

CONTRIBUTIONS OF THE DIGITAL IMAGE TO THE ASSESSMENT OF QUALITY IN ENDODONTIC OBTURATION

Authors: Gabriela V Pisterna, Gustavo A. Dietrich, Martha Siragusa

Every stage of the endodontic treatment should be equally approached, giving each one the same importance: correct diagnosis, treatment orientation, meticulous cleaning and instrumentation and a sufficiently compacted obturation that would guarantee the impermeable sealing of the root-canal in its apical, lateral and coronal levels, coronal reconstruction and distance control.

Despite the fact that Schilder determined as primary objectives of the endodontic therapy: cleaning, instrumentation and filling of the root-canal appropriately, these objectives are not easy to achieve taking into account the complex anatomy of the root-canals system, which is characterized by the presence of curvatures, accessory canals, laterals and apical deltas.

Having defined obturation as the replacement of the space achieved in the surgical preparation of the root-canal by an inert or antiseptic, stable, three-dimensional and permanent material, its priority objective is to operate as an impregnable barrier to liquids and bacteria and the material for obturation must be sufficiently compacted to be radiographically acceptable.

Several studies have shown that the therapeutic successes and failures are closely related to the quality of the obturation and its transverse compaction.

Zerlotti⁽³⁾ Ingle⁽⁴⁾ Grossman⁽⁵⁾ Holland⁽⁶⁾, Leal⁽⁷⁾ Leonardo⁽⁸⁾ et al. agree to accept that the cause of failures of endodontic treatments is directly related to inadequately sealed root- canals.

Others state that the leakage that facilitates a new bacterial contamination produces a new process of tissue disease .^{(9) (10) (11).}

At present, the ideal obturation material is still being looked for through various research techniques .^{(12) (13) (14).} Thus, in order to assess the apical obturation, the following has been suggested: microleakage with artificial coloring, bacterial microleakage, studies with fluid leakage, electrohistochemical methods and radioisotope marking. .⁽¹⁵⁾

Traditionally, the assessment of the endodontic obturation quality has been done by radiographic observations of: the apical limit of obturation, the degree of compaction and the coronal obturation. ⁽¹⁶⁾. Yet this analogical view is limited, since it records a three- dimensional image on a plane. Even though every technique is valuable, none of them meets totally our expectations to estimate the quality of obturation.

The digital images are those obtained both by direct methods through radiopvisiographs or Digoras systems and indirect ones through scanned x-rays. The digital images provide a new tool that enables us to visualize from another viewpoint the slight differences of gray concentrations.

The aims suggested for this work were as follows: digitalizing of periapical X-rays, applying some tools of a program of digital image treatment, and determining if they themselves favor the assessment of the endodontic obturation compaction..

METHODS AND MATERIALS

15 periapical radiographic plates from patients of the undergraduates of the Chair of Endodontics of the School of Dentistry of Rosario were selected. These plates corresponded to teeth with sealed canals. Some were assessed as acceptably well condensed and others as poorly condensed.

The radiographic plates were "scanned" using an Agfa Scanner, and transforming them into digital images.

For the image processing the "IMAGE TOOL"® program was chosen, which has been developed by the School of Dentistry of the University of Texas Health Center in San Antonio (UTHSCSA). The images are treated through the following tools:

1. Inverted Palette: it inverts or reverses the image colors of the radiographic plate;
2. Focusing filter – High Pass 3x3: it highlights the borders;
3. Shadow North West Filter it enhances the image, through "shadowing";
4. Pseudo color Palette: it gives the image three basic colors (red, green and blue);
5. Image softener filter – Mean 3x3: it removes the color noise from the image, in the same way as
6. Image softener filter – Mean 7x7.

A comparative observation was carried out between the original image and those obtained after the application of each tool.

The results were arranged in a table with the following values: 1 when the resulting image was the same as the original; 2 when the resulting image was better than the original; and 3 when the resulting image was worse.

The data was statistically processed and summarized in a table. (see Table I).

X-ray Digitalized	High Pass 3x3	Palette Inversion	S North West	Pseudo Color Palette	Mean 3x3	Low Pass 7x7
1	2	2	1	2	3	3
2	2	1	1	1	3	3
3	2	2	1	2	3	3
4	2	1	1	2	3	3
5	2	2	1	2	3	3
6	2	2	3	1	3	3
7	2	2	1	2	3	3
8	2	1	1	2	3	3
9	2	2	3	2	3	3
10	2	1	1	1	3	3
11	2	2	1	2	3	3
12	2	1	1	2	3	3
13	2	1	1	2	3	3
14	2	1	1	1	3	3
15	2	1	1	1	3	3

Table I

RESULTS

We started from an original digital image, made from the indirect capture of the scanning of a conventional radiographic plate, and we applied the High Pass 3x3 filter (fig. 1), whose main function is to highlight the borders, thus increasing the contrast. When comparing this to the original image, even though this tool adds color noise to the image, its application improved its quality.

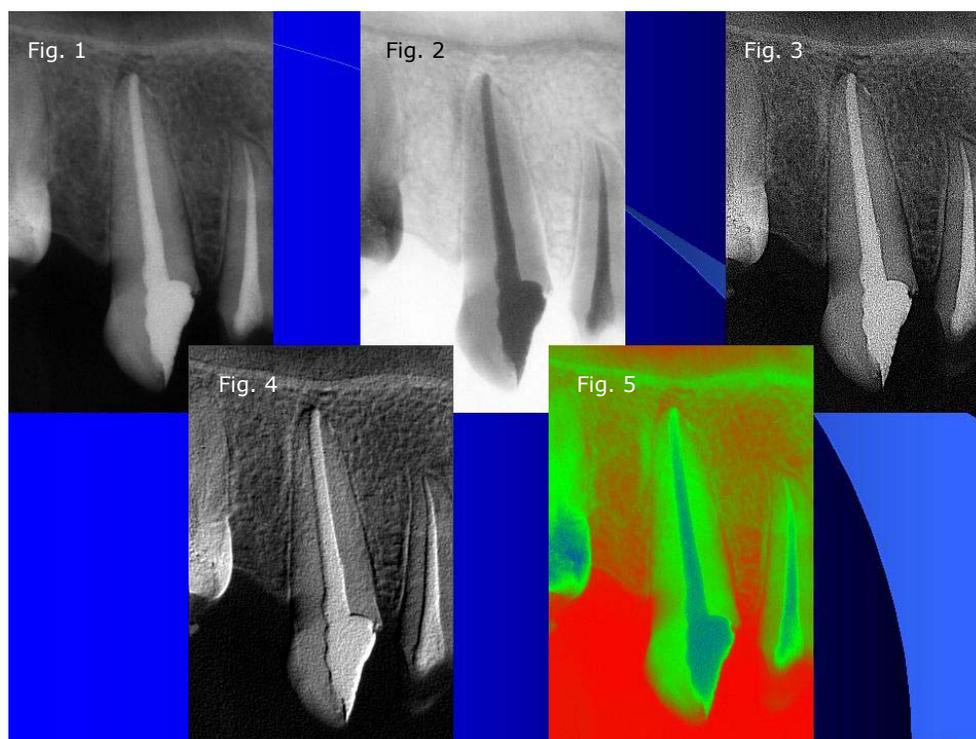
Later the inverted palette tool was used, (fig. 2) which reverses the colors of the radiographic image. No differences were observed with the latter when comparing it with the original image. Simply, another way of visualizing it was obtained. It was ascribed value 1.

Later, the Shadow North West filter was applied (fig. 3), which gives the image a relief which does not improve the assessment of the quality of the endodontic sealing, but it allows the observer to visualize it as in third dimension, thus making it useful for teaching aims.

The pseudo color palette gives the original image color red for the radiolucyd areas, green for the intermediate ones, and blue for the radio-opaque ones. In most cases, this filter improves the interpretation quality, highlighting the obturation defects or the lack of compaction of the sealing mass.

The Mean 3 x 3 (fig. 4) and Low pass 7 x 7 (fig. 5) filters, also known as defocusing filters, distorted the image in all the cases, removing contrast from it, and thus losing the borders definition. In this study, it has not allowed us to improve the interpretation of the obturation quality.

These operations were repeated with all the radiographic plates.



CONCLUSIONS

The visual variations in the digital images were comparatively assessed, and not the traditional radiographic plates and digital images. Even though they have the same amount of information, what varies is the way in which they are represented: some filters improve the image quality and others deteriorate it.

When comparing the different tools of the program used in the present study, it can be concluded that the images resulting from the High pass 3x3 filters, the pseudo color palette, are a great help to the interpretation of the obturation quality.

The Mean 3x3 and 7x7 filters do not add any improvement and they produce image defocusing.

Meanwhile, the Shadow North West filters and inverted palette do not add substantial advantages to the observer in most cases, but in some images they improve the interpretation quality.

Bibliography

- (1) Leonardo, Leal: Endodoncia. Tratamiento de los Conductos radiculares. 1991. Segunda edición. Medicina Panamericana. Cap. 22 Pag: 373
- (2) Ramsey, WD: Hermetic sealing of root canals. JOE, 8:100, Mar. , 1982.
- (3) Zerlotti Filho. Contribucao a terapeutica dos condutos radiculares. Campinas, 1957.
- (4) Ingle JL. A standardized endodontic technique utilizing new designed instruments and filling materials. Oral Surg 14 (1): 83-91, 1961.
- (5) Grossman L, Shepard L, Pearson, LA. Roentgenologic and Clinical evaluation of endodontically treated teeth. Oral Surg 17 (3):368-73, 1964.
- (6) Holland R, Hizatugu R, Scarparo C. Avaliacao radiografica dos resultados obtidos com o tratamento endodontico radical. Rev. Farm. Odont. 37(3): 173-174, 1971
- (7) Leal JM, Simoes Filho A, Leonardo MR. Avaliacao clinica e radiografica dos tratamentos endodonticos verificados nos universitarios da faculdade de Farmacia e Odontologia de Uberlandia. Trabajo presentado. Guaruya 1972
- (8) Leonardo MR, Marcal P. Avaliacao clinica e radiografica dos tratamentos radiculares nos universitarios da faculdade de Farmacia e Odontologia de Araraquara. Trabajo presentado. Guaruya 1972
- (9) Gutmann JL, Clinical, radiographic, and histologic perspectives on success and failure in endodontics, Den Clin North Am 36:379, 1992.
- (10) Sjögren U, Sundqvist G, Hägglund B, Wing K: Factors affecting the long-term results of endodontic treatment. J Endod 16:498, 1990
- (11) Baumgardner KR, Taylor J, Walton R. Canal adaptation and coronal leakage: lateral condensation compared to Thermafil. J Am Dent Assoc. 1995 Aug;126(8):1084, 1086, 1088-9
- (12) Edgar Schäfer, Priv-Doz, Gudrun. Effect of three different sealers on the sealing ability of both thermafil obturators and cold laterally compacted gutta-percha. J of Endodon. 28 (9):638-639, 2002
- (13) Bill Greer, Lesley West, Frederick Liewehr, David Pashley. Sealing ability of dyract, geristore, IRM, and superEBA as root-end filling materials. J of Endodon 27(7):441-443, 2001
- (14) Kenan Clinton, Van Himel. Comparison of a warm gutta-percha obturation technique and lateral condensators. J of Endodon 27(11):692-695, 2001
- (15) Ludovic Pommel, Bruno Jacquot, Jean Camps. Lack of correlation among three methods for evaluation of apical leakage. J of Endodon. 27(5):347-350, 2001
- (16) Najla Al, Simon J, Dummer PM. Comparison of laterally condensed and low-temperature thermoplasticized gutta-percha root fillings. J Endod. Dec; 26(12):733-8, 2000

Authors' address: Cátedra de Endodoncia – Facultad de Odontología UNR - Santa Fe, 3160, Piso 6º - (S2002KTT) ROSARIO, Provincia de Santa Fe, República Argentina
E-mail: gpisterna@funescoop.com.ar