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ASSESSING CLINICAL AND RADIOGRAPHIC EVIDENCE OF FAILURE FOLLOWING PULP THERAPY IN PRIMARY ANTERIOR AND POSTERIOR TEETH AMONG PATIENTS LESS THAN SIX YEARS OLD

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ABSTRACT

Aim: to reveal relation between clinical and radiographic evidence of failure following pulp therapy in primary teeth among patients less than six years old.

Subjects and Methods: The study was carried out on 100 mandibular primary molars treated by formocresol pulpotomy and 50 maxillary primary anterior teeth treated by pulpectomy in patients showing radiographic evidence of failure, regardless of their clinical conditions. Clinical examination was performed and clinical failures were given scores as follows; score 0: normal, score 1: history of pain, score 2: gingival swelling/sinus tract, score 3: purulent exudate and score 4: excessive mobility. Radiographic examination was accomplished to detect any signs of failure. Radiographic failures were given scores as follows; score 1: internal or external resorption, score 2: periapical radiolucency, score 3: widening of periodontal membrane space and score 4: furcation infection.

Results: Significant difference was noted (P=0.001) when type of teeth and radiographic scores were compared. Relation between clinical scores and type of teeth was statistically insignificant (P=0.295). Significant difference was noted (P =0.001) when type of treatment and radiographic scores were compared. No significant difference was revealed comparing type of treatment and clinical scores (P=0.900). Statistical analysis revealed no statistical significant difference relating radiographic and clinical scores (P= 0.410).

Conclusion: Evidence of radiographic failure was revealed in clinically successful treated primary teeth. Thereby, radiographic examination is not elective in determining success/failure of treatment.

INTRODUCTION

Treating pulp pathology in primary teeth is a cornerstone in pediatric dentistry. This relies significantly on comprehensive history taking, proper diagnosis, accurate clinical procedure and finally sealing by a hermetic postoperative restoration [1-3]. Failure of treatment can be identified either clinically, radiographically or even both [4].

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Absence of sensitivity on percussion, swelling or fistula or pathological tooth mobility dictates clinical criteria for successful pulp therapy [5]. On the other hand, radiographic criteria for successful pulp therapy include; absence of furcational radiolucency or external/internal root resorption or other pathological changes that might endanger the developing permanent successor [6].

Reviewing literature, the available studies show the clinical and radiographic success/failure of formocresol pulpotomy in comparison with other medicaments [7, 8, 9]. To the best of our knowledge, most of the studies illustrated both clinical and radiographic findings of their investigated treatments and/or medicaments, but none identified any statistical relation between them.

Aim of the Study:

To reveal the relation between clinical and radiographic evidence of failure among primary anterior and posterior teeth previously treated by pulp therapy among patients less than six years old.

SUBJECTS AND METHODS

Study design and Settings: The current correlational study was carried out on patients randomly selected from outpatients attending Pediatric Dentistry and Dental Public Health Department - Cairo University.

Subjects: Patients were recruited in the study after obtaining faculty's ethics committee clearance. The written informed consents were obtained from the parents prior to the study. Participation in the study was voluntary, in this manner, only patients of parents/caregivers who agreed to participate in the study were included according to the following inclusion criteria: medically free patients, those younger than 6 years old and possessing the ability to cooperate during radiographic assessment. Whereas special health care needs patients and those attending requiring emergency dental treatment were excluded.

Sample size: The study sample was calculated statistically using Rasolt computer software (Raosoft, Inc) [10]. Due to lack of typical studies in the literature, a hypothesis of 50% to get the largest sample size was recommended. The estimation recommended studying at least 101 subjects to be able to reject the null hypothesis.

Methods: Research randomizer software (https://www.randomizer.org/) freely available online was used to specify the selected patients per day. As an average, it was estimated that the minimum number of patients attending the clinics of Pediatric Dentistry and Dental Public Health Department-Cairo University was around 150 daily. It is worthy to note that, all patients attending the clinics are registered and given a sequential number/code according to their attendance. Therefore, using the research randomizer, the answer to the available question regarding the total number of the set chosen was 50, from a range of 1-150 patients. Accordingly, the software chose randomly the numbers/codes of the 50 patients to be included in the study for this day. The selected numbers/codes were highlighted in the list, so that the researcher can identify the patients randomly selected in order to carry out the assessment before commencement of dental treatment. This process was repeated till the total sample size was obtained.

The study was carried out on 100 mandibular primary molars treated by formocresol pulpotomy and 50 maxillary primary anterior teeth treated by pulpectomy in patients showing radiographic evidence of failure, regardless of their clinical conditions, among patients attending for follow-up visits.

Previously treated primary teeth that showed evidence of failure were referred for appropriate subsequent treatment. Radiographic and clinical and examinations were performed by the same examiner for the sake of standardization. Regarding

radiographic examination; patients possessing previously treated primary teeth/molars were subjected to periapical radiographs using size 1 periapical films (Eastman Kodak, Rochester, NY, USA). Periapical radiographs were positioned with the aid of a radiographic film holder (Rinn XCP Instruments, Rinn Corporation, Elgin, IL, USA). Radiographs showing evidence of failure of treatment were included in the study. Radiographic failures were given scores as follows; score 1: internal or external resorption, score 2: periapical radiolucency, score 3: widening of periodontal membrane space and score 4: furcation infection/ involvement.

Regarding clinical examination; it was performed using plain dental mirrors and standard operating light while the child was sitting on dental chair. It included careful observation and palpation of soft and hard oral tissue. The criteria of clinical failure included; spontaneous pain (obtained from patients' chief complaints), evidence of swelling and/or fistula (diagnosed visually), presence of tenderness to percussion (detected using a dental mirror) and evidence of pathalogical tooth mobility (diagnosed using two dental mirrors) [11]. Clinical failures were given scores as follows; score 0: normal with no clinical signs and symptoms of failure, score 1: history of pain, score 2: gingival swelling or sinus tract, score 3: purulent exudate expressed from gingival margin and score 4: excessive mobility.

Statistical analysis:

This was performed with IBM® SPSS® (SPSS Inc., IBM Corporation, NY, USA) Statistics Version 22 for Windows. Data were statistically described in terms of mean, standard deviation (±SD), frequency (n) and percentage (%) when appropriate. Comparison between different groups regarding categorical variables was tested using Chi-square test and Fisher's exact test. The level of significant was 0.05.

RESULTS

The main objective of the current study is to test whether there is association between the radiographic and clinical distribution of the failure scores. In the current study, 150 treated primary teeth were investigated both clinically and radiographically. Males comprised 73.3% of the study sample whereas females presented 26.7%. Regarding age distribution, treated anterior teeth presented a mean of 4.86 and standard deviation (SD) of ±0.5108. On the other hand, treated posterior teeth presented a mean of 4.95 and SD of ±0.5546.

On the other hand, treated posterior teeth presented a mean of 4.95 and SD of ± 0.5546. Regarding the type of restorations used in the investigated teeth in the current study sample, posterior teeth were finally restored by either stainless steel crowns or amalgam or glass ionomer or composite restorations. Stainless steel crowns comprised 61 molars (40.7%). Composite restorations comprised 46 teeth (30.7%) from which 39 were anterior teeth and 7 were posterior molars. Glass ionomer comprised 22 teeth (14.7%) from which 11 were anterior teeth and 11 were posterior molars. Amalgam restorations comprised 21 molars (14%).

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Radiographic scores are given in Table (1) for tooth position and Table (3) for treatment type, while clinical scores recorded in the study sample are presented in Tables (2 & 4). To test the

association between the clinical and radiographic score distributions, our null hypothesis was that the distribution of failure scores should comply with both clinical and radiographic results (i.e. there should be no association between the distribution of defect scores and method used in obtaining that distribution whether clinically or radiographically.

Comparison between different groups regarding categorical variables was tested using McNemar's Chi-Square was used. In addition, for cases in which more than 20% of the cell's frequencies < 5, Fisher's exact test was used. Chi-squared values and probabilities obtained using the Fisher's exact test was shown in Table (3).

TABLE (1): Relation between the type of treated teeth and the radiographic scores.

Type of Tooth	**Radiographic Scores**				**Total**	
	1	**2**	**3**	**4**	**Number (N)**	**Percentage (%)**
Lower left first primary molars	5	8	11	21	45	30
Lower left second primary molars	0	0	2	5	7	4.7
Lower right first primary molars	1	3	3	28	35	23
Lower right second primary molars	0	2	1	10	13	8.7
Upper right central incisors	3	7	12	0	22	15
Upper right lateral incisors	5	4	7	0	16	11
Upper left central incisors	0	0	6	0	6	4
Upper left lateral incisors	1	0	5	0	6	4
Total Number (N)	15	24	47	64	150	100
Percentage (%)	10	16	31.3	42.7		
P-value = 0.001						

TABLE (2): Relation between type of treated teeth and the clinical scores.

Type of Tooth	**Clinical Scores**					**Total**	
	0	**1**	**2**	**3**	**4**	**Number (N)**	**Percentage (%)**
Lower left first primary molars	27	2	7	2	3	41	27
Lower left second primary molars	9	0	1	0	0	10	6.7
Lower right first primary molars	34	3	1	0	0	38	25
Lower right second primary molars	7	0	0	1	2	10	6.7
Upper right central incisors	16	1	1	1	1	20	13
Upper right lateral incisors	13	2	1	0	2	18	12
Upper left central incisors	5	0	1	0	2	8	5.3
Upper left lateral incisors	3	0	2	0	0	5	3.3
Total Number (N)	114	8	14	4	10	150	100
Percentage (%)	76	5.3	9.3	2.7	6.7	100	100
P-value = 0.295							

Cells that show a frequency of zero in both radiographic and clinical scores have been omitted from the sum in the above equation, thus reducing the number1 of degrees of freedom (DOF) as shown in Table (3). A significant association exists between defect type "clinical or radiograph" and defect score distribution at a significance level 0.02. This was found to be true regardless of the tooth position and/or treatment type. Regarding the distribution of previous type of treatment that was set to the investigated anterior and posterior teeth, findings are presented in Figs. 1 and 2.

A significant difference was noted statistically (P=0.001) when the type of treatment and radiographic scores were compared to one another. On the other hand, no significant difference was noted comparing the type of treatment and clinical scores (P =0.900). The outcomes are presented in tables 3 and 4.

Table (5) shows the radiographic and clinical scores of investigated anterior and posterior teeth. Statistical analysis revealed no statistical significant difference (P =0.410). Table (6) shows the association between radiographic and clinical failure scores using the x^2 & Fisher's exact tests.

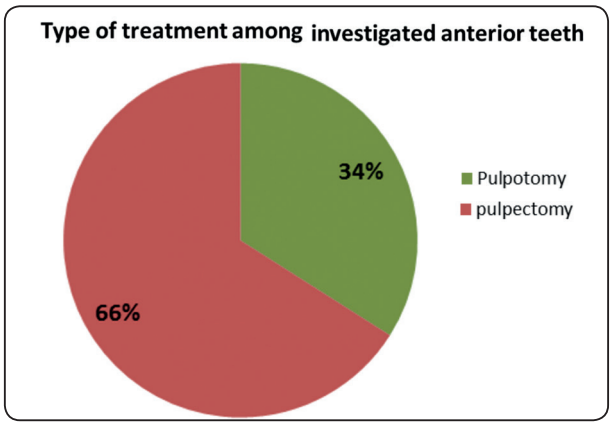

Fig. (1): Type of treatment among investigated anterior teeth.

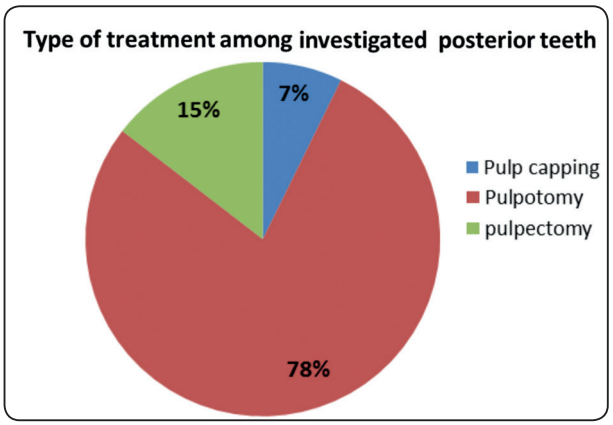

Fig. (2): Type of treatment among investigated posterior teeth.

Table (3): Relation between the type of treatment done and the radiographic scores.

Type of Treatment	**Radiographic Scores**				**Total**	
	1	**2**	**3**	**4**	**Number (N)**	**Percentage (%)**
Pulp capping	1	0	3	4	8	5.3
Pulpotomy	9	17	21	56	103	69
Pulpectomy	5	7	23	4	39	26
Total Number (N)	15	24	47	64	150	100
Percentage (%)	10	16	31	42.7		
P-value = 0.001						

TABLE (4): Relation between the treatment done and the clinical scores.

Type of Treatment	**Clinical Scores**					**Total**	
	0	**1**	**2**	**3**	**4**	**Number (N)**	**Percentage (%)**
Pulp capping	7	1	0	0	0	8	5.3
Pulpotomy	79	5	10	3	6	103	69
Pulpectomy	28	2	4	1	4	39	26
Total Number (N)	114	8	14	4	10	150	100
Percentage (%)	76	5.3	9.3	2.7	6.7		
P-value = 0.900							

TABLE (5): Radiographic and clinical scores of investigated anterior and posterior teeth.

Radiographic Scores	**Clinical Scores**					**Total**	
	0	1	2	3	4	**Number (N)**	**Percentage (%)**
1	12	0	1	1	1	15	10
2	18	2	2	0	2	24	16
3	31	2	9	1	4	47	31.3
4	53	4	2	2	3	64	42.7
Total Number (N)	114	8	14	4	10	150	100
Percentage (%)	76	5.3	9.3	2.7	6.7		
P-value = 0.410							

TABLE (6) Association between radiographic and clinical failure scores

Type and position of the tooth	DOF	x^2	x^2 P-value	Fisher P-value
Lower left first primary molars	4	52.08	< 0.001	2.055×10^{-16}
Lower left second primary molars	3	14.00	< 0.01	2.914×10^{-04}
Lower right first primary molars	4	64.00	< 0.001	1.426×10^{-19}
Lower right second primary molars	3	17.33	< 0.001	1.269×10^{-05}
Upper right central incisors	3	36.81	< 0.001	4.943×10^{-11}
Upper right lateral incisors	2	21.79	< 0.001	3.993×10^{-07}
Upper left central incisors	2	12.00	< 0.01	3.247×10^{-08}
Upper left lateral incisors	3	10.00	< 0.02	2.165×10^{-03}
Pulp capping	4	62.20	< 0.001	1.048×10^{-18}
Pulpotomy	4	14205	< 0.001	
Pulpectomy	3	10.00	< 0.02	2.165×10^{-3}
All data	4	210.55	< 0.001	

(x^2 & Fisher's exact tests)

DISCUSSION

Success of pulp therapy is a strategic pillar in preserving primary teeth and avoiding their untimely loss. Following pulp therapy, treated primary teeth should be regularly assessed both clinically and radiographically [3].

This study was conducted to reveal the relation between clinical and radiographic evidence of failure following pulp therapy in primary anterior and posterior teeth among patients less than six years old.

The planned age group to be recruited in the current study was less than 6 years old. This was chosen to be prior the first peak of normal occurrence of physiological root resorption and 10 years far beyond commencement of shedding of teeth [12].

In order to minimize subjective assessment and possible bias, the authors were blind to operator(s) who had performed the treatment and patients were assessed after 6 months or more post completion of pulp therapy.

To expose a radiograph of consistent diagnostic value, accurate beam angulation and appropriate film placement are of particular importance. As a result, the least distorted image was produced when radiographs were exposed while the central beam was directed perpendicular to longitudinal axes of the teeth [13]. Thus, using beam alignment device or film holder -which was employed in the current study- is of prime importance in order to produce standardized periapical radiographs.

Clinical and radiographic examinations were performed and scores were given accordingly to facilitate ease of reference, apply strict calibration and enhance reliability. Clinical symptoms reported by patients may be subjective and thus may lead to systematic bias or inter-examiner discrepancies. Hereafter, the current study -with the guidance of sample size calculation- evaluated large number of patients, used standardized objective criteria and employed calibrated observers with the purpose of improving the examiner judgments and reliability.

It is worthy to note that avoiding errors in interpretation of radiographs is not an easy task. Therefore a clear strategy had been devised to minimize such misinterpretations. Hence authors set a clear criteria and scoring for recording findings of failure. In addition, inter- and intra-observer agreements had been calculated in Kappa values to reduce any errors which can possibly happen when a precise description of what constitutes failure is not clarified. Further, authors optimized viewing condition and reported findings of failure only when they were beyond any doubt. As a result, the scoring system offered an objective guidance which reduced bias, offered means of quantitative assessment and enriched reliability/reproducibility of scores.

Overall success rate of treatment was a common reported parameter in several studies on pulp therapy in children. In spite of the fact that, several studies showed both clinical and radiographic findings, none identified any statistical relation between them. At that juncture, there was limited available literature employing similar study purpose for drawing straightforward comparisons with attained results.

Regarding radiographic findings, furcation involvement was found to be the most common radiographic failure finding. This complies with results of previous studies [14, 15]. This could be related to the presence of accessory canals which present possible channels that cause spread of infection to inter-radicular bone or presence of leftover minute pulp remnants at that area. In addition, excess of medicament used can affect alveolar bone through such canals.

Results of the current study indicated that tooth type was a significant factor (P=0.001) which affected the outcome of treatment. Lower posterior teeth showed the worst radiographic failure while upper anterior teeth had the best scores. On the

other hand, pulp therapy of upper anterior teeth was relatively simple in most of the cases. This is because; such teeth often demonstrate relatively large straight root canal systems so that instrumentation would be encountered easily.

This came in accordance with other studies who reported high radiographic failure in the first primary molars [16, 17]. The reasoning of this finding can be explained from the clinical point of view as posterior teeth were often badly decayed prior to pulp therapy and might have risk of trauma during function or occlusal loads if left untreated and unrestored for a while prior to treatment. That may also be attributed to short distance between enamel surface and pulp horns of the first primary molars, thus rendering those teeth more prone to rapid caries attack. Consequently, that may affect pulp response and success of treatment [18]. On the contrary, other studies reported no difference between first and second primary molars [19, 20]. This may be attributed to different study sample utilized in the latter studies.

Clinically successful tooth is generally considered by patients as functioning units, thus in this study, the tooth rather than individual roots was considered as the unit of measurement of failure. Radiographically, failure criteria were employed on anterior and posterior teeth alike, though outcomes of multi-rooted posterior teeth here were regarded as failed if any root had showed signs of failure.

This explains the discrepancies noted between clinical (P=0.295) and radiographic failures (P=0.001) as investigated teeth might have been erroneously regarded as clinically successful. Further, that can also explain the noted significant difference (P=0.001) when the type of treatment and radiographic scores were compared in spite of the insignificant difference which was noted comparing the type of treatment and clinical scores (P=0.900).

Though the result of the current study showed that comparing radiographic and clinical scores of investigated anterior and posterior teeth were statistically insignificant (P= 0.410), it was evident that clinical records were generally showing less failure when compared to radiographic scores.

CONCLUSION

Radiographic examination has an imperative role in evaluation of success or failure of any treatment. clinicians should not rely merely on clinical examination.

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