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Investigating the Root Canal Therapy Errors of Dentistry Students of Dental School in Iran in the Academic Year of 2017 - 2018 Using Periapical Radiography

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Abstract

Introduction and Aim: Root canal therapy or endodontic therapy is an important part of the work of a general dentist. The aim of this study was to investigate the radiographic quality of root canal therapy performed by general students of Kashan School of Dentistry.

Materials and Methods: All medical records of 242 people referred to the Department of root canal therapy during 2017 - 2018 and treated by general students were reviewed. To examine the quality of work, the criteria of length of filling, tapering and density were used and errors were recorded during root canal therapy. Fisher exact test and Chi-square tests were used for statistical comparisons.

Results: Based on the results of this study, 272 (86.3%) of the samples had sufficient filling length, while 29 (9.2%) of the samples had short filling and 14 (4.4%) of the samples had long filling. A total of 257 (86.6%) samples had adequate tapering and 132 (41.9%) had adequate density. Transportation and gouging were among the errors seen during the therapy, so that 22 (7%) of the samples had transportation error and 2 (1%) had gouging error. There was a statistically significant relationship between the types of errors and the quality of the filling in terms of the length of filling and the density of the filling and its tapering.

Conclusion: The results of the present study can be useful in proper planning to improve the quality of root canal therapy in the general department of Kashan School of Dentistry by identifying the weaknesses of therapy in different educational departments.

Keywords: *Dentistry Students; Root Canal Therapy; Radiography*

Introduction

As part of the primary goal of dentistry, which is to obtain a natural and healthy dental system for public, the goal of endodontic therapy is to preserve natural teeth without harming public health [1]. Clinical studies have reported that the success rate of endodontic therapies performed by specialists is between 84 and 90 percent, and the success rate of these therapies performed by general dentists is 60 to 75 percent [2].

Endodontic therapy involves processes designed to keep the health of all or part of the dental pulp. When a dental pulp is damaged, therapy is done with the aim of protecting the periapical tissues. When apical periodontitis occurs, the goal of therapy is to restore periapical health. These goals are usually achieved by root canal therapy and sometimes by a combination of root canal therapy and surgery.

The stages of root canal therapy include removing pulp tissue (pulpectomy), preparation and filling of the root canal system. The access hole is prepared with the aim of removing the roof of the pulp chamber and removing the crown pulp, exposing all canals and allowing endodontic devices to have a direct access to root canal. Root canal preparation involves cleaning and shaping the canal. Cleaning the canal involves removing the remnants of pulp tissue and microorganisms. Shaping the canal involves enlarging the canal and creating a shape of the canal that facilitates its washing and filling. Filling the root canal is done with the aim of preventing the passage of microorganisms and fluids through the root canal. Canal filling should completely block the root canal system in three dimensions. For this purpose, in addition to blocking the apical foramen, dentine tubules and sub-canals should also be blocked [1,3].

Success in root canal therapy is a public health problem that has medical, economic, and moral consequences [4]. There are various methods to evaluate the results of root canal therapy. These methods include clinical, radiographic, and histological evaluations. Histological evaluation is not possible without surgery, so it is an impractical method to evaluate the results of root canal therapy. Clinical findings and radiographic evaluations are more common methods for examining the results of root canals. The presence of persistent signs and symptoms after therapy is one of the criteria for failure of root canal therapy. Radiographic success is characterized by the absence of lesions in the periapical tissues, meaning that existing resorption lesions have healed after at least one year or no new lesions have been formed. Studies have indicated that factors such as factors such as status of canal bacteria, apical diseases during therapy, diagnostic errors and therapy plan, lack of knowledge of pulp anatomy, incomplete cleaning and disinfection of root canal system, vertical fracture of root, dentine restoration quality, length and the quality of canal filling and errors during therapy affect the prognosis of root canal therapy [5,6].

It is difficult to determine the exact position of constriction. However, it is better to determine the operating length 0.5 to 2 mm shorter than the X-ray radiograph. The apical constriction should be maintained during canal preparation and the filling should be restricted to the canal space. The final filling length of the canal should not be reduced during preparation. Also, the preparation of canal should be narrowed continuously (not regularly narrowed necessarily) so that the smallest cross-sectional diameter of the prepared canal should be in the apical area. The shape of the prepared canal should be a reflection of the original shape of the canal. Also, the filling of the canal in radiographic evaluation should have no void space inside the filling material, between the filling space and the wall of the canal or in the apical where the filling ends and have a uniform density (although the dentine area and large canals are more radiopaque due to differences in volume of materials than the apical area).

The sharp and non-folded edges of the gutta-percha are a good reason to good match of filling material with the canal wall. The canal prepared in the anterior teeth should be filled to the edge of gum, and in the posterior teeth, it should be filled to the opening of the canals unless it is to be placed in the posterior canal. Teeth should be well restored after root canal therapy to prevent re-infection. Lateral perforation of the root during the access hole preparation is caused by non-placement of a milling alongside the longitudinal axis of the tooth. Careful positioning of the tooth relative to adjacent teeth and alveolar bone and paying attention to crown and root location in radiographic images, especially in teeth with full veneers, can prevent its occurrence.

Sudden pain despite proper anaesthesia, sudden bleeding, and feeling of burning and bad taste when using canal cleaners can be a sign of perforation into the PDL space. Improper positioning of the file in the radiography image or when the apex locator shows the PDL in a length very shorter that the length of operation can also be a sign of perforation. If the lateral perforation is higher than the crystalline bone, it will be accessible and restorable and have a favourable prognosis. However, perforation under the crystal bone in one-third of the crown of the root has a poor prognosis and a periodontal pocket is formed in this area. In this case, it is possible to access the perforation area and restore it through surgery to increase the length of the crown or orthodontic extrusion to perforation area [4]. Transport of the apical area is the change in the position of the natural end of the canal to an iatrogenic position on the outer wall of the root. With the occurrence of apical transport, an elbow is formed and a view of the "sand clock" is observed in the apical part of the canal. This inverted form of the apical area cannot resist the gutta-percha and forms a canal with non- dense filling that is vertically over-extended but internally under-filled. It should be noted that in any stage of root canal therapy, adverse conditions may occur, known as "endodontic

accidents" and can cause problems in cleaning and shaping the canal, leading to improper filling. They can also contaminate the tissues around the roots and reduce the prognosis of therapy. Having adequate knowledge of errors during work is essential to prevent them.

No study has been conducted so far on the quality of root canal therapy and technical errors of root canal therapy by Kashan dentistry students. Such studies can evaluate the effectiveness of root canal training status and be helpful in designing future training programs. Dadresanfar., *et al*. (2008) conducted a study to evaluate the quality of root canal therapy by general students of the School of Dentistry in Azad University of Tehran. In the mentioned study, they examined 400 medical records that each file included at least three radiographies. These researchers evaluated the quality of root canal therapy in terms of filling length and its density [7]. Mokhtari., *et al*. examined the quality of root canal therapy performed by general students of School of Dentistry of Yazd during 2011 - 2013. The results of the study indicated that 155 (64.6%) of the samples had a proper filling length. However, 55 (22.9%) of the samples had short filling and 30 (12.5%) of the samples had long filling, and the difference among the three groups was statistically significant (P = 0.001) [8].

Mahmoudizadeh examined the quality of root canal therapy performed by general students of School of Dentistry of Bushehr during 2015 - 2016. The results showed that a total of 51.8% of root canal therapies had all proper filling criteria that is far from ideal endodontic therapy success rate (90 to 95%). He concluded that it can be compensated by better prioritizing of educational subjects (e.g. focusing more on molar teeth), using new techniques in canal preparation, and working on rotating systems [9]. Elhadi M Awooda., *et al*. (2016) examined the quality of root canal therapy performed by general students of the Sudan School of Dentistry in 2013 - 2014. The results of the study showed that 55.5% of the channels had acceptable filling length. Finally, they concluded that due to the gap between this rate and the ideal success rate of root canal therapy, better prioritization of educational topics (for example, more focus on molar teeth), the use of new techniques in canal preparation and working on rotational systems can compensate this gap [10]. The method used to evaluate root canal therapy is based on radiographic evaluation. Radiographic evaluation of the quality of root canal filling is relatively easy, because the materials filling the canal provide a good contrast. Evaluating root canal therapy is difficult. Radiography is the only immediate tool for this purpose and it is not adequate even at the best conditions. However, radiographic evaluation is standard and meets the minimum criteria for judging the quality of root canal therapy. Evaluating the success rate of root canal therapy performed by dentistry students due to its effect on the preparation of students' educational programs is crucial.

Aim of the Study

The aim of the present study was to investigate radiographic errors in endodontically treated teeth by Kashan dentistry students in the academic year of 2017 - 2018.

Materials and Methods

In this cross-sectional study, medical records of root canals treated by dentistry students in the endodontics department of Kashan School of Dentistry from 1996 onwards were evaluated. The medical records that met the inclusion criteria were selected.

These records had initial radiography, measurement, MC (Master cone) and filling and showed clear information about the relevant tooth, the shape of the roots, their formation, cleaning and filling. The records that had poor radiographic quality or had incomplete root canal therapy were excluded. Also, records needed to follow standard root canal therapy strategy in the Endodontic Department of School of Dentistry in Kashan. Accordingly, the technique of isolating teeth must be done by using rubber dam, the length of operation must be done by using radiography, preparing canals must be done with manual k files with an approximate of 2% and washed by passive step-back method and with using normal saline and sodium hypochlorite and the canal must be filled with lateral density method by using gutta-percha and AH26 sealer.

It should also be noted that all radiographies were prepared using a bisecting technique and clinical monitoring of students' practice was done by the professors of the department. The radiographs of the records were examined by three observers (one of the professors of the endodontics department, one of the professors of the radiology department and one of the dentistry students trained by the

professor of the endodontics department) using magnifying glass with magnification of ×2% and a negatoscope. The results of the two professors' observations were compared, and if there was no agreement between their examinations, the third person (the professor of the endodontics department) was asked to examine the radiographs. Also, the results of observations of the dentistry students were compared with those of the professors. Radiographs were examined in terms of technical errors during root canal therapy. The recorded data included tooth type, gouging in the access hole, transport, filling length, density and tapering of filling. According to the results of the study conducted by Dadrasan., *et al.* [7], half of the dental restorations had at least one error. Considering the accuracy of 0.05 and the confidence level of 95%, the minimum required sample was calculated at 384 people. A convenient and non-probabilistic sampling was used in this study. After collecting the information, a table frequency on the characteristics of filling and underlying factors was prepared and the subgroups were compared using the statistical tests of Chi-square and Fisher exact tests. Also, to compare the groups based on the quantitative factors, T or ANOVA tests were used.

Results

In this study, all medical records of root canals treated by students in the academic semesters of 8 (practical endo 1), 9 (practical endo 2) and 10 (practical endo 3) were examined. A total of 242 teeth and 315 canals that their frequency is listed in chart 1, were evaluated in terms of quality of endodontic therapy.

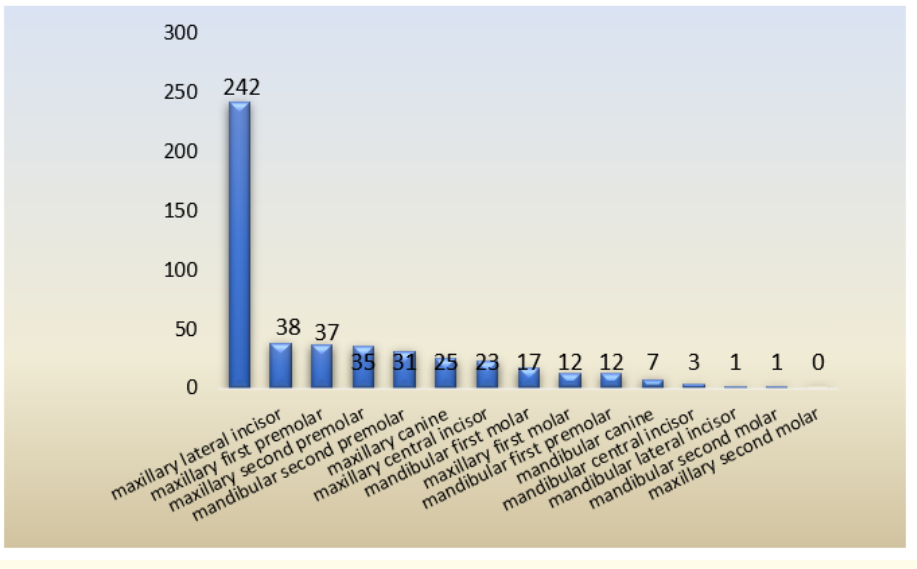

Figure 1: *Frequency of tooth type.*

Academic semester	f	%
8 (practical endo 1)	209	66/3
9 (practical endo 10)	64	20/3
10 (practical endo 3)	42	13/3
Total	315	100

Table 1: *Frequency of academic semester (practical endo).*

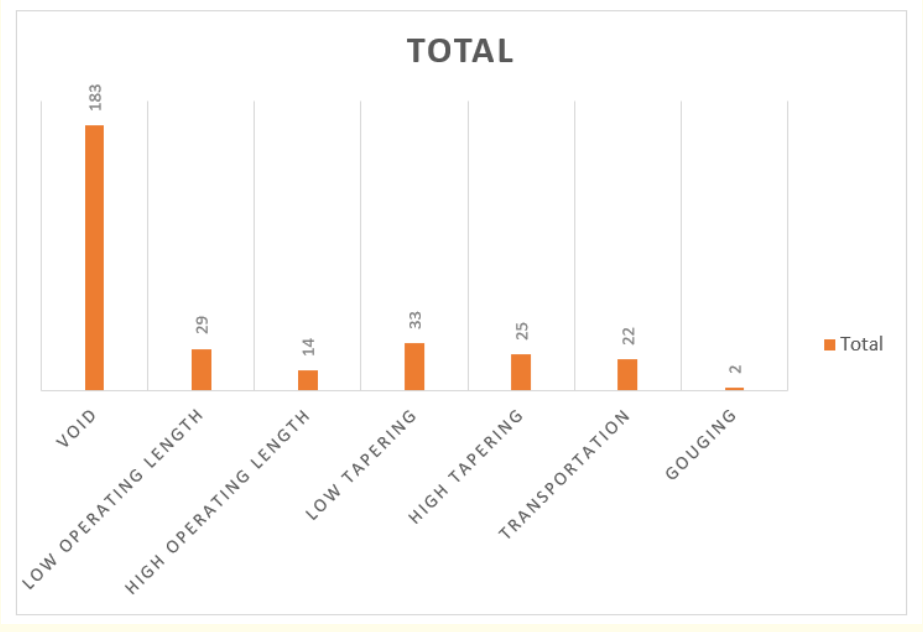

Figure 2: *The frequency of the types of errors occurred in each canal.*

As shown in chart 2, the most common errors made by students were the presence of voids in the filling with a frequency of 183, followed by preparation with low tapering with a frequency of 33 and filling with low operating length with a frequency of 29.

Tooth type	Yes	No
Maxillary central	0	(100)23
Maxillary lateral	0	38 (10)
Maxillary canine	0	25
Single- canal maxillary premolar	(7%)3	(933)40
Buccal canal maxillary premolar	0	29
Lingual canal maxillary premolar	(7%) 2	(93%) 27
Mesial canal maxillary premolar	(50%)6	6 (50%)
Distal canal maxillary premolar	(3/8%)1	(7/91%)11
Palatal canal maxillary molar	0	12
Mandibular central	0	3
Mandibular lateral	0	1
Mandibular canine	0	7
Single- canal mandibular premolar	(4/7%)3	(6/92%)38
Buccal canal mandibular premolar	0	2
Lingual canal mandibular premolar	0	2
Mesial root mandibular molar	(39%)7	(61%)11
Distal root mandibular molar *	0	18
Total	(7%)22	(93%)293

Table 2: *Frequency and percentage of transport according to the types of dental canals examined.*

According to the results of table 2, the most canals that had transport error were the mesial maxillary molar canals with 6 cases out of 12 cases of the mesial canal (50%).

Tooth type	Low tapering	Good tapering	High tapering
Maxillary central	(3/4%)1	22 (7/95%)	0
Maxillary lateral	(5/10%)4	31 (6/81%)	3 (9/7%)
Maxillary canine	(12%)3	(88%)22	0
Single- canal maxillary premolar	(7%)3	35 (4/81%)	(6/11%)5
Buccal canal maxillary premolar	(2/17%)5	20 (69%)*	(8/13%)4
Lingual canal maxillary premolar	(2/17%)5	(69%)20	4 (8/13%)
Mesial canal maxillary premolar	(25%)3	(50%)6	3 (25%)
Distal canal maxillary premolar	(3/8%) 1	8 (7/66%)	(25%)3
Palatal canal maxillary molar	(3/8%)1	(7/91%)11	0
Mandibular central	0	(100%)3	0
Mandibular lateral	0	(100%)1	0
Mandibular canine	(3/14%)1	(4/71%)5	(3/14%)1
Single- canal mandibular premolar	(9/4%)2	39 (1/95%)*	0
Buccal canal mandibular premolar	(50%)1	(50%)1	0
Lingual canal mandibular premolar	0	(100%)2	0
Mesial root mandibular molar	(1/11%)2	(3/83%)15	(6/5%)1
Distal root mandibular molar *	(6/5%)1	16 (8/88%)	(6/5%)1
Total	33 (5/10%)	(6/81%)257	(9/7%)25

Table 3: *Frequency and percentage of tapering according to the types of dental canals examined.*

According to the results of table 3, most of the canals were filled with good tapering with a frequency of 257 (81.6%).

Tooth type	Low length	Good length	High length
Maxillary central	(3/4%)1	(87%)20	(7/8%)2
Maxillary lateral	0	(4/97%)37	(6/2%)1
Maxillary canine	(8)2	(88%)22	(4%)1
Single- canal maxillary premolar	(3/9%)4	(4/88%)38	(3/2%)1
Buccal canal maxillary premolar	(4/3%)1	(2/93%)27	(4/3)1
Lingual canal maxillary premolar	0	(6/89%)26	(4/10%)3
Mesial canal maxillary premolar	(50%)6	6 (50%)	0 (0)
Distal canal maxillary premolar	(7/16%)2	(75%)9	(3/8%)1
Palatal canal maxillary molar	2 (7/16%)	(3/83%)10	0
Mandibular central	0	(100%)3	0
Mandibular lateral	0	(100%)1	0
Mandibular canine	(3/14%)1	(7/85%)6	0
Single- canal mandibular premolar	(8/9%)4	(2/90%)37	0
Buccal canal mandibular premolar	0	(100%)2	0
Lingual canal mandibular premolar	0	(100%)2	0
Mesial root mandibular molar	(2/22%)4	(7/66%)12	2 (1/11%)
Distal root mandibular molar *	(1/11%)2	(8/77%)14	(1/11%)2
Total	(2/9%)29	(3/86%)272	(5/4%)14

Table 4: *Frequency and percentage of operating length according to the types of dental canals examined.*

According to the results of table 4, most teeth have a suitable length of operation with a frequency of 272 (86.6%).

Tooth type	No void	Void
Maxillary central	(8/47%)11	(2/52%)12
Maxillary lateral	(8/36%)14	(2/63%)24
Maxillary canine	(56%)14	(44%)11
Single- canal maxillary premolar	(9/41%)18	(1/58%)25
Buccal canal maxillary premolar	(4/41%)12	(6/58%)17
Lingual canal maxillary premolar	(9/37%)11	(1/62%)18
Mesial canal maxillary premolar	(3/33%)4	(7/66%)8
Distal canal maxillary premolar	(3/58%)7	(7/41%)5
Palatal canal maxillary molar	(7/41%)5	(3/58%)7
Mandibular central	(3/33%)1	(7/66%)2
Mandibular lateral	(100%)1	0
Mandibular canine	(1/57%)4	(9/42%)3
Single-canal mandibular premolar	(9/43%)18	(1/56%)23
Buccal canal mandibular premolar	(50%)1	(50%)1
Lingual canal mandibular premolar	0	(100%)2
Mesial root mandibular molar	(1/11%)2	(9/88%)16
Distal root mandibular molar *	(50%)9	(50%)9
Total	(9/41%)132	183 (1/58%)

Table 5: *Frequency and percentage of filling density according to the type of dental canal examined.*

According to the results of the above table 5, most of the filled canals had voids with a frequency of 183 (58.1%).

Tooth type	Gouging	No gouging
Maxillary central	0	(100%)23
Maxillary lateral	0	(100%)38
Maxillary canine	0	(100%)25
Maxillary first premolar	0	(100%)37
Maxillary second premolar	(8/2%)1	(2/97%)35
Maxillary first molar	0	(100%)12
Mandibular central	0	(100%)3
Mandibular lateral	0	(100%)1
Mandibular canine	0	(100%)7
Mandibular first premolar	0	(100%)12
Mandibular second premolar	(1/3%)1	(8/96%)31
Mandibular first molar	0	(100%)17
Mandibular second molar	0	(100%)1
Total	2	242

Table 6: *Frequency and percentage of gouging according to the type of teeth examined.*

P-value in this table is 0.31 and there is statistically a relationship between type of tooth and the possibility of gouging error.

According to the results of the table 6 above, only two cases of gouging occurred, one in the maxillary second premolar with a frequency percentage of 2.8% out of total maxillary premolars and one case in the mandibular second premolar with a frequency percentage of 3.1% out of total mandibular premolars.

	No transport	Transport	Total
Single-canal	(7/96)175	(3/3)6	181
Buccal canal	(100)31	(0)0	31
Palatal or lingual canal	41 (3/95%)	2 (7/4%)	43
Mesial canal	17 (7/56%)	13 (3/43)	30
Distal canal	29 (7/96%)	1 (3/3%)	30
Total frequency	293	22	315
Total percentage	93%	7%	100%

Table 7: *Distribution and relationship between transport and dental canal examined in this study. P-value in this table is 0, and statistically there is a relationship between transport error and canal types.*

	Low tapering	Good tapering	High tapering	Total
Single-canal	14 (7/7)	158 (3/87)	9 (5)	181*
Buccal canal	6 (3/19)	21 (7/67)	4 (13)	31*
Palatal or lingual canal	6 (14)	33 (7/67)	4 (3/9)	43
Mesial canal	5 (7/16)	21 (70)	4 (3/13)	30
Distal canal	2 (7/6)	24 (80)	4 (3/13)	30
Total frequency	33	257	25	315
Total percentage	10/5%	81/6%	7/9%	100%

Table 8: *Distribution and relationship between the tapering and the canal of the teeth examined. P-value in this table is 0.133, and there is statistically relationship between filling tapering and canal type.*

	Low operating length	Good operating length	High operating length	Total
Single-canal	12 (6/6)	164 (6/90)	5 (8/2)	181*
Buccal canal	1 (2/3)	29 (6/93)	1 (2/3)	31*
Palatal or lingual canal	2 (7/4)	38 (4/88)	3 (7)	43
Mesial canal	10 (3/33)	18 (60)	2 (7/6)	30
Distal canal	4 (3/13)	23 (7/76)	3 (10)	30
Total frequency	29	272	14	315
Total percentage	9/2%	86/3%	4/4%	100%

Table 9: *Distribution and relationship between the operating length of and the canal of the teeth examined. P-value in this table is 0, which indicates a significant relationship between operating length and canal type.*

Discussion and Conclusion

One of the criteria examined in radiographic quality of root canal therapy is the length of the filling. To evaluate the quality of root canal filling, radiographic evaluation was used according to the three criteria of filling length, tapering and density. Errors during root

	No void	Void	Total
Single-canal	(8/44)81	(2/55)100	181
Buccal canal	13 (42)	18 (58)	31
Palatal or lingual canal	16 (2/37)	27 (8/62)	43
Mesial canal	6 (20)	24 (80)	30
Distal canal	16 (3/53)	14 (7/46)	30
Total frequency	132	183	315
Total percentage	41/9%	1/58%	100%

Table 10: *Distribution and relationship between filling density and canals of teeth examined. P-value is 0.017 and there is statistically a significant relationship between filling density and canal types.*

canal therapy were also recorded. In the present study, 272 (68.3%) of the canals had a filling with good length, which was similar to the result of the study conducted by Adl., *et al*. [11] with a frequency of 89.2%, while in the study conducted by Mokhtari., *et al*. [8], 64.6% of the canals had acceptable filling length, and in the study conducted by Barreshi Nasir., *et al*. [12], 61% of the canals had acceptable filling length. In the present study, the least acceptable length was related to the mesial canals (maxillary mesiobuccal canal and mandibular mesial canal) (60%), which seems to be due to the specific morphology of these canals and the complexity of access to them.

The results of the present study showed that 29 (9.2%) of the canals had short fillings. In the study conducted by Mokhtari., *et al*. [8] (29.9%) and in the study conducted by Adl., *et al*. [11] (1.2%) and in the study conducted by Barreshi Nasir., *et al*. [12], (34.5%) of the samples had short length of filling. If the filling ending point of the root canal distance to the radiographic apex is more than 2 mm, filling is considered short. However, in teeth with inflamed and live pulp, the filling ending point at a distance of 3 mm to apex is also considered acceptable.

The unfilled part of the canal creates an environment for the growth of stimulating factors that can lead to therapy failure in long term. The presence of natural barriers in the canal, errors in determining the length of operation, lack of proper tapering, gutta-percha master cones with undesirable tapering and insufficient pressure and density are among the causes of short filling. Hence, proper preparation of canal in terms of length and tapering can prevent it. It has been shown that in 23 to 32% of fillings that had a distance of more than 2 mm from the radiographic apex, the therapy failed. If short filling is detected by radiography at the end of therapy, re-therapy will be recommended, but if the master cone displacement is detected during gutta-percha compaction, the cones can be removed and the canal can be filled to the desired length. In the present study, 14 (4.4%) of the samples had long filling, which is similar to the results of the study conducted by Barreshi Nasir., *et al*. [12] (4.2%). In the studies conducted by Dadrasanfar., *et al*. [7], Mokhtari., *et al*. [8] and Adl., *et al*. [11], 19.5%, 12.5%, and 9.6% of the samples, respectively, had long fillings. The canal filling materials are removed from the apex, causing tissue damage and inflammation (the term overfilled is often used when the filling density is appropriate). The canal filler is removed from the apex, which causes tissue damage and inflammation (the term overfilled is often used when the filling density is appropriate). Since the apical constriction is not histologically identical to radiographic apex, in many cases, the canals that have been filled to the apex have a long filling. Causes of long filling include natural opening of the apex or the loss of the apical constriction as a result of improper preparation, lack of optimal tapering, and the use of a thin master gutta-percha cone.

Preventing foramen perforation, maintaining the apical barrier, and properly preparing the canal prevent long fillings. Also, the master gutta-percha cone must have a proper stop during operation. Using hand-made master gutta-percha cone can partially prevent long fillings. If we detect high filling during the gutta-percha compaction and before the sealer tightening, the entire filling mass can be removed. After the end of the root canal therapy, surgical therapy might be needed if the signs and symptoms of therapy failure appear. Therapy failures has been indicated in one quarter of teeth with long filling. The general prognosis depends on the quality of the apical seal and the

tissue response to the materials removed from the canal. Another criterion for examining the quality of filling in radiography is to examine the canal tapering, which is expected to be tapered from the apical part to coronal canal. In this study, a total of 257 (81.6%) of canals had good tapering, which is similar to the results of the study conducted by Adl., *et al*. [11] (85.4%). Canal filling density is another criterion in evaluating the quality of root canal therapy. Improper density and the presence of void inside the canal filling due to increased leakage can cause failure in root canal therapy. In fact, the density of voids in the filling material itself indicate insufficient filling.

The results of this study show that 132 (41.9%) of the canals have a sufficient density and have no void. This result is inconsistent with the results of the study conducted by Mokhtari., *et al*. [8] (65.4%). The differences results of the present study and those of other studies could be due to differences in canal filling techniques. Errors during root canal therapy are sometimes unavoidable. Some of the errors examined in the present study included the transportation from the main path and gouging during the preparation of the access hole. In this study, 22 (7%) of the canals had a transportation error. Most of the canals with this error belonged to maxillary mesiobuccal molar canals (50%), which could be due to specific anatomy and difficult access and curvature in this canal. Be. In the study conducted by Mokhtari., *et al*. [8], 5.8% transportation occurred and two cases of gouging error occurred that one case was observed in the maxillary second premolar and one case was observed in the mandibular second premolar. The results of present study can be useful in proper planning to improve the quality of root canal therapy in the general department of Kashan School of Dentistry by identifying the weaknesses of therapy in different educational departments.

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