of the medial crura. (*Figure 2*) The sides of the PCL mesh were further reinforced with bridge grafts using harvested septal and conchal cartilages. (*Figure 3*) To finish, a folded conchal cartilage was placed over the caudal margin of the SEG. Depending on the areas requiring coverage, a folded conchal cartilage—typically measuring 12 mm × 14 mm—was scored. (*Figure 4*) The folded conchal cartilage was then secured to the caudal end of the PCL SEG, ensuring that its margins aligned with the caudal margin of the medial crura. (*Figure 5*)

The PCL mesh that was unilaterally placed as ESG did not only



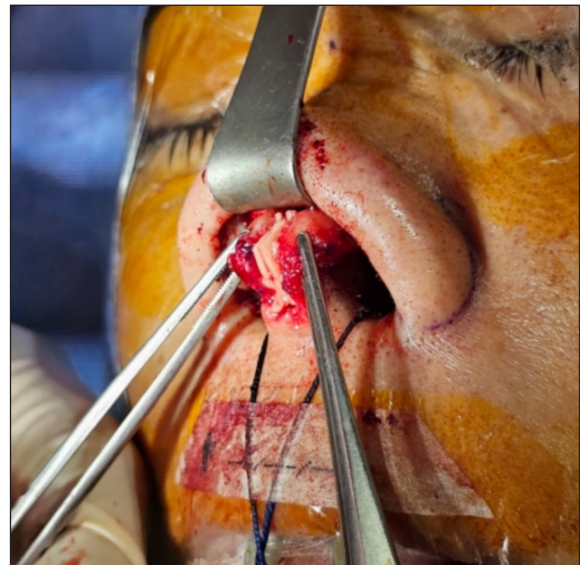
**Figure 1.** PCL mesh used as ESG on the left (solid arrow) and the harvested septal cartilage used as extended caudal strut batten graft on the right (dashed arrow). Note that the caudal margin of the PCL mesh does not extend beyond the cephalic margin of medial crura (black dotted line).



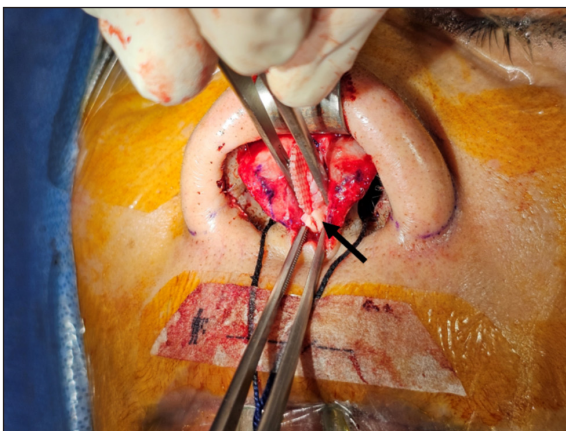
**Figure 4.** Conchal cartilage scored on the convex side, measuring 12mm x 14mm



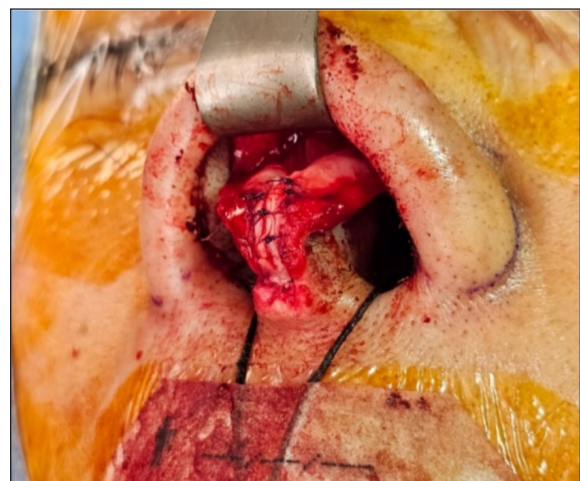
**Figure 2.** Showing the curved SEG (arrow) following the contour of the medial crura. Note that the caudal margin of SEG does not extend beyond the caudal margin of medial crura.



**Figure 5.** Folded conchal cartilage covering the caudal border of PCL mesh SEG. Note that the margins of the folded conchal cartilage are at level with the caudal margin of medial crura.



**Figure 3.** Bridge grafts (arrow) placed at the posterior end of SEG, bridging the PCL mesh to the caudal strut



**Figure 6.** Fully sutured PCL mesh structured graft



strengthen the dorsal strut but also stabilized the SEG. The end-to-end attachment of SEG assured that the vector of wound contracture was midline resulting to decreased chances of mucosal extrusion. (Figure 2) Caudal strut deviation was corrected by placement of a batten graft from the harvested central cartilage. This technique therefore could correct dorsal and caudal cartilaginous deviation. Covering the PCL mesh with remaining harvested central septal and conchal cartilages allowed cartilage tissue ingrowth while acting as a bridge graft that prevented contact of the PCL to mucosa thereby preventing erosion and subsequent extrusion. Lastly, the folded conchal cartilage was placed over the caudal margin of the SEG to prevent erosion of columellar skin. This structural grafting design ensured that the whole system would not deviate because the SEG was held by the ESG deep from the dorsal septum. (Figure 6)

This technique was applied only in cases of weak strut system after harvest, and in cases of small and weak central harvested cartilage for use in tip support system.

#### Data Analysis

IBM® SPSS® version (IBM Corp., Armonk, NY, USA) was used for Data Analysis. Descriptive statistics were used to describe demographic characteristics of the cases. The mean was calculated for all continuous variables while frequencies and percentages were estimated for all categorical variables. The relationship of Yap technique with post-operative complications was determined using Chi-square tests with a 95% confidence interval. A p-value of < .05 was considered statistically significant.

#### RESULTS

The index surgeon performed structural rhinoplasty in a total of 1,404 cases from August 2018 to July 2022 (excluding cases of rib rhinoplasty and revision rhinoplasty). A PCL mesh was used in 697 (49.6 %) with indications that included soft cartilage, soft struts after cartilage harvest and septal deviation. Of the 697, a total of 74 male and 623 female patients with ages that ranged from 15-63 and a mean age of 28 underwent structural rhinoplasty with the use of PCL mesh.

A PCL mesh was used as plain unilateral ESG in 12 cases (1.72%), plain end-to-end SEG in eight cases (1.14%), double columellar strut graft in seven cases (1 %), floating strut graft in six cases (0.86%), bilateral ESG in three cases (0.43%) and Yap technique as combined unilateral ESG and end-to-end SEG in all of the remaining cases (661; 94.8%).

Out of the 697, there were no cases reported to have extrusion or hemorrhage requiring revision surgery within the 6-month to 4-year post-operative period. There were two (0.29%) cases of caudal strut deviation needing minor submucous resection at 6 months and 1-year

post-operative period. Only one (0.14%) developed bleeding and significant deviation requiring removal of PCL mesh because of trauma at around 1-year post-operative period.

Among the 661 patients who underwent Yap's technique, only one (0.15%) experienced post-operative complications because of trauma at around 1-year post-operative period. Consequently, among the 36 patients who did not undergo Yap's technique, two patients (5.56%) had post-operative complications of caudal strut deviation.

A chi-square test was performed to determine the relationship between the use of the Yap technique and post-operative complications. The relationship between these variables was significant,  $X^2(1, N = 697) = 23.2664, p < 0.00001$ , suggesting that structural rhinoplasty with PCL mesh using the Yap technique is significantly less likely to result in post-operative complications compared to other techniques.

#### DISCUSSION

This study evaluated the safety outcomes of the Yap Technique which utilizes PCL mesh as nasal tip support in structural rhinoplasty. Over a four-year period involving 697 cases, there were no reported instances of extrusion or hemorrhage requiring revision surgery. The overall complication rate was low (0.43%), with only one case (0.14%) requiring PCL mesh removal due to trauma. These findings indicate that PCL mesh when used with the Yap Technique can provide stable structural support with a high safety profile.

Septoplasty and rhinoplasty are almost always a combined procedure for aesthetic and functional rhinoplasty. Grafts are taken from the central septum with simultaneous reconstruction of the remaining dorsal and caudal struts to correct any deviation and improvement of nasal airway especially the internal valve.

Southeast Asian noses are relatively short and small.<sup>1,4,6</sup> Considerable strength of the structural design with its foundation base at the caudal septum should be achieved in order to elongate the nose, counter rotate and project the tip.<sup>2</sup> Generally, structural grafts used are either columellar strut grafts (free floating or fixed to anterior nasal spine) and septal extension graft (side to side or end to end).<sup>6,7</sup> Solely using columellar strut graft is not effective for support of Asian noses. Its effectiveness in maintaining tip projection and unifying the tip complex has been shown to be very limited.<sup>7</sup> Adequate structural support, however, was made possible by using the central harvested cartilage as septal extension graft (SEG) attached to the residual strong dorsal and caudal strut.<sup>6</sup> Since its introduction, the SEG has been the primary graft for tip support in the Asian nose.<sup>6,8</sup>

The septal cartilage is thinner in Asian patients and submucous resection of quadrangular cartilage has the tendency to weaken nasal support.<sup>8</sup> When harvesting the quadrangular cartilage, pathologic

findings of deviated dorsal and caudal margins of the septum may be observed. Two structural grafts commonly used for these defects are spreader grafts and caudal strut batten grafts to support the dorsal strut and caudal strut, respectively. A spreader graft that is extended beyond the anterior septal angle is called an extended spreader graft (ESG).<sup>6</sup> An ESG, aside from addressing dorsal strut deviation, is an effective structural graft that supports the lower cartilage for counter rotation and tip support. In addition, an ESG supports the SEG for stability.

A spreader graft is the main workhorse graft recommended in strengthening the dorsal strut and enlarging the internal valve<sup>6</sup> but Asian noses have a small and weak septum.<sup>1,4</sup> In such cases, there is inadequate septal material for multiple simultaneous grafts hence the need for additional graft material arises. Polycaprolactone (PCL) is used for this purpose.

The use of non-autologous material for structural rhinoplasty has its critics because of concerns with infection and protrusion.<sup>11,12</sup> The use of PCL mesh is no exception. A number of rhinoplasty surgeons reported complications with PCL mesh use such as infection, mucosal ulceration and extrusion.<sup>2,10</sup> This study aimed to determine the safety of utilizing PCL mesh as tip support for structural rhinoplasty.

In the earlier years of using PCL, the index surgeon used it as columellar strut graft for support and observed that the graft was not stable. The vector of wound healing is cephalad which led to tip rotation. Complications like erosion to the columellar and tip skin were also encountered. Application of PCL as side-to-side SEG, on the other

hand, resulted in gradual sliding of the PCL mesh causing erosion of the septal mucosa. Protecting the septal mucosa with cartilage or soft tissue caused thickening and widening resulting in nasal obstruction. In some cases, the SEG was weak which resulted in tip twisting and deviation. The ESG was noted to be important in maintaining the midline stability of the SEG. Because of the stiff nature of the PCL mesh, a unilateral placement of ESG is adequate to support a SEG which is designed as an end-to-end attachment. This grafting design ensures that the vector of healing contraction force is in the midline, minimizing chances of extrusion in mucosa. Because of these occurrences, the senior author conceptualized the Yap Technique: PCL mesh as unilateral ESG and end to end SEG. The ESG lengthens, straightens and strengthens the dorsal strut while the SEG extends the whole strut system for tip support. To further enhance the ingrowth of cartilage and protection against mucosal erosion, the PCL mesh were covered with septal and ear cartilages. This resulted in a fool-proof design against erosion of mucosa that caused subsequent extrusion.

Although autogenous cartilage remains the preferred choice for structural rhinoplasty,<sup>2,5,9</sup> our study findings suggest that PCL mesh, when properly integrated using the Yap Technique, provides a viable alternative for nasal tip support, particularly in cases with limited autologous cartilage. However, further long-term studies and comparative analyses with other grafting techniques are recommended to fully establish PCL mesh's role in rhinoplasty.

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