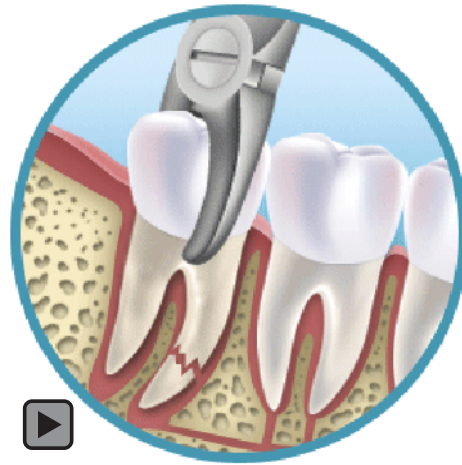


## Influence of Trans-operative Complications on Socket Healing Following Dental Extractions

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### Abstract

**Aim:** Extraction healing complications have been attributed to several factors. The influence of trans-operative complications on an extraction site wound healing was the focus of this investigation.

**Methods and Materials:** This prospective study was conducted at the Oral Surgery Clinic of the Department of Oral and Maxillofacial Surgery of the Lagos University Teaching Hospital (LUTH) in Nigeria. Subjects selected were those referred for one or two adjacent extractions and who satisfied the inclusion criteria for the study. The relevant pre-operative information recorded for each patient were age and sex of patient, indications for extraction, time taken to extract the tooth, tooth/teeth removed, and any trans-operative complications. Extractions were performed with dental forceps, elevators, or both under local anaesthesia. Patients were blindly evaluated on the third and seventh post-operative day for socket healing assessment without reference to pre-operative information on the patients.

**Results:** Seventy-three (24.25%) of 301 teeth considered for socket healing assessment had various trans-operative complications due to accidental crown, root, or alveolar bone fractures. Of the 73 extractions with trans-operative complications during extraction, 18 developed a socket healing complication, while 17 of the 228 extractions without trans-operative complications developed socket healing complications ( $p = .000$ ). The mean (SD) time taken to extract teeth developing healing complications was also found to be significantly longer than those without healing complications ( $p < .01$ ).

**Conclusions:** The study demonstrated the combination of tooth/bone fragments in the socket and increased time of extraction due to trans-operative complications and accidents predispose to the development of extraction site wound healing disturbance.

**Keywords:** Tooth extraction, surgical complications, dry socket, acutely inflamed socket, acutely infected socket

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## Introduction

Extraction of teeth is the most common procedure performed in oral surgery clinics.<sup>1-3</sup> The most frequent reasons for extraction are dental caries and its sequelae, periodontal disease, trauma, retained roots, endodontic failure, and periapical pathology.<sup>1-7</sup> In most cases healing of extraction sockets following routine intra-alveolar dental extraction are uneventful. However, proper healing may be disturbed even in normal healthy patients for various reasons.<sup>8,9</sup> Factors implicated in the disturbance of extraction wound include trans-operative complications, presence of local infection, bacteria contamination of the socket, experience of the surgeon, contraceptive use, smoking, alcohol intake, use of local anaesthetic agent with vasoconstrictor, diabetes mellitus, and previous radiation therapy.<sup>8,10-14</sup> Blum<sup>14</sup> even suggested a genetic predisposition.

Complications and accidents during the course of the extraction itself are not uncommon. These may include fracture of the crown, fracture of the roots, fracture of the alveolar bone, fracture of the adjacent teeth, dislocation of adjacent teeth, excessive hemorrhage, and damage to the soft tissue.<sup>1,15-17</sup>

The aim of this prospective study was to investigate the influence of trans-operative complications and accidents on extraction site wound healing at the Lagos University Teaching Hospital (LUTH), Lagos, Nigeria.

## Methods and Materials

This prospective study was conducted in the Oral Surgery Clinic of the Department of Oral and Maxillofacial Surgery at the LUTH in Lagos, Nigeria. The study was granted approval by the Research and Ethics Committee of the hospital.



Subjects were patients referred for one or two adjacent extractions. The exclusion criteria were:

- Presence of local infection (such as dentoalveolar abscess)
- Patients receiving antibiotic therapy, oral contraceptives, or steroid therapy
- Patients with underlying systemic conditions (such as diabetes mellitus, severe nutritional deficiencies, endocrine disturbances)
- Smokers
- Alcoholics
- Patients with pre-operative Gingival Index of Silness and L oe greater than 1<sup>18</sup>
- Patients who required surgical extraction of their teeth were also excluded from the study

Informed consent was obtained from each patient and the following information was recorded:

- Age
- Gender
- Reasons for extraction
- Clinic time required to extract the tooth
- Tooth or teeth removed
- Trans-operative complications and accidents

Table 1. Post extraction instructions.

- Do not rinse your mouth with water or any liquid for the next 24 hours.
- Continue to swallow your saliva and avoid spitting out saliva as much as possible for the next 24 hours.
- Adhere strictly with the instructions given on how to use your medication.
- Do not use any other medication apart from the one given.
- Report to the clinic on the third and seventh day after the extraction for post operative check-up/ review.
- Report to the clinic should there be any increased or persistent pain in the extraction socket within seven days following the extraction or beyond.
- If bleeding begins from the extraction socket at home, use a clean gauze, cotton wool or if not immediately available, a clean handkerchief and place on the extraction site and bite down for at least 15 minutes. Report to the clinic or accident and emergency section of the hospital if bleeding continues.

Patients were randomly allocated to three oral and maxillofacial surgery residents with a minimum of three years enrolled in the training program. Extractions were performed with dental forceps, elevators, or both under local anaesthesia (2% Xylocaine with epinephrine 1:80,000). No sutures were placed, and irrigation of the extraction socket was not performed. No postoperative antibiotics were prescribed. Each patient was given four grams (eight tablets) of Paracetamol and instructed to take 1 gm two hours postoperatively and then 1 gm every eight hours for the following 24 hours. The same verbal and written post-extraction instructions were given to all the patients (Table 1), and they were reviewed on the third and seventh post operative day for socket healing assessment. They were also instructed to report to the clinic if there was any increased or persistent pain in the extraction socket within seven days following the extraction or beyond.

Socket healing assessment was carried out without violating the blind protocol of the study. The diagnosis of socket healing complications was based on the following criteria.<sup>16,19</sup>

**Dry Socket:** Persistent or increased post-operative pain in and around the extraction site accompanied by a partially or totally disintegrated blood clot or an empty socket with or without halitosis. The diagnosis is confirmed when extremely sensitive bare bone is encountered by passing a small curette into the extraction wound.



**Acutely Inflamed Socket:** Painful socket with exuberant inflamed tissue but without pus or systemic fever.<sup>16</sup>

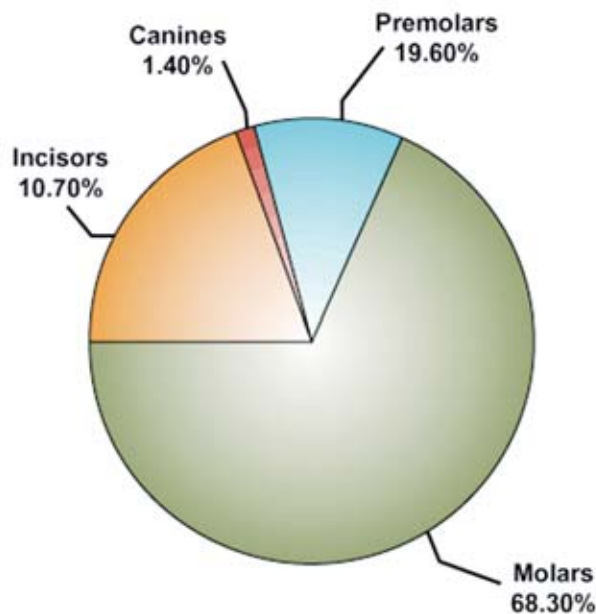
**Acutely Infected Socket:** Painful socket with suppuration, erythema, and edema with or without systemic fever.<sup>16,19</sup>

Socket healing complications were managed according to established clinic protocol. A socket with normal granulation in the absence of signs and symptoms of disturbed wound healing was considered an “*uneventful*” healing.

Data was analyzed using SPSS for Windows (version 11.5; SPSS Inc, Chicago, IL, USA) statistical software package. Descriptive statistics and test of significance ( $\chi^2$  and t-test) were used as appropriate. The critical level of significance was set at  $P < .05$ .

### Results

A total of 347 teeth were extracted from 311 patients with ages ranging from 11-72 years (mean age (SD),  $34.6 \pm 16.0$  years) during the study. Most of the extracted teeth were the molars (68.3%), followed by the premolars (19.6%) (Figure 1).



**Figure 1.** Distribution of types of teeth extracted.

Dental caries and its sequelae (i.e., pulpitis, apical periodontitis, retained roots) was the most common indication for dental extraction accounting for 62.25% followed by periodontal diseases at 17%. Other reasons for extractions were orthodontic (6.34%), trauma (8.65%), endodontic failures (1.44%), and others (supernumerary teeth, attrition, abrasion) (4.32%). Table 2 summarizes the indications for extraction and age range of patients.

Out of 311 patients included in the study, 269 patients with 301 extraction sockets were evaluated postoperatively for healing. The male to female ratio was 1:1.5. Two hundred thirty-seven patients (88.10%) with 266 extraction sockets had uneventful socket healing. A total of 32 patients (11.9%) with 35 sockets developed socket healing complications. Dry socket (alveolar

osteitis) constituted 74.29% (26 sockets) of the socket healing complications, while infected socket and inflamed socket constituted 14.28% (5 sockets) and 11.43% (4 sockets), respectively. Most sockets with healing complications were molars (60%), followed by premolars (37.1%), and incisors (2.9%). A total of 18 maxillary and 17 mandibular teeth (ratio 1:1.05) were involved.

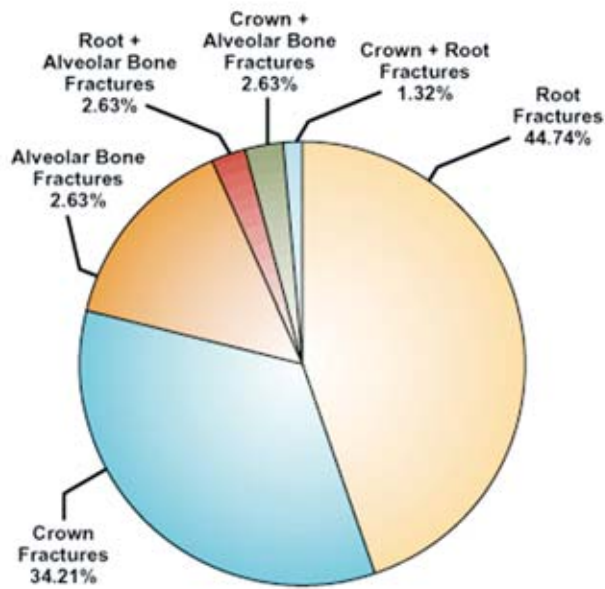
Of a total of 311 patients who had teeth extractions, 76 (24.4%) had different types of complications resulting from trans-operative accidents. Fracture of the roots was the most common accident and occurred in 34 patients (44.74%). This was followed by crown fracture in 26 patients (34.21%) and alveolar bone fracture in 11 patients (14.47%). Some patients had more than one type of trans-operative accident as follows: crown and root fracture - one patient (1.32%); crown and alveolar bone fracture - two patients (2.63%); and root and alveolar bone fracture - two patients (2.63%) (Figure 2).

The highest trans-operative complication rate of 78.1% was related to molar extractions followed by premolars (20.6%) and canines (1.3%). No case of fractures was recorded with incisor teeth. No case of excessive intra-operative bleeding was recorded.

Seventy-three (24.25%) out of 301 teeth considered for socket healing assessment had various types of trans-operative complications. Of the 73 extractions with trans-operative accidents, 18 developed socket healing complications, while 17 of the 228 extractions without trans-operative complications developed socket healing complications (p=.000) Table 3.

**Table 2.** Age range of patients and indication for teeth extraction.

AgeRange (Yrs)	Caries and its Sequelae	Periodontal Diseases	Orthodontic Reason	Trauma	Others	Failed Endodontic Treatment	Total (%)
11 – 20	33	1	13	5	3	1	56 (18)
21 – 30	82	7	9	3	7	1	109 (35)
31 – 40	41	4	0	1	2	1	49(15.8)
41 – 50	21	8	0	2	0	1	32 (10.3)
51 – 60	17	13	0	0	1	0	31 (10)
61 – 70	9	11	0	6	0	1	27 (8.7)
71 – 72	0	7	0	0	0	0	7 (2.2)
<b>Total</b>	<b>203</b>	<b>51</b>	<b>22</b>	<b>17</b>	<b>13</b>	<b>5</b>	<b>311 (100)</b>



**Figure 2.** Percentage distribution of trans-operative complications among patients.

The mean time (SD) taken for extraction was 5.24 ± 7.64 minutes (range, 0.17 – 30.2 minutes). The mean (SD) time taken to extract teeth developing healing complications was found to be 9.6 ± 9.3 minutes (range, 1.2 – 30.2 minutes), while the mean (SD) time taken to extract teeth not developing healing complications was 4.5 ± 7.1 (range, 0.2 – 25 minutes) ( $p < .01$ ).

### Discussion

Dental extractions are common procedures in clinical practice. The majority of the resulting extraction wounds heal normally in approximately six weeks.<sup>20</sup> Only 1.0 to 11.5% have been reported to heal improperly or incompletely.<sup>1,8,10,16,21-23</sup> Although the incidence of socket healing complications is minor, the problems created by disturbances in extraction wound healing are not only limited to localized symptoms (pain, pus discharge, foul odor) but lost days at work and

decreased productivity due to frequent hospital visits. Disturbed healing can also complicate or even jeopardize dental implant placement and other procedures.<sup>20</sup>

Dental caries and its sequelae and periodontal disease are the two most common reasons for dental extraction.<sup>1-7,24-28</sup> This is also corroborated by the present study. This report confirmed dental caries as the leading indication of dental extractions as recorded earlier,<sup>1,2,7</sup> but this is in contrast to the results of Murray et al.<sup>4</sup> and Odusanya<sup>27</sup> where periodontal disease predominated. It was also observed dental caries declines with increasing age, while the reverse is the case for periodontal disease (Table 1). This is also in agreement with previous studies.<sup>1,2,25,27</sup> While Okoisor,<sup>25</sup> in a retrospective study, reported periodontal disease as an indication of tooth extraction was not found below the age of 20 years, one case was found in the present study.

Posterior teeth were more affected by socket healing complications in this study which is in agreement with other reports in the literature.<sup>21,22,29</sup> Mandibular and maxillary teeth were affected by socket healing complications almost equally in this study in contrast to reports in the literature<sup>10,30</sup> stating mandibular teeth are more affected than maxillary teeth.

Dry socket constituted 74.29% of socket healing complications in the present study. This confirms the long-held belief dry socket is the most common healing complication following extraction of permanent teeth.<sup>1,8-10,14,31</sup> Acutely inflamed socket and acutely infected socket have also been reported in the literature.<sup>16,23,32</sup>

Fractures of teeth and alveolar bone were the most common trans-operative accidents seen in this study. This is in agreement with other

**Table 3.** Post-operative healing in relation to trans-operative complications.

	Socket Healing Status		
	Uncomplicated Healing Sockets	Complicated Healing Sockets	Total
Teeth with trans-operative complications	55	18	73
Teeth without trans-operative complications	211	17	228
Total	266	35	301

$P = 0.000$  ( $\chi^2 = 15.92$ )

reports.<sup>1,15,16</sup> Molars and premolars had the highest fracture rate in this study, thereby, corroborating other studies.<sup>1,16</sup> The incidence (24.4%) is higher than other reports<sup>1,16</sup> and probably due to the prospective nature of the present study. Efforts were made to record all cases of trans-operative accidents.

There was no statistical influence of root or crown fracture during extraction on socket wound healing in the study by Cheung et al.<sup>16</sup> However, the present study showed a statistically significant influence of trans-operative accidents (tooth/alveolar bone fractures) on socket healing. This result gives credence to the suggestion of Blum<sup>14</sup> and Birn<sup>33</sup> that tooth or bone fragments/remnants acting as foreign bodies could lead to disturbed wound healing and contributes to the development of socket healing complications.

The present study also found longer surgical times were significantly related to increased number of socket healing complications. A tooth fractured during its removal becomes more difficult to extract and, hence, increases the length of surgery. The more time spent on extracting a tooth, the more trauma inflicted on the alveolar bone cells causing inflammation of the alveolar bone marrow.<sup>33</sup> Other studies confirm trauma and difficulty of surgery play an important role in the development of dry socket.<sup>33,34</sup> Excessive trauma has been known to result in delayed extraction wound healing due to the compression of bone lining the socket impairing vascular penetration and results in thrombosis of the vessels.<sup>33</sup> More fibrinolytic activity has been reported in cases with longer extraction times.<sup>35</sup> It was observed during the study, teeth extracted for periodontal disease were not associated with any trans-operative



complications and none developed socket healing complications. The ease of removal and, hence, less inflicted trauma during removal due to pathological destruction of periodontal structures gives credence to the “trauma theory.”

The decision to employ the services of surgeons of similar training and experience for the study was based on reports less-experienced surgeons tend to cause more trauma during extractions than experienced surgeons.<sup>17,30</sup> This is probably due to excessive trauma and trans-operative complications inflicted by the less experienced surgeons. No significant difference was found in the trans-operative complication rate among the three surgeons.

### Conclusion

This study confirmed the combination of tooth/bone fragments in the socket and increased time of extraction due to trans-operative accidents significantly predispose extraction site wound to healing disturbances, especially alveolar osteitis. Therefore, avoidance of excessive trauma and trans-operative complications and accidents, careful handling of the tissues, use of controlled force, meticulous surgical technique, and thorough debridement of the extraction socket will help to reduce extraction socket healing complications. All of these factors are within the control of the surgeons unlike many other factors implicated in the etiology of extraction socket healing complications, especially the dry socket.

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