

# Two-Dimensional Change in the Cystic Defects after Decompression and Enucleation of Jaw Cysts - A Comparative Study

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## Abstract

**Introduction:** To compare the treatment methods of enucleation and decompression with regards to reduction of the dimension of the cystic defect with the aid of a software program. **Materials and Methods:** Thirty patients with regular controls of 3, 6, and 12 months treated between January 1, 2013, and January 1, 2021, were selected and included in the study. Sixteen patients were treated with enucleation and 14 patients with decompression. All preoperative and control radiographic and clinical data were retrieved from the archives. The area measurement of cystic cavities was made on panoramic radiographs taken at preoperative (T0), 3-month (T1), 6-month (T2), and 12-month (T3) control periods with a software program. Intra-group and inter-group analyses were made to compare the reduction of cystic defects between two treatment methods. **Results:** The mean age of study patients was  $45.2 \pm 7.3$ . Eighteen of them were male and 12 of them were female. Statistically, a significant difference was not observed between decompression and enucleation groups at T0, T1, T2, and T3 control periods ( $P > 0.05$ ). There was a statistically significant difference in the defect dimensions between all control periods in both decompression and enucleation groups ( $P < 0.05$ ). **Discussion:** Decompression and enucleation of jaw cysts are both successful in reducing cystic cavities. However, there is no superiority between the two treatment modalities regarding the defect reduction at the 12-month control period.

**Keywords:** Enucleation surgery, jaw cysts, surgical decompression

## INTRODUCTION

Jaw cysts are liquid-filled or empty bone cavities that are lined by epithelium. The extent of the treatment protocol of jaw cysts depends on the biological behaviour and proximity of the cystic lesion to anatomically vital structures.<sup>[1,2]</sup> Preservative methods such as decompression and marsupialization can be used when simple enucleation may pose several difficulties such as damage to the nervus alveolaris inferior or mental nerve during instrumentation or unnecessary extraction of an impacted permanent tooth which is enclosed by the cystic cavity.<sup>[3]</sup> Decompression is a treatment method used to decrease the volume of the cystic cavity by decreasing the internal pressure with the aid of a catheter or stent placed into the cystic lumen in the treatment of odontogenic cysts and cystic tumours.<sup>[4,5]</sup> The reduction in the cystic cavity can be followed by panoramic radiography or volumetric tomography.<sup>[6,7]</sup>

The reduction rate of cystic defects after decompression has been studied in several publications with varying results and it has been concluded that the treatment modality is quite successful in reducing the cystic cavity.<sup>[8,9]</sup> However, there is no clear therapeutic difference between enucleation and decompression yet. The indications for decompression are not yet established except the large dimensions of the cystic lesion with disturbance to the vital structures and impacted permanent teeth that are inside the cystic lesion. There is

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also no clear data regarding the comparison of the reduction rates of cystic defects after treatment with decompression and enucleation. In this context, the comparison of the reduction rates of cystic defects after decompression and enucleation may reveal the superiority in these treatment modalities in terms of the regeneration potential. The null hypothesis in the current study is that there is no statistically significant difference in defect reduction between decompression and enucleation. The study aims to compare the treatment methods of enucleation and decompression two-dimensionally with regards to the reduction rate of the defect with the aid of a software program.

## MATERIALS AND METHODS

### Patient selection

The clinical and radiological data of 945 cysts diagnosed and treated between January 2013 and January 2021 in Eskişehir Osmangazi University, Faculty of Dentistry, Department of Oral and Maxillofacial Surgery were retrieved from the archives. The inclusion criteria were: (1) patients with unharmed preoperative and postoperative panoramic radiographs taken at 3-, 6-, and 12-month control sessions. Exclusion criteria for the study were: (1) patients who had metabolic diseases or are under chemotherapeutics or other medications for any systemic diseases and (2) patients without documented postoperative follow-up. There were a total of 65 patients with consistent and unharmed clinical and radiological data. However, thirty patients with regular follow-ups of 3, 6, and 12 months were selected and included in the study. Fourteen patients were treated with enucleation and 16 patients with decompression followed by enucleation.

The study was approved by the local Clinical Research Ethics Committee with approval number E-25403353-050.99-165881. All procedures performed in the study were conducted in accordance with the ethics standards given in 1964 Declaration of Helsinki, as revised in 2013. Panoramic radiographs were taken with the same device (Planmeca ProMax; Planmeca, Helsinki, Finland) and patient head positions were standardized with the cephalostat technique.<sup>[10]</sup>

### Surgical protocol

Enucleation was performed under local anaesthesia. A full-thickness periosteal flap was reflected to provide an approach to the osteotomy site and the epithelial lining was exposed with suitable round and fissure burs under copious saline irrigation. The cyst was peeled off the bony cavity with the aid of periosteal elevators and completely loosened with care to prevent any tear to the epithelium and the flap was secured in place with 3-0 silk sutures. The specimen was sent for histopathological examination.

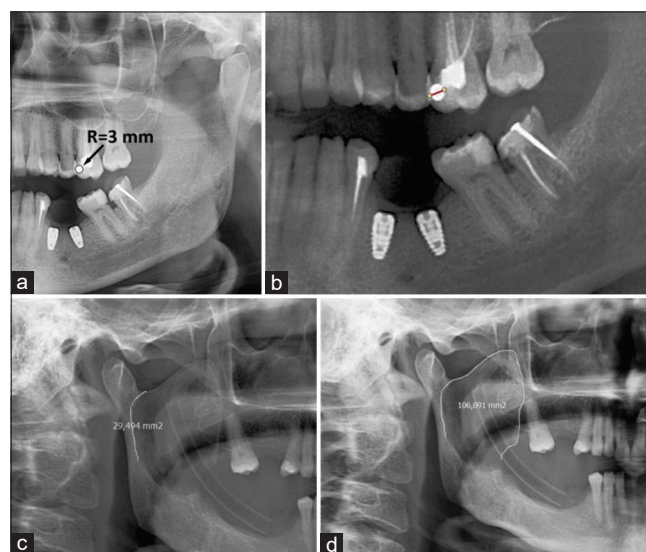
In decompression cases, a full-thickness periosteal flap was reflected and the epithelial lining of the cyst was exposed by forming a bony aperture with round burs under copious saline irrigation. An incisional biopsy was taken from the cystic lining for a provisional diagnosis of the lesion. Nelaton catheters 12 or 14 were cut with surgical scissors and adjusted into the osteotomy site as irrigation stents. After that, the stents were

secured to the surrounding flap margins with absorbable 3-0 vicryl sutures, the remaining parts of the reflected flap were reapproximated with 3-0 silk sutures. The irrigation of the cystic cavity with physiological saline was performed twice a week. In addition, patients were instructed to irrigate the cavity with physiological saline after every meal daily and a demonstration of irrigation for each patient was done after the completion of stent placement. The shape and position of the irrigation stent were controlled and adjusted every month in the follow-up period. Decompressed cysts were all enucleated after varying controls depending on the reduction rate of the cystic cavity.

A routine postoperative medication regimen including antibiotics (amoxicillin + clavulanic acid 1000 mg, 2 × 1), nonsteroid anti-inflammatory tablets (Naproxen sodium 550 mg, 3 × 1), and mouth rinse (chlorhexidine digluconate %0, 12, 3 × 1) was given after both enucleation and decompression.

### Measurement protocol

A computer software (Kameram 21, Argenit Smart Technologies Ltd. Co., Istanbul) that is mainly programmed to analyse morphometric data in biological studies was used for the area measurement of the cystic defect at preoperative (T0), 3 month (T1), 6 month (T2) and 12 month (T3) controls in the panoramic radiographs. A calibration protocol was followed prior to the measurements. An acrylic stent with a metal marble with a diameter of 3 mm was fabricated. A calibration radiograph was taken with this acrylic stent and the radiography was digitally transferred to the software program [Figure 1a]. A calibration ratio was automatically calculated using the diameter of the image of the metal marble in the digital radiograph and the real diameter



**Figure 1:** (a) A metal marble with 3-mm diameter was mounted on an acrylic splint and panoramic radiography was taken to form a template for the calibration of control radiographs. (b) Calibration of the study radiographs was made using the ratio between the measured diameter and genuine diameter of the metal marble. (c) The perimeter of the peripheral rim of the cystic cavity was marked steadily by a marking tool. (d) Care was taken in marking the cystic lining especially in expansion areas

of the metal marble [Figure 1b]. The bony lining of the defect was circumferentially marked with a measurement device [Figure 1c and d] and the area of the defect was displayed automatically in mm<sup>2</sup> [Figure 2a]. The area of the cystic defect was calculated for all control periods of T1, T2, and T3 [Figure 2b-d].

The primary variable in the study was defect area in all control evaluations. Secondary variables were the histological type of the cystic lesion and gender.

**Statistical analysis**

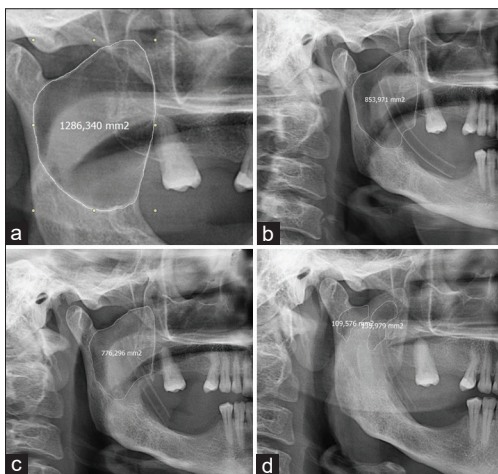
Statistical analysis was performed by software program SPSS version 22.0 (IBM, Chicago, USA). The normality was evaluated by the Kolmogorov–Smirnov test and nonparametric distribution of the data was detected ( $P < 0.05$ ). Mann–Whitney *U*-test was used for the evaluation of inter-group analysis. Intra-group analysis of control periods of T0, T1, T2, and T3 for both decompression and enucleation treatment modalities was made with Friedman Test. Wilcoxon signed-rank test was used for post hoc analysis.

**RESULTS**

The mean age of study patients was  $45.2 \pm 7.3$ . Eighteen of them were male and 12 of them were female. The histological diagnosis of treated cysts was radicular cyst (15 cases), dentigerous cyst (10 cases), odontogenic keratocyst (4 cases), and residual cyst (1 case) [Table 1].

There were no reported complications in enucleation cases. The tubes of 8 decompression cases were changed due to the incompatibility between the irrigation tube and entrance of the cystic cavity. The decompression treatment was continued and no enucleation for these cases was made at the time of T3 control evaluation.

The change in the defect area between control periods was shown in Figure 3 for decompression and in Figure 4

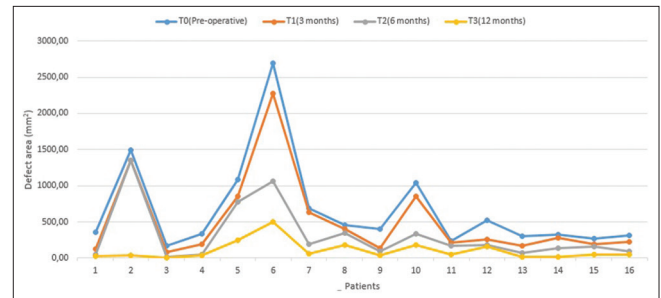


**Figure 2:** (a) The pre-operative area of the cystic defect was displayed in square millimeters immediately after the marking process was over. (b) Area of the cystic cavity at T1, (c) T2, and (d) T3 control radiographies

for enucleation. The mean reduction rate of the cystic defect was 85.08% for decompression cases and 80.76% for enucleation cases at T3. Statistically significant difference was not observed between decompression and enucleation groups at T0, T1, T2, and T3 control periods ( $P > 0.05$ ) [Table 2]. There was a statistically significant difference in the defect dimensions between all control periods in both decompression and enucleation groups ( $P < 0.05$ ) [Tables 3 and 4].

**Table 1: The distribution of gender and histological diagnosis of study cases**

| Case number | Treatment     | Gender | Histological diagnosis |
|-------------|---------------|--------|------------------------|
| 1           | Decompression | Male   | Radicular cyst         |
| 2           | Decompression | Male   | Dentigerous cyst       |
| 3           | Decompression | Male   | Radicular cyst         |
| 4           | Decompression | Male   | Residual cyst          |
| 5           | Decompression | Female | Radicular cyst         |
| 6           | Decompression | Male   | Dentigerous cyst       |
| 7           | Decompression | Male   | Dentigerous cyst       |
| 8           | Decompression | Female | Radicular cyst         |
| 9           | Decompression | Male   | Odontogenic keratocyst |
| 10          | Decompression | Female | Radicular cyst         |
| 11          | Decompression | Male   | Dentigerous cyst       |
| 12          | Decompression | Male   | Radicular cyst         |
| 13          | Decompression | Female | Dentigerous cyst       |
| 14          | Decompression | Female | Radicular cyst         |
| 15          | Decompression | Male   | Odontogenic keratocyst |
| 16          | Decompression | Female | Radicular cyst         |
| 17          | Enucleation   | Male   | Dentigerous cyst       |
| 18          | Enucleation   | Male   | Dentigerous cyst       |
| 19          | Enucleation   | Female | Radicular cyst         |
| 20          | Enucleation   | Female | Dentigerous cyst       |
| 21          | Enucleation   | Male   | Radicular cyst         |
| 22          | Enucleation   | Male   | Odontogenic keratocyst |
| 23          | Enucleation   | Male   | Radicular cyst         |
| 24          | Enucleation   | Female | Dentigerous cyst       |
| 25          | Enucleation   | Male   | Dentigerous cyst       |
| 26          | Enucleation   | Female | Radicular cyst         |
| 27          | Enucleation   | Male   | Radicular cyst         |
| 28          | Enucleation   | Female | Odontogenic keratocyst |
| 29          | Enucleation   | Male   | Radicular cyst         |
| 30          | Enucleation   | Female | Radicular cyst         |



**Figure 3:** The distribution of the defect area measurement in all control periods for all decompression cases

**Table 2: The inter-group comparisons of defect dimensions (mm<sup>2</sup>) between decompression and enucleation in individual time periods**

|                                | T0                  | T1                  | T2                  | T3                  |
|--------------------------------|---------------------|---------------------|---------------------|---------------------|
| Decompression (n=16) (mean±SD) | 667.92±654.65       | 516.52±587.27       | 317.32±393.55       | 103.36±127.96       |
| Enucleation (n=14) (mean±SD)   | 373.06±235.237      | 248.35±164.97       | 129.78±109.74       | 58.30±45.68         |
| P                              | 0.101 <sup>MW</sup> | 0.205 <sup>MW</sup> | 0.253 <sup>MW</sup> | 0.603 <sup>MW</sup> |

P<0.05 is statistically significant. MW=Mann-Whitney U-test; T0=Preoperative; T1=3 months; T2=6 months; T3=12 months; SD=Standard deviation

**Table 3: The intra-group comparison of defect dimensions between time periods after decompression**

|                | n  | SD     | Minimum | Maximum | Median              |
|----------------|----|--------|---------|---------|---------------------|
| T0             | 16 | 654.65 | 170.96  | 2696.48 | 376.53 <sup>a</sup> |
| T1             | 16 | 587.27 | 80.90   | 2279.89 | 245.79 <sup>b</sup> |
| T2             | 16 | 393.54 | 17.87   | 1344.53 | 162.30 <sup>c</sup> |
| T3             | 16 | 127.95 | 8.75    | 498.77  | 49.99 <sup>d</sup>  |
| P <sup>F</sup> | 16 |        |         |         | <0.001              |

<sup>a-d</sup>Median values that share same letters in the column have no statistical differences between them. P<0.05 is statistically significant. F=Friedman test (post hoc Wilcoxon test); T0=Preoperative; T1=3 months; T2=6 months; T3=12 months; SD=Standard deviation

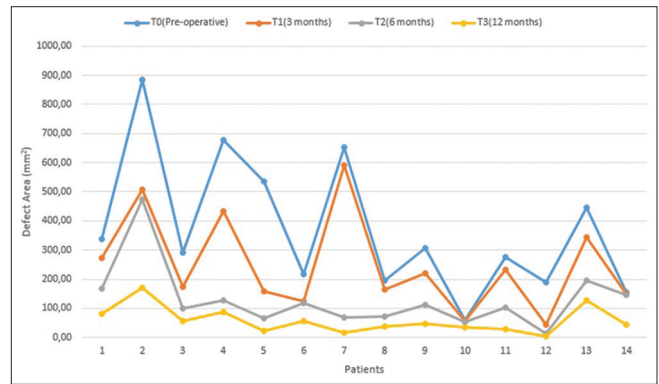
**Table 4: The intra-group comparison of defect dimensions between time periods after enucleation**

|                | n  | SD     | Minimum | Maximum | Median              |
|----------------|----|--------|---------|---------|---------------------|
| T0             | 14 | 235.23 | 59.42   | 883.54  | 298.28 <sup>a</sup> |
| T1             | 14 | 164.96 | 44.97   | 591.10  | 197.73 <sup>b</sup> |
| T2             | 14 | 109.74 | 12.27   | 473.25  | 107.78 <sup>c</sup> |
| T3             | 14 | 45.68  | 3.30    | 170.04  | 45.99 <sup>d</sup>  |
| P <sup>F</sup> |    |        |         |         | <0.001              |

<sup>a-d</sup>Median values that share same letters in the column have no statistical differences between them. P<0.05 is statistically significant. F=Friedman test (post hoc Wilcoxon test); T0=Preoperative; T1=3 months; T2=6 months; T3=12 months; SD=Standard deviation

## DISCUSSION

Decompression is an effective initial treatment protocol to reduce the dimensions of the cystic cavity.<sup>[11]</sup> It is reported that it could be successfully used to reduce the cystic cavities in radicular cysts, odontogenic keratocysts, and unilocular ameloblastomas.<sup>[8]</sup> The total decrease in the volume of the cystic cavity is correlated with the duration of decompression.<sup>[12,13]</sup> Marker *et al.*<sup>[14]</sup> reported that at least 12 months is needed for a reduced rate of 50%–60% in cystic lesions. It is reported that the cystic cavities disappeared 3–9 months after the initial tube placement in a paediatric patient population.<sup>[15]</sup> Similarly, Lizio *et al.*<sup>[12]</sup> reported that 8 months duration of decompression may be deterministic in the prediction of the total duration of the decompression treatment. In the current study, the cystic cavity did not seem to resolve 12 months after tube placement in the decompression cases, and the mean reduction rate in the cystic cavity was approximately 86% at 12 months. This finding is consistent with the literature. The enucleation cases demonstrated a lower reduction rate of 80% than decompression cases. However, there was no statistical significance between



**Figure 4:** The distribution of the defect area measurement in all control periods for all enucleation cases

the two treatment methods. The current study only focused on the two-dimensional change, which is displayed as area measurement on panoramic radiography in the cystic defect at a 12-month control period. Both decompression and enucleation were found to be successful in reducing the defect size at the end of the 12-month control period. In addition to this, a possible difference in the defect reduction between enucleation and decompression may have revealed which treatment modality is better or predictable in achieving an optimal regeneration in the defect. However, there was no statistically significant difference between the two surgical methods in any control evaluations suggesting that the quantity of newly formed bone following both treatments may be similar.

The cystic epithelium has several changes after decompression such as the transformation of the epithelial lining to hyperplastic squamous epithelium, severe thickening in the cystic epithelium, increase in the density of the connective tissue of the cystic wall, and decrease in the ability of adhesion to adjacent structures.<sup>[16]</sup> Park *et al.*<sup>[17]</sup> suggested that the aggressiveness and biological behaviour of the cystic lining does not change after decompression in odontogenic keratocysts. It is reported that there is no significant association between cystic cavity reduction rate and pathological type of jaw cyst.<sup>[9]</sup> Similar findings regarding the histological diagnosis were reported in the study of Gao *et al.*<sup>[8]</sup> In the current study, there were only 4 cases of odontogenic keratocyst and 1 case of residual cyst and therefore, the data was not adequate to make a comparison between reduction rate and pathological type of the cyst.

The timing of enucleation after decompression or a need for enucleation at the end of the decompression process

is controversial. Ugurlu *et al.*<sup>[15]</sup> used decompression as a successful method in 34 paediatric cases in the treatment of dentigerous cysts even without a second enucleation surgery. It is usually recommended that the cystic lesions should be enucleated after the lesion goes into a static state in which the ossification around the epithelial lining does not improve during the decompression procedure.<sup>[18]</sup> Asutay *et al.*<sup>[18]</sup> reported that the timing of the enucleation should be performed when the cystic cavity is reduced to the dimension that the vital structures are not damaged by the procedure. In the study of Pejović *et al.*,<sup>[19]</sup> a patient population including 21 patients with 14 dentigerous cysts and 9 odontogenic keratocysts treated with decompression was evaluated and it was reported that all odontogenic keratocyst cases needed enucleation after a mean follow-up period of 9.9 months. They also reported that 8 cases of dentigerous cysts were successfully treated with only decompression.<sup>[19]</sup> Oliveros-Lopez *et al.*<sup>[11]</sup> reported that there was no recurrence after enucleation following decompression in their case series with 23 patients. A second enucleation surgery is needed to eliminate the total cystic cavity after decompression.<sup>[20]</sup> Decompression cases also were treated with enucleation at further controls, which are not relevant in the current study.

Volume reduction and changes in the bone quality during decompression procedures can be successfully monitored and predicted with a three-dimensional CT evaluation.<sup>[8,13]</sup> Shudou *et al.*<sup>[21]</sup> reported that the future shape of marsupialized odontogenic keratocysts can be predicted with significant accuracy with computerized tomography. Although CT imaging is the gold standard in the volumetric evaluation of cystic cavities, periodic exposure to the increased levels of X-ray may not be well-tolerated by patients. The exact two-dimensional area measurement in the panoramic radiography may correlate with the volume of the cystic cavity. In that sense, panoramic radiography may be more cost-effective and effortless regarding the evaluation of the changes in the cystic cavity between controls.

Decompression may be usually gruelling for the patient. Besides the necessity of continuous controls after the placement of the irrigation tube, several problems such as obstruction in the decompression tube, loss or displacement of the tube, irrigation impediments, and infection may also be encountered in the decompression process.<sup>[11]</sup> Patients should be given clear instructions on how the cavity should be irrigated or that they should inform the clinician in case of an obstruction or displacement of the tube. The patient should always be alert regarding his/her irrigation stent and should immediately inform the health institution if the stent does not function. The irrigation stents of 8 patients were severely displaced and the cleaning function was hampered during the treatment in the current study. New tubes were prepared and adjusted into the osteotomy site and secured to return the function.

One of the main limitations of this study is the limited number of cases and limited range of pathological types of cysts. The

data included in the study was derived from a specific time interval and authors could not effect on the sample size and pathological type due to the retrospective nature of the study. Another limitation is the relatively short-term follow-up of 12-month. The predictive results of decompression are usually prominent in a 1 year. This study was designed on the idea that the behaviour of the defect after decompression should be analysed and compared to a more conventional method of enucleation to reveal which treatment method is more successful in reducing the cystic defect in short-term. Therefore, we set 1 year and the patient selection was made in that sense.

## CONCLUSION

Decompression and enucleation of jaw cysts are both successful in reducing cystic cavities. However, there is no superiority between the two treatment modalities regarding defect reduction. Area measurement of the cystic cavity on panoramic radiography may be a simple and effective way of controlling the dimensional changes during decompression. Decompression treatment may not be easily tolerated by patients due to the disadvantages of constant clinical controls and complications. Future prospective studies focusing on the comparison of the regeneration process in the bone defect after decompression and enucleation may be conducted to understand the dimensional changes in the bone defect.

## Patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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