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FACTORS INFLUENCING THE SUCCESS AND FAILURE OF ROOT CANAL TREATMENT: A CLINICAL AND DIAGNOSTIC PERSPECTIVE

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ABSTRACT

Knowing the outcome of root canal treatment (RCT) is determinant to substantiate the clinical decisionmaking process, especially when RCT is weighed against the extraction of natural teeth or replacement by prosthetic elements. The ideal scenario in all clinical situations should combine healing/prevention of disease (apical periodontitis) and the functional retention of the tooth. Understanding the risk factors associated with endodontic failure is a key factor to increase the chances of success. The logical action is to reverse the existing disease, which requires intervention to neutralize the bacterial invasion and disrupt the bacterial biofilm within the complex anatomy. Success is more predictable when the immune host defenses are favorable. However, success has different meanings to the dentist, to the patient and to the tooth itself. The life of an endodontically treated tooth depends on the accuracy of the diagnosis and planning, excellence of disinfection, instrumentation and filling procedures (antimicrobial strategies, root canal shaping and coronal and apical seal) and finally the rehabilitation management. The interpretation of constant or intermittent pain and/or discomfort associated with apical periodontitis (AP) in endodontically treated tooth may be suggestive of endodontic failure. The success features of RCT, namely absence of pain, regression of AP, tight seal of canal and coronal spaces, and recovery of tooth function, must be reevaluated over time. In case of doubt between success and failure, cone beam computed tomography (CBCT) could be indicated for detection and precise localization of AP. The possibility of map reading on CBCT images characterizes the real multidimensional structure,

providing accurate information on the presence, absence or regression of AP. The survival of an endodontically treated tooth implies understanding the biological and mechanical outcomes as multifactorial events over the individual's life span. The objective of this review of literature is to discuss relevant factors associated with patient's health, tooth and dentist that could account for a successful RCT. Success; failure; outcome; apical periodontitis; healing.

KEYWORDS: *root canal treatment, prosthetic elements, bacterial invasion, disinfection, instrumentation and filling procedures, cone beam computed tomography.*

INTRODUCTION

Success is the expected outcome after root canal treatment (RCT), regardless of the clinical conditions. However, predicting success usually requires adopting a referential or criteria, and presupposes that the patient is healthy. It is estimated that RCT should be considered completed when the tooth is permanently restored and in function.[1] RCT clinical success can be analyzed based on different points of view, with specific values that involve the dentist, the patient or the tooth itself. References for the dentist are the value of symptom (clinical silence - absence of pain), the value of image (root canal space completely filled with no evidence of periapical inflammation), and the value of clinical condition (a well-restored and functioning tooth). The dentist's skills are crucial to interpret correctly the radiographic features and establish a diagnostic hypothesis. For the patient, the value of symptom (no pain) is essential. Apart from this, RCT success is associated with predictive aspects that eliminate the need of interventions and establishes treatment conclusion. The success for the tooth itself is associated with absence of disease (root canal infection or periapical inflammation).[1]

The life of an endodontically treated tooth implies understanding that biological and mechanical events have a multifactorial nature and cannot be viewed separately. Ideally, it is expected to preserve the largest possible number of teeth until the end of life. Successful RCT prevents pain, apical periodontitis (AP) and tooth loss, but it is a real challenge because several clinical conditions can contribute, alone or in combination, for a poor prognosis, namely root canal perforation, overfilling, endodontic and periodontal lesion, root fracture, periapical biofilm, traumatic dental injury, fracture of instrument, AP, root resorption, etc.[2]

Systemic and periodontal conditions should be carefully examined before RCT. Preoperative iagnosis of dental pulp and/or periapical tissues is an important reference to establish case

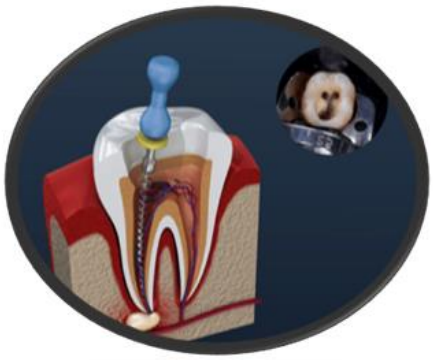
prognosis. The dentist's health represents a human aspect that is frequently neglected and can also be a risk factor for the occurrence of intraoperative procedural errors. Human error may be associated with stress, working conditions, and lack of attention, adequate planning and sufficient knowledge of new technologies. Retoured and Charier discussed some human factors that could induce accidents and reported that as far as the interactions between the individual and the working environment, errors could be related to other people (life ware), technology (hardware), documentation (software) and environment.

The objective of this review of literature is to discuss relevant factors associated with patient's health, tooth and dentist that could account for a successful RCT. Table 1 enumerates determinant aspects associated with the health of the individual, the tooth and the professional that must be carefully observed for a successful RCT.[3]

THUMBNAIL

Determinant factors associated with health of individual, tooth and professional that must be carefully observed for RCT Success.[4]

ROOT CANAL THERAPY



The Value of Diagnosis

Establishing a correct diagnosis is essential for planning clinical procedures. A favorable prognosis in RCT relies on the endodontist's scientific experience level and skills. The challenge is to overcome the complex canal morphology, neutralize the microbial pathogenicity regardless of the type and duration of infection, and disrupt the bacterial biofilm. Host's defense (immune response) is fundamental in this process.

Pulpal or periapical inflammatory diseases are usually identified by the consequences of tissue aggressions. The main purpose of canal therapy is the removal of the causative -

bacterial, chemical, mechanical and physical etiological - agents. During the diagnosis, it is essential to recognize the clinical conditions that could have led to tissue response, such as dental caries, pain, inflammation, primary infection, secondary infection, symptomatic/ asymptomatic AP, periapical abscess with/without sinus tract, open/closed cavity, history of traumatic dental injury.[5]

Knowing the clinical factors associated with pulpal and periapical pain may provide important information for planing the therapeutic strategies and predicting RCT outcomes. The most frequent diagnosis of pulpal pain has been associated with symptomatic pulpitis and hyper-reactive pulpalgia, and the most frequent periapical pain is symptomatic AP of infectious origin. Endodontic diagnosis and local factors associated with pulpal and periapical pain suggest that the important clinical factor in pulpal pain is closed pulp chamber and caries, and is periapical pain is open pulp chamber.

Understanding the general clinical condition (patient's systemic health) and local (clinical conditions of the tooth) favors the first impression to predict a possible outcome of RCT. The impact of patient's age, smoking status, initial treatment versus retreatment, root canal system exposed to salivary contamination prior to treatment, and the type of instrumentation on RCT outcome were recently evaluated. The integrity of a patient's nonspecific immune system, which has been neglected in earlier investigations, is a significant predictor for endodontic treatment outcome, and should receive more attention. The immune status of the patient, and the quality of the root filling showed a great influence on RCT outcome in a cohort study.

Several non-endodontic diseases suggest a typical case of AP. The differential diagnosis of diseases of non-endodontic and endodontic origin should always be made carefully. Radiolucent or radiopaque images in the mandibular or maxillary areas surrounding the root apexes may be a sign of non-endodontic disease, and may be misdiagnosed as AP.[6]

STUDIES

Previous studies have shown that in teeth presenting with symptoms of irreversible pulpitis (IP), bacteria and their by-products driving inflammation are confined mainly within the coronal pulpal tissue. The present study aimed to determine the presence and identity of bacteria within pulps presenting with clinical symptoms of IP using molecular methods.[7]

METHODS

Samples were obtained from 30 adult patients presenting to the dental emergency department with signs and symptoms of IP. After meticulous surface decontamination, the pulp space was accessed, and clinical samples were collected from inflamed pulp tissue using sterile paper points. Genomic DNA was extracted from the clinical samples, and quantification of bacteria was performed using quantitative polymerase chain reaction targeting the conserved 16S ribosomal RNA (rRNA) gene. To characterize the microbial composition, the V3–V5 hypervariable regions of the 16S rRNA gene were amplified and subjected to next-generation sequencing on the Miser platform (Illumined, San Diego, CA.[8]

RESULTS

Of the 30 teeth that presented with IP, half of the intracanal samples had a substantial bacterial load (16S rRNA copies) within the IP vital pulp as determined by quantitative polymerase chain reaction. Next-generation sequencing microbial identification was successful in 7 intracanal samples and yielded 187 bacterial operational taxonomic units within the IP samples. The most abundant genera observed among the vital cases were Veillonella (16%), Streptococcus (13%), Corynebacterium (10%), Cutibacterium (9.3%), and Porphyromonas (5.7%).[9]

CONCLUSIONS

Bacterial loads and composed of genera reflective of established endodontic pathology and thus may offer insights into the initial events preceding pulpal necrosis.

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Factors such as microbial control, quality of obturation, coronal seal, and the patient's systemic health significantly influence treatment outcomes. Conversely, failures often stem from persistent infection, missed canals, procedural errors, or inadequate restorations. Advancements in diagnostic tools such as CBCT and dental microscopy, along with improved materials and techniques, have enhanced clinicians' ability to predict and improve outcomes. However, comprehensive understanding.

SECTION SNIPPETS

SUBJECTS AND PATIENTS

Samples were obtained from 34 adult patients who attended King's College London Dental Institute, Guy's Hospital, London, UK, seeking emergency treatment at a secondary care, acute dental unit. Patients were recruited after informed, written consent was obtained. The clinical study was conducted following the Declaration of Helsinki. The study was approved by the London-Surrey Research Ethics Committee (reference no. 18/LO/1661).

The diagnosis of IP was based on clinical and radiographic.[11]

RESULTS

A total of 34 patients attending a dental emergency department with acute symptoms of IP and fulfilling the criteria set out in Table 1 were initially recruited. Four cases were subsequently excluded because of the absence of bleeding upon pulp chamber access (pulpal necrosis). The remaining 30 teeth with IP were composed of 18 molars, 8 premolars, and 4 anterior teeth. The average age of the patients was 44 years (range, 19–56 years).[12]

DISCUSSION

To our knowledge, this is the first study in which NGS has been used to investigate the microbiome of the pulp space of teeth presenting with signs and symptoms of IP in the absence of apical radiolucency.

The microbiologic status of the sampled teeth ranged from no detection of bacteria to a substantial bacterial load of limited diversity, suggesting a selective ingress of bacteria into vital pulp tissue. Despite the intrinsic variability in bacteria and sampling efficiency, the pulp of almost.[13]

Credit authorship contribution statement

Shatha Zahran: Investigation, Formal analysis, Data curation, Visualization, Resources, Writing - original draft, Writing - review & editing. Elizabeth Witherden: Formal analysis. Francesco Mannocci: Supervision, Conceptualization, Writing - review & editing. Garrit Koller: Supervision, Methodology, Validation, Visualization, Writing - review & editing.[14]

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SUMMARY

Debridement of the root canal system is essential for predictably successful endodontic therapy. The use of an endodontic irritant during canal preparation is necessary to adequately debride the canal system. A review of the scientific evidence related to the desirable properties of an endodontic irrigant indicates that a solution of 5.25 per cent sodium hypochlorite is currently the irrigant of choice. This chemical agent exhibits powerful antimicrobial activity, is an excellent necrotic tissue solvent, and is the most efficient irrigant in removing organic debris from the root canal system.[16]

REFERENCE

1. Makanjuola JO, Onay EO, Oginni AO. Treatment outcome and root canal preparation techniques.
2. Burns LE, Kim S, Kratchman S. Outcomes of primary root canal therapy.
3. Estrela C, Pécora JD, Estrela CR, et al. Characterization of successful root canal treatment.
4. Jurič R, Vidmar G, Blagus R, Jan J. Factors associated with the outcome of root canal treatment—a cohort study.
5. Mehta D, Siqueira JF Jr, Patel S. Success and failure of endodontic treatment: predictability, causes and prevention.
6. Liu SQ, Zhang JL, Tang Q, et al. Outcomes and prognostic factors of apical periodontitis by root canal treatment or surgery.
7. Lin LM, Skribner JE, Gaengler P. Factors associated with endodontic treatment failures: a clinical and histobacteriologic study.
8. Arias Z, Pedrera R, Biswas S, et al. Recent advances in apical periodontitis treatment: new therapies for persistent lesions.
9. Guo J, Rikkers J, Orstavik D. Immunomodulatory effects of endodontic sealers.
10. “Microbiological aspects of root canal infections and disinfection strategies” (Review).
11. De Figueiredo FED, Lima LF, et al. Apical periodontitis healing and postoperative pain after root canal filling.

12. Azarpazhooh A, Dao T, Ungar WJ, et al. A scoping review of 4 decades of outcomes in endodontics.
13. “Diagnostic accuracy of cone beam computed tomography used for diagnosis of apical periodontitis”.
14. Efficacy of imaging techniques for the diagnosis of apical periodontitis.
15. “Pain and immunologic response to root canal treatment”.
16. “Apical lesion from formation to healing” (Review).
17. “Failure of endodontic treatment: The usual suspects” (Review).
18. “Microbial challenges and solutions in root canal therapy”.
19. “Outcomes of root canal treatment performed by undergraduate dental students: systematic review”.
20. “CBCT in endodontics: current overview and future directions” (for additional CBCT reference).