Differential diagnosis between dentigerous cyst and benign tumor with an embedded tooth

Atsushi Ikeshima and Yoshiyasu Tamura

Department of Radiology, Nihon University School of Dentistry at Matsudo, Chiba 271-8587
§Research and Development 1, Center for Development of Statistical Computing, The Institute of Statistical Mathematics, Tokyo 106-8569

(Received 16 October 2000 and 21 February 2002)

Abstract: It has been generally recognized that the radiological appearances of cysts and tumors related to an embedded tooth are similar. However, based on their clinical experience, Abrams et al. pointed out that there was a difference between the two lesions at the attachment point to the embedded tooth. To investigate this difference, we conducted a study employing the radiographs of patients who visited Nihon University Dental Hospital at Matsudo and were pathologically defined as having a cyst or tumor. Using radiographs of these patients, we investigated the attachment point to the embedded tooth, and expressed the results as the proportion of the attachment point to the embedded tooth root length. The study was carried out in 100 patients with cysts (87 dentigerous cysts and 13 odontogenic keratocysts), and 27 patients with benign tumors (24 ameloblastomas and three adenomatoid odontogenic tumors). Prior to treatment based on the numerical results, the distribution of the results was examined. Thus, we evaluated several methods of examining the distributions, and found the best method to be discriminant analysis. The results showed that the discriminated boundary value (from the cemento-enamel junction) was 0.38 for the embedded tooth root length. The cases showing a boundary value of less than 0.4 for the cemento-enamel junction were judged to be cysts, and those showing a value of 0.4 or more were judged to be benign tumors. The rate of misjudgement was 28% in the cyst group and 33.3% in the benign tumor group. (J. Oral Sci. 44, 13-17, 2002)

Key words: differential diagnosis; embedded tooth; cyst; benign tumor; discriminant analysis.

Introduction

Dentigerous cysts and some benign tumors with embedded teeth show similar images on the radiographs(1-4). These benign tumors are ameloblastoma and adenomatoid odontogenic tumor without calcified bodies on the radiograph. Based on their clinical experience, Abrams et al.(5) pointed out a difference between cysts and benign tumors with an embedded tooth: the attachment point to the embedded teeth. Generally, radiographs of the dentigerous cysts and the benign tumors with an embedded tooth have similar appearances in terms of the contents and the boundaries of the lesions(6-8). The treatment plan is basically different for dentigerous cysts(9,10) and benign tumors(11,12). Therefore, it is important to distinguish between dentigerous cysts and benign tumors on the radiographs. For the above reasons, we attempted to make a differential diagnosis between dentigerous cysts and benign tumors with an embedded tooth. A study of this problem is underway(13-15).

In this study on dentigerous cysts and benign tumors with an embedded tooth, the number of diseases and cases has been on the increase compared with our last report(15).
The difference in the attachment point to the embedded tooth was studied in the current research.

**Materials and Methods**

The radiographs used were of the patients with dentigerous cysts and some benign tumors with an embedded tooth (ameloblastoma and adenomatoid odontogenic tumor without calcified bodies on the radiographs) that came to our dental hospital from 1976 to 1980 (Table 1). The age of patients in the dentigerous cyst group ranged from 10 to 79 years, with an average of 32.6 years. The patients included 61 males and 39 females. The age of patients in the group with benign tumors with embedded teeth ranged from 12 to 47 years, with an average of 22.6 years. The patients included 14 males and 13 females. Cases of incomplete tooth root and uncertain tooth root on the radiographs were excluded.

In this study, either a rotational panoramic radiograph or a lateral oblique view was used in each case. The lateral oblique view was selected if both images were available. The embedded tooth and the boundary of the cyst or the benign tumor were traced on the radiographs. The distance from the cemento-enamel junction to the attachment point and the root length were measured by the method shown in Figs. 1 and 2. The data were expressed as a ratio to the length of the root. The dentigerous cyst group and the benign tumor with an embedded tooth group were established based on this value, and each distribution was investigated (Fig. 3). The truncated normal distribution was estimated by applying the maximum likelihood method(16,17) for the dentigerous cyst group. The mean and variance were then estimated from the distribution (Table 2). When the data generally given \( X_1, ..., X_n \), the mean(\( \mu \)) and variance(\( \sigma^2 \)) were estimated using the following formula.

\[
\hat{\mu} = \frac{n^2 - 1}{n^2 + 1} \left( \frac{1}{n} \sum_{i=1}^{n} x_i \right)
\]

\[
\hat{\sigma}^2 = \frac{1}{n^2 + 1} \sum_{i=1}^{n} (x_i - \hat{\mu})^2
\]

Moreover, abnormal values of the benign tumor with an embedded tooth group (6 cases) were excluded based on the probability plot method(18). Therefore, the distribution was estimated to be normal.

The discriminated boundary point(19) between the dentigerous cyst group and the benign tumor with an embedded tooth group was obtained from the estimation of mean and variance. The boundary point was obtained using the following formula.

\[
\frac{\bar{x}_1 \cdot \sigma_2 + \bar{x}_2 \cdot \sigma_1}{\sigma_1 + \sigma_2}
\]

\( \bar{x}_1 \):mean (first group)

\( \bar{x}_2 \):mean (second group)

\( \sigma_1 \):standard deviation (first group)

\( \sigma_2 \):standard deviation (second group)

A misjudgement probability was obtained by this discriminant analysis.

**Results**

The dentigerous cyst group showed many small values (near 0) while the benign tumor with an embedded tooth group had many large values (near 1 and over 0.5).

The mean of the dentigerous cyst group was estimated at 0.29, while the variance of the group was estimated at 0.078. In contrast, the mean of the benign tumor with an embedded tooth group was estimated at 0.46, and the
variance of the group was estimated at 0.063, as shown in Table 2. However, the reliability of the value for the benign tumor with an embedded tooth group was 78% due to the accepted outlier. The boundary point of the discriminant analysis was 0.38. However, the boundary point became 0.4 because the value indicated one digit below the decimal point. Therefore, it discriminated as a cyst when the attachment point was less than 0.4 in terms of the length of the embedded tooth root. Other values (0.4 or more) discriminated as a benign tumor with an embedded tooth. In this case, the misjudgment probability, according to the discriminant analysis, was 28% in the dentigerous cyst group and 33.3% in the benign tumor with an embedded tooth group.

Discussion

Lesions related to an embedded or an unerupted tooth, dentigerous cysts (including odontogenic keratocyst) and ameloblastoma represented 1/4 to 1/3 of all cases(1,20). In particular, adenomatoid odontogenic tumors represented 3/4 of all cases(21,22). If there is a difference between dentigerous cysts and benign tumors with an embedded tooth (ameloblastoma and adenomatoid odontogenic tumors), it may be useful in differential diagnosis. Concerning the embedded tooth, Abrams et al.(5) found a difference of the attachment position between the cyst and the tumor. Therefore, we have been investigating the difference between dentigerous cysts and ameloblastoma containing teeth(13-15). In this study, we examined a number of the cases of odontogenic keratocysts and adenomatoid odontogenic tumors without calcified bodies on the radiographs.

It is necessary to make a differential diagnosis between a dentigerous cyst and benign tumor, as the treatment plan differs for each lesion(9-12). We excluded incomplete tooth roots due to the problem of infection, and uncertain tooth roots because it could not be measured at the attachment point. In addition, we selected the lateral oblique view if there was both a rotational panoramic radiograph and a lateral oblique view, because there was greater enlargement of the rotational panoramic radiograph than of the lateral oblique view. I have data of the area of the lesion between the rotational panoramic radiographs and the lateral oblique views. The correlation coefficient was 0.78, the measurement value of this study was a distance (square root of the area), and the correlation coefficient was estimated at 0.88. Therefore, the distance from the attachment point to the root apex was useful in this study.

The traced radiographs were used in this measurement.

<table>
<thead>
<tr>
<th>CYST</th>
<th>BENIGN TUMOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>DENTIGEROUS CYST</td>
<td>AMELObLASTOMA</td>
</tr>
<tr>
<td>87 cases</td>
<td>24 cases</td>
</tr>
<tr>
<td>ODONTOGEnIC KERATOCYST</td>
<td>ADENOMAtOID ODONTOGEnIC TUMOR</td>
</tr>
<tr>
<td>13 cases</td>
<td>3 cases</td>
</tr>
<tr>
<td>TOTAL</td>
<td>TOTAL</td>
</tr>
<tr>
<td>100 cases</td>
<td>27 cases</td>
</tr>
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Table 2 Estimate using maximum likelihood method and approximate normal distribution

<table>
<thead>
<tr>
<th>ESTIMATE USING MAXIMUM LIKELIHOOD METHOD</th>
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</thead>
<tbody>
<tr>
<td>ESTIMATE of MEAN</td>
</tr>
<tr>
<td>CYST</td>
</tr>
<tr>
<td>APPROXIMATE NORMAL DISTRIBUTION</td>
</tr>
<tr>
<td>MEAN</td>
</tr>
<tr>
<td>BENIGN TUMOR</td>
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</tbody>
</table>

Table 3 Comparison of basic statistics

<table>
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<tr>
<th>CYST GROUP</th>
<th>MEAN</th>
<th>VARIANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NON-MODIFICATION</td>
<td>0.29</td>
<td>0.079</td>
</tr>
<tr>
<td>APPROXIMATE NORMAL DISTRIBUTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESTIMATE VALUE</td>
<td>0.29</td>
<td>0.078</td>
</tr>
</tbody>
</table>

Fig. 3 Distribution of the data.
by applying the maximum likelihood method(16,17) in this study. This is an estimated value based on the maximum likelihood method, and it is useful when using binomial, multinomial, Poisson, and normally distributed. The normal distribution (mean and variance) was estimated based on the data of the dentigerous cyst group. Therefore, the best fit of the estimation from the maximum likelihood method could be determined from table 3, which compares the method of accepting the outlier(13-15), not accepting the outlier, and conducting estimation by the maximum likelihood method. After 6 outliers were accepted by the probability plot method(18), the mean and the variance was calculated for the benign tumor with an embedded tooth group.

The boundary point of the discrimination(19) was obtained from the distribution by the maximum likelihood method (estimate of the mean and variance), and approximated to normal distribution in this study. As a result, less than 0.4 indicated a dentigerous cyst and 0.4 or more indicated a benign tumor with an embedded tooth (in a comparison of the distance between the cemento-enamel junction to the attachment point and the root of the embedded tooth). However, the misjudgment probability with the discriminant analysis of the dentigerous cyst group was 28%, while that of the benign tumor with an embedded tooth group was 33.3%. In addition, the confidence of the benign tumor with an embedded tooth group decreases to 52% due to the outlier. It is thought that this caused a distribution bias.

Moreover, ameloblastoma are divided into five types (follicular type, plexiform type, acanthomatous type, granular cell type and other variations) in the WHO classification(23). Therefore, more detailed examination will be necessary.

**Conclusion**

Using the radiographs of 100 cases of dentigerous cyst and 27 cases of benign tumor with an embedded tooth diagnosed histo-pathologically, we measured the distance from the cemento-enamel junction to the attachment point in the embedded tooth. This value was expressed in the ratio to the length of the root of the embedded tooth. In this study, the mean and variance were estimated by applying the maximum likelihood method, as there was a problem with the distribution of the data. From the results of the discriminant analysis, less than a 0.4 ratio of the length of the embedded tooth root (attachment point) indicated a dentigerous cyst (with a 28% misjudgment probability) and 0.4 or more (attachment point) indicated a benign tumor with an embedded tooth (with a 33.3% misjudgment probability).

**References**