Official Dental Journal of Suez Canal University
DENTAL SCIENCE Updates
Print ISSN 2636-3836
Online ISSN 2636-3844
www.dsujournals.ekb.eg
DSU — Vol. 6, No. 1, March (2025) — PP. 133:140

VALIDITY OF MODIFIED CARNOY'S SOLUTION AS A CHEMICAL CURETTAGE FOR TREATING KERATOCYSTIC ODONTOGENIC TUMOR: AN IN-VIVO STUDY

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DOI: 10.21608/dsu.2025.318425.1258
Manuscript ID: DSU-2409-1258

KEYWORDS

Keratocystic Odontogenic Tumor, Modified Carnoy's Solution.

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ABSTRACT

Introduction: Maxillofacial surgeons usually face difficulty in treating odontogenic keratocysts since it has a high risk of recurrence and are small and delicate, which prevents one-piece enucleation. **Aim:** To assess the effectiveness of modified Carnoy's solution as a chemical curettage method for treating Odontogenic Keratocysts and lowering their propensity to recur. **Material and Methods:** The current study included twelve patients diagnosed with having odontogenic keratocysts either in the maxilla or mandible. The lesion was enucleated and any teeth adhering to the lesion were removed. Modified Carnoy's solution was applied for 3-5 min using ribbon gauze or cotton applicators in the bony cavity and the fenestrated area where excision of the overlying soft tissue was not possible. After thorough irrigation with saline, then the wound was closed with a resorbable suture. During the follow-up visits (six and twelve months after surgery), the presence and/or rate of recurrence were examined clinically and radiographically by panoramic radiography to evaluate presence of osteolytic areas in the surgical site. **Results:** The recurrence rate of odontogenic keratocysts in the present study after six months follow up was 8.3% and after twelve months follow up was 33.3%. Eight patients showed no recurrence after twelve months follow up, while one patient showed recurrence after six months and the remaining three patients showed recurrence after twelve months follow up. **Conclusion**: The recurrence rate of OKC was reduced in the current trial using a modified version of Carnoy's solution, nevertheless, it is still considered high compared to conventional treatment techniques.

INTRODUCTION

Treatment of Odontogenic Keratocysts has always been a challenge for maxillofacial surgeons. The parakeratinized stratified epithelium, aggressive squamous cells, infiltrative behaviour, and high recurrence rates of Odontogenic Keratocyst (OKC) are its defining features. Following surgical therapy, the lesions frequently recur. The likelihood of a recurrence is increased by the cystic epithelium's high mitotic activity and potential link with the Syndrome of Nevoid Basal Cell Carcinoma (NBCC) [(1)].

It's still debatable how OKC can be been treated. Simple enucleation, with or without curettage, preceded by or accompanied by supplementary

therapies are examples of less invasive measures. However, marginal/segmental excision of the jaw and marsupialization/ decompression are associated with the lowest recurrence rates of OKC [2].

The treatment including the removal of marginal or segmental tissue results in a notable occurrence of patient disability. Compared to other treatment methods, replacing the lesion with bone autograft requires a longer and more costly anesthesia and surgical procedure, as well as extended postoperative and rehabilitation periods. Therefore, early detection and treatment of OKC stop the aggressive behavior-related damage to the maxillofacial skeleton [2].

Modified Carnoy's solution is a cautery agent that quickly induces chemical necrosis of the skin surface. The solution is now applied directly to the remaining bone bed following enucleation to locate and remove the remaining keratocyst epithelium, thus minimizing the risk of recurrence. The solution was first designed for intra-cystic use to facilitate the full excision of the cystic membrane [3].

Additionally, it can enter spongy bone, devitalizing and adhering to cystic cells in the process. Lowering the recurrence rate of OKC and reducing patient impairment are the primary goals of surgical treatment for OKC [4].

This study's goal was to assess the effectiveness of modified Carnoy's solution as a chemical curettage method for treating Odontogenic Keratocysts and lowering their propensity to recur.

MATERIALS AND METHODS

1. Ethical Considerations:

The present study was approved from the Research Ethics Committee (REC) Faculty of Dentistry, Suez Canal University with approval number (278/2020).

2- Study design:

Twelve patients diagnosed with odontogenic keratocyst were chosen for the current investigation from the outpatient maxillofacial surgery clinic.

3- Patient selection:

The patients were chosen from the maxillofacial surgery outpatient clinic, Faculty of Dentistry, Suez Canal University. Each patient received full information regarding the surgical process, possible complications, and follow-up periods. Each patient was then asked to sign an informed consent.

The inclusion criteria of patients participating in the current study included any age, both genders, patients having small or large odontogenic keratocysts in both mandible and maxilla and those who are medically free [5].

The exclusion criteria included patients suffering from systemic diseases, patients under prescriptions interfering with bone healing, patients allergic to any of the drugs used in the study, pregnant and lactating females [5].

4- Methods:

I- Diagnostic criteria:

Each patient underwent a thorough evaluation that included a review of medical history, intra- and extra-oral examinations, laboratory evaluation, radiographic examination (figure 1)(CBCT and panoramic radiographs), and biopsy investigation to determine the histological features of the region that revealed the OKC lesion.

II-Surgical protocol:

Anesthesia:

Based on the size, location, and severity of the abnormal tissue, each surgical procedure was carried out with the administration of anesthesia, either local or general.

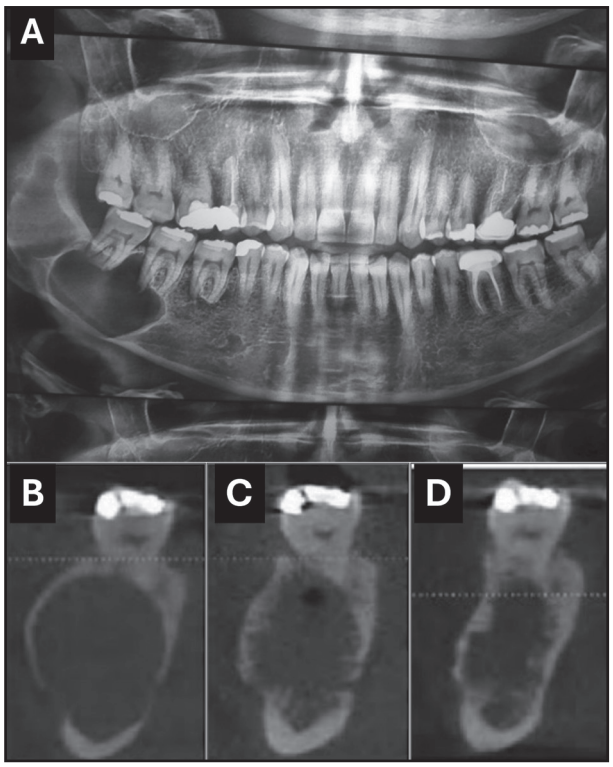

Fig. (1) (A) Pre-operative Panoramic x-ray of one of the studied cases. (B, C and D) Pre-operative cross-sectional CBCT images.

Incision:

- After standard disinfection and draping, the KCOT was exposed by mucoperiosteal flap elevation and bone removal.
- To access the odontogenic keratocyst (OKC), an intraoral incision was made, taking into consideration the location, size, and extent of the lesion. This incision can be done using a two-sided or three-sided mucoperiosteal flap, depending on specific circumstances.

Surgical procedure (Figure 2):

- The lesion was enucleated and any teeth adhering to the lesion were removed. The overlying mucosa or periosteum in contact with the KCOT that fenestrated through the bone was excised and removed. The adjacent soft tissues were protected with gauze.
- Modified Carnoy's solution was applied for 3 to 5 min using ribbon gauze or cotton applicators in the bony cavity and the fenestrated area where excision of the overlying soft tissue was not possible.
- After thorough irrigation with saline, the wound was closed with resorbable continuous 3/0 silk suture.

Modified Carnoy's solution (Composition): Ferric chloride (1 g), glacial acetic acid (1 mL), and ethyl alcohol (96%).

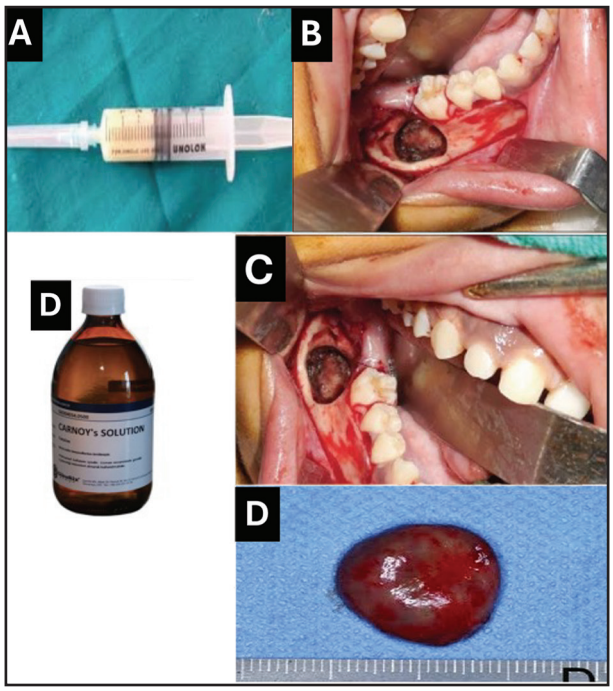

Fig. (2) (A) Aspiration biopsy, (B) surgical procedure, (C), Application of modified Carnoys solution (D), and the removed cyst after enucleation

III -Drug prescription protocol:

All patients received prescriptions for antibacterial medication (Hibiotic 1 gm tab twice daily for one week), anti-emetic medication (Flagyl 500 mg 1 tab three times daily for one week), anti-inflammatory and antiedematous medication (Alphintern 2 tab three times daily for one week) and analgesic medication (Brufen 600 mg one tab per day) and was instructed to take one tablet upon feeling pain.

IV -Postoperative evaluation:

The patient was recalled for assessment of wound healing and suture removal one week after surgery. During the follow-up visits (six and twelve months after surgery), he surgical site was examined clinically and radiographically; clinically to assess absence of any clinical manifestations indicating lesion recurrence, and radiographically by panoramic radiograph to evaluate if any osteolytic area in the surgical site was present (**Figure 3).**

After six and twelve months, the recurrence rate (if present) of the lesion was assessed radiographically and histo-pathologically to determine the efficacy of modified carnoy's solution in decreasing the recurrence rate of odontogenic keratocyst.

Sample Size calculation: Sample size was calculated based on the Arkin's equation (Arkin, 1984). A total sample size of 12 sample was calculated to be sufficient for current study.

Statistical analyses

The data were analyzed using the Statistical Package for Social Science (SPSS) version 22.0 for Windows (IBM Corp, Armonk, NY). The significance level used was 0.05. The data were assessed for normalcy using the Shapiro-Wilk test. The data was presented using statistical measures such as the mean ± standard deviation (SD), range (Max - Min), median, and coefficient of variation (C.V %). Repeated measures ANOVA and Friedman's test were utilized to assess the disparity and subsequently, Bonferroni post hoc testing was conducted.

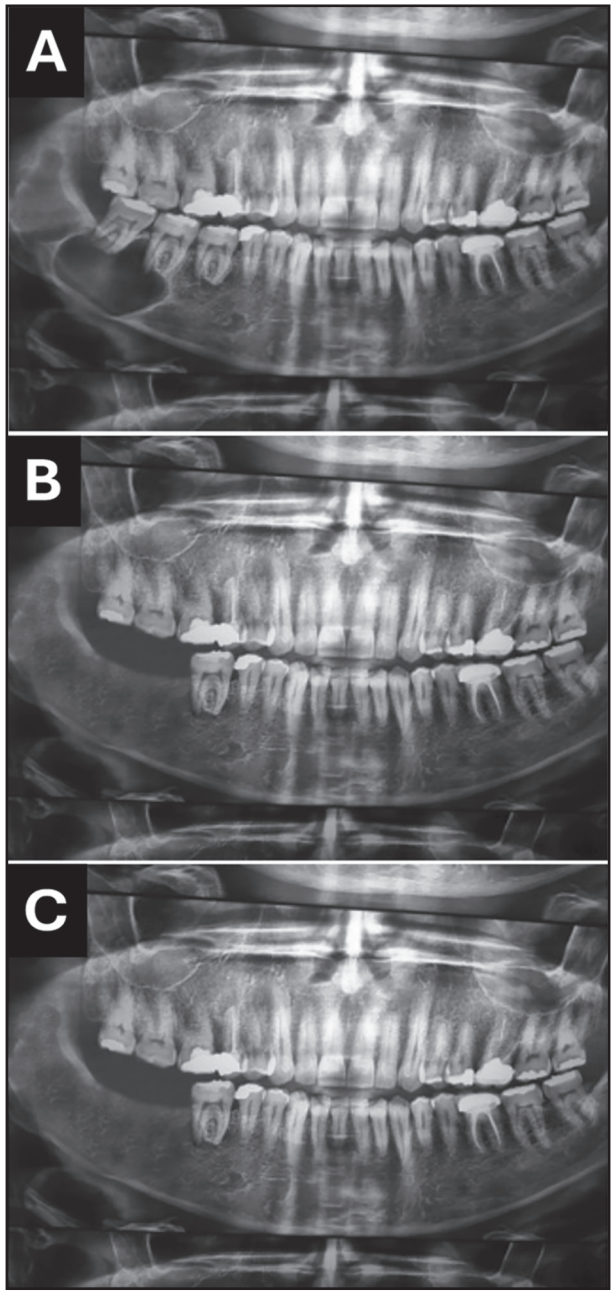

Fig. (3) Panoramic view of a study case (A) preoperative, (B) 6 months postoperative, (C) 12-months postoperative.

RESULTS

Results of the current study assessed the clinical and radiographic parameters that suggest recurrence of odontogenic keratocyst after surgical removal and application of modified Carnoy's solution for 3-5 minutes. The patients were recalled after six months and twelve months post-operatively.

Table 1 presents the results of the recurrence rate of OKC throughout the study follow-up period by comparing the pre-operative findings to the 6 months and 12 months findings.

The findings revealed that the p= 0.001 and 0.005, respectively, which means that there is statistically significant difference between the data of pre-operative to 6 months and the pre-operative to 12 months, whereas there was no significant difference between the data of 6 months to 12 months (**Table 1).**

Table (1) *Mean and standard deviation of recurrence rate between pre-operative, after 6-months and 12 months postoperative.*

Time of observation	Mean ±SD	Dun's Bonferroni	Wilcoxon's signed rank against preoperative data
Preoperative	1.0±0.000[a]	a	---
After 6 Months	0.083±0.289[b]	b	0.001***
After 12 Months	0.333±0.492[b]	b	0.005**

*** significant at p<0.01; *** highly significant at p<0.001; ns, non-significant at p>0.05*

Different letters in the same column are statistically significant

The recurrence rate of odontogenic keratocyst investigated in the current study after six months follow up was 8.3% and after twelve months follow up was 33.3%, eight patients showed no recurrence after twelve months and one patient showed recurrence after six months while the remaining three patients showed recurrence after twelve months follow up (**Figure 4).**

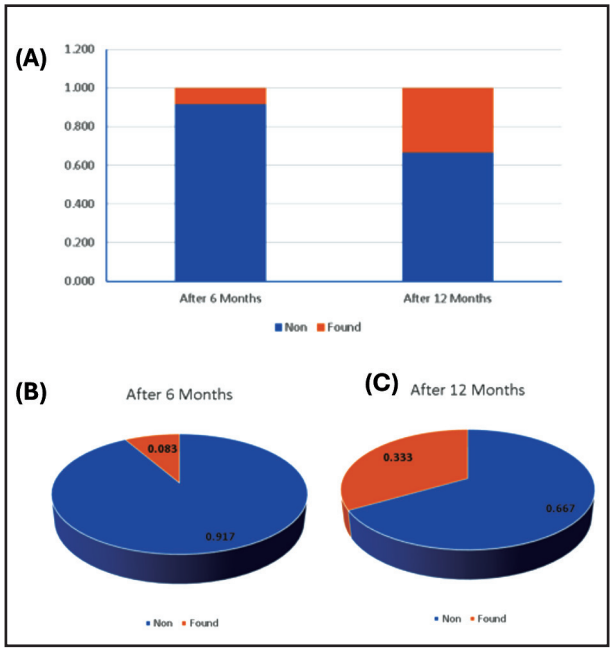

Fig. (4) (A , B and C). The recurrence rate after 6 months, and the recurrence rate after 12 months.

DISCUSSION

It is universally acknowledged that OKC is not a typical cystic lesion, as defined by WHO (2017[(1)] . This may be because of the characteristics of the epithelium and the cystic capsule itself. The aggressive clinical behavior and high risk of recurrence of the lesion, as well as its histological profile and features unique to the epithelium and friable cystic capsule, make it different to deal with surgically and necessitate special considerations [(6)].

OKC ranges in prevalence from 6.7% to 25.7% of all odontogenic cysts, with a very wide age distribution that can range from 8 to 82 years of age. Almost 64% of all OCKs occur in men, indicating

the condition's preference for men, according to retrospective and regional distribution studies [7]. The mandibular body and angle are the most often affected regions [8].

Treatment options depend on factors like the location and size of the lesion. The suggested course of treatment for lesions up to 1 cm in diameter is conservative. However, vigorous therapy is necessary for lesions larger than 1 cm. This is because there's a chance the lesion could spread locally[9]. Accordingly, the choice of therapy may have a direct impact on the frequency of recurrence[10].

Aggressive therapy can decrease recurrences to 8%, whereas cautious treatment can increase them by up to 32.3%. Due to the ongoing research that shows conservative treatments have high success rates in preventing recurrence, there is currently no agreement in the literature regarding the specific connections between lesion size, the type of treatment used, and the likelihood of recurrence [11].

Previous studies and comprehensive reviews including meta-analyses have demonstrated that decompression, followed by either enucleation or marsupialization, results in recurrence rates ranging from 17 to 56%. [10]. Conservative techniques provide several benefits in comparison to more aggressive treatments, such as preserving anatomical and dental features and being suitable for persons of all age groups [12].

Prior assessment of the patient's age, overall health, and both cosmetic and functional considerations is necessary. More invasive therapeutic interventions, such as partial or complete removal, have a reduced recurrence rate of around 8% of instances. Although resections, as radical procedures, have reduced recurrence rates but result in significant aesthetic-functional deterioration, which negatively impacts patients' quality of life [7].

Conservative treatments on the other hand, have a greater likelihood of recurrence, which in turn impacts the patients' quality of life since they may require more surgeries, hence raising the risk of a malignant transformation. Utilizing a conservative treatment alongside adjuvant therapy, such as modified Carnoy's solution, cryotherapy, or Carnoy's solution, might serve as a viable approach. This can reduce the postoperative complications and the reappearance of lesions [6]. The expert must exercise prudent evaluation while analyzing the lesion, including its pace of advancement and the extent of tissue infiltration. Other factors like as patient compliance and the need for extended monitoring must also be considered to determine the optimal treatment approach for patients with OKC [7]

The rates of recurrence (RR) for different treatment methods were as follows: 23.1% for enucleation alone, 17.4% for enucleation with curettage, 11.5% for enucleation plus Carnoy's solution, 14.5% for enucleation plus liquid nitrogen cryotherapy, 32.3% for marsupialization alone, 14.6% for decompression followed by residual cystectomy, and 8.4% for resections. The combined relative risk (RR) of KOT, taking into account all therapies, was 16.6% [13].

Results of the current study showed recurrence rates 33.3% after enucleation and the use of modified carney's solution, which is high when compared to other treatment techniques.

Longer follow-up periods (at least 3–5 years) would be advantageous because the majority of OKC recurrences happened within 3–5 years of first treatments [14]. To reduce bias and remove the confounder of including studies with different follow-up times. The higher RR (32.3%) with

marsupialization alone bolsters the arguments of those who are critical of this course of treatment and assert that it does not allow for the complete ablation of the epithelial lining, which would cause the epithelium to continue to proliferate and facilitate recurrence. [15]. Resections have the lowest relative risk (RR) at 8.4%, however, because to the extensive nature of the procedure, they also result in notable adverse effects. Nevertheless, an early presentation has the potential to greatly decrease the extent of resection required and the associated morbidity [15].

In order to reduce the likelihood of recurrence, it has been recommended to remove the lining mucosa that is in contact with the cystic lesion, as a result of the persistence of cystic remnants or epithelial islands [16].

It is suggested that classic Carnoy's solution may be useful in management of OKC as a recurrence-reducing supplementary therapy to enucleation. When choosing the best course of action to treat OKC, surgical morbidity is another important factor to take into account [17,18].

The modified Carnoy solution destroys cyst cells and induces tissue necrosis. After cyst enucleation, less food packing and dead space are created by inserting an iodoform pack into the cavity, allowing healing by secondary intention and cleansing of the necrotic material. It is thought that this measure is responsible for the reduced postoperative infection rate [17].

Nevertheless, recurrence rates in the present study were 33.3% after enucleation and the use of modified Carnoy's solution, which is still high when compared to previously documented recurrence rates using other treatment techniques.

CONCLUSION

The present study demonstrates that enucleation of odontogenic keratocystic with the application of modified Carnoy's solution may reduce the recurrence rate of OKC in comparison to enucleation alone, however, it is still considered high when compared to other treatment techniques.

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