

Management of Cystic Defects of the Lower Jaw Depending on Cyst Volume – A Retrospective Study

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Abstract

Introduction: Following the removal of cysts of the jaw, the resultant bone defect is filled or left unfilled depending on its size. There is, however, no universal standard defining the volume above which a bone defect should be filled. The objective of this study was therefore to determine a threshold for bone defect filling and to assess whether this threshold value can be used for preoperative planning.

Methods: We analysed cone-beam computed tomography (CBCT) and computed tomography (CT) data from 88 patients who presented with a jaw cyst. First we determined cyst volumes on the basis of CBCT and CT datasets and then we assessed the volume above which defects were filled.

Results: We were able to identify a suitable threshold for bone defect filling which correlates well with the cyst diameter described in the German literature by Partsch for deciding whether to perform cyst marsupialisation or enucleation.

Conclusion: The preoperative assessment of cyst volume is a simple and effective method of obtaining information about the necessity of filling bone defects and is thus a useful and reasonably accurate tool for surgical planning.

Key Words: Mandibular cyst, Defect reconstruction, Cyst enucleation, Cyst volume assessment

Introduction

Bone cysts are pathological structures associated with varying degrees of bone destruction. Most cysts occur in the head and neck region. Approximately 3% of the adult population are likely to develop a cyst at some time in their lives [1]. Since the progressive growth of cysts can lead to damage to surrounding tissues as a result of pressure atrophy, resorption or displacement [1] and large cysts can cause jaw fractures, surgery is the treatment of choice [2]. Irrespective of the method used for cyst management, the goal of treatment is to restore patients to their previous state of health. The most common surgical methods are marsupialisation and enucleation, although the latter is preferred in many cases. The enucleation of cysts was first described by Partsch in a book that was published in 1910. For this reason, this treatment is also known as a Partsch II procedure [3]. He recommended that cysts with a diameter of no more than 2 cm be treated by enucleation. This recommendation is still valid in the current literature [4,5]. Since larger cysts are associated with the risk of wound healing problems and secondary infection, they should be treated by marsupialisation. This method was described by Partsch [3].

On the basis of the assumption that cysts are spherical in shape, the volume of a jaw cyst with a diameter of 2 cm is calculated to be 4.19 cm³. The objective of this study was to assess whether this threshold value still plays a role in making decisions about appropriate treatment.

Material and Methods

Using computed tomography (CT) and cone-beam computed tomography (CBCT) data from 88 patients who underwent treatment for a mandibular cyst, we retrospectively assessed cyst volumes and the methods that were used for treating the cysts. The volumes of the 88 mandibular cysts were calculated

using iPlan software (Brainlab® iPlan 3.0.2, Feldkirchen, Germany) [6].

We measured each cyst three times in order to obtain representative volumes. The three measurement results were averaged so that a mean value was obtained for every cyst. Data were recorded using Microsoft Office Excel 2007 and analysed using IBM SPSS Statistics 19 and SAS 9.2. Microsoft Office Excel 2007 and IBM SPSS Statistics 19 were also used to create tables and figures for presenting data. We determined cyst volumes and assessed which bone defects were filled during surgery. For this purpose, we reviewed the operative reports of the patients. In routine clinical practice, cyst volume was often not the overriding factor in the decision to reconstruct a defect using autogenous bone grafts after cyst removal. For this reason, we conducted this study to determine the cyst volume above which autogenous bone grafts were used to fill bone defects in patients who received treatment at the Department of Oral and Maxillofacial Surgery of Hanover Medical School.

Data were analysed by receiver operating characteristics (ROC) curve analysis [7,8]. An ROC curve was obtained by calculating sensitivity and specificity, which are important measures of the accuracy of a diagnostic test. All possible pairs of values were considered and Youden's index [9] (i.e. sensitivity + specificity – 1) was used to obtain an optimum threshold value, which gives the highest sensitivity and specificity. This provides the basis for determining the cut-off value. Sensitivity is also known as the true positive rate. In this study, it measures the proportion of patients who presented with defects that, as shown by experience, were correctly filled with bone grafts after cyst enucleation. Specificity relates to the ability to identify defects that do not require filling. In this test, it thus measures the proportion of patients who were correctly identified as negatives or, in other

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words, patients who presented with bone cavities that were correctly left unfilled.

Results

Statistical analysis showed the following results.

The Youden index was highest at a cut-off of 3.205. At this point, sensitivity was 0.730 and 1-specificity was 0.333.

Sensitivity and specificity results thus suggest that autogenous bone grafts were used for the intraoperative reconstruction of defects resulting from the removal of cysts with a minimum volume of 3.21 cm³. A scatter plot [10] shows the distribution of volumes around the cut-off (*Figure 1*).

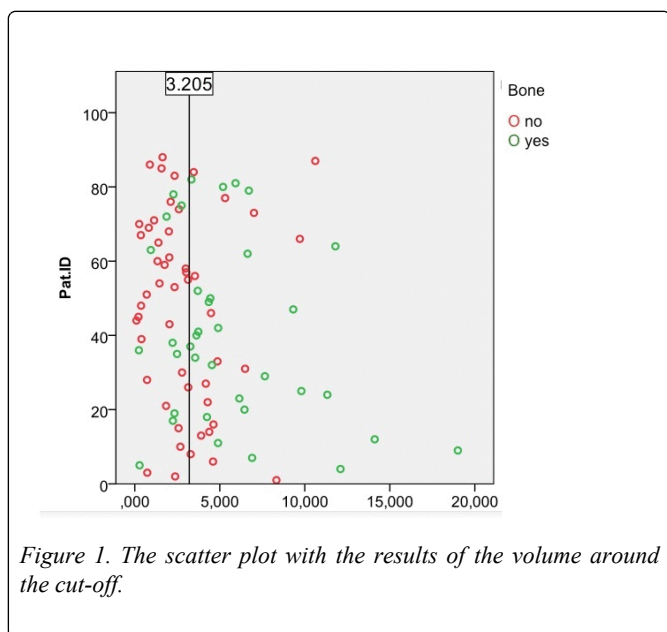


Figure 1. The scatter plot with the results of the volume around the cut-off.

Ideally, all red circles, which represent patients who did not undergo defect reconstruction with autogenous bone grafts, should lie to the left of the cut-off at a specificity and sensitivity of 100%. By contrast, all green circles, which represent patients with a cyst volume of more than 3.21 cm³, should lie to the right of the cut-off.

In this study, the threshold above which mandibular defects were reconstructed with autogenous bone grafts was a cyst volume of 3.21 cm³.

Discussion

The cut-off that was retrospectively determined in this study was 3.21 cm³, which corresponds to a sphere with a diameter of 1.83 cm.

The simplified model presented here confirms the recommendation of Partsch that only cysts with a maximum diameter of 2 cm be treated by enucleation. The diameter that was calculated in a computer-assisted manner on the basis of CT and CBCT data (i.e. 1.83 cm) is almost identical to the threshold reported by Partsch.

For this reason, both the historical value suggested by Partsch and the cut-off volume of 3.21 cm³ calculated using computer software are legitimate and useful tools for basic treatment planning. With a sensitivity of 73% and a specificity

of 66.6%, however, the cut-off volume (3.21 cm³) does not provide sufficient evidence to serve as a basis for a guideline on the management of cysts. Since Partsch recommends that only cysts with a maximum diameter of 2 cm be treated by enucleation with a view to avoiding complications in bone regeneration, the cut-off nevertheless provides helpful information. In a simplified sphere model, a cyst with a cut-off volume of 3.21 cm³ has a diameter of 1.83 cm, which is almost identical to the threshold value defined by Partsch. Owing to medical advances in the field of augmentation materials, the role of this threshold has changed. Whereas it initially helped surgeons decide whether to perform marsupialisation or enucleation, it now helps surgeons decide in favour of or against the reconstruction of a defect with autogenous material.

In the past, surgeons focused more on deciding whether they should perform marsupialisation or enucleation. Today, the focus is on whether a defect should be filled after cyst enucleation. These decisions are similar to each other since surgeons usually decide against the open management of cysts and prefer enucleation as a result of medical advances. The question is and will continue to be whether a defect should be filled with an autogenous bone graft or not. The thresholds presented above help surgeons in making decisions about appropriate treatment.

Conclusion

It is true that the study presented here included only patients who underwent treatment in a single centre. It is also true that the assumption of a cyst as a sphere can only serve as a model. Nevertheless, the study shows that the recommendation of Partsch to only reconstruct defects resulting from cysts with a diameter of 2 cm and more is still appropriate and is still implemented. Defects with a size of more than 2 cm should always be filled in order to stabilize the blood clot and to ensure a good and rapid osseointegration.

The difference between the cut-off calculated in the present study and the threshold of 2 cm can be explained by the use of a model in which cysts are spherical in shape. The preoperative assessment of cyst volume can be a useful tool in clinical practice.

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