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CASES REQUIRING RETREATMENT DUE TO OVEREXTENDED OBTURATION - A RETROSPECTIVE STUDY

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ABSTRACT

Root canal treatment is one of the most commonly performed procedures in a dental office. It is aimed at removing the entire pulpal tissue, debris and microbes and creating a three dimensional fluid impervious seal of the root canal. The failure of root canal treatment can occur due to a number of reasons like underfilling, missed canals, overextended obturation, persistent lesion,etc. Overextended obturation irritates the periapical tissues leading to periapical lesion and possible cystic transformation. The aim of the study was to determine the prevalence and management of cases of retreatment due to overextended obturation. The retrospective study involved analysis of case sheets of all patients undergoing retreatment RCT and data tabulation based on the following parameters: age, gender, tooth number, techniques of gutta percha retrieval, cleaning & shaping and obturation techniques. Using SPSS Version 20.0, categorical variables were expressed as frequency and percentages and significance of associations was tested using a Chi-Square test. A p-value < 0.05 was considered significant. Incomplete obturation was the most common reason for root canal retreatment (52.5%). The prevalence of overextended obturation as a reason for retreatment was 14.1%. The overall prevalence of retreatment due to overextended obturation was 0.10% among all other dental procedures. H files were highly used for GP retrieval (52.4%). The association between technique of cleaning and shaping & technique of obturation [p=0.021<0.05] was statistically significant. The use of H-files was mostly followed by lateral compaction technique of obturation while the use of rotary files was followed by matched taper single cone obturation. Incomplete obturation is the most common reason for retreatment and overextended obturation is the third most common reason. H-files were the most preferred for GP retrieval in cases of retreatment. The usage of solvent varied significantly based on the method of GP retrieval. The technique of cleaning and shaping determined the technique of obturation.

Keywords:
GP retrieval; obturation; over-extension; Retreatment; Solvent.

INTRODUCTION

Root canal treatment is one of the most commonly performed procedures in a dental practice. The main aim of a root canal treatment is to completely debride the root canal system free of pathogens and debris and to create a three dimensional fluid impervious seal (Kumar and Delphine Priscilla Antony, 2018). Root canal treatment typically involves the use of endodontic instruments for cleaning and shaping of root canals, combined with the use of root canal irrigants, intracanal medicaments and finally obturation using obturating materials and endodontic sealers (Ramamoorthi, Nivedhitha and Divyanand, 2015). One of the most commonly used obturation material is Gutta Percha, which can be used with different obturation techniques namely lateral compaction, vertical condensation, carrier based, thermoplasticized gutta percha and matched taper single cones techniques for use with rotary instruments.

Root canal treatment is highly technique sensitive and requires a skillful operator, lack of which can lead to failure of the endodontic therapy. The most common reasons for endodontic treatment failure are missing canals during treatment, insufficient removal of pulpal remnants & debris leading to a symptomatic root canal therapy, persistence of microbes in the root canals, errors during obturation - underfilling or overfilling leading to extrusion of sealer & obturating materials and a persistent lesion .

An overextended obturation can lead to irritation, inflammation of periapical tissues, pain swelling, tenderness to percussion, sinus tract formation and at times, development of periapical lesion. Gonzalez-Martin et al. (González-Martín *et al.*, 2010), have also reported a case of over obturation of mandibular third molar leading to ipsilateral paresthesia of lips and oral mucosa due to sealer penetration into the mandibular canal. Bearing all these risks in mind, an overextended obturation can be deemed as one of the most important reasons for a Retreatment RCT to be done. Retreatment RCT can be done using surgical or non surgical procedures depending upon the indications. Different authors have reported different techniques for root canal retreatment. Emmanuel JL Silva et al. (Silva *et al.*, 2012), have reported the removal of overextended gutta percha using K-files and rotary M2 files as a successful method. Lee Sang Ho et al. brought to light the case report of overextended gutta percha in an immature permanent tooth that was retrieved using H-files followed by apexification (Lee Sang Ho, 2015). Nevertheless, surgical options have also been an equally important option for retreatment. Pai et al. (Shrikrishna, Shah and Pai, 2014), present a case of an infected periradicular cyst due to overextended obturation leading to retreatment with periapical surgery followed by root end filling with MTA.The existing literature evidence consists mostly of case reports with focus on the management of one particular case only.

Till date, the institutional team has conducted several clinical trials- (R, Rajakeerthi and Ms, 2019) (Janani, Palanivelu and Sandhya, 2020) (Nasim *et al.*, 2018), in-vitro studies- (Nandakumar and Nasim, 2018)(Teja, Ramesh and Priya, 2018)(Rajendran *et al.*, 2019)(Ramanathan and Solete, 2015)(Siddique *et al.*, 2019), literature reviews-(Teja and Ramesh, 2019) (Ravinthar and Jayalakshmi, 2018) (Noor, S Syed Shihaab and Pradeep, 2016) and awareness surveys - (Manohar and Sharma, 2018) (Jose, P. and Subbaiyan, 2020) in the field of Conservative Dentistry and Endodontics. Hence, this study was designed in a retrospective epidemiological setup, in order to study the population based difference in the trends.

The aim of the current study was to determine the various reasons behind retreatment and the prevalence and management of cases of retreatment due to overextended obturation. The study also focused on the method of GP retrieval for retreatment and the technique of retreatment obturation.

MATERIALS AND METHODS

Study setting

The study was carried out in an institutional setting with the advantage being a wide range of data availability in digital format and the disadvantage being assessment of patients in a single location only. The approval of the Institutional Ethics Committee was sought [SDC/SIHEC/2020/DIASDATA/0619-0320]. The study consisted of one reviewer, one assessor and one guide.

Study design

The study was designed to include all dental patients above 18 years of age who underwent retreatment RCT. The patients who did not fall under this inclusion criteria were excluded .

Sampling technique
The study was based on a non probability convenience sampling. To minimise the sampling bias, all the case sheets of patients with root canal retreatment were reviewed and included.

Data collection and Tabulation
Data collection was done using the patient database with the timeframe work of 1st June 2019 to 30th April 2020. The case sheets of around 80,000 patients were reviewed. Cross verification of data was done by a reviewer. The collected data was tabulated based on the following parameters:

- Patient's demographic details- age, gender.
- Reason for Retreatment
- Technique of GP retrieval
- Usage of solvent
- Cleaning and shaping instrument
- Technique of obturation

Statistical analysis
The collected data was validated, tabulated and analysed with Statistical Package for Social Sciences for Windows, version 20.0 (SPSS Inc., Chicago, IL, USA) and results were obtained. Categorical variables were expressed in frequency and percentage; and continuous variables in mean and standard deviation. Chi-square test was used to test associations between categorical variables. p value < 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

The total number of retreatment cases which met inclusion criteria during the stipulated time frame was 297. Among these the prevalence of overextended obturation as a reason for retreatment was, n=42 (14.1%). Among all case sheets reviewed the prevalence of retreatment due to overextended obturation was only 0.10%.

The distribution of different reasons for retreatment showed the highest prevalence of incomplete obturation [52.5% (n=156)] and the least prevalence being missed canals [6.1% (n=18)]. The prevalence of retreatment due to overextended obturation was 14.1% (n=42): lesion [18.2% (n=54)]; symptomatic RCT [9.1% (n=27)]. Thus, overextended obturation is the third most common reason for root canal retreatment in the study population. [Figure 1]

The association between gender and reason for retreatment is depicted in Figure 2 and Table 1. Among males, incomplete obturation was the most prevalent reason for retreatment [32.2% (n=96)] and missed canal was the least prevalent reason [5.05% (n=15)]. The prevalence of overextended obturation as a reason for retreatment in males was [9.43% (n=28)]. Among females, incomplete obturation was the most prevalent reason for retreatment [20.2% (n=60)] and missed canal was the least prevalent reason [1.01% (n=3)]. The prevalence of overextended obturation as a reason for retreatment in females was [4.71% (n=14)]. This association was statistically not significant $p= 0.296$ ($p> 0.05$, Chi-square test).

The gender based distribution revealed higher prevalence of retreatment due to overextended obturation in males [66.7% (n=28)] than in females [33.3% (n=14)].[Figure 3].

The distribution of different techniques of GP retrieval in overextended obturation cases showed highly prevalent usage of H-files [52.4% (n=22)] and least usage of retreatment file [16.6% (n=7)]. The

prevalence of usage of both H files and retreatment files together for GP retrieval was 31.0% (n=13) [Figure 4].

The distribution of various instruments for cleaning and shaping revealed higher usage of rotary files [81.0% (n=34)] than hand files [19.0% (n=8)]. [Figure 5].

The usage of solvent for dissolution of gutta percha was observed in 66.7% (n=28) for the overextended obturation cases. [Figure 6]

The association between the technique of GP retrieval and technique of obturation was as follows: the use of retreatment files was highly associated with matched taper single cone obturation [14.29% (n=6)] and use of H-files highly associated with lateral compaction technique [28.57% (n=12)] [Figure 7]. This association was also statistically significant with a p-value of 0.021 [$p<0.05$, Chi-square test] [Table 2].

The success rate of a root canal treatment varies from 7% to 97% (González-Martín *et al.*, 2010), and whenever a failure of root canal treatment occurs, other possibilities to save the tooth must be sought rather than extraction of the tooth. In order to manage a failed root canal treatment, one must have a thorough knowledge of its etiology. Various studies have reported different factors for failure of root canal treatment. In a cross-sectional study of Nepali population, it was found that 45% of retreatment cases were due to incomplete obturation, followed by missed canals (32%) and fractured / dislodged restoration (14%) (Gautam, Thapa and Rajkumar, 2012). According to Sheikh et al. (Aliuddin *et al.*, 2019), unfilled root canal space and inadequate obturation were the main indications for retreatment in the Pakistani population. Cleen et al. (De Cleen *et al.*, 1993), reveal that in the adult Dutch population, 50.6% of endodontic treatments were assessed to be inadequate & indicated for retreatment. In the French population, 27% of endodontically treated teeth were associated with unacceptable obturation and peripheral pathology, as reported by Boucher et al., (Boucher *et al.*, 2002). However, contradictory to the above findings is the study by Yousuf et al. (Yousuf, Khan and Sheikh, 2015), which revealed that about 89.8% of overextended obturation cases were successful and retreatment was required only in 10.2% cases.

In the current study also, the most common reason for retreatment was incomplete obturation (52.5%), followed by periapical lesion (18.2%). Overextended obturation had a prevalence proportion of 0.10% among all other dental problems and was the 3rd most common reason for retreatment (14.1%).

The overextension in a root canal system can be caused by extrusion of sealer or obturating material or a combination of both. The sealers are usually caustic in nature and are easily resorbed by the action of the immune system, thus reducing untoward consequences. But, this is not the same during the use of gutta percha. Augsberger et al. (Augsburger and Peters, 1990), have reported that a sealer is rapidly cleared from the periradicular tissues than a gutta percha. The extrusion of gutta percha is not only technique sensitive but also depends on the diameter of apical foramen.

A study by Ritchie et al. (Ritchie et al., 2014), revealed that there was only very little extrusion in a 0.20 mm apical foramina, irrespective of the technique used, but a significant amount of extrusion was reported with 0.40 mm apical foramina. This overextended obturation leads to periapical pathology .

The process of retreatment can be accomplished by means of surgical or non surgical procedures. A non surgical retreatment procedure follows certain basic principles: 1. A proper access to the root canals for retreatment 2. Complete removal of existing root canal filling material 3. Maintain adequate patency of canals. According to Mandel et al. (Mandel and Bourguignon-Adelle, 1996), the removal of existing root canal filling can be accomplished by use of rotary instruments, or files, by exerting pressure in the apical direction or by using the canal finder to bypass gutta percha in curved canals.

According to Hulsmann et al. (Hülsmann, Drebenstedt and Holscher, 2008), in the systematic review it was revealed that, though Ni-Ti was preferred for GP retrieval, it couldn't clean the canal completely of gutta percha and was more successful in bypassing gutta percha rather than removing the same. Further, the review also stated that there was no single possible method for complete removal of filling materials from root canals. Similarly Somma et al. (Somma *et al.*, 2008), have also reported the superiority of Ni-Ti rotary retreatment files over the manual use of H-files in retreatment and a Scanning Electron Microscopy analysis revealing incomplete removal of material, irrespective of technique used. Contradictory to this, Schirmeister et al. (Schirrmeister *et al.*, 2006), have reported that there was no significant difference between the use of H-files and rotary files for Gutta Percha retrieval. Supporting this, Betti et al. (Betti and Bramante, 2001), have also demonstrated the superior efficiency of hand files used along with solvent resulting in better cleanliness in the cervical third and in the whole canal ($p<0.05$). A case report by Gupta et al. (al., 2007), supports the use of H-file for GP retrieval being more conservative, safe , easy and quick to perform. Shrikrishna et al., presented a case report of apical root end resection followed by MTA apical plus in a symptomatic mandibular molar due to overextended obturation (Shrikrishna, Shah and Pai, 2014).

The current study revealed high usage of H-files (52.4%) for GP retrieval, followed by the use of a combination of both H-files and retreatment files (31.0%). The current study also reveals an association that is statistically significant: The use of retreatment files for GP retrieval associated with Matched taper single cone obturation and use of H-files with Lateral compaction [$p<0.05$]. The success rate of non surgical retreatment RCT is 65.6% as reported by Allen et al. (Allen, Newton and Brown, 1989), and 83.3% for anterior teeth, 87.2% for premolars and 87.1% for molars as reported by Gorni et al., (Gorni and Gagliani, 2004).

Although the success rate of retreatment procedures is reported to be high, the significant fact that there is a constant amount of previous filling material that persists irrespective of technique of GP retrieval is of particular consideration. Hence, it is advised to perform root canal treatment with utmost care following proper protocols in order to avoid a more complex retreatment procedure.

The current study possesses few limitations in the sample size being very small. However, the findings and statistically significant associations revealed will serve as an eye opener for future research.

CONCLUSION

According to the results of the study it can be concluded that incomplete obturation is the most common reason for retreatment and overextended obturation is the third most common reason. In both males and females, incomplete obturation was the most common reason for retreatment. H-files are most preferred for GP retrieval in retreatment cases due to overextended obturation. The use of H-files, necessitates the use of solvent for GP retrieval. The technique of cleaning and shaping decides the technique of obturation in retreatment cases.

AUTHORS CONTRIBUTIONS

First author (Kalyani. P) performed the analysis, and interpretation and wrote the manuscript. Second author (Dr. Iffat Nasim) contributed to conception, data design, analysis, interpretation and critically revised the manuscript. Third author (Dr. M. P. Santhosh Kumar) participated in the study and revised the manuscript. All the three authors have discussed the results and contributed to the final manuscript.

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CONFLICTS OF INTEREST: None declared.

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FIGURES AND TABLE

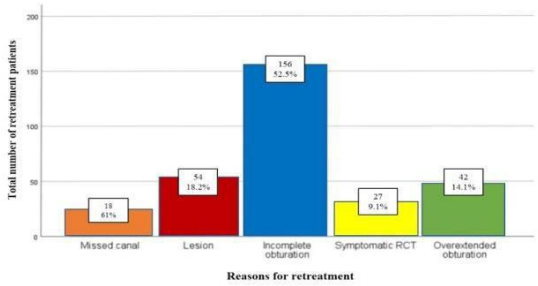

Figure 1: Bar chart depicting the various reasons for root canal retreatment. X-axis - different reasons for retreatment; Y-axis - total number of retreatment cases. Incomplete obturation was the most prevalent reason for retreatment [blue].

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	**4.916[a]**	**4**	**.296**
Likelihood Ratio	**5.304**	**4**	**.257**

Linear-by-Linear Association	**.005**	**1**	**.941**
N of Valid Cases	**297**		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.55.

Table 1: Table showing the results of chi-square test between gender and reasons for retreatment with p-value =0.296,(p > 0.05 statistically not significant) .

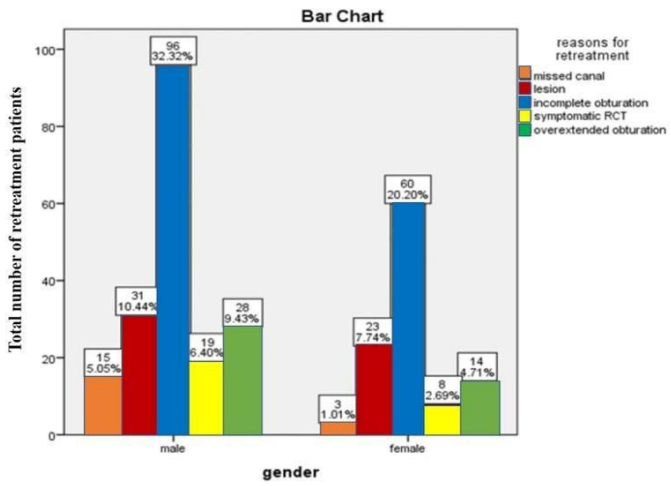

Figure 2: Bar chart depicting the association between gender and reason for retreatment. X-axis - gender; Y-axis - total number of retreatment cases. Incomplete obturation was the most prevalent reason for retreatment in both males [32.32%] and females [20.20%]. The prevalence of overextended obturation as a reason for retreatment was higher in males than in females. Chi-square test, p-value 0.296 (p> 0.05, statistically not significant).

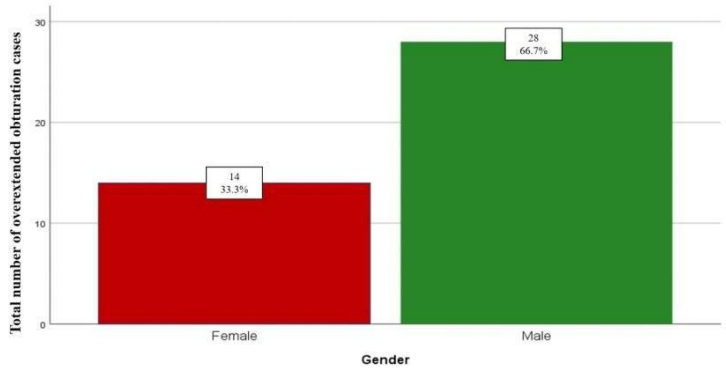

Figure 3: Bar chart depicting the gender based distribution of retreatment cases due to overextended obturation. X-axis - gender; Y-axis - total number of overextended obturation cases. Higher prevalence was observed in males [green] than females.

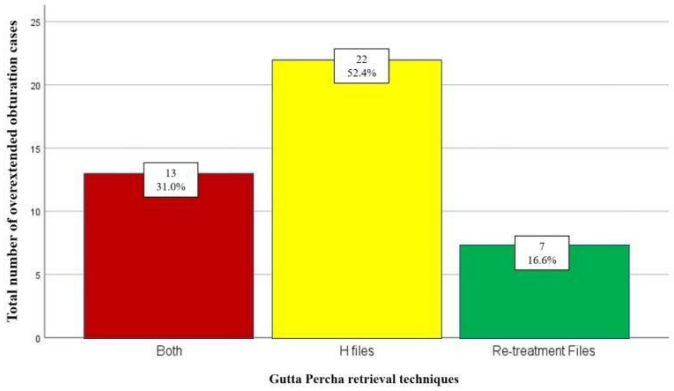

Figure 4: Bar chart depicting the distribution of technique of GP retrieval. X-axis - instrument used for GP retrieval; Y-axis - total number of cases of retreatment due to overextended obturation. Highest prevalence of use of H files for gutta percha removal was observed [yellow].

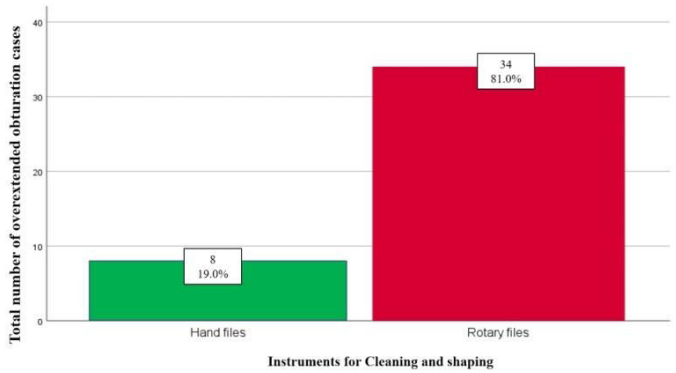

Figure 5: Bar chart depicting the distribution of various instruments used for cleaning and shaping. X-axis - instrument used for cleaning and shaping; Y-axis - total number of cases of retreatment due to overextended obturation. Higher prevalence was observed for the use of rotary files for cleaning and shaping in cases of retreatment [red].

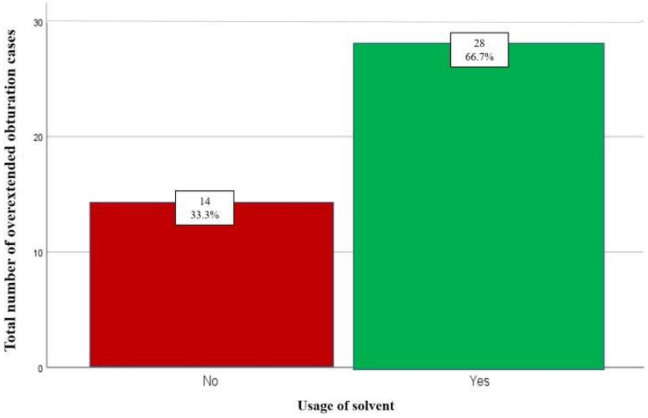

Figure 6: Bar chart depicting the usage of solvent during retreatment. X-axis - usage of solvent (yes / no); Y-axis - total number of cases of retreatment due to overextended obturation. Higher prevalence of usage of solvent during cleaning and shaping was observed in retreatment cases[green].

Chi-Square Tests			
	Value	**df**	**Asymptotic Significance (2-sided)**

Pearson Chi-Square	**7.207**[a]	**2**	**.027**
Likelihood Ratio	**7.739**	**2**	**.021**
N of Valid Cases	**42**		
a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 3.17.			

Table 2: Table representing the results of Chi-square test for association between technique of GP Retrieval and technique of obturation with p=0.021 [p<0.05, statistically significant]

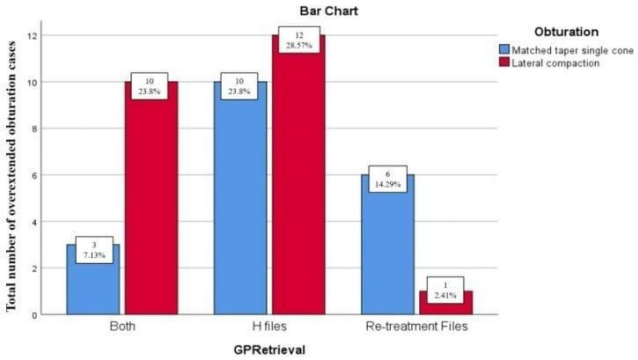

Figure 7: Bar chart depicting the association between technique of GP retrieval and technique of obturation. X-axis - method of GP retrieval; Y-axis - total number of overextended obturation cases. The use of H-files was highly associated with lateral compaction technique [red]. The use of retreatment files was highly associated with matched taper single cone obturation [blue] . Chi-square test, p=0.021 (p<0.05, statistically significant) .