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*RESEARCH ARTICLE*

# IS CYSTIC ENUCLEATION WITH PERIPHERAL OSTEOTOMY SUFFICIENT TREATMENT FOR OKCS OF THE JAWS?

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## Abstract

**Background** - Odontogenic Keratocyst (OKC) is a developmental cyst of odontogenic origin behaving aggressively in term of high recurrence rate. Aggressive behavior and tendency to recur are related to greater proliferative activity of the epithelial lining. There have been many arguments made and still controversial regarding the treatment option for OKCs.

**Aim**- The aim of the study is to investigate the Prevalence and incidence of OKC Riyadh city and the Assessment of recurrence rate of different management scheme for treatment of OKC.

**Objective**- The objective of this study is to study the efficacy of enucleation with peripheral osteotomy versus resection method in management of OKC.

**Material and Method**-Data has been obtained through a retrospective review of patients admitted at five main oral and maxillo-facial surgery departments in Riyadh City with a diagnosis of OKC. A retrospective review of OKC patients was conducted between July 2010 and December 2022. After excluding patient files with incomplete, unclear data. The data of the patients with a diagnosis of OKC, complete record patients were included in the study. The following data were recorded for each patient: Gender, age, medical history, date of diagnosis, radiology type, location, radiology description, associate complications (local/systematic) biopsy date, biopsy type, histopathology, surgery performed, date primary procedure, post-operative complications (numbness/infection/limited mouth opening/lymphadenopathy) and whether it resolved or not, recurrence, date of recurrence, number of recurrence, time between first surgery and recurrence, secondary

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procedure for the recurrence, date of secondary procedure, type of the second procedure, complications after the second procedure, date of diagnosis of second recurrence, date of third procedure, type of the third procedure, complications of the third procedure, date of forth procedures, type of the forth procedure, complications after the forth procedure, date of follow- up.

**Results -** The total of 30 patients with clear medical records and at least one follow-up record, with the age ranged from 5 to 53 years, the mean age for patients without recurrence was 30.8 ±11.7 years, while for those with recurrence, it was 25.3 ±14.3. The p-value of 0.072 suggests that there is no statistically significant difference between the age of patients who had a recurrence and those who did not. Gender-wise, there were 11 (36.7%) females, 3 of them experienced recurrence. and 19 (63.3%) males, and 9 of them experienced recurrence (table 1). The majority of the patients underwent radiology using CT at the rate of 56.7%, followed by CBCT at the rate of 23.3%. The majority of the patients had a mandible location at the rate of 93.3%, with 70% of them diagnosed with a Unicystic radiological description and the rest were Multicystic.

**Conclusion** - Enucleation was the most common first procedure for treating OKCs of the jaws, and most patients did not experience post-operative complications, but about 40% of the cases has been recurred whatever the procedure was except for the decompression procedure there were no recurrence. Patients who required a secondary procedure were most likely to undergo enucleation. Overall, 60% of patients did not have a recurrence, 33.3% had one recurrence, and 6.7% had two recurrences.



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## Introduction:-

Odontogenic Keratocyst (OKC) is a cystic lesion of odontogenic origin, which was firstly described by Mikulicz, in 1876, Philipsen, in 1956 was the first to name and recognize OKC as an entity. It accounts for approximately 10% of jaw cysts and is considered to be an aggressive lesion because of a relatively high recurrence rate. The term Primordial cyst, synonymous with OKC, was used in the 1992 World Health Organization (WHO) classification and put under the category of developmental odontogenic cysts. In 2005, WHO identified OKC as a neoplasm and renamed it as Keratocystic Odontogenic Tumor (KCOT) contributed to its aggressive nature, high recurrence rate, its association with Nevoid Basal Cell Carcinoma Syndrome (NBCCS) or GorlinGoltz syndrome, and mutations seen in the Protein Patched Homolog (PTCH) tumor suppressor gene. In 2017, WHO reclassified this lesion under developmental odontogenic cysts as OKC. The reported age range is 5 to 53 years old, with a peak in the third decade of life with a slight male predilection. When associated with the NBCCS, the mean age of incidence is around 25 years old. OKCs originate in tooth-bearing regions, the predilection for mandible is more than that of maxilla, the most common location being the posterior part namely the angle or the ramus whereas, in maxilla, the anterior region and the third molar area are the most common sites of occurrence. Due to unpredictable nature of OKC various treatment modalities have been proposed, few of them advocate for conservative procedures and others for aggressive surgical treatment. The recurrence rate for OKC ranges from 2.5 to 62%, depending on the treatment modality used. The majority of recurrence occurs during first few years of treatment. Enucleation alone is associated with a high recurrence rate, it decreases with the addition of an adjuvant procedure. The treatment modality that has shown the lowest recurrence rate is resection of the lesion with or without continuity defects but at the same time causes highest patient morbidity, therefore the requirement of a low recurrence rate needs to be weighed against patient morbidity.[11]

We present a study of 30 patients with OKC who were treated by enucleation with peripheral ostectomy followed by chemical cauterization with Carnoy's solution. The purpose of the present study was to analyze the recurrence rate of OKC in the same patients for a period of four to five years.[7]

Odontogenic Keratocyst is places in a singular position within the series of odontogenic lesions because of its high rate of recurrence, Nevoid Basal Cell Carcinoma Syndrome association, typical features of histology and aggressive biological manner. In 2005, the World Health Organization published the Tumors Classification of the Head and Neck.3 In this classification, the odontogenic keratocyst was reclassified as a Keratocystic Odontogenic tumor KOT. Based on tumor genetic findings, the decision is to reclassify the odontogenickeratocyst as a neoplasm. In the 2017, the most controversial classification decision was to move keratocystic odontogenic tumor back into the cyst denomination as odontogenic keratocyst OKC. OKCs are possible be present in peoples with wide field of age from infancy till elderly, but around 60% of lesions are diagnosed between 05 and 53 years old aged peoples with tenuous male tendency (male to female ratio of 2:1). The mandibular involvement is about 60% to 80% of all lesions, with obvious tendency to the posterior part of the body and ramus involvement. The growing of odontogenic keratocysts is by cellular proliferation, expanding within the cancellous bone, leading to a greater anteroposterior dimension on radiographic examination.[1,9,15]

Three histologic types were determined initially: ortho-keratinized variant, a parakeratinized variant (86.2%), and combination of the both. It is substantial to differentiate parakeratinized OKC, which has a high recurrence risk, and theortho-keratinized type, which recurs rarely. There are, unfortunately, only a few authoritative studies available from which significant conclusions can be gained regarding to the best possible strategy of treatment. Woolgar et al described different recurrence theories. The incomplete removal of the original cyst lining is the 1$^{st}$theory. The growth of a new OKC from satellite cysts or odontogenic rests of epithelium left behind after the surgery is the 2nd theory. The development of new OKC unrelated to the adjacent jaws region is the 3rd theory.[15]

The OKC is a benign in nature with a 17% to 56% rate of recurrence when enucleation alone is applied. Any additionof assisted treatment decreased the rate of recurrence to1% - 8.7%. Surgical bony resection is another choice, with a documented rate of recurrence of 0%; it might be preferable when long-term lesion follow-up is doubtful. This wide variety may be attributed to the length of follow-up times, the total number of cases included, and the exclusion or inclusion of ortho-keratinized cysts in the study. The peripheral ostectomy is an adjunctive surgical procedure after curettage or enucleation, in which the bony walls of the remaining defect after enucleation are abraded with a surgical bur in an endeavor for ensuring removal of the possible remaining daughter cells and/or neoplastic tissue thus reducing the rate of recurrence. Now, more conservative modalities have been advised. It has been recognized that a low risk of recurrence is preferred on a resection of the jaws and consequent functional and cosmetic morbidity. One of the immanent problems that are associated with the peripheral ostectomy, amount of the resected bony tissue. Attempts have been made to dye or mark the residual cystic bony cavity, after simple enucleation, by methylene blue in an attempt to guarantee that the whole bony cavity is involved with peripheral ostectomy, but the actual depth of osseous tissue removal is unknown once the dye has been removed. The existing data revealed that the recurrences may occur especially likely up to five years post treatment, if detected early the recurrence they may be easily managed with simpler surgical procedures, and a second curettage will mostly be successful. [2,8,13,16]

## Materials and Methods:-

Data has been obtained through a retrospective review of patients admitted at five main oral and maxillo-facial surgery departments in Riyadh City with a diagnosis of OKC. A retrospective review of OKC patients was conducted between July 2010 and December 2022. After excluding patient files with incomplete, unclear data. The data of the patients with a diagnosis of OKC, complete record patients were included in the study. The following data were recorded for each patient: Gender, age, medical history, date of diagnosis, radiology type, location, radiology description, associate complications (local/systematic) biopsy date, biopsy type, histopathology, surgery performed, date primary procedure, post-operative complications (numbness/infection/limited mouth opening/lymphadenopathy) and whether it resolved or not, recurrence, date of recurrence, number of recurrence, time between first surgery and recurrence, secondary procedure for the recurrence, date of secondary procedure, type of the second procedure, complications after the second procedure, date of diagnosis of second recurrence, date of third procedure, type of the third procedure, complications of the third procedure, date of forth procedures, type of the forth procedure, complications after the forth procedure, date of follow- up.

Thirty lesions (66%) were in the posterior mandible region, two in the anterior mandible (18%), one for anterior maxilla (8%) and one for posterior maxilla (8%). The follow up after the surgery with enucleation and peripheral ostectomy was from six months to four years. Thirty lesions were asymptomatic and discovered just the enough the radiographic examination, however, four lesions were associated with jaw expansion, one of them which is the

largest one sized was associated with drainage intraorally posterior to the last molar tooth. The size of the lesions determined preoperatively by CT scan (Siemens/ Syngo software). The definitive diagnosis was with open surgical incisional biopsies and lining sampling for all lesions. The surgical operations of enucleation and peripheral ostectomy for all patients were under general anesthesia and the surgical approach for the lesions was intraorally for all lesions.

Two sided flap applied for the access to the lesions and the bony windows created with round surgical bur, the windows enlarged progressively and delicately to avoid lining tearing. The enucleation completed with large curette and the peripheral ostectomy with large diamond round bur under copious irrigation to make sure that there is no remnant of cyst lining still present adherent to the bony cavity. The specimen immediately placed in a plastic container which contains a solution of 10% formalin and is at least 20 times the volume of the specimen. The specimen contained container sent to histopathologist for confirmation of the primitive diagnosis. Al of the specimens reveal parakeratinized OKC as expected. The follow up schedule applied was every 6 months for the first year and later annually for 4 years.

Table 1: Socio demography and Primary Procedures in relation to recurrence of OKC

| Characteristic | Description | No Recurrence (N=18) | Recurrence (N=12) | p value |
|---|---|---|---|---|
| Age (year) | Mean ± SD | 30.8 ± 11.7 | 25.3 ± 14.3 | 0.072 |
| Age (year) | < 30 | 7 (38.9) | 9 (75) | |
| | ≥ 30 | 11 (61.1) | 3 (25) | |
| Gender | Female | 8 (44.4) | 3 (25) | 0.245 |
| | Male | 10 (55.6) | 9 (75) | |
| Laterality | Left | 9 (50) | 5 (41.7) | 0.618 |
| | Right | 7 (38.9) | 4 (33.3) | |
| | Bilateral | 2 (11.1) | 3 (25) | |
| Radiology description | Unicystic | 16 (88.9) | 5 (41.7) | 0.013 |
| | Multicystic | 2 (11.1) | 7 (58.3) | |
| Biopsy type | excisional biopsy | 3 (16.7) | 1 (8.3) | 0.632 |
| | incisional biopsy | 15 (83.3) | 11 (91.7) | |
| Primary Procedure | Enculeation | 10 (55.6) | 7 (58.3) | 1.000 |
| | Marsupialization | 3 (16.7) | 3 (25) | 0.660 |
| | Decompression | 2 (11.1) | 0 (0.0) | 0.513 |
| | resection | 3 (5.6) | 2 (0.0) | 1.000 |

| Table 2: Demographic Characteristics | | |
|---|---|---|
| Characteristic | Description | N (%) |
| Age (year) | min - max | 5 - 53 |
| | Mean ± SD | 28.6 ± 12.8 |
| | Median (P25 - P75) | 29 (20 - 40) |
| Gender | Female | 11 (36.7) |
| | Male | 19 (63.3) |
| Hospital | KFMC | 9 (30.0) |
| | KFSHRC | 8 (26.7) |
| | KKUHMC | 5 (16.7) |
| | KSMC | 6 (20.0) |
| | SFH | 2 (6.7) |
| Radiology type | CBCT | 7 (23.3) |
| | CT | 17 (56.7) |
| | CT/CBCT | 5 (16.7) |
| | CT/MRI | 1 (3.3) |
| Laterality | Left | 14 (46.7) |
| | Right | 11 (36.7) |
| | Bilateral | 5 (16.7) |
| location | Maxilla | 6 (20.0) |
| | Mandible | 28 (93.3) |
| Radiology description | Unicystic | 21 (70.0) |
| | Multicystic | 9 (30.0) |
| Associated Complications (Local) | Swelling | 20 (66.7) |
| | Bone expansion | 6 (20.0) |
| Biopsy type | excisional biopsy | 4 (13.3) |
| | incisional biopsy | 26 (86.7) |
| Histopathology | PARAKERATINIZED | 30 (100.0) |

| Table 3: Subsequent Procedure and Follow Up | | |
|---|---|---|
| Characteristic | Description | N (%) |
| First Procedure (Surgery performed) | Enculeation | 17 (56.7) |
| | Marsupialization | 7 (23.3) |
| | Decompression | 2 (6.7) |
| | Segmental resection | 4 (16.6) |
| Post-Operative Complications | Dehisence | 1 (3.3) |
| | Lymphadenopathy affecting the neck level 2 on the left side | 1 (3.3) |
| | Mild weakness in marginal mandibular nerve /infection | 1 (3.3) |
| | None | 24 (80.0) |
| | Numbness | 3 (10.0) |
| Recurrence | No | 18 (60.0) |
| | Yes | 12 (40.0) |
| Time between first Surgery and recurrence (month) | min - max | 2 - 36 |
| | Mean ± SD | 17.5 ± 13.6 |
| | Median (P25 - P75) | 11 (5 - 36) |
| Time between first Surgery and second procedure (month) | min - max | 7 - 48 |
| | Mean ± SD | 17.5 ± 16.3 |
| | Median (P25 - P75) | 9.5 (7 - 24) |
| **Secondary procedure** | | **18 (60.0)** |
| Second procedure (N=18) | Enculeation | 12 (66.7) |
| | Marsupialization | 2 (11.1) |
| | Decompression | 1 (5.6) |

## Results:-

The total of 30 patients with clear medical records and at least one follow-up record, with the age ranged from 5 to 53 years, the mean age for patients without recurrence was 30.8 ±11.7 years, while for those with recurrence, it was 25.3 ±14.3. The p-value of 0.072 suggests that there is no statistically significant difference between the age of patients who had a recurrence and those who did not. Gender-wise, there were 11 (36.7%) females, 3 of them experienced recurrence. and 19 (63.3%) males, and 9 of them experienced recurrence (table 1). The majority of the patients underwent radiology using CT at the rate of 56.7%, followed by CBCT at the rate of 23.3%. The majority of the patients had a mandible location at the rate of 93.3%, with 70% of them diagnosed with a unicystic radiological description and the rest were multicystic (table 2). 5 cases were bilaterally, and 3 of them recurred. While 25 cases were unilaterally and 9 of them recurred (table 1).

In term of associated local complications 20 patients experienced swelling, 6 patients had bony expansion. Incisional biopsy was done for most of the cases which was 86.7%, and the excisional biopsy for the remaining 13.3%. All the cases categorized histopathologically as Parakeratinized type (table 2). Regarding the procedures performed, 26 patients underwent enucleation with peripheral osteotomy as the first procedure, and 12 of them experienced recurrence. 6 patients underwent marsupialization, half of them recurred. 2 cases treated by decompression with no recurrence. 5 cases treated with resection, and 2 of them recurred (table 1). The majority of patients 80% did not experience post-operative complications after the first procedure. The recurrence rate occurs to 40% of the patients, with the time between the first surgery and recurrence ranged from 2 to 36 months, with an average of 17.5 months and a standard deviation of 13.6 months.

The time between the first procedure and the second procedure ranged from 7-48 months, with an average of 17.5 months and a standard deviation of 16.3 months. Among the 18 patients who had a secondary procedure, 66.7% underwent enucleation followed by peripheral osteotomy as the second procedure. In terms of complications, 13.3% of patients experienced post-operative complications after the second procedure. Six patients underwent a third procedure which was enucleation, and 50% receiving peripheral osteotomy after the enucleation. Of those, 50% experienced complications, which were resolved in all cases. Only one patient underwent a fourth procedure, which was enucleation with peripheral osteotomy, with no complications recorded (table 3).

## Discussion:-

This cross-sectional study evaluated the rate of recurrence of OKC in patients treated with enucleation and peripheral ostectomy in the period between 2015 and 2020. The mean age of the patients was 30 years old. The male: female ratio for the patients with OKCs was 1:0.5 at the diagnosis time which is near to other studies and the posterior mandibular area was the most popular affected site.[8]

Two thirds of the included patients in our study were symptoms free at the time of diagnosis (with incidental radiographs). The most frequent symptoms for symptomatic patients were local pain in the involved area, swelling, or drainage. These observations are in agreement with those documented by other investigators. Treatment of OKCs remains a controversial subject but depends on several factors such as patients age the location and the size of the cystic lesion, multilocularity or unilocularity, absence or presence of the perforation of the cortical bone or involvement of the soft tissue, and whether the lesion is recurrent or primary. The three changes in the classification of odontogenic keratocyst by world health organization suggest that the specific features of this lesion are important for differential diagnosis and so, important to perform an adequate choice for the surgical treatment. The management of OKCs intent to decrease the risk of recurrence and, on the same time, minimizes the patient morbidity. Till now, there is no unanimity about the best modality for the treatment. The treatments recommendations options have ranged from simple curettage to osseous resection. Various options for surgical eradication of the lesion have been employed, including enucleation only or associated with adjunctive methods (cryotherapy, peripheral osteotomy, carnoy's solution), marsupialization and decompression, segmental or marginal osseous resection. caustic tissue fixative consists of glacial acetic acid, chloroform, absolute ethanol, and ferric chloride, it may cause toxicity to the adjacent soft tissue, dental follicles and skin, irreversible neurotoxicity, irreversible devitalization of the osseous margin, impossibility of early grafting of the bone. Chloroform exposure has been associated with reproductive toxicity and cancer.[18]

Therefore, in the United States of America, the FDA prohibits the employment of chloroform solution and some operators used a chloroform free carnoy's solution for the treatment of OKCs. In cryotherapy, the liquid nitrogen

may lead to the necrosis of the osseous tissue while preserving the inorganic osseous framework. The precision lack in this technique can lead thermal trauma to soft and hard tissues with a possibility of pathological fractures of the thin inferior mandibular border. Surgical osseous resection, marginal or segmental, is associated with the lowest rate of recurrence to even 67 percent but because of associated cosmetic and functional morbidity it is not recommended as a primary modality for the treatment of OKCs and should be confined for retreatment of recurrent multiple OKCs. So, we recommend less aggressive surgical procedures for the management of OKC that give less recurrence rate and, associated with fewer complications. Odontogenic keratocysts have a considerable rate of recurrence, which may vary obviously depending on the applied treatment modality. Enucleation only give a high risk of recurrence (20.8%; 95% CI = 18.3 to 23.2%) which belong to be a consequence of technical difficulties for the removal of the lesion totally because of the thin epithelial lining or even the difficult or inaccessible cyst location.

Therefore, the cystic enucleation as a not fragmented, single piece may be a challenge to accomplish in most instances.[14,19] The epithelial remnants and/or daughter or satellite microcysts left behind post enucleation outwardly recurrence potentiation factors. Johnson et al. proposed that the enucleation alone is associated with a highest risk of recurrence to nearly 30%, then Marsupialization alone of about 18% recurrence rate. The employment of adjuvant chemical cauterization technique reduced the rates of recurrence significantly to about 8%. [15,19]

Brannon suggested that the recurrence mechanisms of theOKC were incomplete removal, the growth of a new OKCfrom remnant cyst or satellite cysts after treatment, and development of a newly formed OKC, Woolgar et al. reported that the operative or technical factors have a considerable influence on the recurrence of the OKCthrough a comparative study of the histological and clinical features of not recurred and recurred OKCs.Enucleation with peripheral ostectomy is the procedure applied in this study which refers to surgical eradication of the lesion by enucleation, followed by a reduction of peripheral bone with large coarse round drill and a powered hand-piece under copious irrigation with normal saline for removal of the peripheral bone without leaving any macroscopic remnants. It can be used primarily as an adjunctive for osseous tissue removal when surgical resections can be averted. Although enucleation with peripheral ostectomy is classifieds an aggressive treatment modality, it has minimal morbidity and complications in comparison with resection, (enucleation with cryotherapy) The recurrence rate in our study was 8.3%. [3,4,10]which is less than other studies that has been reported to range from 14.8% to18.2% and more than zero recurrence rate reported by Kolokythas et al. The follow-up time is different among studies. Our followupprotocol consists of biannual exam in the first year and then annual exam to complete four years of follow-up. Other investigators recommend a longer follow-up to 10years. Even this does not exclude the recurrence possibility, as the lesion has been reported to recur 20 to 40 years post the initialtreatment. The more radical and aggressive management of OKCsreduces the recurrences frequency, at least in the short termpostoperatively, which was not the largest one among our cases, the patient was signs of recurrence free at the time of recurrence detection. It is detected by routine OPG radiographical examination during the follow-up program.[2]Till now there is controversy about the relationship between the site and/or size of involvement of OKC and recurrence. Some authors propose that size or the location of the OKC did not have an influence on the recurrence risk. Others demonstrate the increasing the size may be correlated with the recurrence. The cyst that recurred in this study was in the in the anterior mandibular region, while the posterior mandible is the most common site of recurrence in most studies. The recurrence of OKCs mostly within 5-7 years after the primary surgery, and a considerable number of recurrences surgical procedure. In this study, the recurrence was after six months. At follow-up program, which is 4 years after the initial surgery, all patients were satisfied and did not report complication, except two of the twelve patients included in this study demonstrate paresthesia, one after 3 months and the other after 6 months, which disappeared spontaneously.

## Conclusion:-

In conclusion, the study found that age and gender had no significant association with recurrence of the medical condition. Mandible is the most common location of the OKCs, and occur unilaterally weather right or left side more often than bilaterally, the majority were unicystic. Enucleation was the most common first procedure for treating OKCs of the jaws, and most patients did not experience post-operative complications, but about 40% of the cases has been recurred whatever the procedure was except for the decompression procedure there were no recurrence. Patients who required a secondary procedure were most likely to undergo enucleation. Overall, 60% of patients did not have a recurrence, 33.3% had one recurrence, and 6.7% had two recurrences.

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