Radiographic Assessment of Post-Endodontic Pain

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Abstract

Aim:To radiographically assess and identify the factors that influence post-endodontic pain (PEP) in patients received nonsurgical root canal treatment. **Study Design:** a longitudinal study. **Place and Duration of Study:** the study performed on 375 patients (200 male, 175 female), aged 15–65 years randomly attend Dr. Sameer Hatem private clinic in Karbala between 2014- 2019 Method. the complete history of patients was taken, clinically examined and then radiographically examined by CSN x-ray machine and Xpod digital sensor to identify the possible factors and assess the status of previously treated teeth, the patients divided into groups according to the age, causative factors, and the onset of pain from patients' chief complain. **Results:**(Table.2) shows the differences in numbers and percentages of overall patients according to the onset and the causative factors of pain after root canal treatment, the high percentage of the pain of 102/(27.2%) of patients was due to overextension of filling material, (most of these patients were suffering from spontaneous pain 47.05%). Followed by 78/(20.8%) which were due to failure of treatment due to under-filled root canal (most of them 34.61% have intermittent pain). **Conclusion:** Periapical x-ray radiography is a valuable technique to identify the causative factors of post endodontic pain and evaluate the success of RCT and the status of endo treated tooth and periapical tissues. All procedural errors can not be depicted on radiographs.

Keywords*: Nonsurgical root canal treatment, Post-endodontic pain (PEP), Radiographic, Radiographic assessment, longitudinal study.*

Introduction

In the past, root canals endodontic procedures were extremely painful. This is one reason of many reasons why people sometimes avoided such procedures. Dentists now have pain-relieving measures that can be used to reduce the amount of pain experienced during the procedure. Prevention and management of post-endodontic pain (PEP) is an integral part of endodontic treatment. Informing patients about expected post-endodontic pain (PEP) and prescribing medications to manage it can increase patient confidence in their dentists, increase patient's pain tolerance, and improve their attitude toward future dental treatments [1, 2]. According to recently published data, pulp therapy and root canal treatment (RCT) causes more frequent and more severe postoperative pain compared to other dental procedures [3, 4]. In this published literature, reported frequencies of PEP range from 1.5 [5] to 53% [3]. But less than 12% of patients experienced severe pain [6]. Pain after endodontic procedure is one of the most commonly known complications of endodontic treatment. It can be caused due to many preoperative factors like acute exacerbation of chronic lesion, non-vital tooth, previously opened canal, the extension of either the filling material and/or the instrument beyond the tooth apex during the procedure, and any leakage in temporary or permanent filling done after endodontic treatment. Various factors responsible for post endodontic pain are the position of the apical foramen, pulp tissue between two canals which cannot be easily instrumented without proper care, presence of fourth accessory canal in case of maxillary first molars which may be left out without instrumentation, inaccurate determination of working length can lead to over instrumentation, extrusion of root canal debris beyond the apex during instrumentation, irrigants used like sodium hypochlorite and hydrogen peroxide may cause periapical discomfort, an obturating technique like lateral condensation causes immediate postoperative pain than single cone obturation technique [7]. Mechanical factors, including over instrumentation or extrusion of root-filling materials, have been associated

with the presence of postoperative pain [8,9], suggesting that root canal instrumentation and obturation techniques may influence postoperative pain. In fact, several studies have found a correlation between the root canal instrumentation technique and postoperative pain [10,11]. Another overlooked factor that may play a role in the higher frequency of PEP in the current study is that the whole root canal treatment was performed at a single visit. The single-visit treatment has been shown to result in a higher frequency of PEP, and consequently, higher consumption of analgesics [13, 14, 15,16,17]. Nevertheless, the main advantages of single visit treatment are the reduced time and added convenience for both patient and dentist, without increasing short or long complications [16] Radiographic examination is an essential component of endodontic management [34] the principal aspects of diagnosing, treatment planning, intra-operative control and procedural outcome assessments is the intra-oral periapical radiographs which are still most commonly exposed during endodontic procedures [35], providing usefulinformation for the presence and location of periradicular lesions, root canal anatomy, and the proxymity of adjacent anatomical structures. Understanding the etiology of postoperative pain after obturation may greatly help clinicians to adopt strategies to prevent such a highly distressing phenomenon [12].

The purpose of this study was to radiographically assess and identify the factors that influence post-endodontic pain (PEP) in patients who received nonsurgical root canal treatment.

Methods

This is a longitudinal study performed on 375 patients (200 male, 175 female), aged 15–65 years randomly attend Dr. Sameer Hatem private clinic between 2014-2019 presenting with post endodontic pain with a different intensity that not resolved after root canal treatment, with onset ranged from 1 day to 60 days post-operatively, the complete history of patients were taken, clinically examined and then radiographically examined by CSN x-ray machine and Xpod digital sensor to identify the possible factors and assess the status of previously treated teeth, the periapical radiographs show that the factors were different, so the patients divided into groups according to the age, causative factors and the onset of pain from patients chief complain.

Table 1: The distribution of patients according to the age group is presented.

Age (Pt. No.)	Factors/ Pt. No./ (%)	Spontaneous pain /(%)	Intermittent /(%)	After 3-7 days /(%)	After 2 weeks or more /(%)	Chi & p.value
15-24 N=125	Under-filling/ 24/(19.2%)	5/(20.83%)	9/(37.5%)	3/(12.5%)	7/(29.16%)	3.3 & 0.34
	Over-filling/ 42/(33.6%)	17/(40.47%)	8/(19.04%)	6/(14.28%)	11/(26.19%)	6.57 & 0.09
	Broken instrument/ 9/(7.2%)	5/(55.55%)	2/(22.22%)	1/(11.11%)	1/(11.11%)	4.78 & 0.19
	Unhealed periapical lesion/18/(14.4%)	9/(50%)	3/(16.66%)	2/(11.11%)	4/(22.22%)	6.44 & 0.092
	Perforation/ 6/(4.8%)	3/(50%)	2/(33.33%)	1/(16.66%)	0/(0.0%)	1.0 & 0.61
	Missed canal/ 7/(5.6%)	2/(28.57%)	2/(28.57%)	1/(14.28%)	2/(28.57%)	0.43 & 0.934
	Unknown factors/ 19/(15.2%)	10/(52.63%)	2/(10.52%)	5/(26.31%)	2/(10.52%)	9.0 & 0.029
Chi & p.value	53.7 & 0.00	22.157 & 0.001	14.5 & 0.025	9.37 & 0.154	16.33 & 0.005	
25-34 N=70	Under-filling/ 16/(22.85%)	6/(37.5%)	3/(18.75%)	2/(12.5%)	5/(31.25%)	2.5 & 0.48
	Over-filling/ 21/(30%)	8/(38.09%)	4/(19.04%)	3/(14.28%)	6/(28.57%)	2.81 & 0.42
	Broken instrument/ 6/ (8.57%)	1/(16.66%)	2/(33.33%)	1/(16.66%)	2/(33.33%)	0.67 & 0.88
	Unhealed periapical lesion/9/(12.85%)	2/(22.22%)	1/(11.11%)	2/(22.22%)	4/(44.44%)	2.11 & 0.55
	Perforation/3/(4.28%)	2/(66.66%)	1/(33.33%)	0/(0.0%)	0/(0.0%)	0.33 & 0.56
	Missed canal/ 5/(7.14%)	2/(40%)	1/(20%)	1/(20%)	1/(20%)	0.6 & 0.9
	Unknown factors/ 10/(14.28%)	5/(50%)	3/(30%)	1/(10%)	1/(10%)	4.4 & 0.22
Chi & p.value	24.8 & 0.00	11.15 & 0.08	4.13 &0.66	2.0 & 0.85	7.21 & 0.21	
35-44 =62	Under-filling/ 13/(23.63%)	3/(23.07%)	6/(46.15%)	2/(15.38%)	2/(15.38%)	3.31 & 0.35
	Over-filling/ 18/(32.72%)	12/(66.66%)	1/(5.55%)	2/(11.11%)	3/(16.66%)	17.11 & 0.001
	Broken instrument/ 4/(7.27%)	2/(50%)	1/(25%)	1/(25%)	0	0.5 & 0.78
	Unhealed periapical lesion/7/(12.72%)	3/(42.85%)	1/(14.28%)	1/(14.28%)	2/(28.57%)	1.57 & 0.67
	Perforation/ 5/(9.09%)	3/(60%)	0/(0.0%)	2/(40%)	0/(0.0%)	0.2 & 0.66
	Missed canal/ 4/(7.27%)	1/(25%)	1/(25%)	1/(25%)	1/(25%)	0.00 & 1.0
	Unknown factors/ 11/(20%)	7/(63.63%)	1/(9.09%)	2/(18.18%)	1/(9.09%)	9.0 & 0.029
Chi & p.value	19.29 & 0.002	19.81 & 0.002	11.36 & 0.045	1.09 & 0.98	1.56 & 0.82	

Table 2: Total numbers of examined cases

Factors/ Total Pt. No.	Spontaneous pain /(%)	Intermittent /(%)	After 3-7 days /(%)	After 2 weeks or more /(%)	total	Chi & p.value
Under-filling/ 78/(20.8%)	19/(24.35%)	27/(34.61%)	10/(12.82%)	22/(28.2%)	78	
Over-filling/ 102/(27.2%)	48/(47.05%)	16/(15.68%)	14/(13.72%)	24/(23.52%)	102	
Broken instrument/ 35/(9.33%)	13/(37.14%)	11/(31.42%)	4/(11.42%)	7/(20%)	35	105.05 & 0.00
Unhealed periapical lesion/59/(15.73%)	23/(38.98%)	9/(15.25%)	6/(10.16%)	21/(35.59%)	59	
Perforation/ 21/(5.6%)	12/(57.14%)	4/(19.04%)	4/(19.04%)	1/(4.76%)	21	
Missed canal/ 19/(5.06%)	6/(31.57%)	6/(31.57%)	3/(15.78%)	4/(21.05%)	19	
Unknown factors/ 61/(16.26%)	34/(55.73%)	9/(14.75%)	11/(18.03%)	7/(11.47%)	61	
total	155	82	52	86		
Chi & p.value	80.72 & 0.00					

Results

During the study period, 375 patients were examined and statistically analyzed. In (Table.2) we notice the differences in numbers and percentages of overall patients according to the onset and the causative factors of pain after root canal treatment, the high percentage of the pain of 102/(27.2%) of patients was due to overextension of filling material, (most of these patients were suffering from spontaneous pain 47.05%). Followed by 78/(20.8%), which were due to failure of treatment due to the under-filled root canal (most of them 34.61% have intermittent pain). The least affecting factor was missed untreated canal, which mostly causes spontaneous and intermittent pain (31.57%). The unknown factors including (over-instrumentation, NaOCl extrusion) which represent a (16.26%) of patients and mostly cause spontaneous pain (55.73%)

The high incidence of post endodontic pain present in (15-24), (25-34) & (35-44) age groups was due to over-filled canal (33.6%), (30%) & (32.72%), most of them have spontaneous pain, with variable percentages of other factors as present in table.1, while (45-54) age group show a high percentage of unknown factors (21.33%) (discussed in the discussion) followed by (18.66%) over-filled canal.

In (55-65) age group, the causative factors were mostly (28%) under-filled canal with (35.71%) have intermittent pain, and (26%) due to Unhealed periapical lesion with (53.84%) start suffering from pain after two weeks or more post-operatively.

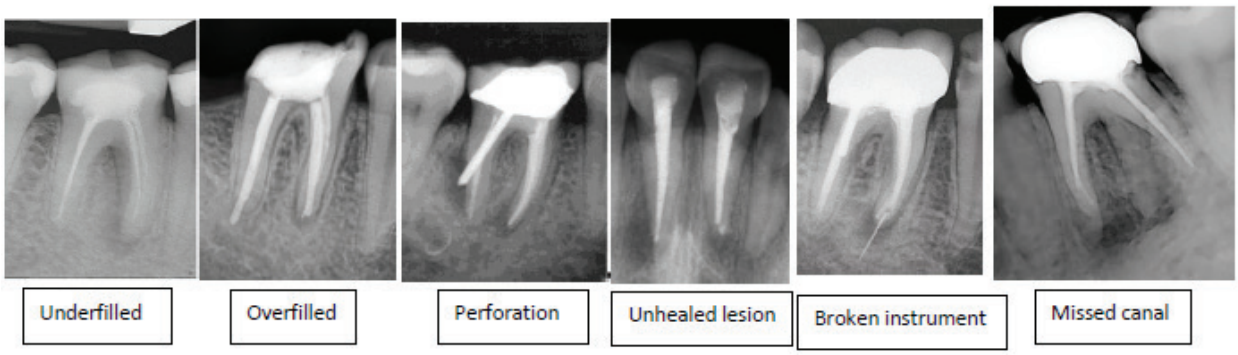

Figure1: Showes the effect of teeth

Discussion

Dental patients have become increasingly less tolerant of any dentist or dental procedure that causes pain. In endodontics, offering adequate local anesthesia is essential for successful patient management and represents a practice-building strategy that increases both patient loyalty and treatment acceptance. Endodontic pain management must encompass all aspects of treatment: preoperative pain control encompasses accurate diagnosis, anxiety reduction, intraoperative pain control revolves around effective local anesthetic and operative techniques, and postoperative pain management can involve a variety of pharmacologic agents [18]. In this longitudinal study, the post-endodontic pain in 375 atients received root canal treatment that has been radiographically analyzed according to age, causative factors, and its relation with the onset of pain post-endodontic intervention that describes from patients chief complain. The results revealed that the most common factor was over-filled root canal (extrusion of filling material) (27.2%) in most age groups, as shown in Table.1, and the pain was spontaneous in most cases.

It has been well established that endodontic overfilling should be avoided during obturation. its only indicated when it would be followed by apicoectomy when the foreign material has been removed. Accidental overfilling may still occur with soft materials (for example, certain, pastes, and cement) or with hard materials (like gutta-percha or silver cones). Such overfilling might cause an unnecessary mechanical and chemical irritation, which hinders the healing of the periapical tissue and thus reduce the probability of a successful outcome. The patient may experience localized, sharp pain after the procedure, which gradually fades down.if the mandibular nerve is injured during the treatment, the pain will be located in the immediate periapical area with radiation to the whole area innervated by the injured nerve [19].

Initial radiographs taken with the files in position will not only ensure the correct working length but also prevent canal perforation and possible subsequent damage to the inferior alveolar nerve resulting from endodontic treatment. Diagnosis of complications caused by accidental overextension of endodontic filling material will require an accurate dental history to determine the onset of altered sensation and its evolution. When complications are suspected from the patient's complaints, history, and clinical examinations, overextension of filling material should be confirmed via radiography to verify any overextension of materials and to determine the specific location of the overfilled materials [23]. The second most common factor of PEP was under-filled root canal in (20.8%) of cases that were mostly suffering from intermittent pain (34.61%) every now and then. Underfilling was determined when root canal obturation was shorter than the radiographic apex by ≤2 mm resulted from inaccuracies in working length determination and mechanical preparation, which are mostly seen in the old age group due to pulp calcification and narrowing of canals with age. The endodontic treatment failures most commonly occurred in underfilled root canals, followed by poorly filled root canals and were associated with periapical radiolucencies [20].

The unhealed periapical lesion was reported in (15.73%) of total cases with high incidence in older age than in younger age patients, especially in diabetic patients. (38.98%) have spontaneous PEP, and (35.59%) have PEP started after two weeks or more. Periapical lesions develop as sequelae to pulp disease. They often occur without any episode of acute pain and are discovered on routine radiographic examination. The incidence of cysts within periapical lesions varies between 6 and 55%. The occurrence of periapical granulomas ranges between 9.3 and 87.1%, and of abscesses between 28.7 and 70.07%. It is accepted that all inflammatory periapical lesions should be initially treated with conservative nonsurgical procedures [21]. On the basis of the average healing rate of approximately 3 mm2/mo, a 30 mm2 lesion will require ten months for complete resolution. If the lesion becomes larger, remains the same size, or demonstrates a below-average rate of healing, then surgical intervention must be considered, and there is always the possibility that quiescent epithelial cells may be stimulated by instrumentation in the apical region, with resultant proliferation and cyst formation [22].

Broken instruments presented in (9.33%) of total cases and increase with aging, (37.14%) of them have spontaneous pain. Rotary instruments tend to fracture inside the canals when either law of access

cavity preparation are not adhered to, or when rotary instruments are not used according to guidlines. As a result of instrument fracture, the access to the apical portion of the root canal becomes limited, which can cause deleterious effect on canal disinfection distal to the fractured instrument, and later on, on obturation. studies conducted on the effect of fractured instruments have demonstrated a minimal influence on the success rate of the treatment [25, 26, 27]. The stage of instrumentation at which the instrument breaks can affect the prognosis. The disinfection and obturation of the canal distal to the fractured instrument become difficult, leading to a persistent infection in that area [27]. However, the fractured instrument itself has less to do with failure because most of the time, the success is only affected when a concomitant infection is present [28]. Root perforation presented in (5.6%) of cases, (57.14%) have spontaneous PEP. Root perforations can occur pathologically as a result of resorption and caries or iatrogenically during root canal treatment [29]. Such perforations might compromise the treatment outcome and persist as a significant complication if not repaired. Perforation might occur during the preparation of access cavities, post space, or may occur as a result of the extension of internal resorption into periradicular tissues [30].

Missed canal reported in (5.06%) of total examined cases, with (31.57%) have spontaneous pain and the same percentage presented with intermittent pain. It's not an uncommon practice to miss a canal during an endodontic treatment, especially in molar teeth where one root, one canal formula, is frequently overruled by the fact that the number of canals is more than the number of roots. Moreover, a less than adequate access opening makes it difficult for the primary dentist to locate the supplemental canals. The inability to treat all the canals is one of the causes leading to endodontic failure. Bacteria residing in these canals lead to the persistence of symptoms. The results of one study carried out on 5616 molars, which were retreated, showed that failure to locate the MB2 canal had resulted in a significant decrease in the long-term prognosis of those teeth [24]. The Unknown factors that could not be detected by radiograph mainly include the complications of over-instrumentation and Sodium Hypochlorite Leakage during the irrigation of the root canal. These factors consist (16.26%) of total examined cases and presented with (55.73%) spontaneous PEP. Inadvertent injection of NaOCl beyond the apical foramen is uncommon and is infrequently reported in the literature. This complication occurs in teeth with wide, apical foramina or when the apical constriction is destroyed during root canal preparation. In addition, extreme pressure during irrigation may result in contact with large volumes of the irrigant with the apical tissues. If this occurs, the excellent tissue-dissolving capability of NaOCl will lead to tissue necrosis [31]. The sequence of signs and symptoms that occurs after the extrusion of NaOCl into the periapical tissues seems to follow a typical pattern. According to Hulsmann's criteria, the diagnosis of NaOCl accident includes the following: (1) acute pain, swelling, and redness; (2) bruising; (3) progressive swelling involving the infraorbital area or mouth angle depending on the site of NaOCl injection; (4) profuse hemorrhage often manifesting intraorally from the orifice of the tooth; (5) numbness or weakness of the facial nerve; and (6) secondary infection, sinusitis, and cellulitis [31,32]. Iatrogenic over instrumentation promotes the enlargement of apical foramen and irritate the apical tissue, which may allow an increased influx of exudate and blood into the root canal [33]. This will enhance the nutrition supply to the remaining bacteria inside the root canal, which can then proliferate and cause exacerbation of a chronic periradicular lesion and pain.

Conclusion

There are many factors that influence post-endodontic pain (PEP); these factors cause a variable onset of pain and other complications that eventually lead to the failure of root canal treatment. Periapical x-ray radiography is a valuable technique to identify the causative factors of post-endodontic pain and evaluate the success of RCT and the status of endo treated tooth and periapical tissues. All procedural errors cannot be depicted on radiographs. Over-instrumentation, for example, may push the pulp remnants and microbes beyond the apex of the tooth, causing acute apical periodontitis, which can be demonstrated by using radiographs only, which is followed by extrusion of the filling materials but not during previous stages of RCT.

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