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CLINICAL STUDY

Decompression and cystectomy of the odontogenic keratocysts of the mandible: a clinical study

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Abstract
Objectives Owing to the aggressive nature of OKC's if one could stop or even reverse the growth of the cyst with a simple procedure like decompression, regardless of the histologic type, it would be an alternative to radical and disfiguring surgery.
Methods Eight patients who were diagnosed with Odontogenic keratocyst of the mandible were chosen and the first stage of treatment being, insertion of the decompression stent into the most prominent or dependent part of the cystic cavity. Then based on assessment of regular second monthly OPG radiograph the second stage ie. Enucleation of the cyst and treatment of the cystic cavity with Carnoy's solution was carried out, when the size of the cystic cavity had decreased.
Results The radiographs of all the patients were analyzed at a two month interval and compared with the pre operative radiograph. The percentage of change in radiodensity of the lesion ranged from 35.15% to 66.16% with a mean decrease of 53.85%. This also indicated that the quantum of bone regeneration which occurred simultaneously and as observed during the cystectomy procedure was commendable.
Conclusion Reduction of surgical morbidity while preserving anatomy and function, is the greatest advantage of decompression, however one should not forget the emphasis on the value of long term studies needed to be carried out with regular follow-up, to keep a check on those patients treated with decompression.

Keywords OKC · Decompression · Cystectomy

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Introduction

Odontogenic keratocyst is a developmental cyst of the jaws derived from epithelial origin. It was first identified by Philipsen [1] in 1956. The term 'laminal cysts' was even suggested by Toller [2] as the years passed, the thought gained ground that remnants of the dental lamina played a role [3,4] in its development and was more recently defined in 1990 by the World Health Organization as a cyst 'characterized by a thin fibrous capsule and a lining of keratinized stratified squamous epithelium, usually about five to eight cells in thickness and generally without rete pegs' [5].

This is an aggressive type of cyst with a high rate of recurrence, usually due to a part of the fragile cystic lining remaining behind in the cystic cavity after enucleation. Due to this nature of the cyst, attempts have been made to reduce the high recurrence rates by improved surgical techniques like radical surgery with resections and bone transplantation or removal of lateral cortical plate and enucleation of the cyst, often followed by excision of the overlying mucosa in continuity with the lesion. If, however one could stop or even reverse the growth of the cyst with a simple procedure, regardless of the histologic type, it would be an alternative to radical surgery.

Thus the main objectives of the study are to determine the course of healing of the cyst during decompression and conservation of anatomic structures, especially bone.

Methods

The study conducted was a non randomized prospective in vivo study, involving eight patients both male and female, who presented to the Oral and Maxillofacial Surgery Department in V.S. Dental College & Hospital, Bangalore and were diagnosed with a cystic lesion in the mandible (Table 1 and 2). The inclusion criteria being odontogenic keratocysts of size greater than 30 mm in size in the mandible is included. Those patients with odontogenic keratocysts of the maxilla and Gorlin-Goltz syndrome were excluded.

Recurrence history of OKC was included in the criteria. 1) Complete haemogram and Chest radiograph 2) Orthopantamograph radiograph - Preoperative 3) Biopsy 4) Follow-up Orthopantamograph radiographs - Every 2 months till enucleation, and also immediate post enucleation and thereafter every 6 months.

The first stage of treatment consisted of examination of the patient, and then

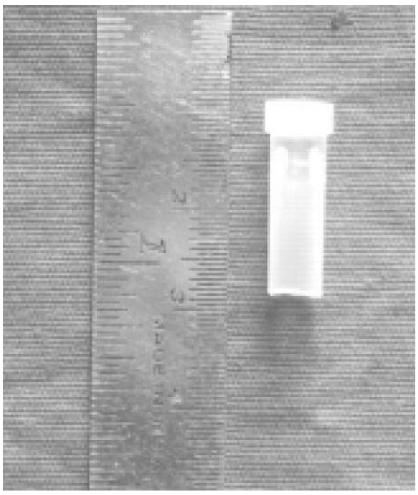


Fig. 1 Decompression stent

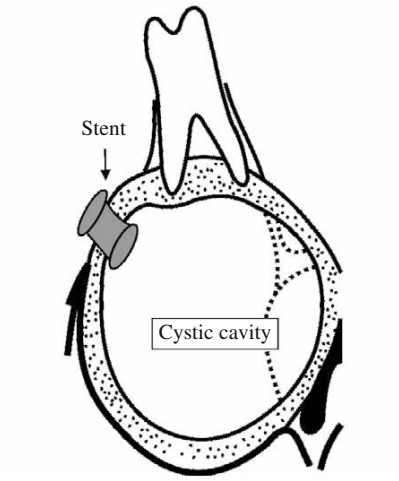


Fig. 2 Decompression stent - illustration

Fig. 3 Decompression stent in place

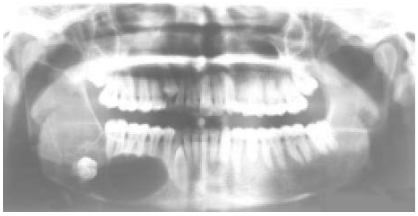


Fig. 4 Pre-decompression radiograph

Fig. 5 Post-decompression radiograph

insertion of the decompression stent, fashioned out of a 2cc disposable syringe needle cover (Fig. 1). This material was chosen for use as a stent mainly because of its inert nature, its ability to resist distortion and maintain the patency of the opening during the period of decompression and also the ease of availability. It was inserted into the most prominent or dependent part of the cystic cavity (Fig. 2), if the cyst was large and crossing the midline two stents were inserted as with one of the patient in our study.

The first stage procedure was carried out under local anesthesia on an outpatient basis. The stents were inserted into the socket of extracted teeth where the extraction of a tooth in the region of lesion was inevitable and also if the area favoured the insertion of the stent, the advantage of doing so is that it avoids the removal of bone for creating a window in the buccal cortex for the insertion of the stent. A silk suture was used to stabilize the stent during its initial placement during the decompression stage (Fig. 3), was left in-situ for 2 weeks and later removed. In our study the extraction socket was used as a site for insertion of the stent in most cases.

The patients were then recalled once every week for the first four weeks post decompression and thereafter once every two weeks, the patients were given home care instructions about irrigating the decompression stent using a syringe twice every day using chlorhexidine mouthwash. When the patients came for follow up the stability and patency of the stent was examined and the site was thoroughly irrigated using a mixture of betadine (5%) and normal saline.

The radiographic evaluation consisted of regular 2nd monthly radiographs (OPG) and observing for changes in the size of the radiolucency, which would suggest a decrease in the size of the cyst and also observing for a change in the radiodensity of the lesion (Figs. 4 and 5), which was done using a computer software wherein the lesion was outlined on the photograph of the radiograph and the number of pixels of the representative area measured. This change of radiodensity, especially at the borders, which was suggestive of cyst shrinkage and simultaneous bone deposition.

Once the radiolucency on the radiograph appeared to be less than 2cms the cyst would be enucleated under general anesthesia and the cystic cavity was treated with carnoys solution for about 3mins, following which the cavity was rinsed using copious amounts of normal saline, and a closure obtained.

The patients were recalled for follow-up on the first two post operative days, then on the seventh day and subsequently the 1st month, 3rd month, 6th month, and every 6 months thereafter.

Results

All cases in the study underwent an uneventful period of decompression except in one patient where it was observed that there was tissue overgrowth onto the decompression stent thus partially blocking it this was later rectified by excision of the hyperplastic tissue.

The radiographs of all the patients were analyzed at a two month interval and compared with the pre operative radiograph (Table 3 and 4). The percentage of change in radiodensity of the lesion ranged from 35.15% to 66.16% with a mean decrease of 53.85% and a standard deviation of ±11.19%. The quantum of bone regeneration as observed during the cystectomy procedure was phenomenal.

Discussion

According to literature, OKC's have an incidence rate of about 12% to 14% of all odontogenic cysts with 2 peaks around the ages of 30 and 60 and seem to be more frequent in males (M/F 2:1). From 60% to 80% of reported cases occur in the mandible, mainly found in the molar, angle, and ramus area, though reports of several studies indicated that they can occur anywhere in the jaws, including the midline of the mandible and maxilla and the 'globulomaxillary area' in the maxilla [2,6,7].

There is no uniformly agreed treatment of large mandibular cysts. The aim is to

remove the cyst as completely as possible and to avoid complications. There are two ways to achieve this: The first option is to biopsy the cystic wall and decide from the histological report whether to treat the lesion conservatively or aggressively. There is controversy about this, particularly for less well understood lesions such as keratocysts.

Significantly, studies have shown that the orthokeratinized keratocysts had a substantially lower recurrence rate than keratocysts that were parakeratinized, and later molecular studies showed significant differences between the two varieties [8]. Unfortunately, there is not yet clarity on the behaviour of keratocysts that show both orthokeratotic and parakeratotic areas histologically [9]. No significant histologic variation was seen post decompression in our series of patients.

The second option is to remove the whole cyst and treat it as if it were an aggressive cyst, such as a keratocyst. This includes either lavage of the lumen with Carnoy's solution before or after removal, and curettage of the bony wall, or radical resection [10,11,12,13]. Perhaps the most extensive form of treatment indicated for the management of select OKC's is that of osseous resection, marginal or segmental. Although some individuals consider this treatment to be radical for a benign cyst, en bloc resection is the only treatment modality consistently cited in case series with a zero recurrence rate hence the preferred and appropriate therapy in face of a recurrent lesion [11]. Of academic concern is the lack of consensus concerning the margins required in a primary resection to ensure removal of all possible satellite cysts. Anecdotal reports have suggested that a minimum 5 mm bony margin is adequate to ensure satellite cyst removal.

The optimal option for large mandibular cysts is to biopsy it under local anesthesia and then to decide on further steps. During biopsy nothing could be easier than to insert a decompression stent into the opening of the wall of the cyst to keep the cyst from further expansion. In our series, all operations were done under local anesthesia on an outpatient basis.

There are two main drawbacks of the method: one is that only a small section is taken for histological reporting. Secondly, cooperation by the patient is required throughout the duration of the treatment. However, the treatment can be stopped, the stent removed, and the cyst enucleated at any time if the patient is not willing to proceed.

By definition, decompression of a cyst involves any technique that relieves the pressure within the cyst that causes it to grow [10,14]. Decompression and marsupialization of cysts of the jaws were first suggested by Partsch in the German literature, and in many parts of the world they are still described as the Partsch I procedure. (The Partsch 2 procedure is enucleation and primary closure) [2]. Growth of cysts is believed to occur by a combination of osmotic pressure and pressure resorption coupled with release of prostaglandins and growth factors. Decompression by any means seems to change the environment and decreases the amount of interleukin that is released [12]. Decompression can be performed by making a small opening in the cyst and keeping it open with a drain of some kind. This management is often advocated to stop subsequent growth and cause some decrease in the size of the cyst to take it away from vital structures, such as the inferior alveolar nerve or adjacent teeth in the mandible or the maxillary sinus or nasal cavity in the maxilla. This approach allows subsequent enucleation to be performed without complication [12]. Also in the case of mandibular lesions, initial marsupialization or decompression may help avoid pathologic fracture [14].

Fig. 6 Change in radiolucency

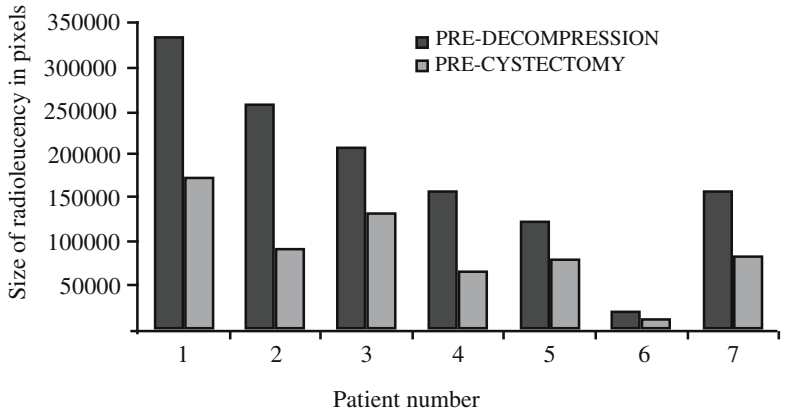
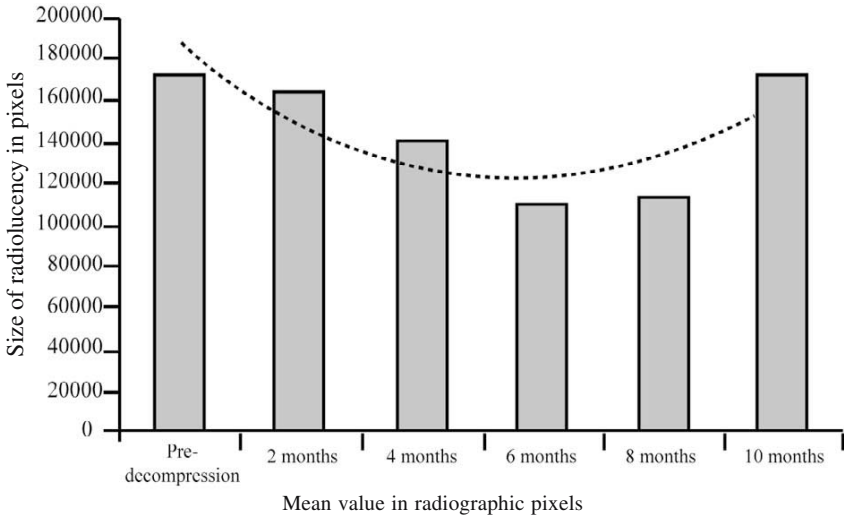


Fig. 7 Mean value in radiographic pixels



The patients in our study were treated by initial decompression followed by subsequent Enucleation and application of carnoy's solution at a later date, which was decided, based on radiographic (OPG) evaluation at a regular 2 month interval. All but one patient were regular for their follow-up appointments and followed proper home care instructions, the one patient who did not report for follow-up was given repeated reminders but there was no response from the patient.

Stoelinga, Voorsmit and colleagues from Denmark advocate excision of the overlying mucosa and have popularized the use of Carnoy's solution as a chemical tissue fixative. Carnoy's solution is a mixture of absolute alcohol 6ml,

Table 1 Age and sex distribution

Age and Sex distribution	
Age in years; Mean ± SD	30.00 ± 15.33
Male : Female	6:2

Table 2 Location of cysts and period of decompression

Sl. No.	Location	Period of Decompression (months)
1	Right body-ramus region of mandible	Eleven
2	Right body and bilateral parasymphysis region	Nine
3	Left body-ramus region of mandible	Six
4	Left body of mandible	Eight
5	Bilateral parasymphysis region	Seven
6	Left body region of mandible	Six
7	Left angle region of mandible	Six
8	Left body region of mandible	Lost in follow-up
	Total period of decompression	7.57 ± 1.90

Table 3 Comparison of pre-decompression and pre-cystectomy pixels (size of radiolucency)

Patient number	Pre-decompression	Pre-cystectomy	% change
1	330501.0	170162.0	51.49
2	251836.0	88527.00	35.15
3	204775.0	128932.0	62.96
4	153693.0	62340.00	40.56
5	119281.0	78920.00	66.16
6	16996.00	7984.00	46.98
7	155316.0	81869.00	52.71
8	153068.0	-	-
Mean ± SD	173183.3 ±92841.5	88390.57 ±51000.43	53.85 ±11.19

Table 4 Percentage change of size of radiolucency of the lesion on the radiograph

Study period	Pixels (Size of radiolucency)	
	Mean ± SD	% change
Pre-decompression	173183.3 ±92841.5	
2 months	163612.4 ±93364.6	0.55%
4 months	141079.3 ±87274.2	91.9%
6 months	110735.3 ±70604.92	93.61%
8 months	113294.3 ±61207.94	93.45%
10 months	172063.0	-

chloroform 3ml, glacial acetic acid 1ml, and ferric chloride 1g, that penetrates bone to a predictable, time-dependent depth without injuring the neurovascular structures. A 5-minute application penetrates bone to a depth of 1.54 mm, nerve to a depth of 0.15mm, and mucosa to a depth of 0.51 mm [2,11]. Because most residual cells and daughter cysts from locally recurrent lesions are adjacent to the main lesion, it is likely that fixation of vital bone need only extend for 2 to 3 mm beyond the enucleated lesion. Application of the Carnoy's solution can occur before enucleation or afterward. Voorsmit's original description of the technique called for treatment of the cyst before enucleation, which causes a 'tanning effect' of the lesion and facilitates complete removal. No evidence in the literature supports one method over another. There is nothing to suggest that coating the neurovascular bundle with petroleum jelly or the like affects neurosensory outcome, but is widely practiced [2].

The decompression period in our series varied from 6–11 months, with a mean decompression period of eight months, the least being 6 months and the maximum being 11 months.

The decompression stent was regularly examined for stability as well as patency of the opening, during the follow-up appointments. All patients maintained cleanliness around the decompression stent and their overall oral hygiene was good. In all the cases it was observed that a firm band of tissue formed around the stent thus holding it in place. In one patient it was observed that there was tissue overgrowth onto the decompression stent thus partially blocking it, this we observed and concluded may have been due to the stent having been placed on the labial cortex and the lip mucosa always being in contact with the stent opening, thus friction would have precipitated an overgrowth of tissue extending and covering the opening. This was later rectified by excision of the hypertrophic tissue.

Radiographic observation revealed varying changes beginning from the 2nd month post decompression. In all the cases the OPG taken after 2 months post decompression did not show marked changes in the radiodensity of the lesion, but the following radiographs especially by the third OPG ie. six months post decompression showed marked decrease in the radioleucency. The mean reduction of radiolucency post decompression was found to be 53.85% with a standard deviation of ±11.19%. This change in

radiodensity is indicative of two important things, firstly, the shrinking of the cyst lining and secondly, simultaneous bone deposition along the walls of the cystic cavity, which is one of the major advantages of the decompression procedure. This was confirmed during the second stage procedure ie. Cystectomy procedure, where it was observed that bone formation had occurred in the areas adjacent to the cyst lining, which accounted for the theory that the decompression procedure results in decreased surgical morbidity.

Thus it can be inferred from the observations in the cases evaluated that decompression is a procedure where phenomenal decrease in the surgical morbidity can be achieved however time and patient compliance does play a crucial factor.

Conclusion

The Odontogenic Keratocyst since being formally described by Philipsen has proven to be a challenge to the treating surgeon. The surgeons of today even though equipped with the modern day technology and gadgetry, still find the treatment of the OKC an enigmatic task. The trick here being to conserve the natural structures and also at the same time preventing recurrence of the cyst, which the OKC is known for.

Though the controversy goes on regarding the optimal treatment for the Odontogenic Keratocyst, this study deals into one of the lesser known modality. Decompression has been observed in the patients treated during the course of this study, that it indeed reduces the size of the cystic cavity in a phenomenal manner and thus decreasing the surgical morbidity especially in young individuals where more aggressive treatment would leave a life long surgical defect. It also provides the added advantage of simultaneous bone deposition along the walls of the cystic cavity.

These findings in this study support the view that in a select group of co-operative patients, treatment with decompression allows for a less invasive approach with less surgical morbidity thus avoiding extensive disfiguring procedures.

Although complete resolution of the lesion while preserving anatomy and function can be achieved with conservative treatment the need for long term follow-up of these patients cannot be overemphasized.

Thus we could conclude that, given the new understanding of the OKC's biologic behaviour and hypothesized reasons for recurrence, a shift in the management paradigm for the OKC would soon evolve.

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