Decompression of odontogenic cystic lesions: clinical long-term study of 73 cases

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Objective. The aim of this study was to evaluate the effectiveness of decompression as the initial treatment for odontogenic cysts.

Study design. Pre- and postdecompression panoramic radiographs of 57 patients treated for 73 odontogenic cysts were reviewed for reduction parameters. Findings were evaluated against time of decompression and clinical and histopathologic data.

Results. Decompression reduced lesion area by a mean of 79.3%. The reaction was good in 60% of cysts, moderate in 29%, and poor in 11%. Mean decompression time was 9.2 ± 5.2 months; it was 7.6 months in patients ≤18 years old and 10.2 months in older patients (P < .0001). Mean rate of reduction was 0.14 in cysts <10 cm² and 0.10 in cysts >20 cm² (P = .0884); by age, values were 0.14 in patients ≤18 years old and 0.09 in older patients (P < .05).

Conclusions. Decompression is effective in reducing odontogenic cysts. A shorter decompression period is needed for young patients. For aggressive lesions, secondary definitive surgery is recommended. (Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2011;112:164-169)

Marsupialization is a well accepted technique for primary treatment of odontogenic cysts.1-12 As originally described by Partsch,1,2 and then cited by Thoma3 and Archer,4 a large window is created within the cyst bony wall and the cystic lining is sutured to the oral mucosa. This forms a pouch connecting the oral and cystic cavities, allowing new bone to fill the defect. Thoma2 suggested that intraluminal pressure may also be reduced by creating an opening into the cystic cavity, a technique termed decompression. This requires a much smaller window, which is kept open by packing the cystic cavity or, more often, by suturing a device (tube, stent) to its periphery.3,13,14 Both procedures are based on the rationale that releasing the intramural pressure causes the cysts to diminish by gradual bone growth from the periphery.

The benefits of marsupialization and decompression include gradual decrease in the cystic cavity; preservation of oral tissues; maintenance of pulp vitality; prevention of dental extractions; avoidance of surgical damage to important anatomical structures, such as the inferior alveolar nerve, maxillary sinus, nasal cavity, and developing teeth; avoidance of mandibular fracture; and low risk of recurrence.3,4

Pogrel and Jordan10,11 advocated marsupialization as a definitive treatment for keratocystic odontogenic tumors (KOTs) in a selected number of cases. Others8,9,15-23 suggested that marsupialization or decompression be followed by enucleation, curettage and application of Carnoy’s solution or liquid nitrogen or peripheral ostectomy. Most textbooks focus on aggressive cysts, such as KOT and glandular odontogenic cyst (GOC)3,4,13,22,24; fewer data are available on the treatment of nonaggressive odontogenic cysts.

The aim of the present retrospective study was to evaluate the effectiveness of decompression as the initial treatment of odontogenic cysts regarding reduction parameters and decompression time.

PATIENTS AND MATERIALS

Data collection

We reviewed the medical files of all patients who underwent decompression for a cystic lesion of the jaw at the Department of Oral and Maxillofacial Surgery of a tertiary university-affiliated medical center from 1994 to 2009. Data were collected on patient age and gender, presenting symptoms and signs, lesion location, size, radiopacity and locularity, tooth resorption, displaced or unerupted teeth, invasion or interference of the lesion with adjacent anatomic structures, pre- and post-treatment histopathologic diagnosis, total decompres-
sion period, definitive surgery, complications, and follow-up.

Then we reviewed the patients’ panoramic films made before and after decompression. All radiographs were performed with the same Panorex machine. To simplify the area measurement of the irregular forms of different cystic lesions, we defined a standard lesion area index (SLAI) as the maximal vertical length (in cm) multiplied by the maximal horizontal length (in cm). The percentage of reduction of the lesional area (POR) was recorded as a fraction of the final SLAI from the original SLAI and graded according to the formula of Nakamura et al.9: >80% reduction, good reaction; 50%-80% reduction, moderate reaction; <50% reduction, poor reaction. To eliminate possible distortions or magnifications due to the panoramic imaging technique, the rate of reduction (RR) was determined by dividing the decompression time (in months) by the POR.

Exclusion criteria for the study were missing clinical or radiographic data, failure to maintain the decompression window, and follow-up of <6 months.

Treatment protocol

Cystic lesions measuring ≤3 cm² were treated with enucleation or left open if they were located in the alveolar bone and were suitable for removal through the sockets of extracted teeth. Cysts >3 cm² were treated with decompression: an opening was created that was just large enough for performing an incisional biopsy of the cystic lining. If the opening was made with a scalpel, the cystic lining was sutured to the oral mucosa. If electrocautery or CO₂ laser was used (in the anterior regions of the oral cavity, where the oral mucosa is more pliable), the cystic cavity was kept open. Depending on the surgeon’s preference, the opening was maintained either by packing with iodoform gauze or by suturing shortened nasopharyngeal tubing or short polyethylene stents to the window’s periphery. Packing, when used, was replaced once weekly after the cavity was thoroughly rinsed with copious amounts of chlorhexidine gluconate 0.1%; each new packing was reduced in length commensurate with the reduction in the size of the cavity. If the cystic cavity was kept open without a stent or packing, the patient was instructed to self-irrigate constantly. Panoramic radiographs were repeated every 6 months for evaluation of cystic size. Patients in whom the cystic cavity did not shrink completely underwent subsequent surgery.

When necessary, definitive surgery for KOT consisted of enucleation or enucleation and peripheral ostectomy. Unilocular lesions were treated by enucleation, and multilocular lesions by peripheral ostectomy and marginal resection.

Statistical analysis

Data were recorded and analyzed using Microsoft Excel (Redmond, WA, USA). Two-tailed Fisher F test was used for statistical analysis; the significance level was set at $P < .05$.

RESULTS

The study group consisted of 67 patients, 39 (58.2%) male and 28 (41.8%) female (ratio 1.4:1), of average age 30.8 years (range 7-76 years). Cyst prevalence was highest in the second decade (19/67 patients [28.4%]; Fig. 1). Four patients had basal cell nevus syndrome with multiple KOTs of the jaws, for a total of 73 treated cysts. Thirteen patients were asymptomatic, and 54 presented with various signs and symptoms (Table I). Swelling was the most prominent clinical presentation (46/67% [68.7%]).

<table>
<thead>
<tr>
<th>Symptom</th>
<th>n</th>
<th>%</th>
</tr>
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<tbody>
<tr>
<td>Swelling</td>
<td>46</td>
<td>68.7%</td>
</tr>
<tr>
<td>Teeth mobility</td>
<td>6</td>
<td>8.9%</td>
</tr>
<tr>
<td>Pain</td>
<td>5</td>
<td>7.5%</td>
</tr>
<tr>
<td>Neuropathy</td>
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<td>7.5%</td>
</tr>
<tr>
<td>Trismus</td>
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<td>1.5%</td>
</tr>
<tr>
<td>Abscess</td>
<td>1</td>
<td>1.5%</td>
</tr>
<tr>
<td>Fistula</td>
<td>1</td>
<td>1.5%</td>
</tr>
<tr>
<td>None</td>
<td>13</td>
<td>19.4%</td>
</tr>
</tbody>
</table>

Fig. 1. Age distribution of 69 patients with odontogenic cysts.

On radiographic examination, 70 cysts (95.9%) were found to be unilocular, and 3 (4.1%) multilocular. Twenty lesions (27.4%) were characterized by root resorption (total 32 teeth), 44 (60.3%) by tooth dis-
placement (total 70 teeth), and 39 (53.4%) by unerupted teeth. Sixty-two lesions (85.0%) invaded or pushed adjacent structures, including the maxillary sinus, pterygopalatine fossa, floor of the nose, and mandibular canal.

The histopathologic diagnoses on primary biopsy study of the 73 cysts were as follows: dentigerous cyst in 28 (38.4%), KOT in 22 (30.1%), radicular cyst in 17 (23.3%), not otherwise specified in 4 (5.5%), and GOC in 2 (2.7%). Twenty-five cysts (34.2%) were treated with decompression alone, and 48 (65.8%) required definitive surgery. The final pathologic reports for the surgically treated cysts showed that 25 (52.1%) were dentigerous, 7 (14.6%) were odontogenic keratocysts, 3 (6.2%) were radicular cysts, 3 (6.2%) were not otherwise specified, and 1 (2.1%) was a glandular odontogenic cyst; 9 (18.8%) were described as scar tissue without epithelial lining.

The SLAI before decompression ranged from 3.74 to 44 cm² (mean 14.5 cm²), and after decompression (before final surgery) from 0 to 22.3 cm² (mean 3.0 cm²). The mean POR in SLAI after decompression was 79.3% (range 28%-100%). The reaction was graded as good in 60% of lesions, moderate in 29%, and poor in 11% (Fig. 3).

Mean decompression time was 9.2 ± 5.2 months (range 2-33 months): 9.1 months (range 2-22 months) for mandibular lesions and 9.3 months (range 3-33 months) for maxillary lesions, with no statistically significant difference between these groups. By age, mean decompression time was 7.6 months (range 2-14 months) in patients ≤18 years old and 10.2 months (range 3-33 months) in older patients. This difference was statistically highly significant (P < .0001).

The RR (Table II) was similar in the mandible (0.11) and maxilla (0.10) (P = .0743; NS). Reduction occurred significantly faster in smaller cysts, averaging 0.14 in cysts with an initial SLAI of <10 cm² and 0.10 in cysts with an initial SLAI of >20 cm² (P = .0884). There was no difference in RR by pathologic type: 0.12 for dentigerous cysts, 0.10 for KOTs, 0.13 for radicular cysts. The most significant result was found on analysis by age: Patients ≤18 years old had an RR of 0.14 compared with 0.09 in older patients (P < .05).

Twenty-five of the total 73 cysts (34.2%) were treated conservatively with decompression alone, and 48 (65.8%) were treated by decompression followed by definitive surgery. Complications in the 48 patients who underwent surgery included infection (n = 2), trismus with lower lip hypoesthesia (n = 1), local flap dehiscence (n = 1), and oroantral connection after closure of the fistula with palatal flap (n = 1). None of the surgical complications was considered to be serious.

The duration of follow-up ranged from 1 to 9 years (mean 2.7 years). Recurrence was found in 1 patient with KOT of the mandible, 2 years after final surgery.

**DISCUSSION**

Since the initial description of marsupialization for the conservative treatment of odontogenic cysts, good results have been reported with suturing of the oral mucoperiosteal flap to the cystic membrane, the addition of a vented acrylic plug to prevent pressure build-up in the cavity, and marsupialization followed by definitive surgery for aggressive cysts (mainly KOT). Pogrel suggested that for KOT, despite the high success rate of marsupialization (100% in 7-15 months), decompression may be easier to perform and safer for adjacent vital structures. In decompression, the small opening maintained allows for constant drainage and bone growth from its periphery and spares more tissue for final closure of the defect. The prosthetic reconstruction is also simpler and quicker. When followed by enucleation, decompression was associated with a very low recurrence rate for KOTs (0-8.7%). In a later study, Pogrel found that in some cases definitive surgical treatment was necessary. Several other authors have also advocated marsupialization followed by definitive surgery for the treatment of KOTs. Enslidis et al. reported that there was no recurrence after decompression and second-stage enucleation for all large mandibular cysts, regardless of histologic type.

In children, some authors favor marsupialization for first-stage treatment of dentigerous cysts to enhance eruption of impacted teeth, whereas others favor decompression because it is less invasive. Marsupialization as a single-stage procedure may be preferable for...
elderly or high-risk patients. Based on a comparison of marsupialization with surgery alone, Nakamura et al. recommended that definitive surgery should be aggressive whether or not it was preceded by marsupialization.

Yoshikowa et al. suggested that the ability of cystic lesions of the jaws to fill completely was not limited to odontogenic cysts and that a reduction of the intraluminal pressure restores the original anatomy by the surrounding tissues, such as bone, periost, or maxillary sinus membrane. The present study investigated the outcome of decompression for various odontogenic cysts treated at a major tertiary center over a 15-year period. There is at present no standardization of the reduction parameters of marsupialization or decompression in the literature. Brondum and Jensen, in a study of 44 KOTs, reported a mean decompression time of 10 months (range 1-14 months). Others have reported a mean reduction of 65% (range 5%-91%) with a mean decompression time of 8.4 months (range 6 to 12 months) and a mean reduction of 81% with a mean decompression time of 17.5 months. Marker et al. suggested that before final cystectomy of KOTs, the decompression time should be 12 months and the reduction 50%-60%. In our series, the mean reduction after decompression was 78.9% with a mean decompression time of 9.2 months. Although our analysis by site suggested that primary treatment of odontogenic cysts with decompression may be associated with a long decompression time of up to 33 months in the maxilla and 22 months in the mandible, and previous studies reported a 100% reduction over a wide time range of even large maxillary cysts with conservative treatment, we believe that for aggressive cystic lesions, secondary definitive surgery should be performed after decompression to reduce the risk of recurrence from remnants of pathologic tissue. In the patients ≤18 years old, the mean decompression time was 7.6 months, significantly less than in the adults (P < .0001). This difference may be explained by osteogenic activity in children.

Analysis by histologic type yielded a slightly lower POR in KOTs (mean 78.85%) than in less aggressive dentigerous cysts (81.52%) and radicular cysts (85.64%). Although this difference was not statistically significant, it disagrees with the finding of Pogrel of a faster reduction time for KOTs than for dentigerous cysts, at least after marsupialization. This finding might be explained by reports that marsupialization in KOTs

Table II. Reduction rate of 73 odontogenic cysts by clinical and laboratory parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Reduction rate*</th>
<th>P value</th>
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<tbody>
<tr>
<td>Location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mandible</td>
<td>0.11</td>
<td>.0743</td>
</tr>
<tr>
<td>Maxilla</td>
<td>0.10</td>
<td></td>
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<tr>
<td>Initial SLAI (cm²)</td>
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<tr>
<td>&lt;10</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>10-20</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>&gt;20</td>
<td>0.0844</td>
<td></td>
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<tr>
<td>Pathologic diagnosis</td>
<td></td>
<td></td>
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<tr>
<td>DC</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>KOT</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>RC</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>Age (y)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;18</td>
<td>0.14</td>
<td>.000063</td>
</tr>
<tr>
<td>≥18</td>
<td>0.09</td>
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</tr>
</tbody>
</table>

SLAI, Standard lesion area index; DC, dentigerous; KOT, keratocystic odontogenic cyst; RC, radicular cyst.

*Reduction rate = (percentage of reduction/months of decompression).
inhibits the expression of interleukin-1α and levels of keratinocyte growth factor and its receptor.

Several techniques have been described to estimate the radiographic size of cystic lesions. Nakamura et al.9 and Enslidis et al.22 used computerized scanning of the area of the lesion by panoramic radiograph, after correcting for the graphs’ different magnifications. They calculated the POR of the lesional area by a formula comparing the surface area (in cm²) before and after marsupialization. Madras and Lapointe,12 in a review of the literature and report of their own experience, referred to the surface area of the cysts on radiographs but did not describe their method of calculation. Bron- dum and Jensen28 and Marker et al.15 measured “across the cavity” without specifying the exact technique. Yoshikawa et al.5 used 3-dimensional estimations on the cavity without specifying the exact technique. They calculated the POR of the lesional area by a formula comparing the surface area (in cm²) before and after marsupialization. Madras and Lapointe,12 in a review of the literature and report of their own experience, referred to the surface area of the cysts on radiographs but did not describe their method of calculation. Bron- dum and Jensen28 and Marker et al.15 measured “across the cavity” without specifying the exact technique. Yoshikawa et al.5 used 3-dimensional estimations on posterior-anterior and lateral radiographs, but they specified the use of panoramic radiographs which by themselves partly display the anteroposterior and lateral projections, depending on the area of the radiograph. Therefore, an additional radiograph could not add a third dimension. In studies in children, Bodner et al.31,32 used computerized tomography (CT) with multiplanar reconstruction in addition to plain radiographs. They did not explain if the linear measurements of mean diameter (in cm) were also made on the scans or only the plain radiographs.

The technique used to measure the surface area of the cystic lesions in the present study appears to be similar to that of Nakamura et al.,9 August et al.,21 and Madras and Lapointe.12 On panoramic radiographs maximum diameters were measured in 2 dimensions, and the SLAI was calculated by multiplying these values. We found this method to be both practical and useful, and it is probably applicable for use in daily practice to plan stages before surgery and for follow-up. Although CT with multiplanar reconstructions is superb for defining cystic bony borders, cortical integrity, tooth displacement, and the proximity of vital organs and anatomic structures,31,32 it is applicable only for large lesions, for precise surgical planning.

Various devices are described in the literature to maintain the opening after marsupialization or decompression. Pogrel11,14 and August et al.21 used a shortened nasopharyngeal tube sutured to the mucosal wall in the posterior part of the mandible and iodoform gauze packing impregnated with bacitracin ointment in the maxilla. Others reported good results with an obturator or stent made of acrylic resin, which allowed patients to rinse the cavity by inserting a syringe through its lumen.9,22,33 Acrylic stents can be custom made by a dental technician to correspond to the width of the opening and exact distance between the mucosal surface and the cystic lining.22 Several groups described the use of small-diameter (1.6 mm) polyethylene tubes cut to various lengths; heating the ends yielded 2 “collars” that help to stabilize the tubes in the opening.16,32 Tolstunov34 applied intravenous administration sets or nasal O₂ cannulas cut to the appropriate size. In our patients, various materials were used, depending on the preference of the operating surgeon: iodoform gauze packing, acrylic stents, or shortened nasopharyngeal tubes. To our knowledge, there are no controlled studies in the literature comparing these materials regarding POR.

Packing is advantageous because it keeps the cavity filled and prevents food debris from being trapped inside; it also prevents closed loculations from forming as a result of “premature” shrinkage of parts of the cyst, particularly in large narrow cysts. Also, the volume of the packing can be gradually reduced, allowing for more controlled reduction of the cystic cavity. Their main disadvantage is the need for frequent changes (every 7-10 days) to prevent a foul smell and possible infection in the depth of the cavity. Devices with an inner lumen are advantageous in that they do not require changing and are more amenable to self-hygiene of the cavity, eliminating the need for frequent ambulatory visits to the clinic. However, it is sometimes difficult, especially for handicapped patients, to wash out small food debris from the depth of the cavity and to comply with the need for twice-daily rinsing with a syringe through the small cavity.

CONCLUSIONS
Our findings show that decompression may serve as the primary treatment of odontogenic cysts, leading to a high percent reduction of the lesional area. However, in aggressive cystic lesions, secondary definitive surgery following decompression is recommended.

REFERENCES
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