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Factors governing the success of non-surgical endodontics: A review

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Abstract

Microorganisms are considered as the primary cause for pulpitis and periapical infection which requires endodontic treatment for pain relief and healthy tooth restoration. Root canal treatment is a sensitive process that requires proper and accurate operative steps accompanied by certain other factors affecting its success. The overall goal of root canal treatment is therefore to prevent or treat periapical disease. Non-surgical endodontic therapy should be attempted whenever feasible and is generally preferred over surgical endodontics, tooth extraction, and replacement. The present review highlights and discusses the major factors affecting the success of nonsurgical endodontic treatment. A multitude of factors has been examined impacting the clinical success of non-surgical endodontics. Some factors had a profound impact on success rates, whereas others showed a negligible effect.

Keywords: Periapical lesion, root canal, non-surgical endodontics, success

1. Introduction

Endodontology is concerned with the study of the form, function, and health of dental pulp and periradicular region, the prevention and treatment of injuries and diseases; the principle of the disease being apical periodontitis, caused by infection” (European Society of Endodontology 2006) ^[1]. Root canal treatment is a “non-surgical” approach used to treat two distinct endodontic disease entities: (1) “extirpated” vital, but irreversibly inflamed pulp, where the goal is to maintain existing periapical health and thus prevent periapical disease; or (2) the non-vital or dying, infected pulp, associated with apical periodontitis ^[2]. Periapical inflammation is an inflammatory response in the apical region toward the end of the root due to bacterial ingress into the periapical area. In the early days, extraction of the involved teeth was the only treatment option, then root canal treatment was advocated along with surgical excision of the lesion. In recent years, a greater awareness of the complexities of root canal systems has led to the development of newer techniques, instruments, and materials which has given rise to the success of non-surgical endodontics. Therefore, only a few cases need periapical surgery ^[3]. A multitude of factors has been examined impacting the clinical success of non-surgical endodontics. Factors affecting are age, gender, general medical health, tooth type, pulpal, and periapical status, number of treatment visits, preoperative absence of a periapical lesion, the absence of sinus tract, proper aseptic and disinfection protocols, achievement of patency at the canal terminus, the extension of canal cleaning as close as possible to its apical terminus, anatomical complexity, missed canal, iatrogenic problems, apical calculus, remaining tooth structure and presence of cracks, absence of perforation, absence of inter appointment flare-up, absence of root-filling extrusion, adequate coronal restoration, the timing of core and/or post-placement, cast restoration versus temporary restoration, proximal contacts, location of the tooth, provider training, etc. Some factors had a profound impact on success rates, whereas others showed a negligible effect.

2. Factors Affecting the Success of Endodontic Treatment

2.1 Pre-operative factors

2.1.1. Gender: Several previous studies have reported the difference in the incidence of extraction between male and female patients to be statistically insignificant.

So, it was concluded that Gender alone did not significantly affect the outcome of non-surgical endodontics [4].

2.1.2. Age: Hussein F E *et al.* (2016) [5]

Concluded that advancing age was found to be more frequently associated with apical periodontitis. Kwak Y *et al.* (2019) [6] concluded that survival rate decreased with age because vertical root fracture was less common in the younger age groups because their teeth were more resilient to the masticatory force. It was concluded that although in several other studies, age was not found to be an outcome predictor in several other studies.

2.1.3. Systemic Health: Ruiz X-F *et al.* (2017) [7]

Showed that hypertension was a significant factor associated with the presence of apical periodontitis. According to a previous study the success rate of RCT was 73.2% in Diabetic patients (DM) and 85.6% in patients with no systemic disease and concluded that DM diminished the success of RCT, especially in teeth with apical periodontitis [8]. The overall intuitive impression, therefore, is that clinicians need not alter their expectations of healing and resolution of periradicular lesion based solely on health status.

2.1.4. Tooth type

It is theoretically appropriate to propose that molar endodontics is more likely to result in failure when compared with simple one-canal root canal treatment, because of complex canal morphology.

2.1.5. Pulpal and periapical status

The weighted success rates for teeth with pre-operative periapical lesions were lower than that for teeth without pre-operative periapical lesions. Proper diagnosis is very important before endodontic treatment as the success of endodontic treatment depends mainly on correct diagnosis and treatment planning. Case selection plays a pivotal role in determining the treatment planning and to decide whether endodontic treatment will be effective or not, for example, many studies have reported that bad oral hygiene patients show less percentage of endodontic success and are not suggested for endodontic treatment [9]. Preoperative X-ray is very important to identify the periradicular status of the tooth, existing of the periapical lesion, and also the anatomical morphology of the root canals.

2.1.6. Pre-operative pain

Preoperative pain is a predictor for post-operative and chronic persistent pain after root canal treatment. The persistent pain may prompt patients to seek further endodontic treatment or tooth extraction sooner rather than later after treatment [10]. The negative impact of pre-operative pain on tooth survival highlights the importance of accurate pain diagnosis.

2.2 Intraoperative factors

2.2.1. Rubber Dam isolation: Ahmad I A (2009) [11]

Concluded that failure to use rubber dam had been shown to influence the choice of root canal irrigant, had a negative impact on treatment outcome and placed the patient at risk of swallowing or aspirating materials and instruments.

2.2.2. Access cavity

Access cavity of the tooth should be properly prepared which will allow easy accessibility to the root canals for cleaning and shaping and final obturation. Improper access cavity may

lead to improper cleaning and shaping of the canals, fracture of instruments inside the tooth, and improper obturation [12]. Also, the perforation of the floor or walls of the pulp chamber decreases the success of endodontic treatment [13].

2.2.3. Chemo-mechanical preparation

The combination of chemical and mechanical instrumentation is important for complete disinfection of the canals and the periradicular area of the tooth [14]. Copious irrigation of the root canals is important, especially using sodium hypochlorite that has been found to be effective with antibacterial irrigation. Also, the intracanal application of calcium hydroxide is important, especially in infected canals as it decreases the number of bacteria. Triple antibiotic paste is another example of an intracanal medicament. It is composed of ciprofloxacin, metronidazole, and minocycline. This mixture has been used for disinfection of the root canal system during root canal treatment and pulpal regeneration [15]. A previous study has shown that the combination of EDTA and sodium hypochlorite irrigation is more effective than the irrigation with sodium hypochlorite alone [16].

2.2.4. Obturation

This step plays an important role in sealing the root canals and prevention of recontamination and bacterial invasion. Any defect in obturation may lead to endodontic failure even if all the previous steps were done accurately [17]. There are many faults that may occur during obturation like overextended gutta-percha which usually occur due to the improper selection of the master cone leading to irritation of the periapical tissues, previous study has shown that over-extended gutta-percha may not cause irritation in case of vital pulp while in non-vital teeth it may result in irritation [18]. Short gutta-percha occurs usually due to improper shaping of the canals allowing bacterial accumulation and re-infection. Missed canals during obturation may occur due to inaccessibility or other causes leading to endodontic failure [19]. In previous study authors investigated the success rate was greater for teeth with optimal quality root fillings (88.4%) than for teeth with suboptimal quality root fillings (75.2%) [20]. Another study concluded that inadequate root filling were found to be more frequently associated with apical periodontitis [21].

2.2.5. Number of treatment visits

Studies found no significant difference in success rates between single and multiple-visit treatments [22]. Factors like preoperative diagnosis, the ability to obtain infection control, root canal anatomy, procedural complications, and subjective factors like patients' signs and symptoms play an important role in the decision-making process of 1- vs 2-visit endodontics.

2.3. Post-operative factors

2.3.1. Post-operative pain

According to a study the incidence of postoperative pain during the first 24-48 h ranged from 3% to 69.3% [23]. Microorganisms are the most common factor associated with postoperative pain after nonsurgical root canal treatment as pain typically results from the acute inflammation of periradicular tissues. Almeida G *et al.* (2012) [24] found that there were no significant differences in postoperative pain between the use of 2% chlorhexidine and 5.25% sodium hypochlorite irrigating solutions.

2.3.2. Quality and type of coronal restoration

If the root canal treatment satisfactorily completed and with no symptoms, it is sensible to place the final restoration immediately especially in a case of previously uninfected and vital tooth. However, if the tooth was symptomatic with periapical pathology, postpone the final restoration until symptoms subside is wiser until there is a clinical and radiographic prove of success. If the tooth had a small periapical lesion which is about 2 mm or less, final restoration can be placed. The goal is to prevent coronal leakage and protect remaining tooth tissue from further damage. Depending upon the primary aesthetic or functional needs and the patient expectations, the tooth may be restored with a plastic filling material (amalgam, composite), cast partial restoration, or cast full restoration (with or without porcelain) [25].

2.3.3. Effect of Core/Post and Crown Placement According to Yee K *et al.* (2018) [26] patients who did not have the core/post placed within 60 days, there was a statistically significant greater failure rate. This can be attributed to microbial leakage via the temporary restoration, because it was found that lipopolysaccharide can penetrate the temporary restoration within 3 weeks, and in particular, intermediate restorative material leaked within 10 days and Cavit leaked within 2 weeks. According to Aquilino and Caplan (2002) [27], endodontically treated teeth that did not have a full coverage restoration after obturation was lost at 6 times greater rate than teeth that had a full-coverage restoration placed after obturation.

3. Conclusion

This scientific paper concludes that endodontic treatment needs to consider major factors affecting its failure and perform accurate steps in tacking for a successful treatment, which if neglected or improperly done could result in failure of endodontic treatment. The success of endodontic therapy, in terms of healing and functionality, is very good for both teeth without and with apical periodontitis. Therefore, the most appropriate form of non-surgical endodontic therapy should be attempted whenever feasible and is generally preferred over surgical endodontics, tooth extraction and replacement. It is recommended to conduct more studies with a focus on the factors affecting the success of surgical and non-surgical endodontic treatment and how to prevent endodontic failure.

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