

A method for calculation of bone socket volume in radicular cysts of jaws by an orthopantomogram

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Abstract

The authors suggest a method for preoperative determination of bone cavity volume (V) in radicular cysts of the jaws by measurement of orthopantomograms (panoramic radiographs) and calculation by the formula:

$$\frac{D_1 \times D_2}{K} = V, \text{ where}$$

D_1 is the largest diameter parallel to the occlusal line of teeth, measured in centimeters on an orthopantomographic image of a radicular cyst; D_2 is the largest diameter, measured in centimeters, perpendicular to D_1 ; K is a factor with a value of 2.53

Key words: radicular cysts, jaw, volume.

Метод определения объёма костной впадины корневой зубной кисты ортопантомограммным измерением

Авторы предлагают метод предоперационного определения объёма костной впадины (V) корневой зубной кисты челюсти ортопантомограммным измерением (панорамная радиография) и расчет по формуле:

$$\frac{D_1 \times D_2}{K} = V, \text{ где}$$

D_1 – диаметр большой параллели окклюзивной линии зуба, измеряемый в сантиметрах, ортопантомографического изображения корневой зубной кисты; D_2 – большой диаметр, измеряемый в сантиметрах, перпендикулярный D_1 ; K – фактор оценки 2,53.

Ключевые слова: зубная корневая киста, челюсть, объем.

Introduction

Cysts are one of the major causes of bone loss in jaws [1]. According to the World Health Organization, radicular cyst is defined as pathological bone cavity of inflammatory origin, lined with epithelium, developing around the apex, or, less commonly, laterally to dental roots in case of accessory lateral root canals [2]. It is a unanimous opinion that they are the most common type of jaw cysts [3, 4, 5], confirmed by our earlier study [6]. The surgical approach to radicular cysts depends on their size. The volume of bone lesions in radicular cysts can be determined preoperatively by the use of computed tomography data [7, 8, 9], but implementation of computed tomography in most of the cases does not make economic sense, and therefore its application in practice is rare. Radiographic assessment of the volume of bone lesions in radicular cysts is a challenge because of the irregular shape of the jaws and the presence of root apexes in the cavity, factors contributing to developing a bone defect with a complex shape. The method for calculating the volume of spheroid ($\pi \cdot [(D_1 \cdot D_2^2) : 6] = V$, where D_1 is the larger diameter, D_2 is the shorter one) is not applicable because of unreal sizes of the x-ray image in orthopantomograms.

The aim of this study was to design a method for calculating the bone socket volume in radicular cysts of the jaws using an orthopantomogram to determine the value of the factor K in the formula:

$$\frac{D_1 \times D_2}{K} = V,$$

where D_1 is the largest diameter parallel to the occlusal line of teeth, measured in centimeters on an orthopantomographic image of a radicular cyst; D_2 is the largest diameter, measured in centimeters, perpendicular to D_1 ; V is the volume of the bone cavity of the radicular cyst in milliliters, determined intaroperatively.

Material and methods

Material: The study involves 80 patients with 80 jaw cysts, histologically verified after being removed. The studied cysts were confined to the jaw bone with no evidence of lysis of the cortical bone plate.

Method: All patients underwent preoperative orthopantomographic study using the unit Orthopantomograph PALO-MEX, Siemens Rontgen SR 90/15 (Siemens AG, Germany). The largest diameter of the shadow of the cyst, parallel to the occlusal line, and the largest diameter perpendicular to it were measured in centimeters on orthopantomograms using a digital caliper (Mitutoyo, Illinois, USA); the measurement was made twice consecutively, and the arithmetic mean of the two measurements was considered reliable. The patient was administered anesthesia and a mucoperiosteal flap was elevated. An opening 5 millimeters in diameter in the ves-

tibular cortical plate over the osteolytic lesion was trepanned and the contents of cyst were evacuated by aspiration. The patient was positioned in such a way that the trepanation opening was at the highest point of the bone cavity. Saline solution was injected into the cavity by the use of a syringe and a needle until it was visually determined that the cavity was completely filled; the amount of saline solution necessary to replace the volume of the cavity was recorded in milliliters as the difference between the amount initially placed in the syringe and the saline remaining after filling the bone cavity. The measurement was made twice consecutively, and the arithmetic mean of the two measurements was considered reliable. The cyst was removed using a chosen method and the surgical intervention was concluded. The value of the factor K was determined by the use of the SPSS 11.0 software.

Results

The distribution of patients by gender was 25 (31.3%) women and 55 men (68.8%), and by localization of the cysts was 38 (47.5%) cysts of the maxilla and 42 (52.5%) of the mandible. Data on the average values of the measured diameters and volume, as well as the value of the factor K, are presented in table 1.

Table 1

Results from the measurements of horizontal (D₁) and vertical (D₂) diameter of the bone cavity volume (V) and the estimated value of factor K

	Average horizontal diameter (D ₁), cm	Average vertical diameter (D ₂), cm	Average cavity volume (V), ml	Factor K
Maxilla	1,99 ± 0,64	2,78 ± 1,39	2,44 ± 1,15	2,39
Mandible	2,36 ± 1,27	3,99 ± 3,09	3,86 ± 2,41	2,65
Jaw bone	2,19 ± 1,03	3,42 ± 2,49	3,19 ± 2,04	2,53

Statistical data processing (Mann-Whitney Test) found that there was no significant difference between the average values of K for maxilla and mandible.

Discussion

Data on the size of the bone lesion in radicular cysts is essential for treatment. There are three approaches:

- Enucleation – one-stage complete removal of cystic wall after forming a flap with or without bone grafting.

- Marsupialisation - “unroofing the outer wall of the cyst by making a surgical incision, evacuating its contents, and establishing a large permanent opening by suturing the remaining part of the cystic membrane to the mucosal surface around the periphery of the opening” [10].
- Decompression - establishing communication between the cyst cavity and the external environment with placement of tubing to maintain drainage. Decompression is also used as a stage in the preparation of the cyst for enucleation with the aim to reduce its size, thus resulting in more normal bony contours after treatment is concluded [11].

Conclusion

The suggested method for preoperative determination of the volume of bone cavity in the case of radicular cysts of the jaws is easy to implement, it is not laborious and the price is low. The data provided by it can be a leading reason for giving preference to a given method of treatment. When bone grafting is used, knowing the estimated volume of the bone cavity allows preparation of the optimal amount of material.

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