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## Appraisal of dental X-ray requests and findings in a northern Nigeria healthcare facility

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### Abstract

**Background:** Research in dental radiography has been a neglected area hence the aim of this study was to determine the diagnostic yield from dental X-rays in a northern Nigeria healthcare facility.

**Methods:** This study was carried out at the dental department of Abubakar Tafawa Balewa University Teaching Hospital, Bauchi from June 2016 to February 2017. All radiographs were interpreted by certified dentists and radiologists and findings were documented.

**Results:** A total of 335 dental X-rays were assessed. Chronic periapical periodontitis was the highest finding (n=72, 21%), followed by irreversible pulpitis (n=42, 12.5%), and dental caries (n=37, 11%).

**Conclusion:** We observed that periapical X-rays was the commonest request. Chronic apical periodontitis, irreversible pulpitis, and dental caries, were found to be the most prevalent dental problems in the region.

**Keywords** Chronic apical periodontitis, dental caries, irreversible pulpitis, impacted 3<sup>rd</sup> molar

### Introduction

The first dental X-ray was taken by Dr. Otto Walkhoff in January 1896 in his own mouth for an exposure time of 25 minutes.<sup>[1]</sup> Since then, dental imaging has seen tremendous progress with its applications in various fields of dentistry.<sup>[1]</sup> Dental radiographs are an essential part of any dental care treatment plan. They are diagnostic, but can also be preventive, by helping a dentist diagnose potential oral care issues in a patient's mouth before they become a major problem.<sup>[2-4]</sup> Dental radiographs may help a dentist identify caries (tooth decay) that develops between the teeth or under restorations (fillings); diseases in the bone; periodontal (gum) disease; infections that develop under your gums; some types of tumours among others.<sup>[3]</sup>

The World Health Organisation (WHO, 2012) reported that 60 to 90% of school children, and nearly 100% of adults, have dental cavities, often leading to pain and discomfort.<sup>[3,4]</sup> It also reported that severe periodontal (gum) disease, which may result in tooth loss, is found in 15-20% of middle-aged (35-44 years) adults.<sup>[3]</sup> Rushton and Horner questioned the importance of X-ray findings for dental diagnostics in the routine recording of clinical

dental findings.<sup>[5]</sup> They argued that the differences between tactile-visual findings and X-ray findings are too small and may cause an unnecessary exposure of a patient to radiation.<sup>[5]</sup> Others reported that radiographs are still a valuable diagnostic tool, as an adjunct to clinical examination in the diagnosis of dental diseases.<sup>[1,6]</sup> This was corroborated in a more recent study by Shivpuje and Sable.<sup>[7]</sup>

While a physical examination can find noticeable signs of issues, some oral diseases are just not visible to the naked eye.<sup>[4,6]</sup> In our locality dental X-rays are taken on a daily basis, however there is dearth of empirical evidence on the diagnostic yield of these X-rays. Consequently, the aim of this study is to report the pattern of requests and findings in the dental department of Abubakar Tafawa Balewa University Teaching Hospital Bauchi, Nigeria.

### Materials and method

A retrospective and prospective cross-sectional technique was adopted for this study. It was carried out at the Dental Department of Abubakar Tafawa Balewa University Teaching Hospital across a period of nine months. Retrospective data were collected from June to October

2016, and prospective data from November to February 2017. A Brighton X-ray machine was used for acquiring the intraoral radiographs. Extraoral radiographs were acquired with a static Siemens X-ray machine. Ethics clearance was obtained from the research ethics committee of the institution.

A total of 335 patients, between the ages of one to eighty years, who had intraoral or extraoral dental radiographs during the timeframe were included in the study. Clinical diagnosis was determined by the dental surgeons prior to radiographic examinations. Dental technologists took the radiographs. These were interpreted by certified dentists and radiologists and the findings were documented.

### Results

There were 335 patients in this study. Table 1 presents the male to female ratio, namely 177 (52.8%) males and 158 (47.2%) females: ratio of 1.12:1. Table 2 shows the pattern of dental X-ray requests. The commonest requests were intraoral periapical radiographs with a frequency of 256 (76.4%), followed by PA mandible 28 (8.4%), and lateral oblique mandible 19 (5.7%). The least requested X-rays were

**Table 1.** Sex distribution of patients

SEX	FREQUENCY	%
Male	177	52.8
Female	158	47.2
<b>Total</b>	<b>335</b>	<b>100.0</b>

**Table 2.** Pattern of dental X-ray requests

REQUESTS	FREQUENCY	%
Periapical view	256	76.4
PA jaws	28	8.4
Mandible (lateral oblique)	19	5.7
Occlusal view	18	5.4
Occipitontental view	9	2.7
Submentovertical view	3	.9
TMJ view	2	.6
<b>Total</b>	<b>335</b>	<b>100</b>

**Table 3.** Age distribution of patients

AGE	FREQUENCY	%
21-30	81	24.2
31-40	74	22.1
11-20	65	19.4
1-10	51	15.2
41-50	36	10.7
51-60	15	4.5
61-70	12	3.6
71-80	1	.3
<b>Total</b>	<b>335</b>	<b>100.0</b>
<b>Mean Age:</b>	<b>28 ± 16</b>	

occipitontental view (OMV), submentovertical view (SMV) and temporomandibular joint views (TMJ) with respective frequencies of 9 (2.7%), 3(0.9%), and 2 (0.6%). As depicted in Table 3, the majority of patients were within the ages of 21 and 30 years.

Table 4 provides information on the clinical findings of the patients prior to radiographic investigations. The commonest clinical finding was chronic apical periodontitis (74/22.4%), followed by irreversible pulpitis (49/14.6%), and dental caries (37/11%).

Table 5 illustrates the prevalence of dental X-ray findings among adult patients who underwent dental X-rays. The most common pathology was chronic apical periodontitis (72/21.5%) followed by irreversible pulpitis (42/12.5%) and dental

caries (37/11%). The lower ranked pathologies were: retained deciduous, dentigerous cyst, LeFort 1 and 2 fractures, with prevalence of 0.3%.

Irreversible pulpitis, dental caries, and chronic apical periodontitis, were the commonest findings in paediatrics with prevalence of 35 (30.3%), 24 (20.7%), and 12 (10.3%), respectively (Table 6).

Table 7 shows pattern of findings among patients in relation to age. The mean age of patients was 28 years ± 16 years. The majority of patients with chronic apical periodontitis fell within the ages of 21 and 40 (n=45, 75%). In this study, female patients (n=42, 58.3%) were more affected with chronic apical periodontitis than their male counterparts (n=30, 41.7%). Females (n=19, 51.3%) were also more affected with dental caries than the males. In relation to findings on irreversible pulpitis we found more males were affected (n=23, 54.7%) (Table 8).

Table 9 illustrates the relationship between provisional diagnosis and the X-ray findings using Pearson's correlation coefficient. We found that provisional diagnosis was strongly correlated (0.0001) with X-ray findings at  $p \leq 0.01$ .

## Discussion

Intra and extraoral dental X-rays are critical diagnostic tools that provide information on several dental defects and other dental abnormalities. Although cone beam computed tomography (CBCT) provides images of superior diagnostic efficacy for dental defects, dental X-rays are often requested by dental clinicians due to convenience, availability, cost and minimal radiation doses associated with dental X-ray equipment.<sup>[8]</sup> In this study, we assessed 335 radiographs: 256 (76.4%) periapical; 28 (8.4%) PA mandibles; 19 (5.7%) lateral oblique mandibles; 18 (5.4%) occlusals; 9 (2.7%) OMV, 3 (0.9%) SMV; and 2 (0.6%) TMJs. This was done to ascertain diagnostic yield of dental X-rays and possibly identify prevalent dental problems associated with patients in the region.

The age distribution of patients was between one and 80 years: mean age of 28 ±16 years. It was evident that the 21-30 years age group had the highest number of radiographic examinations (n=81, 24.2%). This agrees with a similar study by Rushton et al<sup>[9]</sup> on radiological findings from routine dental radiography screening.

**Table 4.** Provisional diagnosis

PROVISIONAL DIAGNOSIS	FREQUENCY	%
Chronic apical periodontitis	74	22.1
Irreversible pulpitis	49	14.6
Dental caries	37	11.0
Mandibular fracture	28	8.4
Impacted 3 <sup>rd</sup> molar	26	7.8
Chronic localised periodontitis	20	6.0
Reversible pulpitis	18	5.4
Radicular cyst	13	3.9
Tooth fracture	10	3.0
Acute apical periodontitis	7	2.1
Retained deciduous	6	1.8
Apical abscess	6	1.8
Dentoalveolar abscess	5	1.5
Lefort II fracture	5	1.5
Osteomyelitis	5	1.5
Zygomatic complex fracture	5	1.5
Maxillary antrum tumour	3	.9
Zygomatic arch fracture	2	.6
Dentoalveolar fracture	2	.6
TMJ ankylosis	2	.6
Ameloblastoma	2	.6
Fibrous dysplasia	2	.6
Acute pulpitis	1	.3
Chronic pulpitis	1	.3
Pericoronitis	1	.3
Retained root	1	.3
Lefort III fracture	1	.3
Condylar neck fracture	1	.3
Palatal cyst	1	.3
Dentigerous cyst	1	.3
<b>Total</b>	<b>335</b>	<b>100.0</b>

Gender distribution: males (52.8%) and females (47.2%). Similar gender distributions are reported in the literature. In Rushton et al's study<sup>[9]</sup>, in the United Kingdom, the males were 51.5%, and 56.2% in Osaghae et al's study<sup>[10]</sup> in Nigeria. There were more females in other studies. In a Ugandan study by Muwazi et al<sup>[11]</sup> females

**Table 5.** Dental X-ray findings/diagnosis

X-RAY FINDINGS	FREQUENCY	%
Chronic apical periodontitis	72	21.5
Irreversible pulpitis	42	12.5
Dental caries	37	11.0
Impacted 3 <sup>rd</sup> molar	26	7.8
Chronic localized periodontitis	25	7.5
Mandibular fracture	25	7.5
Apical abscess	20	6.0
Normal	17	5.1
Tooth fracture	11	3.3
Radicular cyst	10	3.0
Reversible pulpitis	7	2.1
Acute apical periodontitis	7	2.1
Retained deciduous	6	1.8
Dentoalveolar abscess	5	1.5
Zygomatic complex fracture	4	1.2
Acute pulpitis	3	.9
Osteomyelitis	3	.9
Zygomatic arch fracture	2	.6
Dentoalveolar fracture	2	.6
Ameloblastoma	2	.6
Maxillary antrum tumour	2	.6
Fibrous dysplasia	2	.6
retained root	1	.3
Gingivitis	1	.3
Lefort II fracture	1	.3
Dentigerous cyst	1	.3
Lefort I fracture	1	.3
<b>Total</b>	<b>335</b>	<b>100.0</b>

were in the majority (52.9%), and 66.8% in a study by Okoye and Ekwueme<sup>[12]</sup> in Eastern Nigeria.

A provisional diagnosis, based on the clinical findings determined by a dentist, is usually made prior to taking a dental X-ray. These play a vital role in ascertaining the relevance of the dental X-rays. In many cases dental X-rays serve as a confirmatory diagnostic tool by providing deeper insights on the nature and severity of the actual problem.<sup>[13]</sup> In this study, we assessed the pattern of dental problems based on the provisional diagnosis.

**Table 6.** Pattern of X-ray findings among paediatrics

X-RAY FINDINGS	1-20 YEARS
Dental caries	24
Acute pulpitis	1
Irreversible pulpitis	35
Reversible pulpitis	6
Tooth fracture	5
Chronic apical periodontitis	12
Chronic localized periodontitis	3
Retained deciduous	6
Dentoalveolar abscess	2
Apical abscess	9
Acute apical periodontitis	1
Radicular cyst	3
Gingivitis	1
Mandibular fracture	4
Normal	1
Dentoalveolar fracture	2
Zygomatic complex fracture	2
<b>Total</b>	<b>116</b>

**Table 7.** Pattern of findings among adult patients in relation to age

X-ray Findings	Age distribution of Adults					
	21-30	31-40	41-50	51-60	61-70	71-80
Dental caries	4	6	2	1	0	0
Acute pulpitis	0	1	1	0	0	0
Irreversible pulpitis	5	2	0	0	0	0
Reversible pulpitis	1	0	0	0	0	0
Tooth fracture	2	1	2	0	0	1
Chronic apical periodontitis	24	21	8	5	2	0
Impacted 3 <sup>rd</sup> molar	16	8	2	0	0	0
Chronic localized periodontitis	3	6	4	3	7	0
Dentoalveolar abscess	1	0	1	0	1	0
Apical abscess	4	2	4	1	0	0
Acute apical periodontitis	1	3	0	2	0	0
Radicular cyst	2	4	1	0	0	0
Retained root	1	0	0	0	0	0
Mandibular fracture	11	6	3	1	0	0
Lefort II fracture	1	0	0	0	0	0
Zygomatic arch fracture	0	1	1	0	0	0
Osteomyelitis	0	0	2	1	0	0
Normal	4	6	5	1	0	0
Zygomatic complex fracture	0	2	0	0	0	0
Dentigerous cyst	1	0	0	0	0	0
Ameloblastoma	0	2	0	0	0	0
Maxillary antrum tumour	0	0	0	0	2	0
Fibrous dysplasia	0	2	0	0	0	0
Lefort I fracture	0	1	0	0	0	0
<b>Total</b>	<b>81</b>	<b>74</b>	<b>36</b>	<b>15</b>	<b>12</b>	<b>1</b>

**Table 8.** X-ray findings in relation to gender

X-RAY FINDINGS	MALE	FEMALE
Dental caries	18	19
Acute pulpitis	2	1
Irreversible pulpitis	23	19
Reversible pulpitis	5	2
Tooth fracture	6	5
Chronic apical periodontitis	30	42
Impacted 3 <sup>rd</sup> molar	16	10
Chronic localized periodontitis	11	14
Retained deciduous	1	5
Dentoalveolar abscess	3	2
Apical abscess	6	14
Acute apical periodontitis	5	2
Radicular cyst	4	6
Retained root	0	1
Gingivitis	0	1
Mandibular fracture	23	2
Lefort II fracture	1	0
Zygomatic arch fracture	0	2
Osteomyelitis	1	2
Normal	15	2
Dentoalveolar fracture	1	1
Zygomatic complex fracture	2	2
Dentigerous cyst	1	0
Ameloblastoma	2	0
Maxillary antrum tumour	0	2
Fibrous dysplasia	0	2
Lefort I fracture	1	0
<b>Total</b>	<b>177</b>	<b>158</b>

**Table 9.** Pearson's correlation of provisional and X-ray diagnosis

	Provisional Diagnosis	Radiological Diagnosis
Provisional diagnosis	Pearson correlation	1
	Sig. (2-tailed)	0.0001
	N	335
Radiological diagnosis	Pearson correlation	.936**
	Sig. (2-tailed)	0.0001
	N	335

\*\*Correlation is significant at the 0.01 level (2-tailed).

highest (n=72, 21%), followed by irreversible pulpitis (n=42, 12.5%), dental caries (n=37, 11%), impacted 3<sup>rd</sup> molar (n=26, 7.8%), and chronic localised periodontitis and mandibular fracture with frequency of (n=25, 7.5%) each. Just a handful of radiographs (n=17, 5.1%) were absolutely within normal limits. This clearly demonstrates that dental X-rays are indispensable diagnostic tools for dental diseases. In some cases the findings from the dental X-rays disagreed with the dentist's prior clinical diagnosis. This further emphasises why it is necessary to take a dental X-ray before embarking on any therapeutic intervention. This is in contrast to a study by Rushton and Horner<sup>[5]</sup> who argued that the differences between tactile-visual findings and X-ray findings are too small and may cause an unnecessary exposure of the patient to radiation.

Among paediatrics we established that the commonest X-ray findings were irreversible pulpitis (n=35, 30%) and dental caries (n=24, 20.7%). This is in keeping with respective studies in India and African countries.<sup>[12,15-18]</sup>

In this study, it is clear that males suffered from irreversible pulpitis (n=23, 54.8%), mandibular fractures (n=23, 92%), and impacted 3<sup>rd</sup> molar (n=16, 61.5%). Females on the other hand were more affected by chronic apical periodontitis and dental caries with frequencies of (n=42, 58.3%) and (n=19, 51.3%), respectively.

Understanding the relationship between clinical and X-ray findings determines the diagnostic yield and relevance of X-rays as a diagnostic tool. Our study found that the clinical findings and the X-ray findings were strongly correlated. A similar study by Moll et al<sup>[9]</sup> found no significant difference between clinical and dental panoramic X-ray findings in Germany.

The major limitation of this study was that we were unable to consider bitewings and panoramic radiographs because of lack of relevant equipment at our facility. Nevertheless, this study provides useful information on diagnostic yield from intraoral and extraoral dental X-rays in our locality.

## Conclusion

This was a retrospective and prospective study of 335 radiographs. The major problems identified were chronic apical periodontitis, irreversible pulpitis, and dental caries. Adherence to essential oral

We found that the most prevalent clinical finding, among patients in our locality, was chronic apical periodontitis (n=74, 22.1%) followed by irreversible pulpitis (n=49, 14.6%), dental caries (n=37, 11%), mandibular fractures (n=28, 8.4%), impacted tooth (n=26, 7.8%).

It is a fundamental requirement of radiation protection that all exposures to X-rays as part of diagnosis should be clinically

justified for each patient.<sup>[14]</sup> This rule applies to general and dental imaging, respectively. In order to justify the use of X-rays in the dental department, it would be necessary to demonstrate a significant diagnostic yield that outweighed the risks of the X-ray exposure.<sup>[6,9]</sup> In order to determine the diagnostic yield of the X-rays, we reviewed all radiographs and documented the X-ray findings. Out of the 335 X-rays, chronic periapical periodontitis was the

hygiene practices is highly recommended in order to enhance dental wellbeing.

### Conflict of interest

None

### Contributions of each author

PAO: Participated in conceptualisation and design of the work, literature search, data acquisition, statistical analysis, man-

uscript drafting, revision for its intellectual content and approval of the final work. BH: Participated in conceptualisation and design of the work, literature search, data acquisition, statistical analysis, manuscript drafting, revision for its intellectual content and approval of the final work. AE: Participated in conceptualisation and design of the work, statistical analysis, manuscript drafting, revision for its intellectual content and approval of the final

work. CH: Participated in design of the work, manuscript drafting, revision for its intellectual content and approval of the final work. YA: Participated in design of the work, revision for its intellectual content and approval of the final work. JZD: Participated in design of the work, revision for its intellectual content and approval of the final work. GL: Participated in design of the work, revision for its intellectual content and approval of the final work.

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