Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 32s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Retrospective Evaluation of Prolene Suture Complications in the Cartilage-Sparing techniques of otoplasty Procedure

Ali Abdullah Alshehri[1]

[1]Surgery Department, College of Medicine, Najran University, Saudi Arabia

[*]**Corresponding author:**

Ali Abdullah Alshehri

Email ID: aaalshehrie@nu.edu.sa

Cite this paper as: Ali Abdullah Alshehri, (2025) Retrospective Evaluation of Prolene Suture Complications in the Cartilage-Sparing techniques of otoplasty Procedure. *Journal of Neonatal Surgery*, 14 (32s), 987-992.

ABSTRACT

Background: Otoplasty, a cosmetic surgery aimed at correcting prominent ears, is influenced by the choice of suture material. Prolene sutures, which are non-absorbable and durable, are commonly used in otoplasty techniques. This study aims to investigate the complication rates associated with Prolene sutures when using the Cartilage-Sparing techniques.

Methods: This retrospective study focuses on data retrieved from Najran University Hospital between 2023 and 2024. The inclusion criteria included patients aged 5 years and above, with a minimum 3-month follow-up, who underwent otoplasty for prominent ears using Cartilage-Sparing techniques with Prolene suture. Data on demographic and clinical characteristics were collected. Statistical analysis was performed using descriptive statistics and chi-square tests, with a p-value of <0.05 considered statistically significant.

Results: Among the 34 participants (mean age 16.53 ± 11.31 years), there were 9 females (26.5%) and 25 males (73.5%). The mean follow-up duration was 10.38 ± 22.9 months. Of the participants, 94.1% had no complications, while 2.9% experienced hematoma, and 2.9% had suture extrusion. No significant associations were found with age, sex and laterality. However, follow-up duration showed a significant association with complications ($p = 0.016$).

Conclusions: Prolene sutures demonstrated minimal complications in otoplasty using the Cartilage-Sparing techniques. Further prospective studies with larger sample sizes and extended follow-up are recommended to confirm these results and assess long-term outcomes.

Keywords: *Otoplasty, Prolene sutures, Cartilage-Sparing techniques, Hematoma, Complications*

1. INTRODUCTION

Otoplasty is a cosmetic surgery designed to modify the position, shape, or size of the ear using permanent sutures. Its primary purpose is to address Prominent ears, commonly known as protruding ears [1]. The most common anatomical abnormalities requiring surgery include a poorly developed or absent antihelical fold, a hypertrophied concha, and a prominent lobule. Surgical planning depends on a detailed understanding of ear anatomy and development, as the auricle achieves 85% of its growth by age three, with conchal depth growth completed by age six. Otoplasty involves a variety of techniques aimed at reshaping or repositioning the auricular cartilage to achieve a more natural appearance [2]. This procedure involves the use of permanent sutures, and the selection of the suture material is a critical factor that directly affects the success and longevity of the surgical outcomes [3]. Suture selection for otoplasty typically involves non-absorbable sutures like polypropylene or nylon for cartilage reshaping and support, ensuring long-term stability. Absorbable sutures may be used for skin closure to minimize the need for removal [4]. The durability of the material and its interaction with surrounding tissue directly impact the aesthetic results and the likelihood of postoperative complications [3]. Early post-operative complications of otoplasty include hematoma, infection, perichondritis, and cartilage/skin necrosis. Late complications may involve hypertrophic scars, keloids, suture issues, recurrence, and auricular deformities such as telephone ear, vertical post-deformity, overcorrection of the helix, hidden helix, auricular ridges, antihelical malposition, puckering, and narrowing of the external auditory canal meatus [5].

Suture-related complications in otoplasty include suture extrusion, which may occur early due to improper placement or excessive tension, sometimes necessitating revision surgery. Hypersensitivity, often caused by neural axon regeneration, is generally transient. Unsatisfactory aesthetic outcomes, such as asymmetry, overcorrection (pinned-back ears), under

correction, re-protrusion, and deformities like telephone ear deformities, often result from suture failure or improper technique. Severe complications may require revision surgery to address aesthetic or functional concerns [3].

Concerning complication, different suture materials exhibit different rates of complications. For instance, Monocryl (8.57%) and Polydioxanone (PDS) (11.11%) sutures were associated with a small percentage of ear protrusion recurrences, necessitating reoperation. In contrast, Mersilene sutures provided more stable outcomes, with no documented recurrences of protrusion ($p < 0.05$). However, Mersilene was occasionally associated with suture extrusion (2.63%) [6]. Prolene sutures, composed of polypropylene, are synthetic, non-absorbable, and monofilament in structure. They offer several advantages in otoplasty procedures, including the highest tensile strength among synthetic non-absorbable sutures, which lasts for 1-2 weeks. Prolene's low tissue reactivity and resistance to infection help minimize complications, while its high plasticity allows it to accommodate wound swelling without cutting through tissue [7].

Non-absorbable sutures, such as Prolene, have been shown to result in fewer complications compared to absorbable sutures. A study found that, compared to absorbable sutures, Prolene was associated with lower rates of pain, tenderness, swelling, and discharge between Days 3 and 8 post-surgeries. On Day 15, Prolene continued to show fewer complications, with pain reported in 18% of cases (vs. 27% for absorbable sutures), tenderness in 9% (vs. 20%), and swelling in 9% (vs. 18%). By Day 30, Prolene's rates of pain (2% vs. 2%) and tenderness (1% vs. 3%) remained low, while absorbable sutures showed a higher rate of discharge (11% vs. 3%). By Day 45, Prolene demonstrated no significant complications, while absorbable sutures had 1% of cases reporting mild pain. Additionally, Prolene exhibited superior wound healing, with 86% and 93% achieving excellent outcomes on Days 30 and 45, respectively, compared to 68% and 76% for absorbable sutures [8].

In 1959, Furnas introduced an otoplasty technique that utilized permanent sutures on the conchomastoid to correct prominent ears deformity. In 1962, Mustardé expanded on this approach by incorporating permanent conchoscaphal sutures to further enhance the ear's appearance [1]. The Mustarde technique is a widely utilized method for creating the antihelical fold in cases of prominent ear deformity. However, achieving precise tightening of the cartilage-conforming sutures can be a challenging aspect of this procedure [9]. Both techniques are used together to reshape and reposition the ear cartilage to achieve improved aesthetic results. The combined Mustardé and Furnas techniques in otoplasty utilize different suture materials based on procedural needs—braided polyester or Prolene [10] and absorbable sutures like PDS. The choice impacts outcomes such as stability, complication rates, and aesthetic results [11].

While Prolene sutures are noted for their strength and minimal complications in otoplasty, specific data on complication rates linked to their use in Mustardé and Furnas techniques remain limited. Therefore, the following study aims to analyze the complication rates associated with Prolene sutures in Mustardé and Furnas techniques. Additionally, it seeks to identify and evaluate factors contributing to these complications, providing insights into the challenges of using Prolene sutures in these specific techniques.

2. METHODOLOGY

A retrospective research study was conducted at Najran University Hospital from 2023 to 2024. The study utilized a non-probability sampling technique to collect clinical reports from the hospital database over a specified period. All procedures used Prolene sutures (Ethicon, Inc., 4/0 size) and were performed using the Cartilage-Sparing techniques namely Mustardé and Furnas techniques. The sample size was determined based on a standard normal distribution value of 1.96 at a 95% confidence level and a margin of error (d) of 5%.

Selection Criteria

The study comprised patients aged 5 years and older who underwent otoplasty for prominent ears using the Mustardé and Furnas techniques with prolene (non-absorbable polypropylene) sutures. Inclusion criteria required complete clinical records and a minimum follow-up period of 3 months. Patients were excluded if they underwent alternative techniques or used different suture material, had incomplete records, lacked sufficient follow-up, had underlying medical conditions that could affect healing, or had congenital ear abnormalities other than prominent ears.

Data collection

This retrospective study entailed a thorough review of patient records from Najran University Hospital database. Eligible cases were selected based on predetermined inclusion and exclusion criteria to align with study objectives. Key demographic data (age, and gender) and clinical information (follow-up duration, laterality, type of surgery, and complications) were collected. Data were recorded in a structured database to ensure consistency, and a subset of records was cross-checked to reduce potential errors and biases.

Statistical analysis:

Descriptive analysis was conducted for categorical variables at a nominal scale to summarize the demographic and clinical characteristics of the participants. This included measures of central tendency (mean, standard deviation) and frequency distributions with percentages. Associations between postoperative pain and various categorical variables including age,

gender, follow-up duration, laterality, and primary/revision. which were assessed using Chi-square tests. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

This investigation adhered to ethical guidelines and received approval from Najran University's research committee's Institutional Review Board (IRB), under reference number (012136-027255-DS). Data was exclusively gathered from patients' medical records, with no direct participant interaction involved. The study complied with the Helsinki Declaration of 1964, last revised in October 2024 [12]. Ethical guidelines ensured confidentiality and anonymity throughout the process. As a retrospective study, the ethical review boards waived the need for patient consent for using their medical records, as there was no direct contact or intervention and minimal risk to participants.

3. RESULTS

A total of 34 participants with a mean age of 16.53 ± 11.31 years were included. The sample comprised 9(26.5%) females and 25(73.5%) males. The mean follow-up period was 10.38 ± 22.9 months. Regarding laterality, 25(73.5%) involved bilateral surgeries, while 9(26.5%) were unilateral. About 91.2% of the cases were treated with primary procedures, and 8.8% underwent revision surgeries **(Table 1)**.

Variable	Category	Frequency (n)	Percentage (%)
Age (Mean ± SD)	Years	16.53 ± 11.31	-
Sex	Female	9	26.5
	Male	25	73.5
Follow-up (Mean ± SD)	Months	10.38 ± 22.9	-
Laterality	Bilateral	25	73.5
	Unilateral	9	26.5
Primary/Revision	Primary	31	91.2
	Revision	3	8.8
Complication	None	32	94.1
	Hematoma	1	2.9
	Suture Extrusion	1	2.9
	Scar Hypertrophy/ Keloid	0	0

Table 1: Demographic and Clinical Characteristics of Patients

Complications were infrequent, with 94.1% of cases reporting satisfaction and no complications. However, hematoma and suture extrusion were each observed in 2.9% of cases. No statistically significant associations were found between complications and age (p = 0.963), gender (p = 0.682), laterality (p = 0.682), or type of surgery (p = 0.902). In contrast, a statistically significant association was identified between complications and follow-up duration (p = 0.016).

4. DISCUSSION

The Mustardé technique has traditionally been associated with variable rates of complications, including suture extrusion, granuloma formation, and relapsing deformity due to loss of suture tensile strength (0%–22.2%) [13]. Similarly, the Furnas technique, widely used in otoplasty, carries risks such as infection, hematoma, suture extrusion, asymmetry, overcorrection, cartilage necrosis, scar formation, and recurrence of ear prominence. The analysis of the combined use of the Mustardé and Furnas techniques with Prolene sutures will provide valuable insights into the efficacy of this approach. Additionally, it will help identify factors influencing its success.

Our study revealed a statistically significant association between follow-up duration and complications (p = 0.016), indicating that the type, frequency, or likelihood of complications varies over time. The early post-operative phases are more susceptible to acute complications, such as hematoma, likely attributable to immediate post-procedure effects, infection, perichondritis, cartilage/skin necrosis, wound healing processes, or short-term surgical outcomes occurring up to 14 days

postoperatively. In contrast, later-stage complications occur after the 14-day period and are more prone to chronic or structural issues, such as suture extrusion, potentially resulting from prolonged suture tension, insufficient tissue integration, biocompatibility concerns, or infection. Other structural complications, including telephone ear, reverse telephone ear, cartilage irregularities, undercorrection, overcorrection, and recurrence, may appear a month or more postoperatively [5].

The mechanism of suture extrusion in otoplasty involves the body's foreign body reaction, where immune cells attempt to expel the suture material. This process, combined with mechanical stress or inadequate tissue integration, weakens the surrounding tissue, causing the suture to migrate outward. Infection or ischemia further accelerates tissue breakdown, facilitating extrusion [14]. In our study, suture extrusion occurred in 2.9% of our cases during a mean follow-up duration of 12 months. However, in other studies, suture extrusion is reported slightly higher from 10% [15], 12.5% [16], 12.8% [17] to 16.7% [18] cases during the same duration. Extrusion rates for other non-absorbable sutures, such as Mersilene (polyester), have been reported at 2.63% [6], 5.12% [10], and 0.45% [19] within shorter follow-up durations of approximately 6 months. In contrast, 4-0 clear nylon sutures exhibited significantly higher extrusion rates, reaching 16.8% during a follow-up period of 34 months [6]. The lower rate of suture extrusion in our study corroborates the durability of prolene sutures.

Prolene suture extrusion in otoplasty occurs due to factors such as superficial placement, thin retroauricular skin, mechanical stress from ear movement, infection, or low-grade inflammation. Compared to other non-absorbable sutures like nylon or silk, Prolene is more inert but still prone to extrusion under tension or inadequate tissue coverage. Absorbable sutures, on the other hand, are less likely to extrude as they degrade over time, though incomplete absorption may lead to granulomas [6]. Contributing factors include patient-related issues like thin skin and impaired healing, surgical technique involving improper depth or excessive tension, and postoperative challenges such as trauma or infection [21].

Hematoma formation in our study occurred in 2.9% of cases with follow-up duration of 2 months. However, studies reported occurrence of hematoma using prolene sutures in Mustardé and Furnas technique vary across different follow-ups. Studies reported 2-2.5% rate of hematoma complication following 1 year follow up [22, 23], and 2.6-3.2% during two-year follow-up period [24, 25], While other studies did not show any hematoma incidence at 1 year [26] and 18 months follow-up [27, 28]. Caouette-Laberge et al. observed 0.4% over 3 years [29], and Jeffery (1999) reporting 3.4% at 5 years [30]. Interestingly, Kuşcu et al. reported higher hematoma incidences (8.4%) in relatively shorter time duration (6 months) [31]. Other non-absorbable sutures such as mersilene (polyester) sutures revealed hematoma formation i.e. 0% at 2 weeks [32], 31 months [33] of follow-up were observed. The disparity in hematoma formation rates can be attributed to variations in follow-up durations, surgical techniques (including Prolene suture handling and tension), surgeon skill, and patient-specific factors such as tissue characteristics, comorbidities, and healing capacity. Factors like blood pressure, anticoagulant use, infection, and postoperative care also influence hematoma risk, highlighting the importance of meticulous hemostasis and effective postoperative management [34, 35].

The hematoma usually develops in early post-surgery hours mostly due to the rebound vasodilatation effect of the local anesthesia [36]. Hematoma formation is an early complication to otoplasty and its formation two months post-otoplasty is rare and may result from factors such as unnoticed trauma, late-onset infection, impaired wound healing due to comorbidities (e.g., diabetes or nutritional deficiencies), or a delayed inflammatory response to sutures [37].

Prolene's non-absorbable nature may also delay reabsorption, increasing the risk of fluid accumulation [1]. Prolene sutures can cause excessive tissue tension or improper placement, leading to impaired blood flow and vessel rupture [38]. Additionally, infection or inadequate hemostasis during surgery can contribute to hematoma formation [39].

Other complications may cause knot slippage, tissue irritation, granuloma formation, or extrusion due to their smooth, non-absorbable nature [40]. The absence of complications other than suture extrusion and hematoma in our study may be due to the shorter follow-up period, which limited the detection of late complications. Additionally, the use of Prolene sutures with the Mustardé and Furnas techniques may have contributed to a lower complication rate compared to other studies.

This study is significant for its contribution to understanding the complications associated with Mustardé and Furnas otoplasty techniques using Prolene sutures. It examines factors such as follow-up duration, surgical methods, and patient-specific characteristics, offering valuable insights to mitigate complications and improve patient outcomes. Furthermore, the study highlights the critical need for comprehensive and longitudinal follow-up plans, as some complications may manifest early while others could be delayed. These findings are essential for refining surgical practices and enhancing the overall effectiveness of otoplasty procedures. However, limitations such as the retrospective nature of the study, a relatively small sample size, the absence of a control group and lack of longitudinal data may limit the broader applicability of the results. Future studies should focus on conducting larger, multicenter, prospective trials to validate these findings and enhance the external validity of the results. Extending follow-up periods will be crucial to evaluate the long-term stability of otoplasty outcomes using Mustardé and Furnas with prolene sutures and identify late-onset complications. Investigating patient-specific factors such as age, tissue elasticity, and healing capacity can provide further insights into how surgical techniques may be tailored to meet individual needs. Additionally, comparing the biomechanical properties of different suture materials and their impact on complication rates could guide treatment choices.

5. CONCLUSION

The study demonstrates the effectiveness of Prolene sutures in otoplasty procedures using the Mustardé and Furnas techniques, with minimal complications such as hematoma and suture extrusion. The findings suggest that Prolene sutures are a reliable choice for otoplasty, although further research with larger sample sizes and extended follow-up periods is needed to confirm these results and assess long-term outcomes across different patient populations.

Conflicts of interest: Nil

Financial support: Nil

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