Keratocystic odontogenic tumor: An overview of management protocols
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Abstract
Typically, the categorization of odontogenic cysts is complex and can cause a dilemma equally for specialists as well as pathologists. The odontogenic keratocyst (OKC) is definitely a developmental cyst, which is worthy of special consideration. It possesses typical histopathological as well as clinical attributes; however, the thing that makes this particular cyst unique is definitely its overly aggressive tendencies and also a high recurrence rate. In spite of several classes and nomenclature, sadly the specialists nevertheless have to encounter challenges in the control over this frequently observed jaw lesion. This particular brief article is an attempt to deliver a breakdown of numerous facets of OKC with focus on recurrence and the need for a perfect treatment of keratocystic odontogenic tumor.

Keywords: Keratocystic odontogenic tumor, maxillofacial surgery, odontogenic keratocyst

Introduction
Originally coined by Philipsen (1956),[1] odontogenic keratocyst (OKC) is actually a developmental cyst. OKC is currently referenced by the World Health Organization (WHO) as being a keratocystic odontogenic tumor (KCOT), and WHO outlined it as “a noncancerous uni-or multi-cystic, intraosseous tumor of odontogenic origin, having a typical inner lining of parakeratinized stratified squamous epithelium as well as likelihood of a potent, destructive behavior.”[2] KCOT is amongst the most unpredictable odontogenic cysts. It may grow to be fairly massive as a result of its capability for sizeable enlargement, extension into surrounding structures, as well as speedy increase in size.[3] Various reports revealed the frequency of KCOT being 3-11% of the odontogenic cysts.[4] Usually, KCOT tend to be individual lesions except if they may be linked to nevoid basal cell carcinoma syndrome.[5]

KCOT develops out of the cell rests of the dental lamina.[5] Histopathologically, KCOT ordinarily exhibits a slender, friable wall structure, and this can be challenging to enucleate from the bone fragment successfully as a whole, and possess tiny satellite cysts inside the fibrous wall structure. As a result, OKCs frequently have a tendency to be recurrent following management.[6] Radiographically, KCOT displays a well-defined unilocular or multilocular radiolucency together with even as well as typically corticated edges. In 25-40% of occasions, it comes with an impacted tooth within the lesion. KCOT are inclined to expand in the anteroposterior direction inside the medullary cavity of the bone without resulting in apparent enlargement leading to its late observation by the affected individuals.[6,7]

Typically, the management of KCOT is still debatable. The treatment modalities can be conservative or aggressive. Conventional management usually comprises of simple enucleation, together with or without the curettage, or marsupialization. Aggressive management commonly entails peripheral ostectomy, chemical curettage with Carnoy’s solution, cryotherapy, or electrocautery and resection.[8,9]

The line of therapy needs to be determined by numerous variables; affected individuals age, overall size and site of the cyst, involvement of soft tissue, record regarding prior management as well as a histological variation of the disease. The actual objective would be to select a treatment method that bears the minimum likelihood of recurrence and the slightest morbidity.[10]
Marsupialization, however, entails transforming the cyst to a sack and so the cyst is actually decompressed, nevertheless this is a far more conclusive treatment than decompression since it exposes the cyst walls to the oral environment. Mandibular cysts are typically marsupialized within the oral cavity, whereas maxillary cysts might also be marsupialized inside the maxillary sinus or nasal cavity, in addition to the oral cavity.\textsuperscript{[2,12]} Decompression and marsupialization of cysts is most likely the foremost suggested remedy and had been primarily proposed by Partsch in the later part of the 19th century. In several regions of the globe, marsupialization continues to be referred to as a Partsch I technique (the Partsch II procedure is enucleation and primary closure).\textsuperscript{[11]} Despite the fact that decompression or marsupialization had not been advised as cure for KCOT by a few experts, since it had been believed that the pathologic tissue could be remaining \textit{in situ}\textsuperscript{[14]} decompression or marsupialization continues to be encouraged in many reports as being a technique that enables subtle reduction in size in the KCOT in order that important structures like teeth or the inferior alveolar nerve may be preserved.\textsuperscript{[13,16]}

Those writers who happen to be opposed to the usage of marsupialization or decompression to treat KCOT rely on, the fact that this approach fails to eliminate entirely the complete cystic coating, which will result in a continuation of epithelial proliferation and promote the recurrence.\textsuperscript{[17]} A recurrence rate of 25\% has been documented in 32 cases when decompression was used as the sole treatment.\textsuperscript{[16]} However, additional research indicates that the marsupialization of KCOT may be associated with complete settlement of the lesion with virtually no further surgery.\textsuperscript{[11,16]}

The actual marsupialization method was explained by Pogrel in which a window of a minimum of one centimeter across is created into a cyst, as well as an effort is made to suture the cyst lining to the oral mucosa. Within the maxilla, the cyst is then simply just often loaded with packing protruding through the opening. The filling contains iodoform gauze heavy-laden with the bacitracin cream. After it is taken out from the maxilla, the cyst is typically self-maintaining and the affected individual would need to irrigate 2 times a day to avoid food deposition or closure of the fistula. In the mandible, there exists a higher inclination for natural closure of the fistula and reformation of the cyst, especially in the posterior mandible. In these instances, we have realized that the utilization of a nasopharyngeal anesthesia tube suitably trim down makes an exceptional stent to help keep the cyst amenable. Once more, the cavity is irrigated 2 times a day.\textsuperscript{[16]}

Research has proven that if the KCOT is opened up to the oral cavity through marsupialization, several modifications happen in the cyst lining. Histologically, the lining of KCOT is just Five to six cells deep and also breaks quickly upon attempted enucleation; and that is one of the many factors behind the high recurrence rate. With decompression or marsupialization, the lining seems to end up denser and simpler to enucleate, and histologically it can seem to modify and appear like typical oral mucosa, both with routine histology together with immunohistochemistry.\textsuperscript{[16]} Pogrel finally stated that, decompression and/or marsupialization is as good a treatment modality as any other aggressive one as it has a low morbidity rate, and no vital structures are harmed.

**Enucleation With and Without Adjuncts**

To enucleate is simply “to clear away as a whole, the tumor from its envelope.” Curettage means “the eradication of abnormal growths or any other content out of the wall of the cavity.”\textsuperscript{[18]} Enucleation together with and without different adjuncts has long been employed. Despite the fact that enucleation/curettage provides the edge over marsupialization of providing an entire sample for histopathologic evaluation, it displays recurrence rates as excessive as 62.5\%, which can be no more a satisfactory treatment form. This significant likelihood of recurrence is actually revealed from the slender, friable wall structure of the KCOT, that is hard to enucleate from the bone fragments successfully, as well as the tiny satellite cysts inside of the fibrous wall.\textsuperscript{[11,12]} A lot of specialists take into account enucleation and curettage as the bare minimum prerequisite in the management of KCOT.\textsuperscript{[19]} Concerning curettage, clinicians currently have recommended mechanized methods (hand, rotary) alone or perhaps in conjunction with a compound solution (Carnoy’s)\textsuperscript{[20]} or cryosurgical products (liquid nitrogen).\textsuperscript{[21]}

**Enucleation and Treatment of the Bony Defect with Carnoy Solution**

As a consequence of the problem regarding enucleating the slender, friable wall structure of the KCOT as a whole, in addition to the little satellite cysts, thus, treatment method ought to attempt to remove the possible critical cells left out in the defect. For this particular purpose a gentle, not profoundly infiltrating, cauterizing agent is employed for example Carnoy’s solution (is made up 3 ml of chloroform, 6 ml of absolute ethanol, One milliliter of glacial acetic acid as well as One g of ferric chloride).\textsuperscript{[22]} This is generally sufficient to complete cauterization of the leftover cells. Should the cyst have permeated via the lingual or buccal cortex, surgeons referred to the employment of electrocauterization in order to avoid a recurrence within the soft tissues.\textsuperscript{[22]}

Additional research demonstrated that, even though the problem appeared to be cured with Carnoy’s solution, Microcysts as well as epithelial islands ended up generally in the overlying attached mucosa. Therefore, recurrence occurred. Thus, the particular writers of all of these scientific studies suggested the total removal of the overlying mucosa to diminish the recurrence.\textsuperscript{[18]} Additionally it was cited in a research the fact that treatment with Carnoy’s solution failed to display a substantial association with recurrence.\textsuperscript{[20]} Yet, Voorsmit \textit{et al.} documented a reduced recurrence rate subsequent to therapy using enucleation along with Carnoy’s solution (2.5\%) in contrast with enucleation on its own (13.5\%).\textsuperscript{[22]}

As per (Blanas \textit{et al.}, 2000) enucleation of KCOT and use of Carnoy’s solution seems to be the most minimally invasive procedure together with the smallest recurrence rate. Plus they
documented that incorporating Carnoy’s solution to the cyst cavity for 3 min following enucleation provides a recurrence rate similar to that of resection without the need of unjustifiable aggressive surgery. [24]

The side effects associated with Carnoy’s solution over the inferior alveolar nerve had been initially reported by Frerich et al. (1994). [25] The writers failed to detect axonal injury through the initial 3 min of the primary application. On the other hand, another significant research, Wright et al. (1981) [26] mentioned how the modifications in neural conductivity established soon after 2 min of immediate application, with hardly any indications of healing following 2 weeks of follow-up. Nonetheless, Dammer et al. (1997) [27] claimed that whenever a suitable standard protocol is adopted, the chemical therapy for the nerve can be achieved devoid of long lasting functional deterioration.

Enucleation and Liquid Nitrogen Cryotherapy

In principle, the optimal strategy for KCOT will be enucleation as well as curettage accompanied by treating the cavity using an agent designed to destroy the epithelial remains or satellite cysts. Furthermore, the osseous structure ought to be kept undamaged to enable osteoconduction. Liquefied nitrogen has the capacity to devitalize bone in situ whilst rendering the inorganic framework unchanged, as a consequence of this, cryotherapy has been employed for several locally potent jaw lesions, such as KCOT, ameloblastoma and ossifying fibroma (Pogrel, 1993, Lo Muzio 1999). [28,29] Cell death by using cryosurgery takes place simply by immediate injury from intra cellular as well as extracellular ice crystal development in addition to osmotic and electrolyte disturbances (Rosen and Vered, 1979). [30]

As per Pogrel (2001) [21] the regular method is as follows, the 1st step in treating the lesion is enucleation of the cyst. The encompassing tissues are after that guarded with clean and sterile wooden tongue blades as well as gauze, and also the cavity is applied with liquid nitrogen 2 times for 1 min, using a 5 min thaw in between freezes. Bone graft may load within the defect all at once, after which mucosa is closed up with water tight sutures.

The attributes of liquid nitrogen above other methods of devitalizing the tissue over and above the noticeable lesion of the border are that (1) the actual bone fragments matrix remains in position to act like a clear scaffold for new bone development, (2) a bone graft may be put instantly in order to speed up healing and reduce the chance of a pathologic bone fracture, and (3) reduction in hemorrhage and scarring. Nevertheless, due to the issues in managing the quantity of liquid nitrogen used on the cavity, the resulting necrosis in addition to swelling might be erratic (Pogrel, 1993; Salmassy and Pogrel, 1995). [28,31] The recurrence rate subsequent to enucleation and liquid nitrogen cryotherapy happens to be documented at 3-9% (Pogrel, 2005; Schmidt, 1999). [14,21]

Any time the liquid nitrogen cryotherapy is administered about the inferior alveolar nerve, it can be damaged, and affected individuals are affected by paresthesia or maybe anesthesia. Even so, the axon sheaths are still undamaged and neural anesthesia is typical in a way that most patients acquire incomplete or total return of senzation in 3 months (Schmidt, 1999). [21]

Block Resection, With or Without Preservation of the Continuity of the Jaw

Resection represents possibly segmental resection (surgery associated with a portion of the mandible or maxilla without preserving the continuity of the bone) or marginal resection (surgery of a lesion undamaged, having a rim of uninvolved bone, retaining the continuity of the bone) (Kondell and Wiberg, 1988) [32] which in turn is a risky approach, that ends up in significant morbidity, specially due to the fact that reconstructive procedures are required to bring back jaw functionality as well as aesthetics (Barreto et al. 2000) [33] Jensen (1988), [34] ponders whether or not this kind of ambitious treatments are justified for a benign lesion that can be managed reasonably well with relatively simple means.

In a thorough overview by Blanas et al. (2000), [24] the particular experts documented that resection was identified to provide the least recurrence rate (0%) however it has the maximum morbidity rate, whereas enucleation with use of Carnoy’s solution can lead to a recurrence rate similar to resection without unjustifiable aggressive surgery.

Numerous research determined that keratocysts may be addressed with a conservative approach, the sole drawbacks being the prolonged curative time frame. [27,35-37] Substantial resection of the mandible having a high morbidity might be way too radical for massive KCOT and perhaps an overtreatment (Giuliani et al., 2006; Marker et al., 1996). [38,39]

Summary

KCOT is amongst the numerous overly aggressive odontogenic cysts having a significant recurrence rate. Numerous surgical strategies have been published such as decompression, marsupialization, enucleation with or without adjunct (Carnoy’s solution, cryotherapy), as well as resection. Based on additional scientific studies KCOT may be cautiously addressed with enucleation and use of Carnoy’s solution or cryotherapy. This kind of treatment can be utilized mainly in the sizeable lesions that in case cured with resection, the continuity of the jaw would be disrupted. This method displays very similar outcomes to other more aggressive methods.

References

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