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Original Research Article

Comparative evaluation of radiographic density of different endodontic material

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ABSTRACT

The purpose of this study was to evaluate and compare the densities of four different brands of root canal sealers using three different intraoral imaging receptors. Four different root canal sealers used were – AH Plus (Dentsply Germany, Resin based), Epiphany (Pentron USA, Resin based), U/P (Sultan Healthcare, Zinc oxide eugenol based) and Apexit (Ivoclar / Vivadent, Calcium hydroxide based). The sealers were mixed according to manufacturer instructions and six specimens of each material were fabricated. All the specimens were imaged using three different intraoral #2 sized imaging receptors-D and E speed film and storage phosphor plates. D and E speed films were digitized and stored in JPEG format. All the images were exported into the Image J software (rsb.info.nih.gov/ij/) and the mean grey values and integrated density of each material was calculated from four random areas of each image and averaged. Mixed model ANOVA was performed. Pair wise comparison of mean grey values between the three imaging receptors and integral densities recorded by the receptors showed high statistical significance for all the four different root canal sealers. Results showed that the four different types of root canal sealers showed different optical densities on all the three receptors.

Objective: The purpose of this study is to evaluate and compare the optical densities of four different brands of root canal sealers using three different intraoral imaging receptors.

1. Introduction

Various types of root canal sealers are used in endodontics to fill the root canals. These sealers range from zinc oxide eugenol based sealers to resin and calcium hydroxide based sealers. Root canal sealer fills the gap between the gutta-percha and dentinal wall,[1] which prevents leakages and helps in sealing inaccessible area of root canal.[2] However zinc oxide eugenol based sealers have a long successful history in dentistry, newer resin based sealers have more ability to seal and bond to the root dentin. Use of calcium hydroxide based root canal sealers is mainly because of its higher antimicrobial activity,[3,4] and better periapical healing property.[5]

Radiopacity is one of the main property, required for visualizing intraoral dental materials in a radiograph. Any Root canal sealer should have sufficient radiopacity to allow for a clear distinction between the surrounding anatomic structures and the sealer material,[6,7] and to facilitate the evaluation of the quality of the root fillings through radiographic examination.[8]

Conventional radiograph has been used in dentistry since many years. However new digital radiographic technique claims to be more beneficial compared to traditional radiographic film technique.[9] In this study attempt has been made to evaluate and compare the densities of four different

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brands of root canal sealers using both conventional and digital radiographic techniques.

2. Materials and Methods

The four different root canal sealers used were – AH Plus, Epiphany, U/P and Apexit. The sealers were mixed according to the manufacturers instructions and six specimens of 2mm thickness and 10 mm diameter of each material were fabricated using metallic matrices and stored at room temperature. All the six specimens of all 4 sealers were radiographed using three different modalities which were, intraoral #2 sized imaging receptors-D and E speed film and storage phosphor plates for digital radiography. The GENDEX GX770 X-Ray machine was used to take the radiographs. All exposures were standardized at 70kvp, 7ma and 8 impulses / second and object source distance was set at 15 inches by using optical bench. D and E speed films were digitized using the Epson Expression Scanner and stored in JPEG format. All the images were exported into the Image J software (rsb.info.nih.gov/ij/) and the mean grey values and integrated density of each material were calculated from four random areas of each image and averaged. Mixed model ANOVA was performed.

3. Results

Table 1: Gray value

Material	D Speed	F Speed	Digital
AH Plus	84.43	78.71	236.21
Epiphany	75.3	75.84	213.35
U/P	72.43	71.04	196.86
Apexit	69.75	57.69	119.18

Table 2: Integrated density

Material	D Speed	F Speed	Digital
AH Plus	11830.93	10989.56	33977.81
Epiphany	10494.68	10527.12	30721.06
U/P	10221.62	10005.87	28371.12
Apexit	9686.12	8131	17360.06

All tests were performed at 95% confidence intervals and the null was rejected. Pair wise comparison of mean grey values between the three imaging receptors showed high statistical significance (P=0.000 to 0.046) for all the root canal sealers. Integral densities recorded by the receptors also showed high statistical significance (P=0.00 to 0.072) between the three receptors for all the four different root canal sealers. AH plus showed highest and Apexit showed the lowest grey values and integral densities irrespective of the imaging receptor used (Tables 1 and 2).

4. Discussion

Radiopacity has always been an important characteristic of all the dental materials. In order to distinguish root canal filling materials from surrounding tooth structure, it is necessary that the root canal sealers exhibit adequate radiopacity. American National Standard/American Dental Association (ANSI/ADA 2000) Specification No. 57 recommends that, endodontic sealing materials must have a radiopacity not less than that equivalent to 3 mm of aluminum.[10] Several attempts have been made to evaluate radiopacity of dental materials compared to aluminum step wedge.[11,12]

Newer digital radiographic techniques offer many advantages, compared to conventional radiographic methods in terms of quality & time sensitivity.[13] In conventional radiographs, processing technique may even negatively affect the final quality of the radiographic image.[14] New method to evaluate radiopacity of root canal sealers by digitizing conventional radiographs was first proposed by Tagger & Katz (2003),[15] with the help of radiographic software. Use of radiographic software gives an opportunity to analyze digital images more appropriately and easily with the help of grey pixel value. Grey pixel values range from 0 to 255 in which 0 represents black and 255 represents white.[16,17] High density materials absorb more x rays and give light image[18] with gray pixel value 255 and same with the low density materials, which absorb less x rays and give dark image with gray pixel value 0.

This study tried to investigate and compare the optical densities of four different brands of root canal sealers using three different intraoral imaging receptors. All the materials tested in this study showed different densities on all the different modalities. Radiographic density and gray pixel values in decreasing order were: AH Plus, Ephiphany, U/P followed by Apexit. According to Goshima (1989) radiopacity of the material depends on the radiopacifier agents present in the material.[19] Higher radiographic density value of AH Plus obtained in this study might be because of its higher zirconium oxide content.[20]

5. Conclusion

Our study showed that the four different types of root canal sealers showed different densities on all the three receptors. All our exposures were standardized and multiple sites on each image were used to calculate the mean density. Since there was a high statistical significance between the root canal sealers, it is possible to differentiate these materials on radiographic images regardless of the type of image receptor used.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Grossman L. An improved root canal cement. *J Am Dent Assoc*. 1958;56:381–5.
2. Manhart M. The calcium hydroxide method of endodontic sealing. *Oral Surg Oral Med Oral Pathol*. 1982;54(2):219–24.
3. Cvek M. Treatment of non-vital permanent incisors with calcium hydroxide. *Odontol Revy*. 1974;25(3):239–46.
4. Bystrom A, Claesson R, Sundqvist G. The antimicrobial effect of camphorated paramonochlorophenol, camphorated phenol and calcium hydroxide in treatment of infected root canals. *Endod Dent Traumatol*. 1985;1(5):170–5.
5. Tronstad L, Andreason J, Hasselgren G. pH changes in dental tissues after root canal filling with calcium hydroxide. *J Endod*. 1981;7(1):17–21.
6. Beyer-Olsen EM, Orstavik D. Radiopacity of root canal sealers. *Oral Surg Oral Med Oral Pathol*. 1981;51(3):320–8.
7. Katz A, Kaffe I, Littner M, Tagger M, Tamse A. Densitometric measurement of radiopacity of gutta-percha cones and root dentin. *J Endod*. 1990;16(5):211–3.
8. Goldman M, Simmonds S, Rush R. The usefulness of dye-penetration studies reexamined. *Oral Surg Oral Med Oral Pathol*. 1989;67(3):327–32.
9. Sabbagh J, Vreven G, Leloup G. Radiopacity of resin-based materials measured in film radiographs and storage phosphor plate (Digora). *Oper Dent*. 2004;29(6):677–84.
10. American Dental Association. Specification no. 57 for endodontic filling materials. *J Am Dent Assoc*. 1984;108:88.
11. Katz A, Kaffe I, Littner M, Tagger M, Tamse A. Densitometric measurement of radiopacity of gutta-percha cones and root dentin. *J Endod*. 1990;16(5):211–3.
12. Tanomaru-Filho M, Jorge EG, Tanomaru JMG, Gonçalves M. Radiopacity evaluation of new root canal filling materials by digitalization of images. *J Endod*. 2007;33(3):249–51.
13. Mcdonnell D, Price C. An evaluation of the Sens-A-Ray digital dental imaging system. *Dentomaxillofac Radiol*. 1993;22(3):121–6.
14. Syriopoulos K, Sanderink GC, Velders XL, Stelt P. Radiographic detection of approximal caries: a comparison of dental films and digital imaging systems. *Dentomaxillofac Radiol*. 2000;29:312–8.
15. Tagger M, Katz A. Radiopacity of endodontic sealers: development of a new method for direct measurement. *J Endod*. 2003;29(11):751–5.
16. Nummikoski PV, Martinez TS, Matteson SR, Mcdavid WD, Dove SB. Digital subtraction radiography in artificial recurrent caries detection. *Dentomaxillofac Radiol*. 1992;21:59–64.
17. Wagner IV, Schneider W. Computer-aided quality assurance in oral health care: the image of electronic radiographs. *Dentomaxillofac Radiol*. 1992;21(4):195–7.
18. White S, Pharoah MJ. X – Ray film, intensifying screens,and grids in oral Radiology. In: Principals and Interpretation. St Louis Mosby; 2000. p. 68–82.
19. Goshima T, Goshima Y. The optimum level of Radiopacity in posterior composite resins. *Dentomaxillofac Radiol*. 1989;18(1):19–21.
20. Tanomaru JMG, Cezare L, Gonçalves M, Tanomaru-Filho M. Evaluation of the radiopacity of root canal sealers by digitization of radiographic images. *J Appl Oral Sci*. 2004;12(4):355–7.

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