

Determination of the Root Canal Length of Teeth of Bantu Patients Attending the Teaching Hospital of Kinshasa University

Jean Marie Kayembe Bukama^{1*}, Jean Paul Sekele Issourdi², Fidele Nyimi Bushabu^{3,4}, Augustin Mantshumba Milolo², Steve Sekele Masin⁵, M. A. Agbor⁶, Dieudonne Nyembue Tshipukana⁷, Alain Nyengele Kayembe², Hubert Ntumba Mulumba²

¹Endodontic Unit, Service of Operative Dentistry, Teaching Hospital of Kinshasa University, Kinshasa, Democratic Republic of Congo

²Prosthodontics Services, Teaching Hospital of Kinshasa University, Kinshasa, Democratic Republic of Congo

³Oral and Maxillofacial Surgery, Teaching Hospital of Kinshasa University, Kinshasa, Democratic Republic of Congo

⁴Department of Oral Maxillofacial Head and Neck Oncology, School and Hospital of Stomatology Wuhan University, Wuhan, China

⁵Department of Mathematics and Computer Science, Faculty of Science, University of Kinshasa, Kinshasa, Democratic Republic of Congo

⁶Universite des Montagne Dental School, Bangangté, Cameroon

⁷Department of Otorhinolaryngology (ENT), Teaching Hospital of Kinshasa University, Kinshasa, Democratic Republic of Congo
Email: *jmkayembe2003@yahoo.fr

How to cite this paper: Bukama, J.M.K., Issourdi, J.P.S., Bushabu, F.N., Milolo, A.M., Masin, S.S., Agbor, M.A., Tshipukana, D.N., Kayembe, A.N. and Mulumba, H.N. (2018) Determination of the Root Canal Length of Teeth of Bantu Patients Attending the Teaching Hospital of Kinshasa University. *Open Journal of Stomatology*, 8, 16-23.

<https://doi.org/10.4236/ojst.2018.81002>

Received: November 22, 2017

Accepted: January 16, 2018

Published: January 19, 2018

Copyright © 2018 by authors and Scientific Research Publishing Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Background: There is paucity of literature on the determination of the root canal length of Bantu subjects in dental professional practicing in Africa and Democratic Republic of Congo in particular. **Aims:** The aim of the present study was to determine the root canal length of teeth of Bantu patients extracts attending the Teaching Hospital of Kinshasa University. **Methods and Material:** Prospective cross-sectional study was carried out in the service of Conservative Dentistry. The patients suffering with pulpitis of permanent teeth which were selected for root canal treatment during the period of January 2014 to December 2016 were included. All patients whose main root canals were inaccessible, teeth carrying prosthesis, teeth with large coronal decay, teeth having periapical periodontitis, supernumerary teeth, wisdom and primary teeth were excluded. **Results:** The upper canines presented some significant longer canals compared to the lower canine (23.4 ± 2.3 mm and 21.6 ± 1.8 mm). Palatal canals of the first and second molar were respectively longer as compared to the superior teeth canals (21.5 ± 1 mm, 21.3 ± 2 mm). The distal canals of the first and second molar were the longest in the mandibular arch respectively measuring 20.7 ± 2.0 mm and 21.5 ± 1.7 mm. **Conclusion:** Data obtained from Bantu patients show slightly shorter roots compared to

some European populations, but longer than some Asian populations.

Keywords

Bantu, Length, Root Canal, X-Ray

1. Introduction

Endodontics is the discipline regarding prevention, diagnosis and treatment of diseases of the pulp and periapical area. It demands from the practitioner, a near perfect mastery not only of the root morphology of the teeth, but also by perfecting knowledge of the number of roots of each tooth of a dental arch, spatial orientation and moreover their respective lengths. Recognition on the number and Sharpe of canals per tooth, the precise determination of root canal length and the technical skills of the practitioner complete these requirements needed [1] [2].

The majority of studies in literature has been reported estimation of root canal length mentioned in the subjects of Caucasian origin [3] [4] [5] [6] or Asian origin which stated by an anthropologist that taller individual generally has longer teeth than shorter individuals and later studies concluded that the teeth of Caucasians are longer than these of Asians population. These values are presently regarded as reference standards. Therefore, dental professional practice in Africa in general and the DR. Congo in particular refer indiscriminately to this traditional root length of Caucasian or Asian origin which can introduce clinical errors in managing patients. Hence this study was carried out to determine the root canal length of people of Bantu origin consulting in the Teaching Hospital of Kinshasa University.

1.1. Methods

A Prospective cross-sectional study of Bantu subjects aged from 18 to 45 years who were admitted in Service of Conservative Dentistry, suffering from pulpitis with their permanent teeth and subjected to root canal treatment, during the period from January 2013 to December 2015.

Excluded in the study are patients whose main dental canals were inaccessible to apical constriction, with teeth bearing prosthetic crowns or having coronary reconstructions, teeth with gross caries with total crown destruction, abrasions, wisdom teeth, temporary, ectopic and supernumerary teeth, and teeth with periapical lesions.

After the establishment of a sterile operative field, local anesthesia was administered and an access cavity into the pulp chamber was made with a cylindrical or cylindro-conical bur mounted on a turbine. The localization of the pulp orifice and canal catheterization was based on the original root canal length estimated using a preliminary periapical x-ray. A K-type file placed into the root canal which was also used to estimate the working length with a confirmatory x-ray.

The choice of the endodontic instrument was done according to its diameter (the sufficiently fine) and that of the canals which can penetrate without dislodging on the canal wall in and which can adhere to the apical constriction. Cameral trepanation (entry into the pulp orifice) was made by means of the cylindrical probe mounted on a turbine in case of voluminous pulp in case of chamber pulpal calcification; trepanation was done using a drill mounted on steel ball using round bur and a slow speed contra-angle hand piece. The estimation of the original length was based on the basis of the prior radiography by subtracting 2 mm from the image. The canal length was estimated using of a fine file to an estimated depth that was radiopaque, placing a rubber stop in contact with the incisal edge or occlusal surface as a reference point used as an indicator making sure that the desired length is reached.

When the measurement of the exact length of the canal on a radiograph is achieved, 4 situations can be revealed: 1) the file is located exactly at the apex or with some few millimeters from the apex, 2) the file is several millimeters away from the apex, and the length of the file on the radiographic image corresponds to the actual length, in which case the stop was moved to a few millimeters corresponding to the missing length, 3) the file exceeds the apex and the length of the file on the radiographic image is adjusted to the actual length, then the placement of the rubber stop was adjusted corresponding to the excess length, and 4) if the tip of the file was farther away from the apex and the image is elongated, a simple rule of three will be used to calculate a corrected estimate length.

1.2. Statistics

The data were first collected on a data capture sheet, then codified, in Microsoft Excel 2010 and analyzed using SPSS to estimate the average canal lengths for each type of teeth. The student t test, the test of turkey and ANOVA were used to compare values found.

2. Results

The study includes 720 subjects; 480 (66%) were female and 240 (34%) were male (**Figure 1**). A total of 818 teeth were examined with 1539 root canals. The upper central incisor and the lower first molar predominated respectively in the maxilla and the mandible regions (**Table 1**).

The upper canines are anterior teeth having a large root canal length followed by upper central incisors with 23.4 ± 2.3 mm and 21.8 ± 1.6 mm' instead respectively (**Table 2**). Palatal canals of the first and second molar were the longest compared to the Mesio-Vestibular and disto-buccal canals of the first and second upper molars with 21.5 ± 1 mm, 21.3 ± 2 mm, and 19.8 ± 2 mm, 19.0 ± 2 mm and 20.0 ± 2 mm, 19.0 ± 2 mm as well as the vestibular and Palatal Canals of first and second upper Premolars which has 20.9 ± 1 mm, 19.9 ± 1 and 20.4 ± 1 mm, 19.4 ± 1.6 (**Table 3**).

The canals of mandibular canines are the longest followed by those of the lateral incisors which represented 21.6 ± 1.8 mm and 20.0 ± 1.4 mm (**Table 4**). The

Gender of patients

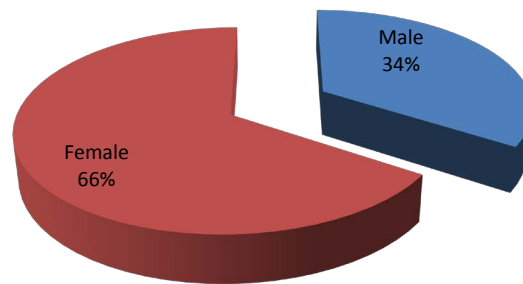


Figure 1. Distribution of workforce by gender.

Table 1. Number of teeth measured.

	Maxillary arch (number of canals)	Mandibular arch (number of canals)
Central Incisors	163 (163)	19 (19)
Lateral Incisors	56 (56)	8 (8)
Canines	22 (22)	5 (5)
First premolars	116 (232)	24 (24)
Second Premolars	135 (270)	35 (35)
Firsts molars	74 (222)	109 (327)
Second molars	13 (39)	39 (117)
Total	579 (1004)	239 (535)

Table 2. The root canal length of the anterior upper teeth according to their typology.

Length (mm)	central incisor	Types of teeth lateral incisor	Canine
Mean \pm SD	21.8 \pm 1.6	21.3 \pm 2.0	23.4 \pm 2.3
Median	22	21	23
Mode	21	21	23
minima	17	16	18
maxima	27	25	26

distal canal of the first and second molar was the longest of the mandibular teeth measuring 20.7 ± 2.0 and 21.5 ± 1.7 mm respectively (**Table 5**). The second lower premolars (21.8 ± 1.9 mm) and the distal canal of the second lower molars (21.5 ± 1.7 mm) presented with the longest roots (**Table 5**).

3. Discussion

This study was carried out as an assessment of the root canal length of Bantu patients attending the Teaching Hospital of Kinshasa University in the DRC Congo. A total of 1539 root canals were included with different types of teeth and mostly in mandibular teeth. The sampling demonstrated an unequal distribution

Table 3. Root canal length of the Posterior Upper teeth depending on their location of the canal.

Root canal length (mm)	First premolars		Second premolars		First molars			Second molars		
	vestibular Canal	palatal Canal	vestibular Canal	palatal Canal	MVC	DVC	palatal Canal	MVC	DVC	Palatal Canal
Mean ± SD	20.9 ± 1.7	19.9 ± 1.7	20.4 ± 1.6	19.4 ± 1.6	19.8 ± 2.2	19.0 ± 2.0	21.5 ± 1.9	20.0 ± 2.4	19.2 ± 2.0	21.3 ± 2.4
Median	21.0	20.0	20.0	19.0	20.0	19.0	22.0	19.0	9.0	21.0
Mode	21.0	20.0	20.0	18.0	22.0	19.0	21.0	19.0	19.0	20.0
Minima	17.0	16.0	16.0	16.0	15.0	15.0	17.0	15.0	15.0	17.0
Maxima	26.0	25.0	24.0	23.0	24.0	23.0	26.0	24.0	23.0	26.0

MPC: Mesio-palatal canal; DVC: Disto-vestibular canal; SD: standard deviation.

Table 4. Root length anterior lower teeth.

Length (mm)	Central Incisor	Lateral Incisor	Canine
Mean ± SD	18.8 ± 1.9	20.0 ± 1.4	21.6 ± 1.8
Mode	18.0	20.0	21.0
minima	15.0	18.0	20.0
maxima	22.0	22.0	24.0

Table 5. Root canal length of posterior lower teeth.

Length (mm)	first premolars	second Premolars	First molars			Second molars		
			MVC	MLC	distal Canal	MVC	MLC	distal Canal
Mean ± SD	21.0 ± 2.2	21.8 ± 1.9	19.6 ± 2.0	19.1 ± 1.8	20.7 ± 2.0	20.2 ± 2.0	19.3 ± 1.7	21.5 ± 1.7
Médiane	21.0	22.0	20.0	19.0	21.0	20.0	20.0	22,0
Mode	21.0	22.0	20.0	19.0	20.0	20.0	20.0	21,0
Minima	15.0	18.0	15.0	15.0	16.0	15.0	16.0	17,0
Maxima	25.0	25.0	23.5	23.0	25.0	24.0	23.0	24,0

in the selected number of teeth due to the fact that only teeth which are predisposing to dental caries were mostly selected. For this reason, this sample could not gather a significant number of lower lateral incisors and canines. This is similar to other studies that reported that lower incisors and canines are least susceptible to decay [7] [8]. But the first lower molar is the most representative tooth in the mandible as reported by some studies [9]. On the contrary, the central incisors are the most representative tooth in the maxilla and this probably reflects the importance that commitment of all patients for the aesthetics aspects. The upper central incisors are the most susceptible anterior teeth due to its prominence and in sufficient exposure to the buffering action of saliva, making it carries prone. In addition, fracture can result also in pulp damage, even without fracture of dental tissues.

Currently, the reports on the determination of root canal length are based on the conventional methods such as the radiography and the apex locators. The present study was based on radiography together with tactile sensation from a reamer inserted into the root canals. It is established that, the radiography can change the dimension of the canal by projection errors [10] [11]. To avoid such changes in this study, periapical radiographs were taken with the reamer placed in the anatomical apex respect in such a way that it does not always coincide with the radiographic apex [12] [13]. This is why teeth with periapical lesions were excluded from this study. In the literature, there is still discussion on the optimal technique of measuring root canal length. Nevertheless, many authors prefer X-rays and tactile sense possible to locate the apical constriction or root canal length accurately [14] [15]. On the other hand, Pratten and McDonald [16] suggested that the true apex can be determined using a calibrated apex locator even where radiography and tactile determination are lacking. This corroborates with the study of Mutu Shanmugaraji *et al.* 2007 [17] indicating that the fifth-generation apex locator showed the highest accuracy and the highest reliability (86.7%) compared to the radiograph (76.6%) and tactile sensation (33.3%). In addition, Bogaert and Van Nieuwenhuysen [18] pointed out that apex locators should be used in confirmation of the prior radiography and the results of electronic measurement are still subject to interpretation or no method is absolutely reliable. Thereafter, Mutu Shanmugaraj [17] recognizes that the exact length of the canal location can be determined by histological methods. While Kim *et al.* 2005 [6] believe that the most reliable way to determine the root canal length is only when the measurement is done on an extracted tooth. Lonzano *et al.* 2001 [19] did not find any differences between conventional radiography, digital radiography and the apex locator as to find the precise root canal length.

In a comparative study of the root canal length of each type of teeth, Kim *et al.* [6] found that Caucasians have longer teeth than those of Asians with a difference between 0 to 2.5 millimeters. The present study showed that Bantu (Black African of Kinshasa) with some exceptions, have longer teeth than the Asian and shorter than that of Caucasians. Reporting results of detailed comparison between Bantu people and other people s for each type of root canal are indispensable, as it is necessary for several clinical applications and will be discussed in a subsequent study. But, in the meaning of the present study shows data on root canal lengths obtained from Caucasians should be corrected when using for root canal therapy (RCT) in Bantu patients. It will be very important that tactile estimation be used in the measurement of root canal length as it reflects the actual canal length since root canal length varies in different races. Since this is a preliminary study, another study should be carried out in any each ethnicities of democratic Republic of Congo and other African ethnicities and results compared, thus may be limit of the present work.

4. Conclusion

The average canal lengths estimated for the Central and lateral incisors and ca-

nines were respectively 21.8 mm; 21.2 mm; 23.4 mm in the maxilla compared to 18.8 mm; 20.0 mm and 21.6 mm in the mandible. In the posterior region, the length of the upper and lower root canals varies between 19.0 and 21.5 millimeters. Some Root canal length teeth of Bantu are different with those of Asian and of Caucasians, this should be observed in endodontic treatment of patients of this ethnic background.

References

- [1] Dehon, P.H. and Van Nieuwenhuysen, J-P. (1999) Détermination électronique de la longueur des canaux radiculaires. *Revue Belge de Medecine Dentaire*, **54**, 259-281.
- [2] Vertucci Vertucci, F.J. (2005) Root Canal Morphology and Its Relationship to Endodontic Procedures. *Endodontic Topics*, **10**, 3-29. <https://doi.org/10.1111/j.1601-1546.2005.00129.x>
- [3] Eliasson, S., Lavstedt, S. and Ljungheimer, C. (1986) Radiographic Study of Alveolar Bone Height Related to Tooth and Root Length. *Community Dentistry and Oral Epidemiology*, **14**, 169-171. <https://doi.org/10.1111/j.1600-0528.1986.tb01525.x>
- [4] Ingle, J.I. (1994) Backland LK. Endodontics. 4th Edition, Lea & Febiger, Philadelphia, 92-226.
- [5] Weine, P.S. (1996) Endodontic Therapy. 5th Edition, CV Mosby, St Louis, 239-304.
- [6] Kim, E., Fallahraghegar, A., Hur, Y.Y., Jung, L.I., Kim, S. and Lee, S.J. (2005) Difference in Root Canal Length between Asians and Caucasians. *International Endodontic Journal*, **38**, 145-151. <https://doi.org/10.1111/j.1365-2591.2004.00881.x>
- [7] Kalenga, K., Pourtois, M., Cantraine, F. and Asiel, M. (1985) Evolution de l'état de santé dentaire au zaïre. *Bulletin du Groupement international pour la recherche scientifique en stomatologie et odontologie*, **28**, 213.
- [8] Kayembe, B. and Ntumba, M.K. (1986) Carie dentaire en milieu scolaire zaïrois, Enquête préliminaire à l'école primaire du Mont Amba ville de Kinshasa. *Odontostomatol Trop*, **IX**, 169-173.
- [9] Kaqueler, J.C. and Lemay, O. (1994) Lésions carieuses de l'émail. In: *Anatomie pathologique buccodentaire*, Masson 2ème éd, 51-58.
- [10] Eggen, S. (1975) Determination Tooth Length from Radiographs. *Quintessence International*, **6**, 69-70.
- [11] Forsberg, J. (1987) Radiographic Reproduction of Endodontic "Working Length" Comparing the Paralleling and the Bisecting—Angle Techniques. *Oral Surgery, Oral Medicine, Oral Pathology*, **64**, 353-360. [https://doi.org/10.1016/0030-4220\(87\)90017-X](https://doi.org/10.1016/0030-4220(87)90017-X)
- [12] Dummer, P., McGinn, J. and Rees, D. (1984) The Position and Topography of the Apical Canal Constriction and Apical Foramen. *International Endodontic Journal*, **17**, 192-198. <https://doi.org/10.1111/j.1365-2591.1984.tb00404.x>
- [13] Stein, T.J. and Corcoran, J.F. (1992) Radiographic Working Length Revisited. *Oral Surgery, Oral Medicine, Oral Pathology*, **74**, 796-800. [https://doi.org/10.1016/0030-4220\(92\)90412-J](https://doi.org/10.1016/0030-4220(92)90412-J)
- [14] Hembrough, J.H., Weine, F.S., Pisano, J.V. and Eskoz, N. (1993) Accuracy of an Electronic Apex Locator: A Clinical Evaluation in Maxillary Molars. *Journal of Endodontics*, **19**, 242-246. [https://doi.org/10.1016/S0099-2399\(06\)81300-2](https://doi.org/10.1016/S0099-2399(06)81300-2)
- [15] Langeland, K. and Camus, J.P. (1998) Corrélations histo-cliniques de l'endodontie en pratique quotidienne. *Clinic*, **19**, 153-164.

- [16] Pratten, D.H. and McDonald, N.J. (1996) Comparison of Radiographic and Electronic Working Lengths. *Journal of Endodontics*, **22**, 173-176.
[https://doi.org/10.1016/S0099-2399\(96\)80095-1](https://doi.org/10.1016/S0099-2399(96)80095-1)
- [17] Shanmugaraj, M., Nivedha, R., Mathan, R. and Balagopal, S. (2007) Evaluation of Working Length. An *in vivo/ex vivo* Study. *Indian Journal of Dental Research*, **18**, 60-62. <https://doi.org/10.4103/0970-9290.32421>
- [18] Bogaerts, P. and Van Nieuwenhuysen, J.P. (2005) Determination of Canal Length in Endodontic. *Revue Belge de Médecine Dentaire (Review French)*, **60**, 31-40.
- [19] Martinez-Lonzano, M.A., Forner-Navarro, L., Sanchez-Cortes, J.L. and Lena-Puy, C. (2001) Methodological Consideration in the Determination of Working Length. *International Endodontic Journal*, **34**, 371-376.
<https://doi.org/10.1046/j.1365-2591.2001.00400.x>