

## THE EFFECT OF POST-PROCESSING VISUALIZATION ON THE IMAGE QUALITY OF A PANORAMIC DENTAL DIGITAL SYSTEM

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### ABSTRACT

The purpose of this investigation is to quantify and evaluate the diagnostic image quality of dental panoramic radiography with and without post-processing visualization. 72 panoramic photos were analyzed and split into two groups: with post processing and without post processing image. Each picture was given a score based on the subject's perception of the anatomical zone and features, as well as the density and contrast of the image. According to these specifications, the digital panoramic system that included post-processing received the maximum score of 3.450.19, whereas the digital panoramic system that did not include post-processing received scores of 3.330.33. In conclusion, the use of digital post-processing visualization has the potential to greatly enhance diagnostic quality in terms of contrast and radiographic density.

**KEY WORDS:** Panoramic dental radiography; digital panoramic system; image quality.

### INTRODUCTION

Digital panoramic images are increasingly used in clinical diagnosis due to their numerous benefits, including speedy communication of images, small storage requirements, and minimal environmental impact (Baksi BG et al 2010).

Further, The digital panoramic method also contributed to the advancement of dental imaging technology since, in comparison to more traditional methods, it generates superior diagnostic pictures while exposing the patient to far less radiation. (Pelekos G et al 2019)).

The radiation dosage required for digital panoramic imaging ranged from 5 to 14 Sv, which is a substantial reduction over the radiation dose required for traditional panoramic imaging, which ranged from 16 to 21 Sv. (4 Visser H, Hermann KP, Bredemeier S, et al 2001).

The lowest radiographic protocol setting could further reduce dose by 76%( Gavala S, Donta C, Tsiklakis K, et al 2009).

Despite this, there is always a choice to be made between the parameters of the low-dose regimen and the quality of the picture. A post-processing approach that modifies the contrast and density of an image might potentially enhance a poor image; nevertheless, it might not

be adequate to increase the sensitivity and specificity in the identification of dental diseases and abnormalities. (Angelopoulos C, Bedard A, Katz JO, et al 2004).

This study compares and evaluates the diagnostic image quality of dental panoramic radiography with and without post processing in order to provide dentists and dental radiographers with knowledge and preferences regarding the benefits and clinical practicality of dental imaging as a modality of choice. The purpose of this study is to provide dentists and dental radiographers with this information. (Granlund C et al 2016).

### MATERIALS AND METHODS

A study of the diagnostic quality of the images produced by dental panoramic radiography with and without post processing visualization was conducted due to the high number of patients referred to the department of oral radiology at the college of dentistry at Duhok University, and no such studies were conducted in Iraqi universities. During the academic year 2020-2021, digital radiographs were taken retrospectively.

A total of 72 there was a collection of panoramic photographs that were split into two

categories: digital panoramic with post-processing, and digital panoramic without post-processing. Detailed information about each image's exposure was recorded.

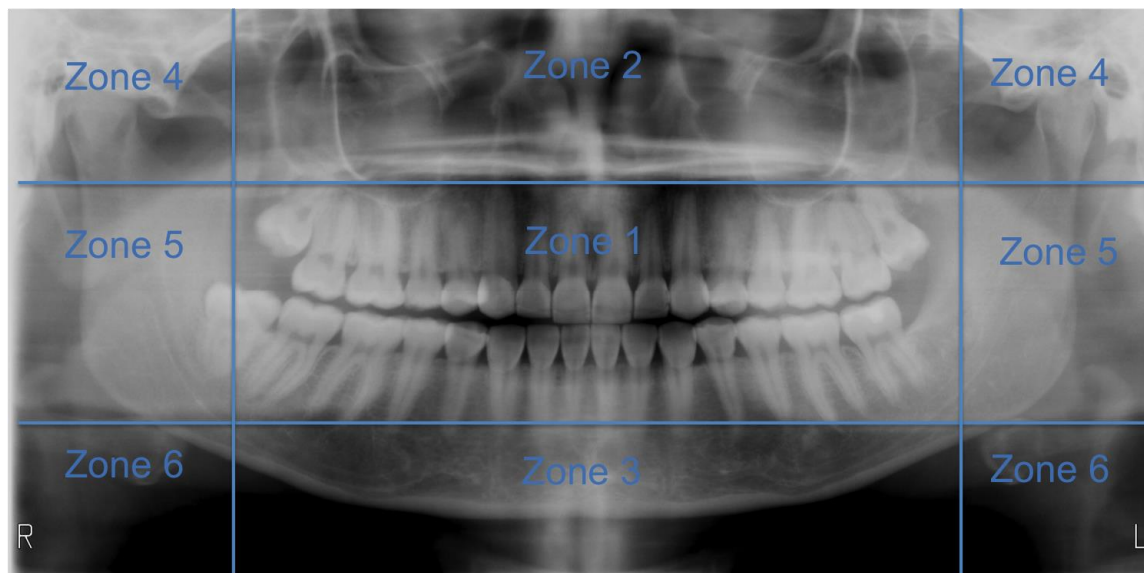
#### Digital panoramic system

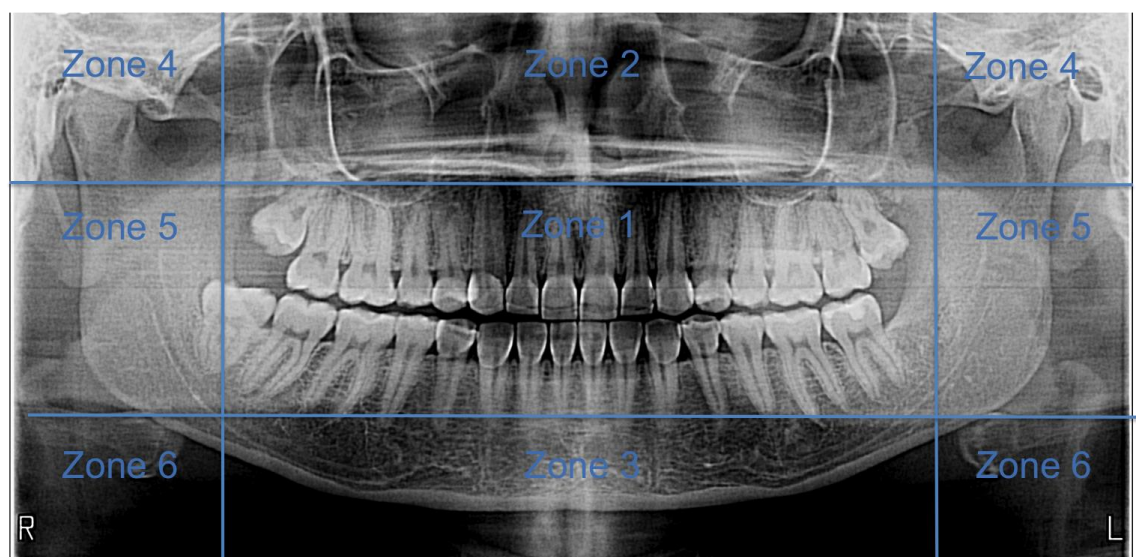
We gathered panoramic photographs generated by computer systems and split them into two categories: those with post-processing graphics and those without. The digital panoramic method makes use of a charged pair device, which is followed by post-processing that modifies the contrast and density of the 2D pictures. This helps to increase the image's overall quality. The program called Vix Win platinum was used to make adjustments to the contrast and density of the photos (Gendex gxdp-300 panoramic X-ray). The median and sharpening filters were applied to the panoramic photos so that there would be less noise.

#### Analysis of image quality

Image quality was qualitatively assessed by two experienced dentists who each had at least 20 years of prior panoramic radiography expertise between them. Both reviewers were given no information on the system procedures or exposure settings. Since all of the digitized pictures were printed out, traditional and digital panoramic photographs underwent the same evaluation process with the illuminators. Each

picture was given a grade based on a subjective evaluation of its anatomical coverage, density, and image contrast, in addition to its various anatomical components, using an ordinal grading system with four possible points. On the panoramic image, anatomical structures were segmented into six zones as follows: dentition (zone 1), nasal cavity and sinuses (zone 2), mandibular body (zone 3), temporal-mandibular joint (zone 4), ramus-spine (zone 5) and hyoid bone (zone 6). Zone 1 represented the dentition, while zone 2 represented the nasal cavity and sinuses (zone 6). Figure 1 illustrates this point. Each zone had its own individual assessment in its entirety. An average score was produced to indicate the diagnostic quality of each panoramic picture based on these six anatomical zones, anatomical coverage, image density, and contrast. This value was then taken into account. The numerical order of the grading scale does not change, with the lower scores (scores of 1 or 2) representing poorer image quality in comparison to the higher scores. There are different scores for different aspects of the evaluations. However, the numerical order of the grading scale does not change (scores of 3 or 4). The ordinal grading system is broken down into its component parts and displayed in Table 1.





**Fig. (1):** demonstrates how the panoramic picture was segmented into six distinct anatomical zones for the purposes of anatomical analysis. Dentition (zone 1), nasal cavity and sinuses (zone 2), mandibular body (zone 3), temporomandibular joint (zone 4), ramus-spine (zone 5) and hyoid bone (zone 5) are the names given to the various zones (zone 6)

**Table (1):** Image quality score description

| Evaluation aspect     | Image score | Description                                                                                           |
|-----------------------|-------------|-------------------------------------------------------------------------------------------------------|
| Anatomy coverage      | 1           | Improper coverage and inappropriate to clinical requirements.                                         |
|                       | 2           | An indication that the coverage in question warrants additional investigation.                        |
|                       | 3           | Access to information about coverage that is relevant to the clinical requirements.                   |
|                       | 4           | Coverage that is both appropriate and optimum, taking into account the therapeutic application.       |
| Density and contrast  | 1           | Inadequate contrast between the enamel and the dentine due to the enamel's poor density.              |
|                       | 2           | A density that is not sufficient with a contrast that is adequate between the enamel and the dentine. |
|                       | 3           | The enamel and the dentine have a satisfactory amount of density and contrast between them.           |
|                       | 4           | The enamel and the dentine have an excellent density and contrast to one another.                     |
| Anatomical structures | 1           | Substantial structures are not seen and no diagnosis is feasible.                                     |
|                       | 2           | Since only broad details were visible, a diagnosis cannot be made.                                    |
|                       | 3           | The diagnosis is shown in its entirety, including all the minute nuances.                             |
|                       | 4           | The diagnosis is shown in its entirety, including all the minute nuances.                             |

### Statistical analysis

All of the information was put into SPSS V17.0 so that it could be analyzed statistically (SPSS, version 17.0 for Windows, Chicago, Illinois, USA). A P-value of 0.05 was regarded to indicate a statistically significant difference between the two groups. Diagnostic image quality ratings were typically distributed in all

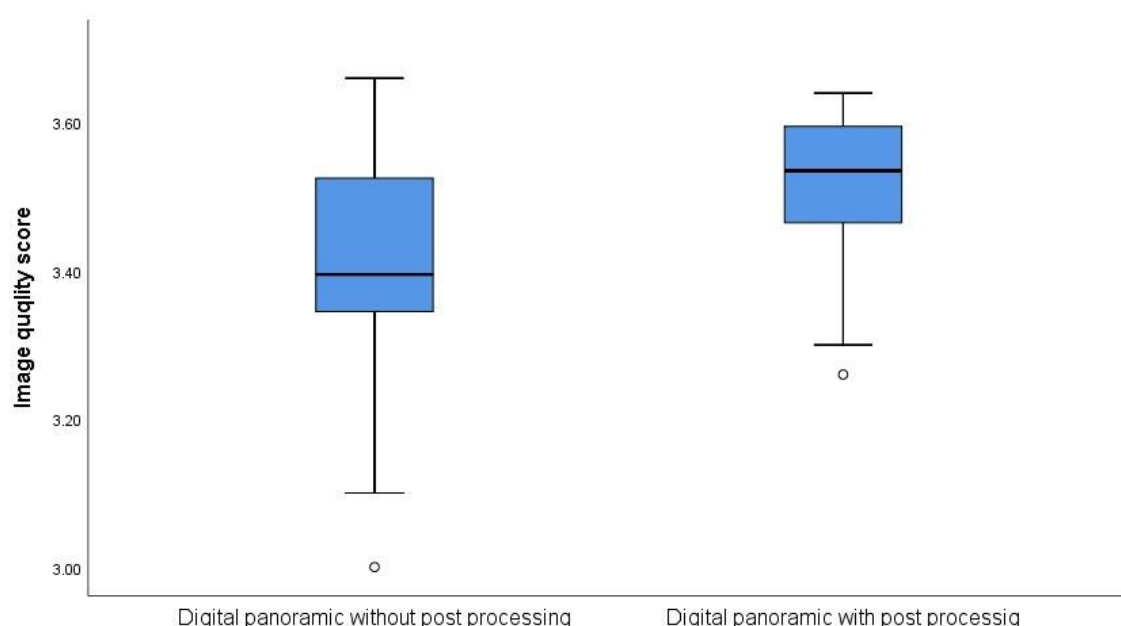
digital panoramic groups. These data were compared with an analysis of variance using a single component for the multi-factor interaction study (ANOVA). In addition, the level of inter-observer agreement for the subjective analysis was calculated using kappa statistics and ranked as follows: poor agreement (0.20); fair agreement (=0.21-0.40); moderate

agreement ( $=0.41-0.60$ ); acceptable agreement ( $=0.61-0.80$ ); and good agreement ( $=0.81-1.00$ ).

## RESULTS

The picture quality was evaluated by two different dentists and given a kappa value of 0.62, 0.61, and 0.65 correspondingly for traditional and digital systems. This result

indicates that there was a high level of agreement between the two sets of observers. According to the total picture quality score, the digital panorama system with post-processing technique received the highest score of 3.450.19, followed by the digital panoramic system without post-processing approach, which received scores of 3.330.33, as shown in Figure 2.



The box plot in Figure 2 displays the mean score of picture quality that was reported in the studies that used digital panoramic photography with and without the usage of post-processing technology. The key difference between the two groups is the image quality score achieved in digital panoramic photography using post-processing techniques. The box represents the first through third quartiles, the line inside the box represents the median quartiles, and the whiskers represent the least and highest possible values.

There was not a significant difference in quality ratings between the photographs obtained with digital panoramic systems with or without post-processing ( $P = 0.70$ ). According to the image evaluation, which was based on the anatomical structures and anatomy coverage (zones 1-6), there was not a statistically significant difference in image scoring between post-processing and not having post-processing in digital panoramic systems ( $P=0.35$ ). This was in accordance with the image evaluation, which was based on the anatomical structures. In

addition to that, it demonstrated that the diagnostic value of the photos may be increased via post-processing visualization using digital panoramic imaging by increasing the density and contrast of the images.

## DISCUSSION

This research illustrates an important discovery from a clinical point of view: the diagnostic quality of digital panoramic imaging may be enhanced by post-processing visualizations that display greater contrast and density than pictures that were not subjected to post-processing. In spite of this, there are no discernible variations in the visualization or coverage of anatomical features between photos that have been post-processed and those that have not been post-processed.

The findings were statistically insignificant despite the fact that digital panoramic imaging with post-processing scored higher than digital panoramic imaging without post-processing ( $P = 0.70$ ). This finding is in line with the findings of

a research by Gijbels et al., which concluded that post-processing photos did not substantially improve signal quality or lower noise levels. Our results, which demonstrated that the diagnostic value of digital panoramic imaging might be improved by the use of computerized post-processing, were disputed by the findings of prior investigations (Gijbels et al 2000). Post-processing image visualization of digital panoramic systems using computational filter manipulation, such as sharpening and median filters, was shown to improve the quality of diagnostic images in previous research (Visser H, Garcia Silva MA, Fujita M et al). These findings were published in a collection of articles titled "Visser H, Garcia Silva MA, Fujita M et al." Yet, it is dependent on the method of post-processing that was used in addition to the operator. As a consequence of this, an operator who has received enough training will be able to generate a high-quality diagnostic of picture quality using post-processing procedures that are suitable and accurate (Visser H et al 2001).

During more research on computerized post-processed photos, it was discovered that post-processed images provide the highest possible density and contrast. As a side point, altered panoramic photos may potentially include significant amounts of visual noise as well as artifacts (Visser H et al 2001).

The majority of dental practitioners have a preference for pictures that have optimal density and contrast because of the subjective nature of image quality evaluation. Hence, a panoramic picture may continue to have a high diagnostic value so long as the image density and contrast are optimal. This is true regardless of whether the image has artifacts or extra image noise.

In contrast, the use of a computerized post-processing method enables anatomical information to be shown in a manner that is both accurate and clear. The mandibular rami and the temporo-mandibular joints are two examples of anatomical components that may be improved by the use of soft tissue shadows in low contrast areas.

It has also been established that the post-processing procedure may increase the accuracy of dental anomaly identification in regions of the head and neck with high image density. These regions include the hyoid bone, the maxillary sinus, and the nasal region (Lehmann TM et al 2002).

Just a few clinical and practical prerequisites need to be fulfilled in order to proceed. It is

essential that the image signals that are created at the conclusion of digital panoramic systems do not suffer any degradation; otherwise, they will lose their diagnostic utility. A digital panoramic system has to be able to generate panoramic radiography images of a diagnostically sufficient quality in order to be useful. For reasons of data exchange, it is necessary for digital picture formats to be interoperable (Benediktsdottir IS et al 2003).

Our research does have a few drawbacks. The photos were separately examined by a radiologist as well as an oral surgeon. The viewers are both familiar with panoramic images; however, the working environment may influence the results of diagnostic assessment in this study because radiologists are more likely to use panoramic images frequently than surgeons. This may cause a difference in how the results are interpreted. A further point to consider is that the operator has complete control over the post-processing processes. So, well-trained and experienced operators may modify an image's contrast and density in order to impact the results. Nevertheless, the picture may be prepared for assessment by a single operator without creating any doubt in the results.

## CONCLUSION

According to the findings of this research project, digital post-processing visualization has the potential to greatly enhance diagnostic quality in terms of radiographic density and contrast. As a consequence of this research, we are able to get new knowledge about the advantages of using digital panoramic imaging in today's dentistry clinics.

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