COMPARISON OF PARALLELING AND BISECTING ANGLE TECHNIQUES IN ENDODONTIC WORKING LENGTH RADIOGRAPHY

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ABSTRACT

This cross sectional comparative study was carried out to compare paralleling technique (PT) and bisecting angle technique (BAT) for working length radiography in endodontics. A sample of 120 patients was selected through purposive sampling. The patients were divided into two groups depending on the arch to be radiographed namely Group A for maxillary arch and group B for patients with mandibular teeth requiring endodontic radiography. Each patient underwent two radiographs, one with each paralleling and bisecting angle techniques respectively giving a total of 240 radiographs. Endo Ray II film holder (Dentsply) was used for PT while a hemostat was utilized for BAT. The results showed a higher accuracy in terms of decreased procedural errors with paralleling technique as compared to bisecting angle technique for teeth in maxillary arch (p<0.05), whereas for mandibular arch there was insignificant difference (p>0.05) between the two techniques.

Overall paralleling technique was found to have better results than bisecting angle technique, during endodontic working length radiography.

Key Words: Radiographs, Paralleling technique (PT), Bisecting angle technique (BAT), endodontic radiography, working length.
nature of WL radiography in endodontics and extra
dose of radiation, errors during endodontic radiogra-
phy should be minimized.\(^5\)

Whenever there is need for multiple radiographs,
the above mentioned periapical radiography techniques
have certain merits and demerits which govern the
repetition of WL radiographs in clinical situations
such as the arch form, the tooth shape, its location and
position, along with radiographer’s technique.\(^6\) In or-
der to reduce the amount of retake during WL radiog-
raphy, these techniques need to be evaluated effec-
tively to determine the factors leading to repeat in
order to devise efficient means to counteract them.

The purpose of this cross-sectional study was to
compare the efficacies and errors of Paralleling tech-
nique (PT) and Bisecting angle technique (BAT) when
used for endodontic working length determination.

**MATERIALS AND METHODS**

This cross sectional comparative study was con-
ducted in the Dental department of Pakistan Institute
of Medical Sciences (PIMS) Islamabad.

A total of 120 patients requiring root canal treatment
were selected utilizing convenience sampling,
and divided into two groups based upon the arch to be
radiographed, namely Group A and B. Former con-
sisted of patients requiring root canals of maxillary
arch while the latter consisted of 60 patients requiring
endodontic radiography for mandibular teeth.

**Inclusion criteria**

Patients included consisted of those requiring root
canal treatment (RCT) due to pulpal necrosis, trauma
involving the pulp chamber, irreversible pulpitis,
retreatment, intentional root canal treatment. Root
canals allowing minimum entry for # 15 file were
included.

**Exclusion criteria**

Patients having teeth with sclerosed canals, root
resorption, blunderbuss canals and severe periodonti-
tis, teeth requiring re root canal treatment, were
excluded from the study.

**Data collection procedure**

After access opening and pulpectomy, endodontic
working length (EWL) radiographs were taken with #
15 K files (Manni, Japan) using both the radiographic
techniques, namely BAT and PT, on the same tooth
utilizing 3x4 cm periapical size films (M-2 Comfort,
Speed E, Agfa Dentus, Hanau, Germany). A single
researcher took all the radiographs using the Endo-
Ray II film holder (Dentsply Rinn Co, Japan) and
hemostat (51/2 inch, Advance Co, Sialkot, Pakistan)
for PT and BAT respectively (X-ray unit, explorer x-70
(Villa Syestemi Medical, Italy).

Data was collected onto a proforma and the results
recorded as acceptable or unacceptable. Radiographs
covering the entire tooth being treated including the
apices of all the involved roots and at least 2mm of peri
radicular bone were considered acceptable (A). If a film
was rated unacceptable (UA), the reason for error was
recorded.

**Data analysis was done using** SPSS version 11.
Descriptive analysis was done for continuous vari-
ables such as age, and frequency and percentage were
calculated for categorical variables such as EWL Ra-
diograph outcome in terms of acceptability. Compara-
tive analysis was done using chi-square test and p-
values were recorded.

Fig 1: Distribution of gender in all the patients (n =
120)
RESULTS

The age of the patients ranged between 15-50 years with a mean of 31.7 ± 7.1 years. Males accounted for 45% (n=53) while 55% (n=67) of the patients were female as shown Fig 1.

In Group A, with paralleling technique (PT) (n=60) the retake (unacceptable radiographs) was 10% (n=6), while 18 out of 60 radiographs (30%) were repeated when bisecting angle technique (BAT) was employed, as shown in Table 1. A significant difference for retake between PT and BAT was found (p= 0.01).

In Group B patients, the retake (unacceptable radiographs) was 11.7% (n=7) with PT while with bisecting angle technique retake was done in 11 patients (18.33%). There was insignificant difference between PT and BAT in group B patients, (p=0.44).

TABLE 1: COMPARISON OF OUTCOME (ACCEPTABLE VS UNACCEPTABLE) IN PARALLELING (PT) AND BISECTING ANGLE TECHNIQUES (BAT) IN MAXILLARY GROUP (A) (N = 120)

<table>
<thead>
<tr>
<th>Endodontic Working Length</th>
<th>PT (n = 60)</th>
<th>BAT (n = 60)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable</td>
<td>54 (90.0%)</td>
<td>42 (70.0%)</td>
<td>0.01</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>6 (10.0%)</td>
<td>18 (30.0%)</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 2: COMPARISON OF OUTCOME (ACCEPTABLE V/S UNACCEPTABLE) IN PARALLELING (PT) AND BISECTING ANGLE TECHNIQUES (BAT) IN MANDIBLE GROUP (B) (N = 120)

<table>
<thead>
<tr>
<th>Endodontic Working Length</th>
<th>PT (n = 60)</th>
<th>BAT (n = 60)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable</td>
<td>53 (88.3%)</td>
<td>49 (81.7%)</td>
<td>0.44</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>7 (11.7%)</td>
<td>11 (18.3%)</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 3: COMPARISON OF OUTCOME (ACCEPTABLE AND UNACCEPTABLE) IN PARALLELING (PT) AND BISECTING ANGLE TECHNIQUES (BAT) IN ALL PATIENTS (N = 240)

<table>
<thead>
<tr>
<th>Technique used</th>
<th>Total Number</th>
<th>Acceptable</th>
<th>Unacceptable</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT</td>
<td>120</td>
<td>107 (89.2%)</td>
<td>13 (10.2%)</td>
<td>0.01</td>
</tr>
<tr>
<td>BAT</td>
<td>120</td>
<td>91 (75.8%)</td>
<td>29 (24.2%)</td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSION

A significantly higher proportion of retake due to errors was found with BAT (24.16%), as compared to PT (10.83%). This shows that the paralleling technique produces less distortion and is less variable as is supported by the results of various other studies therefore paralleling technique principle is more reliable than the bisecting-angle. According to many authors only the paralleling extended-distance technique provides the minimum of dimensional distortion.
In 1994, Gound\textsuperscript{10} conducted a study in which he compared the accuracy of different operators when taking radiographs for endodontic procedures, where as in current study, PT and BAT were compared utilizing a single operator in order to eliminate the inter-operator variability element.

Maxillary teeth Group (A) especially the molars in this study were found to be more difficult to radiograph than mandibular teeth Group (B) utilizing both radiographic techniques. Several other authors had the same difficulty.\textsuperscript{10-14} One explanation for having this problem is the rigidity of palate and most of the palatal vault slopes, with the highest and flattest between the molars.\textsuperscript{10} To overcome this problem according to Walton\textsuperscript{15} the film must be placed in the highest part of vault which is at considerable distance from the tooth.

Of the studies that compared film holders, Bean\textsuperscript{16} and Forsberg\textsuperscript{14,17} reported, radiographs taken with holders that had a positioning arm to guide alignment and that were designed to allow patients to bite together, while the film was exposed, had a lower unacceptability (retake) rates than holders without these advantages.\textsuperscript{10} Endo-Ray II is one of the film holders having both the above mentioned advantages. This holder was selected purely because of its availability and a design, which accommodates the files (basket) during Endodontic WL radiograph and at the same time provides a base to bite on for the patient and hence helps in the stability of the cone indicator (external arm and ring) and the film. The disadvantages of the Endo-Ray II are that it requires assembly before use, and is difficult to place in patients with shallow palatal vaults or restricted mouth opening. During its use in Group (A) 90\% of the radiographs were acceptable, while when used in Group (B) 88.33\% were acceptable.

Higher rate of unacceptability, while using Endo-Ray II in mandibular arch, was probably due to hindrance from the tongue and lack of space for the basket in mandibular anterior region.

Over all lower retake value with Endo-Ray II holder might be because the film is held in a more vertical position and the cone indicator arm guides the operator to accurately determine how the film is aligned.

The results using hemostat as film holder i.e. with BAT showed 70\% acceptability in Group A while 81.66\% acceptability in Group B.

These results clearly indicate that statistically there is no significant difference when either of the two film holders were used in Group B probably due to the reason that the floor of the mouth does not slope and is flexible, so x-ray films can be placed close to the tooth and parallel to the its long axis with either holders.

A higher rate of unacceptability, 30\%, seen while using hemostat (BAT) in the Group A may be because the films placed away from the tooth usually are aligned at an angle to the long axis of tooth rather than being parallel to it.

These results advocate the use of film holders for endodontic periapical radiography as was also seen in the Rushton’s study.\textsuperscript{18}

The major criterion of unacceptability in this study was that the radiographs do not cover the entire tooth being treated including the apices of all the roots and at least 2mm of periradicular bone.\textsuperscript{19} Other criteria included cone cut, fore shortening and elongation.

The major reason for unacceptability in both the groups was found to be incomplete/inadequate apical coverage; 11 (9.16\%) with PT (n=120) and 14 (11.6\%) with BAT (n=120) as shown in graph 2. This finding agrees with the findings of Bean\textsuperscript{16}, Gound and Dubois\textsuperscript{10}, Lim and Teo\textsuperscript{13} who reported that the failure to include the apex was the most frequent of errors.

Cone cut, caused by improper film placement or cone angulation was found to be the second most common reason for unacceptability overall in both the study groups; 2 (1.66\%) with PT (n=120) and 11 (9.16\%) with BAT (n=120) as shown in graph 2. This result of our study is supported by similar results of studies carried out by Moursheed\textsuperscript{11} and Patel\textsuperscript{20} which stated that improper film placement is the most frequent cause of errors.

Due to elongation only 4 EWL radiographs i.e. 3.33\%, graph 2, were retaken when BAT (n=120) was employed whereas when using PT (n=120) no elongation was caused. Elongation results when the x-ray beam is directed perpendicular to the long axis of the tooth rather than through the bisecting line. This was the third most frequent cause of unacceptability in the current study.
CONCLUSION

In endodontics, the paralleling technique has a geometrical advantage over the bisecting angle technique and results in less number of EWL radiographs leading to overall fewer amounts of radiation exposure and discomfort to the patient along with saving time and the cost of an extra film. PT i.e. use of the Endo-Ray II film holder is more desirable for EWL radiography as it can significantly minimize the amount of retakes. However, there are instances where the bisecting angle is preferable, and consideration should be given to this technique to improve the image quality when it is used.

Film holder should be used where required yet it should be remembered that the film holder is an indicating device, not a dictating one.

REFERENCES