

Original Research

Modified Bisecting Angle Technique: A Novel Method to Eliminate Zygomatic Superimposition over the Apices of Maxillary Molars

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ABSTRACT

Objectives: Intra oral radiographic imaging is the most widely used method for obtaining information about root canal anatomy and working length determination. Measuring exact working length is the most essential step for the success of root canal treatment. Bisecting angle technique (BAT) is the most widely used technique for this purpose. However, zygomatic superimposition over the apices of maxillary molars makes it difficult for the dentist to estimate exact working length. The present study made certain modifications in BAT to overcome these undiagnostic shadows. The aim of the study is to compare three techniques, namely paralleling cone technique (PCT), BAT and modified bisecting angle technique (MBAT) to prevent such superimposition over molar apices.

Materials and Methods: A total of 53 patients requiring endodontic treatment for maxillary molars were included in the study. Three radiographs one with each PCT, BAT, MBAT were made. Each radiographic image was recorded acceptable or unacceptable based on the zygomatic superimposition. The data thus collected was subjected to statistical analysis using chi-square test. **Results:** The percentage of acceptability in MBAT was 56.6% ($n = 30$) when compared with BAT which was only 28.3% ($n = 15$) and PCT was 58.3% ($n = 31$) indicating statistically significant difference between BAT and MBAT. But no statistically significant difference was found between MBAT and PCT. **Conclusion:** In the present study, MBAT was found to be more accurate than BAT, and it was relatively as accurate as PCT in eliminating zygomatic superimposition over the apices of maxillary molars.

KEYWORDS: Intra oral periapical radiography, Bisecting angle technique, Modified bisecting angle technique, Paralleling cone technique, Undiagnostic shadows, Zygomatic superimposition, Working length, Periapical imaging

INTRODUCTION

Intra oral periapical imaging is the backbone of imaging for a general dentist [1]. It is a pre-requisite for diagnosing and assessing treatment outcome in periodontal diseases, bone pathologies, dental caries and periapical pathologies. Intra oral periapical radiographs (IOPARs) play an essential role in

Endodontic treatment success and prognosis, especially in determination of root length and estimation of working length. Most commonly used technique in routine dental practices is bisecting angle technique (BAT) [2]. However, superimposition of zygomatic bone over the apices of maxillary molars precludes the measurement of exact working length of the same.

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In IOPARs, the zygomatic buttress of maxilla is shown as U-shaped radiopacity, most commonly seen over the apices of maxillary first and second molars [3]. This is mostly observed while using BAT than in Paralleling cone technique (PCT). However, PCT has its own disadvantages.

Hence, in the present study, a newer radiographic technique was followed which is a modification of routine BAT to eliminate this interference of zygoma over the apices of maxillary molars.

MATERIALS AND METHODS

A total of 53 patients, needing endodontic treatment for first and second maxillary molars were included in the study. Institutional Review Board Ethical Clearance and patients' consent were obtained prior to the study.

The sample consisted of 35 males and 18 females; aged between 15 and 45 years. Patients with dental or skeletal abnormalities, incomplete apex formation and who aren't willing for the study were excluded. Three radiographs were taken for each patient using BAT, modified bisecting angle technique (MBAT), PCT, respectively, accounting for 159 radiographs, in total.

RADIOGRAPHIC TECHNIQUE

Conventional BAT & PCT were used. For MBAT, few modifications in the original technique were made, keeping the basic principal of BAT, the Ciezynski's rule of Isometry, intact. Snap-A-ray film holder was used for taking radiographs.

As stated, the basic principal of MBAT and BAT is similar; except the film position and reduction in vertical angulation.

1. Appropriate radiographic safety measures were taken under National Council on Radiation Protection and measurements [NCRP] guidelines.
2. Patient head positioning is similar to that of BAT, and the film is stabilised using film holder.

3. The film is placed intra orally in a position so that the apical edge of the film was at the same position like in BAT. But the occlusal edge of the film is placed approximately 5 mm distant from the occluso-palatal line angle. This is achieved by positioning the biting platform of the film holder slightly lingually.
4. In BAT, the vertical angulation given to x-rays for maxillary molars is usually 20 degrees. In MBAT, as we placed the film 5 mm lingually, the vertical angulation was reduced by 5 degrees; henceforth, the angulation is 15 degrees.
5. Horizontal angulation of x-ray beam should pass through the interdental regions to prevent proximal contacts from overlapping.
6. Central x-ray beam is directed 1 cm below the junction of ala tragus line and line drawn perpendicularly from outer can thus of the eye.

DATA COLLECTION AND ANALYSIS

For each patient, diagnostic radiographs were produced by using three techniques for the same tooth by using size no. 2 periapical radiographic films. Total 159 radiographs were obtained from 53 patients, exposed and processed under standard conditions. All radiographs were analysed by a radiologist using standard viewing conditions. All the data thus obtained was tabulated in an excel sheet.

The radiographic images were considered acceptable (A) when apices are clearly demarcated and devoid of zygomatic bone superimposition. The images with zygomatic superimposition over the maxillary molars which obscure the apices were considered unacceptable.

The data was further subjected to statistical analysis using chi-square test. 95% confidence levels were set as a threshold and *P* value was obtained.

The Kappa statistics was used to test intra observer reliability regarding over all diagnostic acceptability.

In BAT the zygomatic superimposition over the maxillary molars were observed as shown in Figure 1. In MBAT the molar apices are free from superimposition as shown in Figure 2. In PCT also there is no superimposition of zygomatic arch over the apices as shown in Figure 3 (Table 1).

RESULTS AND DISCUSSION

IOPAR is an important tool for proper diagnosis and treatment in various dental and bone pathologies of oral cavity. IOPARs also have significantly important



Figure 1: Periapical radiograph taken using BAT showing interference of zygomatic process over the palatal root of first maxillary molar



Figure 2: Periapical radiograph taken using MBAT shows molar apices free from zygomatic arch interference in the same patient



Figure 3: Periapical radiograph taken by PCT showing no zygomatic interference with clear apices in the same patient

Table 1: Comparison of BAT, MBAT and PCT in elimination of zygomatic superimposition over the apices of maxillary molars and assessed in terms of acceptability

Technique	A	UA
BAT	28.3% (n = 15)	71.7% (n = 38)
MBAT	56.6% (n = 30)	43.4% (n = 23)
PT	58.5% (n = 31)	41.5% (n = 22)

$P = 0.002$, BAT = bisecting angle technique, MBAT = modified bisecting angle technique, PT = paralleling technique, A = acceptable, UA = unacceptable.

role in endodontic treatment and prognosis. Endodontic treatment largely depends on radiographs for determination of the exact working length of root canal [1]. Any error in the measurement of working length, leads to over instrumentation, leads to periapical tissue injury, difficulty in canal preparation and obturation, leading to failure of the endodontic therapy.

Obtaining the exact working length is not always easy due to anatomical variations in different patients especially with maxillary molars due to the superimposition of the zygomatic buttress over the root apices [2].

The two routinely followed techniques for producing periapical radiographs are BAT and paralleling

technique (PT). As discussed, both the techniques have their own advantages and disadvantages.

The advantages of BAT includes that the technique is simple and quick, and the positioning of film is easy. In addition, it poses less discomfort to the patient. The technique is more effective in patients with anatomical variations like shallow or deep palatal vault, bony overgrowths and in children.

The main disadvantages of BAT are distortion of the image, increased elongation or foreshortening of the images, proximal overlapping of the crowns and roots and superimposition of zygomatic arch on the teeth apices of maxillary molars. As patient holds, the film unnecessary exposure to the patient is more [1].

The advantages of PCT includes that the images produced are more anatomically accurate, and the image has same size and shape [1] as that of the object, so distortion is less compared with BAT images. This technique greatly minimises the superimposition of zygomatic buttress over the roots of maxillary molars making the apices and maxillary sinus better seen.

The disadvantages of PCT mainly are that the patient can't hold the film, and the usage of film holders is mandatory to obtain the parallel relation between film and the object [1]. These holders may impinge on oral structures causing more discomfort and gagging to the patient. Difficult to place the film in proper position in patients with shallow palatal vault, children and patients with gag reflex. Requires more time and adjustments can't be made that easily.

Many controlled studies suggest PCT is superior to BAT. A study was done by Tamse *et al.* in 1980 to evaluate the interference of zygomatic arch in proper diagnosis in maxillary molar endodontic procedures and proved that BAT is unreliable in measuring working length [4].

Forsberg *et al.* compared BAT with PT for evaluation of periapical lesions and reproduction of working length in endodontics in four different studies proved that PCT was the most accurate method than BAT [2,5,6].

There are a very few studies proving that PCT is inferior to other techniques, a comparative study conducted by Forsberg and Halse to evaluate the periapical radiolucencies after endodontic surgery proved when correctly adjusted both the techniques gives the same results [7].

Kazzi *et al.* have conducted a comparative study of three different techniques by using different x-ray holders and proved that in spite of using different holders, the results were same, and PCT was again proved as the best technique to produce accurate images [8].

In routine dental practice, many dentists face situations where positioning of the film and the x-ray beam should be done quickly to produce a diagnostically acceptable images like in emergency cases, children and gagging patients, while performing endodontic procedures [9].

In such cases, following a PT is practically not possible but relying on BAT for acquisition of the most accurate images without superimposition of zygomatic bone is challenging.

In this study, we followed a newer, modified technique of BAT to nullify the disadvantages of the same and adopt the advantages of PCT. The present study made an attempt to prove that MBAT is superior to BAT in preventing zygomatic superimposition over maxillary molars [10].

The main reason behind this superimposition of zygoma over the apices is that the central beam of x-ray is more inferiorly directed, and beam is not low enough and not perpendicular to pass between film and object. So in MBAT, the vertical angulation is reduced by 5 degrees to make the central beam to pass between these structures and made beam almost perpendicular to film and object. But excessive elongation of the image will occur if only the vertical angulation is decreased without minimising the angle formed between the film and object. This angle is reduced by making the patient to bite the holder platform little lingually to produce 5-mm distance between the

occluso-palatal line angle of teeth and the film. This makes the central x-ray beam to pass between the molar apices and the zygomatic bone nullifying the superimposition successfully [10].

The results showed that the unacceptability with BAT is 71.7% ($n = 38$) giving only 28.3% ($n = 15$) acceptable images which are free of zygomatic interference and are diagnostically accurate. The unacceptability with MBAT is only 27.7% ($n = 23$), giving 56.6% ($n = 30$) acceptable images. In PCT, the unacceptability is slightly less than MBAT, that is 26.5% ($n = 22$) making acceptability little more than MBAT, that is 58.5% ($n = 31$).

The advantages of MBAT included that it reduced the routine problems encountered in images produced with BAT like distortion and superimposition. MBAT also produced images that are diagnostically as accurate as PCT. MBAT was also easier and took relatively less time to perform and caused lesser discomfort to patient than PCT.

The limitation of MBAT was that the periapical cut-off was slightly more than in BAT [2]; however, it is statistically insignificant. In the present study, MBAT was proved as the best alternative technique for BAT and PCT, with enhanced accuracy in avoiding superimposition of zygomatic process over the apices of maxillary molars.

CONCLUSION

PT is the most accurate and less commonly used method, whereas BAT is the most commonly used and less accurate method in intraoral periapical radiography. To compensate the limitations of both techniques, MBAT can be followed to produce less distorted images with maxillary molar apices free from zygomatic bone superimposition. To conclude, MBAT can be recommended in routine dental practices without the demand for special equipment and causing less discomfort to patient. The present study shows that MBAT is an effective, simple, quick procedure for

acquiring radiographic images of maxillary molars without any zygomatic bone superimposition.

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