

# AN AUDIT OF POST-RETAINED CROWN RESTORATIONS IN A UNIVERSITY TEACHING HOSPITAL, NIGERIA: A TEN-YEAR REVIEW

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## ABSTRACT

**AIM:** To review the pattern of failure and the associated factors of the post retained restorations done over ten years.

**METHOD:** A retrospective cross-sectional study, which audited the record of post-retained restorations. Data including biodata, tooth type, post type, post size, luting cement, and failure were extracted and analyzed. Statistical significance was set at p value  $\leq 0.05$

**RESULTS:** There were 210 participants (M=106, F=104). Stainless steel para posts mainly were used (91.8%); with size three (3) being the highest (23.8%) recorded. Dual cure composite was mainly (78.1%) used for the post cementation. There were 27 (12.8%) cases of failure of post retained restorations of which post-fracture combined with post and crown dislodgement had the highest (52%), with the tooth fracture being the least reported (14.8%). Post fracture only was commoner in males (66.7%). The majority (81.5%) of the failure was seen in the para post group, with no tooth fracture reported for the fibre post.

**CONCLUSION:** Post and core placement is a common procedure for restoring endodontically treated teeth with a reduced coronal structure for the main purpose of retaining the core and, ultimately, the restoration. Stainless steel post was the commonest used, and post-fracture combined with dislodgement of post and crown constituted the most prevalent failure reported.

**KEYWORDS:** audit, post-retained crown, failure

## INTRODUCTION

Endodontically treated teeth (ETT) are often believed to be structurally compromised because of a series of events such as a carious lesion, trauma, biomechanical preparation of the root canals, and tooth preparation associated with ETT.<sup>1,2,3</sup> It has also been reported that teeth that have undergone root canal treatment have a shorter survival time than vital teeth.<sup>4</sup> Hence, the restorations of an ETT call for careful consideration if the negative influence on longevity is minimized.<sup>5</sup> In situations where the remaining tooth structure is inadequate to retain a direct core build-up material, a post placed into the canal for stable retention and support of the core is required.<sup>6</sup>

An intra-radicular post primarily serves to retain the restorations; however, it should also help to protect the remaining tooth structure.<sup>5</sup> These two functions of post can be assessed by looking at the retention ability of the post and the fracture resistance of the endodontically treated tooth.<sup>5</sup> Although it was initially assumed that post-placement strengthened the root-treated tooth, this has been deflated.<sup>7</sup> In fact, the remaining tooth could rather be weakened due to removing healthy dentine to enable the placement of rigid material with different mechanical properties.<sup>8,9</sup>

Many factors have been found to affect the retention of a post and protection of the tooth structure.<sup>5</sup> Such factors include shape, length, diameter, surface design, stiffness, and luting cement type.<sup>5,10-13</sup> These

characteristics are prognosticators of post-retained restorations' survival.<sup>5</sup> Parallel-sided posts have been reported to provide better retention and less stress formation, and increased fracture resistance than the tapered posts.<sup>10,11</sup> An increase in length of the post also produces an increase in retention.<sup>5,12</sup> but the diameter of the post doesn't seem to influence the retention of the post as little evidence is available as regards this.<sup>5</sup> Therefore, the diameter cannot be relied on as a measure to improve the retention.

Other factors that affect post retention include surface designs, which tend to affect the retention of the post, and susceptibility to root fracture due to stress formation within the root.<sup>13</sup> Also, threaded posts have been found to provide better retention than serrated and smooth-sided posts. However, the risk of root fracture is very high in the threaded post owing to the stress build-up in the root.<sup>13</sup> Furthermore, a combination of elastic modulus and diameter of a post affects the post stiffness, post with low modulus of elasticity (high stiffness) stands the chance of fracturing the root, while on the other hand, insufficient stiffness of the post results in distortion of restorations at the margin during function leading to the breakdown of cement.<sup>14</sup>

Although good survival rate has been documented in the literature,<sup>15,16</sup> post retained crowns are still affected by certain risk factors that contribute to clinical failures.<sup>5</sup>

The failure of post-retained crowns has been reported in many clinical studies.<sup>6,17,18</sup> Many of these studies indicate that the failure rate of restorations on pulpless teeth with post-and-cores is higher than that for restorations of vital teeth.<sup>16,19</sup> Numerous causes of failure of post-retained restorations have been identified. These include recurrent caries, endodontic failure, periodontal disease, post dislodgement, cement failure, post-core fracture, crown-core fracture, core fracture, loss of crown retention, post distortion, post-fracture, tooth fracture, and root fracture.<sup>20,21</sup>

A study by Gbadebo et al.,<sup>15</sup> reported an excellent performance of the teeth restored with glass fiber post retained restorations following a six months' review. But to the best of our knowledge, no other Nigerian clinic-based study evaluated the post-retained restorations of endodontically treated teeth at the commencement of this study. Furthermore, the knowledge of the prevalence of restorations on endodontically treated teeth and associated factors will inform evidence-based practice, and help in proper planning and review of our clinical protocol, as many cases for post retained restorations are evident from the recent presentations in the hospital.

Therefore, this study aimed to review the post retained restorations provided for patients over ten years at the Conservative Clinic, Dental centre, University College Hospital Ibadan. The audit also evaluated the types of restoration, post-use, failure rate, and factors related to their failure.

## MATERIALS AND METHOD

This was a retrospective cross-sectional study that reviewed the record of post-retained restorations provided to patients between January 2010 and December 2019 at the Conservative Clinic of the University College Hospital, Ibadan, covering January 2010 to December 2019. Ethical approval was obtained from the ethical committee of the University of Ibadan/ University College Hospital (UI/EC/21/0219). Identification numbers of all the patients who had post retained composite, post-retained crowns, and bridge restorations during the study period were obtained from the daily record book of the clinic. The numbers were used to retrieve their case notes from the records unit/department of the hospital. All the necessary data were extracted and recorded accordingly. Data collected included: Socio-demographics of patients (age, sex, tribe, occupation, marital status, level of education attained and address), date of the procedure, tooth type that received post, type of post, size of post, luting cement, core material, final restoration, failure recorded and cause. Data were entered into a pass-worded computer and analyzed using the statistical package for social sciences (SPSS) (IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp). Frequencies and percentages were calculated for qualitative variables. Data were compared using descriptive statistics. Level of significance was set at

p value < 0.05

## RESULTS

Two hundred and fifty-five case files of patients that had post retained restorations between 2010 and 2019 were retrieved from the records unit/department, out of which two hundred and ten with complete information were considered. The age distribution of the participants and other demographics are as shown in Table 1.

**Table 1: Frequency distribution of demographics of participants**

Gender	N(210)	%
Male	106	50.5
Female	104	49.5
<b>Age group (years)</b>		
<20	15	7.1
21-40	80	37.9
41-60	52	24.6
61-80	60	28.4
>80	4	1.9
Mean age	45.84±18.9	
<b>Marital status</b>		
Single	63	30
Married	143	68.1
Widowed	4	1.9
<b>Education</b>		
Primary	3	1.4
Secondary	27	12.9
Tertiary	180	85.7
<b>Tribe</b>		
Yoruba	181	85.7
Igbo	15	7.2
Edo	7	3.3
Benue	4	1.9
Others	3	1.5

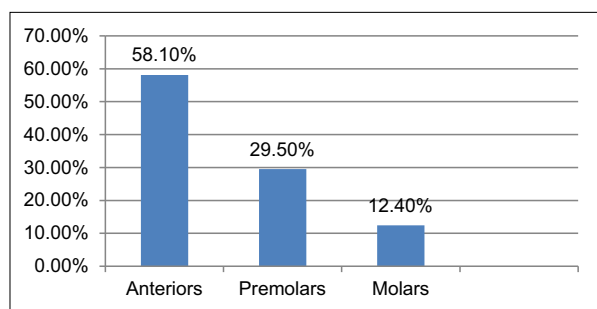
There was approximately 1:1 male: female presentation with the males being 106 (50.5%) of the total population. Most (37.9%) of the patients were in the age group 21-40 years, while the least (1.9%) was seen in the age group 80 years and above, with the mean age of 45.84±18.9years. The majority (85.7%) of the patients had tertiary education, and a higher number of the participants were from the Yoruba tribe.

Stainless-steel para posts were the most (91.8%) used by the clinicians, with size 3 being the highest (23.8%) recorded (Table 2). Dual cure composite was the luting cement mainly (78.1%) used for the cementation of the posts, while zinc phosphate cement was used in 21.4% of cases, and GIC was used in only one patient. Porcelain fused to metal crown was the final/definitive restoration in the majority (92.0%) of the cases; others included all metal crowns, composite restoration and crown reattachment. (Table 2)

**Table 2: Distribution of Post size, luting cement, and Final restoration**

Parameters	N(210)	%
<b>Post type</b>		
Para post	193	91.9
Fiber post	17	8.1
<b>Post Size</b>		
3	50	23.8
4	22	10.5
5	23	11.0
No size recorded	115	54.7
<b>Luting Cement</b>		
Dual cure composite	164	78.1
Zinc phosphate	45	21.4
GIC	1	0.5
<b>Final restoration</b>		
PFM	194	92.0
All metal crown	2	0.9
Composite restoration	11	5.2
Crown reattachment	4	1.9

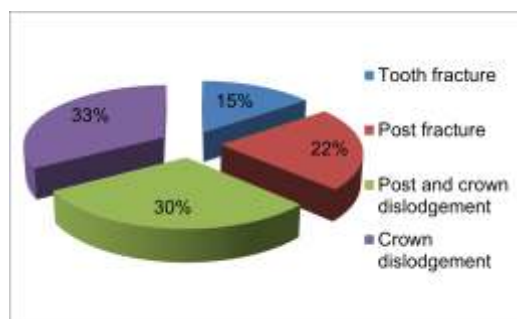
Anterior teeth were the most prevalent (57.6%) among the teeth recorded, while molars were the least prevalent (Figure 1).



**Figure 1: Distribution of teeth restored with post retained crown**

There were 27 (12.8%) cases of failed post retained restorations documented during the study period. The failures

included post-fracture combined with post and crown dislodgement which constituted the highest (52.2%), followed by crown dislodgement alone (33%), with the tooth fracture being the least reported (14.8%). (Figure 2)



**Figure 2: Types of failure of post retained restorations reported**

The age group 61-80 years had the highest percentage (44.5%) of failure and the most common of the failures were crown dislodgement and post and crown dislodgement.

In comparing the various forms of post failure with the different cements. Post and crown dislodgement constituted the highest (72.7%) type of failure in restorations cemented with dual cure composite. However, post-fracture (75%) was the highest failure reported with zinc phosphate cement. There was no significant difference in the rate of failure of post retained restoration between males (48.2%) and females (51.8%). However, post-fracture was commoner in males (66.7%) as compared to females (33.3%), while tooth fracture was seen only in the female gender 4 (100%). Considering the post type and failure of the post, the majority (81.5%) of the failure was seen in the para post group, while 4 (18.2%) out of the 22 para post cases that failed suffered tooth fracture, but there was no tooth fracture reported for the fibre post (Table 3).

**Table 3: Correlation of luting cement, Post type, Tooth type, duration of restoration, Gender and Age group with type of failure**

Parameters	Types of failure				Total N (%)	P value
	Tooth fracture N(%)	Post fracture N (%)	Post and crown dislodgement N (%)	Crown dislodgement N (%)		
<b>Cement</b>						
Dual cure composite	3 (75)	3 (50)	7 (87.5)	9 (100)	22 (81.5)	
Zinc phosphate	1 (25)	3 (50)	1 (12.5)	0 (0)	5 (18.5)	0.099
Total	4 (100)	6 (100)	8 (100)	9 (100)	27 (100)	
<b>Post type</b>						
Parapost	4 (100)	5 (83.3)	6 (75)	7 (77.8)	22 (81.5)	
Fibre post	0 (0)	1 (16.7)	2 (25)	2 (22.2)	5 (18.5)	0.746
Total	4 (100)	6 (100)	8 (100)	9 (100)	27 (100)	
<b>Tooth type</b>						
Anterior teeth	1 (25)	4 (66.6)	7 (87.5)	7 (77.8)	19 (70.4)	
Premolars	2 (50)	1 (16.7)	0 (0)	2 (22.2)	5 (18.5)	0.306
Molars	1 (25)	1 (16.7)	1 (12.5)	0 (0)	3 (11.1)	
Total	4 (100)	6 (100)	8 (100)	9 (100)	27 (100)	
<b>Gender</b>						
Male	0 (0)	4 (66.7)	5 (62.5)	4 (44.4)	13 (48.2)	
Female	4 (100)	2 (33.3)	3 (37.5)	5 (55.6)	14 (51.8)	0.15
Total	4 (100)	6 (100)	8 (100)	9 (100)	27 (100)	
<b>Age group</b>						
<20	0 (0)	0 (0)	1 (12.5)	0 (0)	1 (3.7)	
20-40	1 (25)	1 (16.7)	1 (12.5)	2 (22.2)	5 (18.5)	
41-60	2 (50)	1 (16.7)	2 (25)	4 (44.4)	9 (33.3)	0.803
61-80	1 (25)	4 (66.6)	4 (50)	3 (33.4)	12 (44.5)	
>80	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
Total	4 (100)	6 (100)	8 (100)	9 (100)	27 (100)	

The relationship between types of post and types of failure was, however, not statistically significant. ( $p=0.747$ )

## DISCUSSION

Intra-radicular posts are usually used to restore endodontically treated teeth with an inadequate remaining coronal structure to support and retain the core material.<sup>22</sup> The retention is influenced by many factors related to the post, the luting cement, as well as the cement-post and cement-dentin interactions.<sup>23</sup> For many years, cast post and core systems have been used. However, the quest for simpler procedures and more aesthetic restorations led to the development of prefabricated posts, which were initially made of metal, and recently, non-metallic materials such as glass fibre.<sup>24</sup> Nevertheless, selecting an appropriate post material is essential to the successful restoration of a tooth.

The present study audited the distribution pattern of post retained restorations and the different failure modes of these intra-radicular devices for a ten-year period. There was almost an equal gender distribution with a male to female ratio of 1:1. This is different from the study of Peudfeldt et al.,<sup>5</sup> that recorded a slightly higher ratio (1.4:1) of males to females. Most of the patients who received posts were in their active age of 21-40 years, similar to Pia et al.<sup>25</sup> reported that posts were placed mostly among individuals in the age group 18-30 years. This may be because many endodontically treated fractured anterior teeth are seen in younger patients.<sup>26</sup>

Stainless-steel-posts were the most recorded in the study. Metal posts such as stainless-steel posts are still commonly used in our environment because of the relative availability, cheaper cost, and better strength. More so, a metal-ceramic crown is still in high use compared to the all-ceramic crown in our environment;<sup>27</sup> thus allowing the use of un-aesthetic post without posing much aesthetic challenge, even in the aesthetic zone. However, glass fibre reinforced post systems are reported to demonstrate higher fracture resistance than other post and core systems,<sup>28</sup> due to its elastic modulus similar to that of dentin.<sup>29</sup>

Increasing the post thickness does not lead to an increase in the post's resistance to fracture.<sup>1</sup> The use of smaller post diameter has therefore been suggested by some studies,<sup>1,12</sup> to avoid excessive removal of the root canal dentine during post-space preparation, thereby preventing root fracture.<sup>30</sup> However, studies<sup>31,32</sup> have indicated that posts with increased diameters were more resistant to fracture and provided more resistance to the restored teeth, resulting in less stress distribution to the remaining dentin. In this study, more than half of the restorations had no record of the size of post used. This inadequate record may probably be due to less importance attached to the size of the post by the operators. Among the sizes recorded, size 3 constituted more than half which agreed with the principle of the use of smaller post diameter to prevent excessive removal of

root dentine, as mentioned earlier.<sup>12</sup>

Various types of cement are being used for post cementation, and with a plethora of post systems available, it is often difficult to decide which one to use. Each of these cements has its merits and demerits. For example, composite and resin-modified GIC may be used in cementing posts with compromised mechanical retention. At the same time, zinc phosphate is a good choice for a post with adequate mechanical retention.<sup>33</sup> However, in situations where fluoride release is considered essential, resin-modified GIC will greatly benefit.<sup>33</sup> It has been pointed out that post cemented with resin-modified glass ionomer cement or composite resin cement may be difficult or impossible to remove if retreatment is later required.<sup>33</sup> Ahmed et al.<sup>34</sup> suggested that if composite is the choice for cementation of a post, self-cure, or dual-cure cement should be used due to the limited light penetration into the root, even when a translucent post is used.

The most commonly used agent in the cementation of posts in the current study was dual-cure composite (78.1%), followed by zinc phosphate cement. Contrary to Ahmed et al.,<sup>34</sup> this finding claims that zinc phosphate cement is still the luting material of choice for most conventional dental post-restoration because of its easy handling characteristics and long-term clinical documentation. However, several studies reported that the resin-based cement showed significantly higher retention and resistance to fatigue compared to zinc phosphate cements<sup>33,35,36</sup>

Similarly, a study by Peudfeldt et al.,<sup>5</sup> reported higher (47%) maxillary incisors and canine restored with post-retained restorations. The present study also showed that anterior teeth were the most prevalent teeth that received intra-radicular posts. This observation can be due to the higher rate of trauma to the anterior teeth, which eventually leads to loss of significant tooth structure, thereby necessitating post-placement to retain the core and the restoration.<sup>26</sup>

Basically, posts have been said to serve the sole purpose of retaining the restoration. However, posts should also serve to protect the remaining tooth structure. Many authors have researched the failure and survival rate of posts.<sup>6,2,37</sup> The failure rate observed in this present study is 12.8%, similar to the findings in a prospective study<sup>38</sup> by Nauman (12%) but low compared to Mehta et al.<sup>39</sup> findings (35.1%). It was also higher than the 6% failure rate reported by Weine<sup>40</sup> in his study over a period of 10 years. Crown dislodgement was the highest form of failure reported in this study. This is possibly caused by the problem with the cement-crown interface and is not necessarily related to the post. As observed in this study, post dislodgement was common to the restorations cemented with dual-cure composite, unlike the post-fracture, which was more prevalent in restorations luted with zinc phosphate cements. The technique sensitivity of composite and the fact that it requires more steps may be possible for the observation.

Thus, any minor error may lead to failure at the post-cement-dentine interface.

Also, gender seems to affect the failure rate of the restorations. Post fracture occurred more in male than female in this study; this is in agreement with the findings of Bacchi et al.<sup>29</sup> This might be due to the biting force that may be more in males than females due to the thickness of the masseter muscle, which has been reported to be greater in men and the elderly.<sup>41</sup>

Another determining factor of the post-failure revealed in the current study is the post type. The higher percentage of failure seen in the Stainless-steel para post compared to the fibre post is similar to the survey by Schmitter et al.,<sup>37</sup> which showed that the survival rate of fibre posts was 71.8%. In comparison, that of metal posts was significantly lower (50%,  $p=0.026$ ). This finding is also corroborated by Gbadebo et al.<sup>15</sup> that reported a survival rate of 100% and 97.5% for glass fiber and Stainless-steel posts, respectively, at a 6month review. Notable also was the fact that there was no record of fracture for fibre post in this study. This observation is likely as a result of the high modulus of elasticity of glass fibre post compared to the more rigid Stainless-steel post, as reported by other researchers.<sup>42-44</sup>

Within the limitation of this retrospective clinical study, stainless steel para post was the most common type of post used in the restoration of endodontically treated teeth, and post-fracture with dislodgement of post and crown combined were observed as the most prevalent type of failure. However, there is a need for a further longitudinal study that will consider the effect of the amount of coronal structure and the size of a post on the failure of post-retained restorations. Also, other future studies should look into the possible reasons glass fibre posts are not being adopted into practice in Nigeria as a whole, as it is in many developed countries.

## CONCLUSION

Post and core placement is a common procedure for restoring endodontically treated teeth with a reduced coronal structure for the main purpose of retaining the core and, ultimately, the restoration. Stainless-steel post was the commonest used, and Post fracture with dislodgement of post and crown combined constituted the most prevalent failure seen in this study. Thus, the use of glass fibre posts in our practice should be encouraged as the failure rate with this type of post was relatively low.

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