Evaluation of the Course of the Inferior Dental Canal Using Digital Dental Panoramic Imaging

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ABSTRACT

Background

The position and appearance of the inferior dental canal (IDC)areimportant consideration during a surgical treatment of the mandible.

Objective

To study the appearance of the IDC radiographically with the aid of histogram equalization of digital imaging to improve the vision of the IDC outline on the digital dental panoramic images in the posterior area of the lower jaw.

Method

150 digital panoramic images ofthe right side of the mandible were evaluated according to a particular inclusive criteria.The percentage of the IDCwas calculated to assist the histogram equalization usefulness in the vision of the canal.

Result

The results showed that there was a difference in the appearance of IDC on the panoramic images of the mandible. The evaluation of the histogram equalization of the digital imageshowed that the canal visualization improved in twenty-seven images,representing 52%,and twelve images,representing 23%, did not show any improvement. The researcher was no sure of thirteen images, representing 25%.

Conclusion

Since the radiographic appearance of IDC is not universal, and the evaluation of the histogram equalization of the digital image found to be useful in some cases, but not in all; therefore, there is a need for further investigation using advanced modalities such as cone beam CT.

KEY WORDS:

inferior dental canal, histogram equalization, digital dental panoramic image

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تقييم مجرى قناة الفك السفلي باستخدام التصوير البانورامي الرقمي للأسنان

عمر بشير طه
بكالوريوس طب و جراحه الفم و الاسنان_ماجستير علوم تشخيص فمي/ اشعه الوجه و الفم و الفكين

المستخلص

ان لموقع و مظهر قناة الفك السفلي اعتبارات مهمه اثناء التدخل الجراحي في الفك السفلي, الاهداف من هذه الدراسة هي لتقييم الظهور الشعاعي لقناة الفك السفلي و لتبيان مده قابليه الرسم البياني المعادل في تحسين المظهر الشعاعي للخطوط العريضة لقناة الفك السفلي, العينة المستخدمة كانت ١٥٠ صوره شعاعيه بانوراميا ,الجهة اليمنى فقط ادخلت بالدراسة طبقا لمعايير خاصه ,النسبة المئوية لقناة الفك السفلي احتسبت لبيان مدى فائدة الرسم البياني المعادل في تحسين رؤيه قناة الفك السفلي, النتائج من هذه الدراسة بينت ان هناك اختلافا في مظهر قناة الفك السفلي في صور اشعه البانوراما, كما ان تقييم الرسم البياني المعادل اظهر انه بإمكانه تحسين رؤيه الصورة في ٥٢٪ من الحالات و لم اي يظهر اي تحسن في رؤيه الصورة في ٢٣٪ من الحالات و في ٢٥٪ من الحلات لم يكن الباحث متأكدا من مدى تحسن رؤيه من عدمه, و بما ان صوره قناه الفك السفلي لم تكن موحد في جميع صور الأشعة البانوراما و خاصيه الرسم البياني المعادل كان مفيدا في بعض الحلات فقط و هذا يؤشر الى الحاجه الى فحوصات اضافيه باستخدام طرائق متقدمة كالتصوير المقطعي مخروط الشعاع.

INTRODUCTION

The IDC is a bony structure existing in the mandible allowing the passing of neurovascular bundle includingthe inferior alveolar nerve(IAN), which is the third division of the fifth cranial nerve (trigeminal nerve). The IAN is important for neurotransmission of sensation inthe inferior third of the face. The IDC starts at the mandibular foramen in the middle third of the ascending ramus and terminates at the mental foramen. The mental foramen is located under the apex of the second premolar or between the first and second premolar[1].

Radiographic imaging is an important diagnostic tool throughout the assessment and treatment plan; sometimes IDC cannot appear on dental panoramic image apparently[2, 3]. Angelopoulos et al in 2008 stated that dental panoramic images could not provide reliable knowledge on the position of the IDC[2]. The use of dental implants has widely increasedfor the last twenty years; as a result,the demand for radiographic imaging increasedbecause it is essential in identifying the proper position of the dental implant to avoid postoperative problems such as numbness or failure of implant[4, 5, 6]. The location and appearance of IDC are of great significance during a surgical therapy of the lower jaw.

,Misch in 2005 and Angelopoulos et.al in 2008 showed that osseous density could be related to the images pixel value [2][3].Histogram equalization has

the ability to maximize the contrast of the image through applying a gray level transformation, which can flat the outcome of histogram, and this will lead to the improvement of the contrast of the images. This allows the area of the lower local contrast to obtain a higher contrast, and histogram equalization doesthis through effectively spreading out the most recurrent density values[8]. The first objective of this research is to study of the radiographic appearance of IDC,and the second one isto assess the histogram equalization of digital imaging to see it has the ability to improve the vision of the IDC outline on the digital dental panoramic images in the posterior area of the lower jaw .

METHODS

We studied 150 digital dental panoramic images selected from the stored images taken in 2013 and 2014 for patients coming to the Department of Oral Diagnosis, College of Dentistry,University of Tikrit for various reasons such as initial inspection, orthodontic treatment or surgery. The images were taken according to the manufacturer's instructions using (KODAK CS8100,FRANCE) dental panoramic machine by well-practiced senior dental radiologist.

Fig. 1: Type I(well- defined upper and lower borders)

Fig 3: Type IV (ill-defined upper and lower borders)

Due to variations in the anatomical structure of the patient, the exposure parameter was adjusted accordingly. The mental foramen were not included in the study and only the right side was included for better standardization according to the following inclusion criteria[9]:

- The patient must be 18 years old or older with complete eruption of permanent teeth.
- Resolution of the image must be acceptedwith minimum distortion especially in the area of interest.
- Lower canine, lower first premolar, lower second premolar, andlower first molar must be fully erupted with no pathological lesions.

The visibility and appearance of IDC were identified on all images by the examiner depending on the following criteria:

- Type I:well- defined upper and lower borders (fig.1)
- Type II:well-defined upper and ill-defined lower borders(partially defined)
- Type III: ill-defined upper and well-defined borders(partially defined fig. 2)
- Type IV:ill-defined upper and lower borders(ill-defined fig.3)

F ig 2: Type III (ill-defined upper and well-defined borders)

The second objective of this study (the evaluation of histogram equalization usefulness) was accomplished through the selection of histogram options from the toolbar starting by drawing a line from the distal root of the first molar to the mesial of canine region and the histogram performed. The drawing of this line was repeated twice or even three times, depending on the type of IDC. One of the lines drown in cortical border and the second line on the radiolucent area between the two borders, and the last line drown on the second border, if present. For each case a comparison was done among the

value of histogram equalization (in the radiolucent area between the two borders must be less in the cortical border) to assist usefulness in improving the visualization of the inferior dental canal outline on the dental digital panoramic images in the posterior mandible.

RESULTS

Types of Canals

In 63.33% of cases the IDC was classified as Type I, which was represented in 95 cases (well-defined upper and lower borders), while Type II classification (well-defined upper and ill-defined lower borders) was not be found in any case 0.00%. Type III was found in 26 cases,representing 17.3% of the (ill-defined upper and well-defined borders),finally, when the IDC could not be defined at all, which is Type IV (ill-defined upper and lower borders) was found in 29 cases, representing(19.3 %) as shown in (Table 1)

Table 1: number of cases of IDCappearance

Type	*Number of cases*	*Percentage*
Type I: canal defined	33	63.3
Type II canal partially defined(superior)	Zero	0.00
Type III: canal partially defined(inferior)	9	17.3
Type IV: canal not defined	10	19.3

Histogram Equalization Usefulness

The findings of the150 images were as follows:

1. Histogram equalization could aid in theimprovement of the canal visualization in seventy-eight images,representing (52%),
2. Thirty-five imagesdid not show anyimprovement, representing (23%),
3. The examiner was uncertain of thirty-seven images, representing 25%.

DISCUSSION

In this study, the percentages of IDC types were 63.3 in type I (canal defined), zero in type II (canal partially defined, upper border), 17.3 in type III (canal partially defined,lower border),and 19.3 in type IV (not defined).Pria etal, in 2011[9] findings were type I (canal defined) 36.75%, type II (canal partially defined,superior) 0.2, type III (canal partially defined, (inferior) 34.14,and type IV (not defined) 28.92.

Their sample was 500 panoramic images and the method was the same used for this study. In our study, the sample was 150 images only, but both studies agreed that dental panoramic cannot predict the appearance of IDC in all cases.

Wadu et al [10],studying IDC appearance on the dental panoramic radiographs, found in some cases that the cortical border of the inferior dental canal was either disrupted or did not appear on the dental panoramic radioghraphical image.

The upper border was more liable to disruption than the lower border, whichwas in accordance with our study, in which we did not find visible superior borders or invisible inferior borders type of IDC, but we found invisible superior and visible inferior borders type of canal in 17.3% of the cases.

The second object of our study was the evaluation of histogram equalization usefulness. The results of the study showed that there was improvement of canal visualization in 52% of the cases, and there was no improvementin 23% of the cases. The examiner was uncertainof 25% of the cases, but Pria et al, in 2011[9] found improvement in the canal visualization in 45% of thecases, but in 37% of the cases improvement did not occur. The examiner was uncertain of 16.4% of the cases.

The large sample (500) may be the cause of these differences, but our study was in accordance with Pria et al[9], who in 2011 found that in some cases the histogram equalization tool provided by the manufacture had the ability to improve the vision of cortical border of IDC, but for daily clinical uses the histogram equalization tool was not so much relevant.

CONCLUSION

Knowledge about the position and cortical outline of the IDC is very important when dental implant has been recommended. Since the radiographic appearance of IDC is not universal, and the evaluation of the histogram equalization of the digital panoramic image found to be useful in some cases, but not in all; therefore, there is a need for further investigations using advanced modalities such as cone beam CT, which is required in some cases.

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