

The radiographic localization of unerupted maxillary incisors and supernumeraries

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ABSTRACT

Purpose : To evaluate the use of the vertical tube shift from a panoramic film and a periapical film to localize unerupted maxillary incisors and supernumeraries.

Materials and Methods : The total of 103 displaced maxillary incisors or embedded supernumeraries were examined in this study. The vertical tube shift technique with panoramic and periapical radiography by normal projection taken and compared to localize the position of the embedded maxillary incisors or supernumeraries by a radiologist and 5 general dentists. The gold standard used for the radiographic comparisons was the true position of the embedded tooth as confirmed by horizontal tube shift technique using three periapical radiographs. The general dentist examiners were instructed on the use of the modified acronym "SLDOBU" by the radiologist as it pertains to panoramic radiographs as the principle of vertical tube shift.

Results : All of the embedded maxillary incisors and supernumeraries were successfully located using the vertical tube shift from a panoramic and a maxillary anterior periapical radiograph by the radiologist and 5 general dentists.

Conclusion : The use of a panoramic film with a periapical film combination for a vertical tube shift can be useful to localize unerupted maxillary incisors and supernumeraries. (*Korean J Oral Maxillofac Radiol* 2003; 33 : 217-21)

KEY WORDS : Radiography, Panoramic; Tooth, Impacted; Tooth, Incisor; Maxilla

Mesiodentes are the most common supernumerary teeth, occurring in 0.15% to 1.9% of the population.¹⁻³ Mesiodentes can cause delayed or ectopic eruption of the permanent incisors, which can further alter occlusion and appearance.^{4,5} Treatment options may include surgical extraction of the mesiodens and the unerupted permanent central incisors may orthodontically be brought into proper alignment.^{6,7}

Clinical evidence of the location of unerupted maxillary incisors and supernumeraries may be sparse. The clinician therefore must frequently rely entirely on radiographic evidence.^{8,9}

The two accurate means of radiographic localization currently in use are the right angle technique and the tube shift technique (the parallax method, Clark's rule, buccal object rule).

The right angle technique uses 2 radiographs taken at right angles to each other. According to Wraith,¹⁰ the use of the combination of a lateral cephalometric radiograph with an postero-anterior cephalometric radiograph for localization of

impacted maxillary canines was suggested.

In 1910, Clark¹¹ introduced the parallax method and used 2 periapical films with a shift of the tube in the horizontal plane for the localization of impacted teeth, it is still the preferred method today.¹² The technique was later adapted by Richards in 1952 to shift the tube in the vertical plane.¹³

The acronym SLOB can assist in recalling the principle of tube shift : Same : Lingual, Opposite : Buccal (same direction of movement of the image of the impacted tooth as the tube moves then the tooth is lingual, opposite direction of movement to the tube then the tooth is buccal).¹⁴

Keur¹⁵ used 2 occlusal films rather than 2 periapical films for a horizontal tube shift because 2 occlusal films cover a larger area and introduced the use of a panoramic film with an occlusal film combination for a vertical tube shift.^{15,16}

It is probably true that in routine orthodontic practice today most preliminary consultations include a panoramic film, which is used to decide whether more radiographs and analyses need to be taken.

Because a panoramic film is often taken as an initial radiograph, this combination has the benefit of only requiring 1 additional exposure.

Mason et al.¹⁷ compared two different radiographic techniques for localization of impacted maxillary canines : vertical

*This study was supported by research grant of Chosun University, 2002

Received September 25, 2003; accepted October 28, 2003

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parallax from a panoramic and a maxillary anterior occlusal radiograph and magnification from a single panoramic radiograph. Jacobs^{18,19} reported that for localizing impacted maxillary canines, to facilitate the interpretation of a vertical tube shift, the angle of the tube in the occlusal radiograph should be increased from the customary 60 degrees to 65 degrees to 70 degrees to 75 degrees and periapical radiographs were not recommended to be used for a horizontal tube shift or for a vertical tube shift in combination with a panoramic radiograph through explaining with the example of 4 cases.

Most of studies concerning the localization of embedded tooth were focused to the localization of impacted canine. Furthermore, the study carried out by radiologist with radiographic specialty was rare. Even textbooks on radiograph and on impacted teeth do not clearly mention the panoramic radiograph with occlusal radiograph or periapical radiograph combination for localization of embedded tooth.^{14,20-22}

This paper evaluates the use of the vertical tube shift from a panoramic film and a periapical film to localize unerupted maxillary incisors and supernumeraries.

Materials and Methods

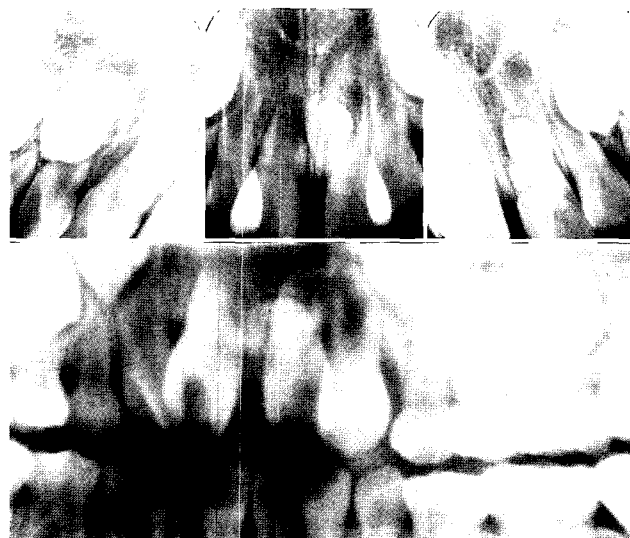
The experimental group consisted of 82 randomly selected young adults (52 male and 30 female) with natural dentitions who required treatment for one or both ectopic maxillary incisors or embedded supernumeraries. Ages ranged from 3 to 39 years; the mean age was 11.3 years.

The total number of displaced maxillary incisor or embedded supernumeraries was 103. Panoramic radiographs were available for each patient, and three periapical radiographs were taken by tube shift techniques for each patient; normal projection for maxillary central incisors (vertical angulation +45°, horizontal angulation 0°), right shifted projection (vertical angulation +45°, horizontal angulation +10°), and left shifted projection (vertical angulation +45°, horizontal angulation -10°).

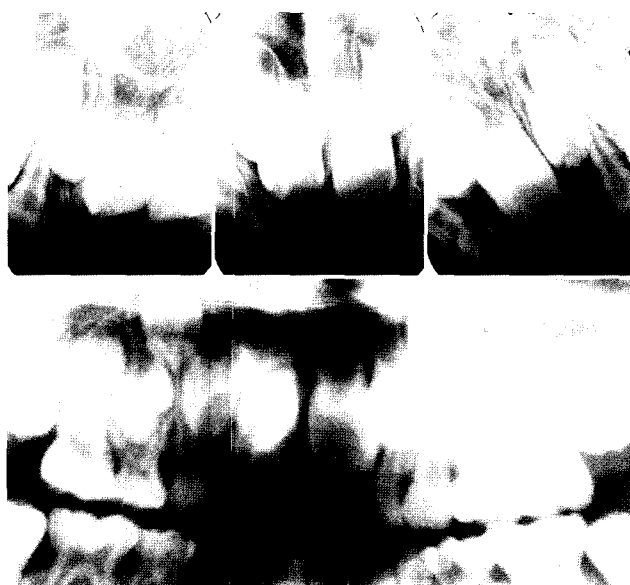
The vertical tube shift technique with panoramic radiograph and periapical radiograph by normal projection were tested blind and compared for localization of the embedded maxillary incisors or supernumeraries by a radiologist and 5 general dentists. The gold standard used for the radiographic comparisons was the true position of the embedded tooth as confirmed by horizontal tube shift technique with three periapical radiographs.

For general dentist examiners, radiologist explained the

modified acronym SLDOBU on panoramic radiograph as the principle of vertical tube shift : Same : Lingual : Downwards moved, Opposite : Buccal : Upwards moved on panoramic radiograph when compared with the position of the image of the embedded tooth on periapical radiograph, because panoramic tube (+7°) has smaller vertical angulation than periapical tube (+40° - +45°), before determining the location of



Case 1. The image of the crown of the embedded tooth was moved downwards on the panoramic radiograph compared with that on the periapical radiograph (center image) : Downward : Lingual.



Case 2. The image of the crown and root of the embedded tooth was moved downwards on the panoramic radiograph compared with that on the periapical radiograph (center image) : Downward : Lingual.

embedded tooth.

Results

Case 1 and 2 were the examples that Same direction in the acronym SLOB coincides with Downward movement of the image of embedded tooth on panoramic radiograph. The image of embedded tooth was moved downwards on panoramic radiograph and resultantly the embedded tooth was interpreted to be located lingually.

Case 3 and 4 were the examples that Opposite direction in the acronym SLOB coincides with Upward movement of the image of the embedded tooth. The image of embedded tooth was moved upwards on panoramic radiograph and the em-



Case 3. The image of the crown of the embedded central incisor was moved upwards on the panoramic radiograph compared with that on the periapical radiograph : Upward : Buccal. Panoramic radiograph with occlusal radiograph combination showed more clearly vertical shift.



Case 4. The crown of embedded canine moved upwards relative to the horizontally embedded lateral incisor on the panoramic radiograph : Upward : Buccal. The crown of the lateral incisor moved upwards relative to the root end of the 1st premolar : Upward : Buccal.

beded tooth resultantly interpreted to be located buccally.

One hundred per cent of the embedded maxillary incisors or supernumeraries could be successfully located with vertical tube shift from a panoramic and a maxillary anterior periapical radiograph by a radiologist and 5 general dentists.

Discussion

Smailiene²³ tested diagnostic value of palpation and orthopantomography in cases of maxillary canines impaction on the basis of evaluation of migration and inclination of impacted teeth. Chaushu et al.²⁴ tested a method of diagnosing the position of a displaced maxillary canine on the basis of a single panoramic radiograph. Freisfeld et al.²⁵ reported x-ray diagnosis of impacted upper canines in panoramic radiographs and computed tomographs. Computed tomography (CT) is the most precise method of radiographic localization, however, its relatively high radiation dose limits the indications for its use.¹²

Tube shift technique is still the preferred method because of its simplicity today. Since the use of a panoramic film with an occlusal film combination for a vertical tube shift has been introduced, the studies with the method was focused to the localization of impacted maxillary canine and still controversial.

In fact, the treatment of the mesiodens and the unerupted

permanent central incisors are also important, and the vertical tube shift by the panoramic film with periapical film combination is need to be evaluated to localize unerupted maxillary incisors and supernumeraries

Image/tube shift is the apparent displacement of an image relative to the image of a reference object and is caused by an actual change in the angulation of the x-ray beam. The change in angulation of the beam is caused by a change in the x-ray tube position. The reference object is normally the root of an adjacent tooth. The image of the tooth that is farther away from the x-ray tube moves in the same direction as the tube, whereas the image of the tooth closer to the x-ray tube moves in the opposite direction to the tube.

In this paper, the modified acronym SLDOBU on panoramic radiograph as the principle of vertical tube shift was adopted. Same direction (Lingual) coincides with Downward movement of the image of embedded tooth (case 1, 2) and Opposite direction (Buccal) coincides with Upward movement of the image of the embedded tooth (case 3, 4) respectively on panoramic radiograph. This principle could be simply understood and applied by 5 general dentists.

The panoramic tube is actually positioned behind the head at an angle of -7° to the occlusal plane, and the film is in front of the head. However, to aid interpretation of the vertical tube shift, the tube can be considered to be in front of the head at an effective angle of $+7^\circ$ because the relationship of the image of maxillary incisors or supernumeraries to the image of the lateral incisor or the normal central incisor is unaltered.^{18,19} The periapical radiograph is taken at an angle of $+40^\circ$ to 45° to the occlusal plane, ie, there is an effective difference of 33° to 38° .

Jacobs^{18,19} insisted that two distances are important in localization, the distance between the impacted tooth and its reference tooth and the distance over which the x-ray tube is moved. The second distance is the magnitude of the tube movement between the two exposures. Case 3 showed that the change in the distance between the embedded tooth and the reference tooth became more clear by moving the tube over as great a distance as possible with occlusal film.

Mason et al.¹⁷ reported that seventy-six per cent of the impacted canines could be successfully located with vertical parallax from a panoramic and a maxillary anterior occlusal radiograph and 66 per cent with magnification from a single panoramic radiograph.

However, this study showed one hundred percent of the unerupted central incisors and embedded mesiodentes could be successfully located with vertical tube shift from a panora-

mic and a maxillary anterior periapical radiograph by 5 general dentists.

When a vertical tube shift is used to localize an impacted maxillary canine, the occlusal radiograph should be exposed with the canine in the center of the radiograph as Jacobs¹⁸ recommended. However, in case of periapical radiograph of central incisor, x-ray beam is directed as the same direction of beam when panoramic radiograph is exposed. That was thought as the reason that the localization of embedded maxillary incisors or supernumeraries could be easily reliable even by the small change in the distance between the impacted tooth and its reference tooth.

In conclusion, the use of a panoramic film with a periapical film combination for a vertical tube shift can be useful to localize unerupted maxillary incisors and supernumeraries.

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