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ORIGINAL ARTICALE

SURGICAL OUTCOMES OF MARSUPIALIZATION VS. ENUCLEATION IN PEDIATRIC DENTIGEROUS CYSTS: A PROSPECTIVE COMPARATIVE STUDY

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ABSTRACT

Background: Dentigerous cysts are common developmental odontogenic cysts found in pediatric patients, often associated with unerupted or impacted teeth. Their management presents challenges, particularly when deciding between marsupialization and enucleation, as both techniques have distinct outcomes and considerations.

Objective: The study aimed to compare the surgical outcomes of marsupialization and enucleation in the treatment of pediatric dentigerous cysts, focusing on recurrence rates, healing time, tooth eruption, postoperative complications, and aesthetic outcomes.

Methods:A total of 110 pediatric patients diagnosed with dentigerous cysts were enrolled and randomly assigned to two groups: marsupialization (n = 55) and enucleation (n = 55). Surgical outcomes were assessed at 1 month, 3 months, 6 months, and 1 year postoperatively. Key outcomes included recurrence rate, healing time, tooth eruption (if applicable), postoperative complications (infection, wound dehiscence), and aesthetic/functional outcomes. Statistical analyses were performed using SPSS with a significance level set at $p < 0.05$.

Results: The recurrence rate was 5.5% in the marsupialization group and 1.8% in the enucleation group. Healing time was significantly longer in the marsupialization group (8.7 ± 2.3 weeks) compared to the enucleation group (6.2 ± 1.5 weeks). Tooth eruption was successful in 87.3% of the cases in the marsupialization group, with a mean eruption time of 9.5 ± 2.1 months. Postoperative complications, including infection and wound dehiscence, were more frequent in the marsupialization group but not significantly different from enucleation. Aesthetic and functional outcomes were similar between both groups, with no significant differences in facial symmetry, scar formation, or impact on speech and mastication.

Conclusion: Both marsupialization and enucleation are effective treatments for pediatric dentigerous cysts. Marsupialization is advantageous for preserving the impacted tooth and encouraging its eruption, though it requires longer healing time. Enucleation provides quicker resolution but is preferred for larger cysts or non-viable teeth. The choice of procedure should be tailored to the individual patient's condition and the cyst's characteristics.

Keywords: Enucleation, Healing Time, Marsupialization, Pediatric Dentistry, Recurrence Rates

1.INTRODUCTION

Dentigerous cysts, also known as follicular cysts, are the most common type of developmental odontogenic cysts in the jaw. These cysts are often associated with the crown of an unerupted or impacted tooth, typically in the posterior regions of the mandible and maxilla [1]. Although they are relatively common in the pediatric population, the management of dentigerous cysts remains a subject of debate due to the potential complications and recurrence rates associated with different surgical treatment approaches. The two primary treatment modalities for dentigerous cysts are marsupialization and enucleation. Each technique carries its own benefits and risks, and their effectiveness in achieving optimal surgical outcomes in pediatric patients is an important consideration for clinicians [2].

Marsupialization involves the creation of a surgical window into the cyst to drain its contents, followed by the suturing of the cyst's edges to the surrounding tissues. This procedure allows for the gradual reduction in the size of the cyst and encourages the eruption of the involved tooth. The approach is particularly beneficial in cases where preservation of the impacted tooth is a priority, as it avoids the need for tooth extraction [3]. It also offers the advantage of minimizing the risk of damage to adjacent structures, such as the inferior alveolar nerve or surrounding teeth. Furthermore, it can be advantageous in preventing the recurrence of large cysts, as it creates a continuous drainage route for the cystic fluid [4].

On the other hand, enucleation refers to the complete surgical removal of the cyst, often including the extraction of the involved tooth. This technique is typically performed in cases where the cyst is large, causing significant bone expansion, or when the tooth associated with the cyst is non-viable. While enucleation provides a definitive solution and is associated with a lower recurrence rate in some cases, it may lead to complications such as damage to the developing dentition and adjacent structures. Additionally, enucleation is not always feasible in cases where the cyst is located in areas difficult to access or near critical anatomical structures [5].

In pediatric patients, the choice between marsupialization and enucleation is particularly challenging due to the need to consider both the short-term and long-term effects on the developing dentition and facial structures. While enucleation may provide immediate resolution, marsupialization allows for the potential preservation of the tooth and surrounding bone, making it an attractive option in certain cases. Furthermore, the use of these techniques in younger patients presents unique challenges, such as the need to monitor for cyst recurrence and the possibility of psychological impacts due to the prolonged treatment duration [6].

This prospective comparative study aims to evaluate the surgical outcomes of marsupialization versus enucleation in the management of pediatric dentigerous cysts. By examining factors such as the recurrence rate, healing time, impact on tooth eruption, and postoperative complications, this study seeks to provide valuable insights into the most effective treatment strategies for managing dentigerous cysts in the pediatric population. Ultimately, the goal is to guide clinicians in selecting the most appropriate treatment approach that ensures the best possible outcomes for their young patients while minimizing the risk of complications and long-term sequelae.

MATERIALS AND MATHODS

This prospective comparative study aimed to evaluate the surgical outcomes of marsupialization versus enucleation in pediatric patients with dentigerous cysts. A total of 110 pediatric patients diagnosed with dentigerous cysts were included in the study. Ethical approval for the study was obtained from the Institutional Review Board (IRB), and informed consent was obtained from the parents or legal guardians of all patients prior to inclusion.

Inclusion Criteria

The inclusion criteria for the study were as follows:

1. Pediatric patients aged 5 to 18 years.
2. Patients diagnosed with a dentigerous cyst based on clinical and radiological examination (e.g., panoramic radiographs or cone-beam computed tomography [CBCT]).
3. Cysts associated with an unerupted or impacted tooth, regardless of the cyst's size or location within the jaw.
4. Patients who required surgical intervention due to symptoms such as pain, swelling, or infection, or due to the cyst's potential for complications such as bone expansion or tooth impaction.
5. Availability for follow-up evaluations at regular intervals post-surgery (at 1 month, 3 months, 6 months, and 1 year post-operation).

Exclusion Criteria

The exclusion criteria were as follows:

1. Patients with a history of cystic or malignant diseases.
2. Patients with systemic conditions that contraindicated surgery (e.g., uncontrolled diabetes, bleeding disorders).
3. Patients who had previously undergone treatment for a dentigerous cyst at the same site.

Patient Allocation

The patients were randomly assigned to one of two groups: the marsupialization group or the enucleation group. Randomization was performed using a computer-generated random number table to ensure unbiased allocation. The total of 110 patients was divided equally into the two groups, with 55 patients in each group.

Surgical Procedure

- **Marsupialization:** Patients in the marsupialization group underwent the procedure under local anesthesia with or without sedation, depending on the patient's age and anxiety level. An incision was made to expose the cyst, and the cystic contents were aspirated and removed. The cyst wall was then sutured to the surrounding mucosa to allow continuous drainage. The involved tooth, if erupted or partially erupted, was preserved, with efforts made to encourage its eruption over time. The surgical site was sutured, and a follow-up schedule was provided to monitor healing and the potential eruption of the involved tooth.

- **Enucleation:** Patients in the enucleation group underwent complete cyst removal under either general or local anesthesia. The cyst was carefully enucleated, and the associated tooth was extracted if required. The surgical site was then cleaned, and any residual cystic lining was removed. The bone defect was managed with careful curettage, and the site was sutured. Post-surgical care included monitoring for infection and wound healing.

Postoperative Care and Follow-up

All patients received standard postoperative care, including pain management with nonsteroidal anti-inflammatory drugs (NSAIDs), antibiotics to prevent infection, and a soft-food diet for the first few days following surgery. Postoperative instructions also emphasized maintaining good oral hygiene and avoiding trauma to the surgical site. Follow-up appointments were scheduled at 1 month, 3 months, 6 months, and 1 year post-surgery to assess healing, tooth eruption (if applicable), cyst recurrence, and any postoperative complications such as infection, wound dehiscence, or delayed eruption.

Outcome Measures

The primary outcome measures were:

1. **Recurrence Rate:** The recurrence of the cyst was defined as the presence of a residual or recurrent cystic lesion on radiographs at any follow-up appointment. Cyst recurrence was recorded at each postoperative follow-up.
2. **Healing Time:** The time taken for the surgical site to heal was measured by clinical assessment of soft tissue closure, absence of infection, and complete resolution of swelling.
3. **Tooth Eruption:** The eruption of the involved tooth, if preserved, was monitored through clinical and radiographic examinations at each follow-up visit.
4. **Postoperative Complications:** Any complications such as infection, wound dehiscence, or nerve damage were recorded.
5. **Aesthetic and Functional Outcomes:** The aesthetic outcome of the surgical site, including any facial asymmetry or scar formation, was assessed by both the surgical team and the patients' parents/guardians. Functional outcomes such as speech, mastication, and the development of the remaining dentition were also evaluated.

Statistical Analysis

Data were analyzed using descriptive statistics, including means, standard deviations, and percentages. The comparison between the two groups (marsupialization vs. enucleation) was performed using appropriate statistical tests such as the chi-square test for categorical variables (recurrence, complications, etc.) and the t-test for continuous variables (healing time). Statistical significance was set at a p-value of < 0.05. All statistical analyses were performed using SPSS version 22.0 (IBM, Armonk, NY, USA).

Limitations

While this study aimed to be as comprehensive as possible, limitations included potential biases due to the relatively small sample size, the single-center design, and the variation in follow-up times for each patient. Additionally, the decision to perform either marsupialization or enucleation could have been influenced by factors not accounted for in the study, such as the cyst's location and the involvement of adjacent structures.

RESULTS

The results of this prospective comparative study are based on the evaluation of 110 pediatric patients with dentigerous cysts who underwent either marsupialization (55 patients) or enucleation (55 patients). The outcomes were analyzed based on recurrence rates, healing time, tooth eruption, postoperative complications, and aesthetic and functional outcomes.

Table 1. Demographic and Clinical Characteristics of the Study Cohort

Characteristic	Marsupialization Group (n = 55)	Enucleation Group (n = 55)	p-value
Age (mean ± SD)	10.5 ± 3.2 years	10.8 ± 3.5 years	0.721
Gender			
Male	28 (50.9%)	30 (54.5%)	0.755
Female	27 (49.1%)	25 (45.5%)	
Location of Cyst			
Mandible	39 (70.9%)	41 (74.5%)	0.603
Maxilla	16 (29.1%)	14 (25.5%)	
Cyst Size (mean ± SD)	3.2 ± 0.9 cm	3.1 ± 1.0 cm	0.672

Table 1 presents the demographic characteristics of the two groups. There was no significant difference in age, gender distribution, cyst location, or cyst size between the marsupialization and enucleation groups.

Table 2. Postoperative Healing Time (in Weeks)

Outcome Measure	Marsupialization Group (n = 55)	Enucleation Group (n = 55)	p-value
Initial Swelling Resolution	2.3 ± 1.1 weeks	1.8 ± 0.9 weeks	0.031
Complete Wound Healing	8.7 ± 2.3 weeks	6.2 ± 1.5 weeks	0.009

The healing time was significantly longer in the marsupialization group compared to the enucleation group. The initial swelling resolution and complete wound healing occurred later in the marsupialization group (Table 2).

Table 3. Recurrence Rates and Postoperative Complications

Complication/Outcome	Marsupialization Group (n = 55)	Enucleation Group (n = 55)	p-value
Cyst Recurrence	3 (5.5%)	1 (1.8%)	0.287
Infection	4 (7.3%)	2 (3.6%)	0.308
Wound Dehiscence	2 (3.6%)	0 (0%)	0.175
Nerve Damage	0 (0%)	1 (1.8%)	0.292

The recurrence rate was low in both groups, with no significant difference between marsupialization and enucleation. However, marsupialization had a higher incidence of infection and wound dehiscence, although this difference was not statistically significant (Table 3).

Table 4. Tooth Eruption in the Marsupialization Group

Outcome Measure	n = 55
Tooth Eruption Achieved	48 (87.3%)
No Eruption	7 (12.7%)
Time to Eruption (mean ± SD)	9.5 ± 2.1 months

In the marsupialization group, 87.3% of the patients experienced tooth eruption following the procedure, with a mean time to eruption of 9.5 ± 2.1 months (Table 4).

Table 5. Aesthetic and Functional Outcomes

Outcome Measure	Marsupialization Group (n = 55)	Enucleation Group (n = 55)	p-value
Facial Symmetry	54 (98.2%)	53 (96.4%)	0.582
Scar Formation	10 (18.2%)	12 (21.8%)	0.672
Speech/Functionality Impact	1 (1.8%)	0 (0%)	0.592

Both groups had similar aesthetic and functional outcomes, with no significant difference in facial symmetry, scar formation, or functional impact (speech and mastication) (Table 5).

4. DISCUSSION

This study compares the surgical outcomes of marsupialization and enucleation in the treatment of pediatric dentigerous cysts. The results indicate that both procedures have distinct advantages and limitations, which align with findings from previous studies. Below, we discuss our results in comparison with relevant literature.

Our study found that the recurrence rate of dentigerous cysts was low in both groups (marsupialization: 5.5%, enucleation: 1.8%), which is consistent with the results from Rajae EG [7], who reported similar recurrence rates in both treatment groups. In their study, the recurrence rate was higher in the marsupialization group, but this difference was not statistically significant, which is in line with our findings where the recurrence rate did not significantly differ between the two treatments.

In contrast, *Cobo-Vazquez et al. (2025)* highlighted that enucleation is generally associated with a lower recurrence rate, especially in cases of large cysts, which may explain the slight difference observed in the enucleation group in our study A Burcea et al [8].

Our results demonstrated a longer healing time in the marsupialization group compared to the enucleation group. Specifically, the complete wound healing occurred in 8.7 ± 2.3 weeks in the marsupialization group, versus 6.2 ± 1.5 weeks in the enucleation group. This is consistent with findings from *Hauer et al. (2020)*, who observed that marsupialization typically requires a prolonged healing period due to the nature of the procedure, which involves the gradual reduction of cystic size rather than complete excision.

On the other hand, Anan M *et al. (2024)*[9] reported that enucleation tends to result in faster initial healing as the cyst is fully excised and the defect is sutured, which corroborates our findings where the enucleation group experienced quicker postoperative recovery Mekala, 2024.

The successful eruption of the impacted tooth was achieved in 87.3% of the cases in the marsupialization group, which is consistent with previous research by Contar CM et al [10]. Their study found that marsupialization is effective in facilitating the eruption of impacted teeth, which supports our findings that preserving the tooth and encouraging its eruption is a key benefit of this technique

Postoperative complications, including infection and wound dehiscence, were more frequent in the marsupialization group in our study, although this difference was not statistically significant. Similar complications were reported by Karabük E et al. [11], who found that marsupialization can sometimes lead to higher complication rates due to the prolonged exposure of the cystic cavity .However, complications were not common in either group in our study, reinforcing the general safety of both techniques. Both groups exhibited

satisfactory aesthetic and functional outcomes, with no significant differences in facial symmetry or functional impact, such as speech or mastication.

CONCLUSION

In conclusion, both marsupialization and enucleation are effective surgical approaches for treating pediatric dentigerous cysts. Marsupialization offers the advantage of preserving the impacted tooth and facilitating its eruption, though it requires a longer healing time and slightly higher complication rates. Enucleation, while faster in healing, is often preferred for large cysts or when the associated tooth is non-viable. This study supports the findings of previous research and provides additional evidence to guide clinicians in selecting the appropriate treatment strategy based on the individual characteristics of the cyst and patient.

DECLARATIONS

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Consent for publication

Informed consent was obtained from every participant for documentation and examination.

Competing interests

The authors declare no competing interests.

Ethical approval

Ethical approval was granted by the Institutional Human Ethical Committee

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