

The Recurrence Rate of Odontogenic Keratocyst after Enucleation with Peripheral Osteotomy

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ABSTRACT

Odontogenic keratocyst OKC is a benign cyst of odontogenic radix. From all odontogenic cysts, it accounts about 10%. It is characterized by a high rate of cell proliferation; relapse and locally aggressive growth guiding the type of surgical treatment choice and, consequently, the prognosis. The determination of the recurrence rate of odontogenic keratocysts after enucleation with peripheral osteotomy is the goal of this study. A cross sectional study was conducted from Feb. 2015 to Jan. 2020. The patients included in this study were 12 (4 females and 8 males), aged from 22 to 38 years old. Ten lesions were in the mandible and two in the maxilla. The distribution of the lesions as follow: 8 in the posterior mandible region, 2 in the anterior mandible, and one for each anterior maxilla and posterior maxilla. The size of OKCs lesions ranged from 1*1.5cm to 3*4 cm. The follow up after the surgery with enucleation and peripheral osteotomy with surgical round bur was from 6 months to 4 years. From all of the 12 OKCs, only one cyst recurred which was

sized 1.5*2 cm in the anterior mandible region. The recurred lesion managed by curettage only with curette under general anesthesia. Peripheral osteotomy is less invasive procedure for management of OKCs in comparison with resection, and associated with lower recurrence rate when compared with other maneuvers such as enucleation with or without Carnoy's solution or liquid nitrogen and marsupialization alone or followed with enucleation.

Keywords: Odontogenic keratocyst peripheral osteotomy, recurrence

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INTRODUCTION

Odontogenic Keratocyst OKC is the term that was introduced in 1956 by Philipsen as a specific entity from other cysts of odontogenic types.¹

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.²

In 2005, the World Health Organization published the Tumors Classification of the Head and Neck³ 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 odontogenic keratocyst as a neoplasm⁴

In the 2017, the most controversial classification decision was to move keratocystic odontogenic tumor back into the cyst denomination as odontogenic keratocyst OKC.⁵

OKCs are possible be present in peoples with wide field of age from infancy till elderly, but around 60% of lesions are diagnosed between 10 and 40 years old aged peoples with tenuous male tendency (male to female ratio of 2:1).⁶ The mandibular involvement is about 60% to 80% of all lesions, with obvious tendency to the posterior part of the body and ramus involvement.⁷ The growing of odontogenic keratocysts is by cellular proliferation, expanding within the cancellous bone, leading to a greater anteroposterior dimension on radiographic examination. Jaw expansion tends to be a delayed feature.⁸ Since Pindborg and Hansen⁹ firstly warn that “through sixteen cases of OKCs, ten had recurred once or multiple times, a great number of articles, there have been published dealing with the recurrence

pathophysiology, prognosis and treatment of the OKCs. A significant controversy exists that dealing with the morbidity and rate of recurrence accompanied with each method of the treatment.¹⁰ Studies published over the last years have reported the rates of recurrence that ranged from 2.5% to 62.5% following the primary treatment with a various treatment modalities¹¹

Three histologic types were determined initially: orthokeratinized 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 the orthokeratinized type, which recurs rarely.¹²

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 al¹³ described 3 different recurrence theories. The incomplete removal of the original cyst lining is the 1st 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.

Eradication of ‘daughter cysts’ is troublesome especially if the associated overlying bone has been resorbed or thinned. It is also believed that as the cyst arises from dental lamina ‘rests’ which are considerably present in the alveolar mucosa in the last molar area. The situation is moreover complicated as it impossible to ensure complete removal if the cyst extends through bony plates into difficult areas especially the lingual surface of the mandible or the maxillary sinus.⁸ For these reasons, the employment of chemical cauterization after enucleation, aggressive curettage of the bony walls, peripheral osteotomy with a

coarse bone bur, cryotherapy, or radical jaw resection involved with OKC have been subscribed for lowering the recurrence for remaining epithelium removal.¹⁴ Zhao et al¹⁵ reported that there is no correlation between recurrence and the age, site or sex but correlated to the modality of the treatment applied. They demonstrate that the least recurrence was with marsupialization and resection while the highest recurrence rate was with enucleation and curettage, followed with **enucleation plus Carnoy's solution**. Till now, there is considerable controversy among the maxillofacial surgeons about the optimal surgical treatment for the odontogenic keratocysts, and what constitutes conservative surgery versus radical surgery.¹⁶

The complex reconstruction needed after resection, with concomitant bone grafting, possible inferior dental nerve loos of function and cosmetic deformity, are potential complications of segmental or radical jaw resections. There are absolute indications for this type of resection but they are very little as ameloblastomatous, untreated OKC, or carcinoma within an OKC.¹⁷

The procedures that are too famous combined with enucleation for eradication of OKCs include: marsupialization, decompression, cryotherapy with liquid nitrogen, peripheral ostectomy with usage of Carnoy's solution.¹¹

The aim is to adopt the surgical treatment type that associated with minimum morbidity and at the same time the lowest possible recurrence risk and while still annihilate the cyst.¹⁸

The OKC is a benign in nature with a 17% to 56% rate of recurrence when enucleation alone is applied. Any addition of assisted treatment decreased the rate of recurrence to 1% - 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.¹⁰ 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 orthokeratinized cysts in the study.⁷

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.¹⁹

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.²⁰ One of the immanent problems that are associated with the peripheral ostectomy, is the "immeasurability" of the 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.²¹ 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.²²

MATERIALS AND METHODS

This cross sectional study was conducted from February 2015 to January 2020. The sample included patients who attended the Oral & Maxillofacial Surgery Department in, Medical City/ Baghdad. Twelve patients, four females (34%) and eight males (66%) were included in this study aged from 22 to 38 years old, free of systemic diseases. Ten lesions (84%) were in the mandible and two (16%) in the maxilla. The distribution of the lesions as follow: Eight 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 size of OKCs lesions ranged from 1*1.5cm to 3*4 cm. The follow up after the surgery with enucleation and peripheral ostectomy was from six months to four years. Eight lesions were asymptomatic and discovered just through the radiographic examination, however, four lesion were associated with jaw expansion, one of them which is the largest one sized 3*4 cm was associated with drainage introorally posterior to the last molar tooth. The size of the lesions determined preoperatively by CT scan (Siemence/ 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. Tow 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. All 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)

Statistical analysis:

All data were analyzed using the SPSS software program version 21 (Chicago), Binomial test applied which is used for binary categorical variables.

Table 1: The patient's and lesions data with follow up and complications:

No	Sex	Age	Site	size	Recurrence	Complications
1	F	22 y	Posterior mandible	2*3cm	No	

2	M	32 y	Posterior mandible	2*5 cm	No	Neurosensory deficit subsided after 6 moths
3	M	37 y	Posterior mandible	3*4 cm	No	Neurosensory deficit subsided after 3 moths
4	M	29 y	Anterior maxilla	2*2 cm	No	
5	M	33 y	Posterior mandible	1*4 cm	No	
6	M	32 y	Posterior mandible	2* cm	No	
7	F	23 y	Posterior mandible	2*2.5 cm	No	
8	F	27 y	Posterior maxilla	3*1.5 cm	No	
9	M	38 y	Anterior mandible	1.5* 2 cm	Yes	
10	M	30 y	Posterior mandible	2*3 cm	No	
11	M	28 y	Posterior mandible	1*3 cm	No	
12	F	31 y	Anterior mandible	1*1.5 cm	No	

RESULTS

From all of the twelve OKCs managed with enucleation and peripheral ostectomy, only one cyst recurred after 6 months which was sized 1.5*2 cm for male patient aged 38years old in the anterior mandible region. The recurrence detected on OPG and confirmed with incisional biopsy which is applied under local anesthesia to confirm the diagnosis and to exclude, although it is very rare, the malignant alteration to carcinoma. The recurred lesion managed by curettage only with curette under general anesthesia.

No gross complications were recorded except for neurosensory deficit of inferior alveolar nerve in two patients, both of them were males, both of cysts were in the posterior mandible region, the first one sized 3*4cm and the patient aged 37 years old, the neurosensory deficit subsided after 3 months, the second cyst recurred was sized 2*5cm and the patient aged 32 years old, the neurosensory deficit subsided after 6months without intervention.

Statistical analysis:

p-value=0.0006 (Binomial test), which is highly significant.

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. ^{14, 23}

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. ^{23, 24}

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. ¹⁴ Treatment of OKCs remains a controversial subject but depends on several factors such as patient's 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. ¹⁰

Various options for surgical eradication of the lesion have been employed, including enucleation only or associated with adjunctive methods (cryotherapy, peripheral ostectomy, Carnoy's solution) , marsupialization and decompression, segmental or marginal osseous resection.

Carnoy's solution, a caustic tissue fixative consist 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. ¹¹

Chloroform exposure has been associated with reproductive toxicity and cancer. ²⁵

Therefore, in the United States of America, the FDA prohibits the employment of chloroform in Carnoy's 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.²⁶

Surgical osseous resection, marginal or segmental, is associated with the lowest rate of recurrence to even 0%⁶⁷ 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.²⁷

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.¹⁸

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.¹⁵

Therefore, the cystic enucleatio as a not fragmented, single piece may be a challenge to accomplish in most instances. The epithelial remnants and/or daughter or satellite microcysts left behind post enucleation outwardly a recurrence potentiation factors.²⁸

Johnson et al. proposed that the enucleation alone is associated with a highest risk of recurrence to nearly 30%, then marsupialisation alone of about 18% recurrence rate. The employment of Carnoy's solution with enucleation as adjuvant chemical cauterization technique reduced the rates of recurrence significantly to about 8%.²⁷

Brannon²⁸ suggested that the recurrence mechanisms of the OKC were incomplete removal, the growth of a new OKC from remnant cyst or satellite cysts after treatment, and development of a newly formed OKC, Woolgar et al.²⁹ reported that the operative or technical factors have a considerable influence on the recurrence of the OKC through 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.²⁸

Although enucleation with peripheral ostectomy is classified as an aggressive treatment modality, it has minimal morbidity and complications in comparison with resection, enucleation with Carnoy's solution or cryotherapy. The recurrence rate in our study was 8.3%.³⁶ which is less than other studies that has been reported to range from 14.8% to 18.2%^{56, 72} and more than zero recurrence rate reported by Kolokythas et al.³⁰

The follow-up time is different among studies. Our follow-up protocol consists of biannual exam in the first year and then annual exam to complete four years of follow-up.³¹

Other investigators recommend a longer follow-up to 10 years.³²

Even this does not exclude the recurrence possibility, as the lesion has been reported to recur 20 to 40 years post the initial treatment.

The more radical and aggressive management of OKCs reduces the recurrences frequency, at least in the short term postoperatively.

In this study, the reported recurred case sized 1.5* 2 cm, 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.

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,³³ others demonstrate the increasing the size may be correlated with the recurrence.⁸

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.^{23,24}

The recurrence of OKCs mostly within 5-7 years after the primary surgery, and a considerable number of recurrences may manifest ≥ 10 years after the primary surgical procedure. In this study, the recurrence was after six months.³⁴

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.³⁵

CONCLUSION

Enucleation with peripheral ostectomy as an option for eradication of odontogenic keratocyst, although classified as an aggressive modality, it is less aggressive than resection with nearly comparable recurrence rate. It is associated with fewer patients compliant in comparison with marsupialization and lowest recurrence rate than that of enucleation only.

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