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Application research of PDCA cycle management in improving the usage rate of rubber dam in root canal therapy

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Abstract: *In order to improve the utilization rate of rubber dam during the process of dental root canal therapy, promote standardized operation and treatment efficacy in dental root canal therapy, effectively protect patient safety, reduce postoperative adverse reactions, and prevent oral cross-infection, this study, based on the PDCA cycle management method, selected patients undergoing root canal therapy at a dental hospital in a city as research subjects. Over a two-year period, the utilization rate of rubber dam was recorded monthly, and the application of rubber dam in root canal therapy was analyzed for continuous improvement. As a result, the utilization rate of rubber dam gradually increased from 23% to 90%, showing significant improvement. Thus, PDCA Cycle management has a positive promoting effect on effectively improving the utilization rate of rubber dam and enhancing the quality of root canal therapy, and it can also address issues related to medical aspects.*

Keywords: *PDCA Cycle, Endodontics, Root canal therapy, Rubber dam*

1. Introduction

Rubber dam technique is a procedure that isolates the treated dental crown from the oral cavity, placing pierced rubber sheet over the cervical area of the tooth as a barrier by utilizing the elasticity of the rubber sheet. The application of rubber dam isolation technique in root canal therapy provides a dry, clean, and disinfected operating field, effectively protecting the patient from swallowing or inhaling instruments and contaminants, preventing damage to instruments and medications during the procedure, enhancing operational safety and efficiency, reducing postoperative complications, and playing an important role in preventing oral cross-infection. This is particularly crucial after the occurrence of the COVID-19 pandemic, as the use of rubber dam has gained even greater significance in infection control [1-2].

The PDCA (Plan-Do-Check-Act) cycle is a commonly used model in management science. It is a standardized and scientific cyclic management system for quality management, following the sequence of planning (P), implementing or doing (D), checking (C), and taking action (A) [3]. In recent years, it has gradually been introduced into clinical management work and plays an important role in improving the quality of clinical work [4]. Based on the PDCA cycle management method, this study uses samples of patients who received root canal treatment in the endodontic department of a stomatological hospital in a city from January 2021 to December 2022, analyzes the application of rubber dam in oral root canal treatment, and formulates a cyclic improvement strategy, to achieve the overall goal of increasing the utilization rate of rubber dam and improving the quality and efficacy of oral root canal treatment.

2. Research subjects and methods

2.1 Research subjects

Not all dental patients are suitable for rubber dam technique during root canal treatment. Proper identification of patients and effective communication with them have a significant impact on treatment outcomes. For this study, patients meeting the following criteria were selected as subjects: adult patients aged 18 years or above who (1) could cooperate with clinical procedures; (2) was diagnosed with pulpal and periapical diseases; (3) was not allergic to rubber material; (4) was able to tolerate the placement of

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rubber dam and root canal treatment procedures; (5) signed an informed consent form and agreed to undergo root canal treatment.

2.2 Research Methods

Monthly statistics of rubber dam usage rate among patients were collected and a curve graph of rubber dam usage rate was plotted. The PDCA management approach was applied to objectively analyze the issues related to rubber dam usage during various stages of root canal treatment. Process and optimization plans were proposed, improvement plans and measures were developed, so as to increase the rubber dam usage rate and enhance the quality and effectiveness of dental root canal treatment.

2.2.1 Team Formation and Training

The application of rubber dam technique involves coordination among multiple departments in the hospital, as well as the cooperation of clinical and functional department personnel. At the hospital level, a management working group was formed to improve the rubber dam usage rate. Before the research, training on basic PDCA cycle theory and methods was provided to the group members, clarifying their responsibilities and division of labor.

2.2.2 Establishment of PDCA Cycle Management Model

In the management process of the applied research, the PDCA cycle management method was implemented as follows: Plan: existing problems was analyzed, improvement measures was formulated, and the division of labor among group members was clarified. Do: the diagnostic and treatment process was optimized, and plans and measures were implemented. Check: the implementation of plans was evaluated. Action: problems and deficiencies were analyzed the identified, corrective measures were formulated, and they were incorporated into a new cycle of the PDCA process.

2.3 Implementation of PDCA Management

2.3.1 Planning (P) phase

(1) Current Situation Analysis: Before 2020, a certain stomatological hospital completed approximately 400 cases of root canal treatment per month, but the usage rate of rubber dam was only about 20%, far from meeting the standards of quality and safety. (2) Cause Analysis: Through team brainstorming, a list of reasons to analyze was created, and a fishbone diagram was used to score all the reasons. (3) According to the Pareto Principle, the main reasons for the low rubber dam usage rate were identified as: insufficient instruments, lack of proficiency in operation, inadequate coordination of four-handed operation, and the absence of incentive systems and constraints. (4) Improvement plans and corrective measures were developed. The purchase of equipment, facilities, and materials was timely applied. Training for medical personnel on rubber dam placement and four-handed operation was provided to improve their operating skills. Establish incentives within the department. Interviews with doctors with the lowest utilization rates were conducted to promote improvement in utilization rates.

2.3.2 Doing (D) phase

(1) The role of the rubber dam utilization improvement management working group was fully utilized. The work responsibilities and specific division of labor for group members were clearly defined. A work plan was researched and developed to improve rubber dam utilization and implement it. Periodic checks and evaluations were conducted on the implementation of the plan to improve rubber dam utilization. Regular work summary meetings were organized, the statistical results were reported to the quality management department, and improvement measures were proposed. (2) Procurement requests were submited, rubber dam punches, face bows, rubber dam clamps, rubber dam forceps, and rubber dam sheets were timely applied, ensuring an adequate turnover of instrument sterilization every day, and ensuring timely supply of rubber dam sheets. (3) Professional training was carried out for general medical and nursing staff by doctors who have good experience in using rubber dams, assess their performance, and reduce the fear of using rubber dams among medical and nursing staff. Two medical and nursing staff members were sent to higher-level specialized hospitals for training in four-handed operation, and guide department members to carry out four-handed operations, to improve the efficiency of rubber dam usage. (4) Promotional videos were produced to be played in the waiting room, the advantages of using rubber dams were introduced to patients before treatment, and human care was shown to reduce their fear of using rubber dams and enhance the acceptance and comfort towards rubber dams. (5) The utilization rate of rubber dams was monitored, with the numerator being the total number of cases using

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the rubber dam isolation method, and the denominator being the total number of root canal preparations plus root canal fillings. The utilization rate of rubber dams is obtained by dividing the numerator by the denominator. The numerator and denominator data were monitored in real-time to know the rubber dam utilization rate of each doctor during specific time periods. (6) Goals were set to gradually increase the utilization rate of rubber dams in stages. It is initially agreed that the doctor with the lowest utilization rate must reach 40% within 1 year and 70% within 2 years. Full use of rubber dams is required for cases undergoing microscopic root canal treatment and root canal retreatment, and higher requirements were also proposed for medical and nursing staff with conditions for four-handed operation. Younger doctors have stronger practical abilities and higher utilization rates, while older doctors may require phased utilization rate targets due to their unfamiliarity with rubber dams, gradually increasing over time. (7) Supervization and reminding. Random checks were conducted on the utilization rate of rubber dams every half months, relevant check results were sent to the department's work group, and then talks were had with doctors with low utilization rates, providing guidance and assistance for operational difficulties, urging them to strengthen usage in the second half of the month, and encouraging those with high utilization rates to further maintain and increase their usage rates. (8) The teaching of rubber dam usage was emphasized in undergraduate education, increasing the number of class hours for learning, and guiding resident doctors and interns in the clinical use of rubber dams to lay the foundation for their future application of rubber dams in their work. (9) Hospital-level and city-level continuing education courses were organized to teach and promote the techniques and methods of rubber dam usage, to promote rubber dam utilization rates in the region.

2.3.3 Checking (C) phase

The team leader held a monthly departmental discussion meeting on quality and safety indicators to report the rubber dam utilization rate for the month, and allow team members to fully express their opinions. Any issues identified during the usage process were promptly analyzed and summarized, and improvement measures were formulated for rectification.

2.3.4 Action (A) phase

For implemented and proven effective methods and measures, standardized process specifications were established. In cases where individual doctors consistently exhibit low utilization rates, slow operation speed, and lack of active cooperation from nurses, their performance assessment scores may be appropriately reduced. For cases where specific tooth anatomical structures make installation difficult, medical and nursing staff exchanged operational experiences, mutually promoted skill improvement, and entered the next round of PDCA cycle (Plan-Do-Check-Act).

3. Results

After 2 years of management using the PDCA cycle model, the rubber dam utilization rate had steadily increased from 23% before improvement to 85% in December 2022, surpassing the set target of 70%. During this period, our department did not experience any adverse medical safety events such as treatment error in tooth positioning, swallowing or inhaling accidents, or soft tissue injuries.

4. Discussion

4.1 The practical effects of rubber dam isolation technique

The rubber dam isolation technique has significant advantages in the process of root canal treatment: After rubber dam isolation, it provides a dry and clean operating area with a clear field of view, especially when performing procedures under a microscope. This greatly improves the efficiency and effectiveness of the treatment [5]. It prevents accidental swallowing or inhalation of treatment instruments, materials, or irrigation solutions, protecting oral soft tissues such as the tongue, lips, and cheek mucosa from damage caused by treatment instruments or medications. It isolates the patient's saliva and blood, reducing aerosol contamination and the risk of iatrogenic cross-infection during procedures. By using a negative pressure suction device in the operating area, it can eliminate saliva droplets and significantly reduce aerosol dispersion [6]. During the outbreak of COVID-19, healthcare professionals who perform splatter-generating procedures played an important role in self-protection by using the rubber dam isolation technique, ensuring the safety of oral diagnosis and treatment for both medical staff and patients [7].

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4.2 Analysis of Restriction factor

Due to reasons such as high costs of instruments and consumables, lack of proficiency among users, and inadequate enforcement of regulations, the utilization rate of rubber dam isolation technique remains low in most regions of China. Even specialized dentists in the field of endodontic disease cannot guarantee the universal use of rubber dam isolation during root canal treatment. Some elderly doctors may not have received systematic learning and training, leading to insufficient theoretical knowledge. They may also believe that placing a rubber dam is time-consuming and hinders their workflow, which deters them from trying to use it. On the other hand, young graduates who have received theoretical knowledge and practical training on rubber dam isolation during their undergraduate clinical internships or standardized training stages, can develop good clinical habits with the necessary hardware conditions, and exhibit a relatively higher utilization rate of rubber dam isolation in their clinical work. Therefore, it is important to have young doctors encourage and guide older doctors to adopt the use of rubber dam isolation, which can effectively increase its utilization rate.

4.3 Analysis of PDCA cycle management practice

4.3.1 Specific analysis of PDCA cycle management in improving the utilization rate of rubber dam

During the first year of implementing the PDCA cycle, the utilization rate of rubber dam isolation in a stomatological hospital in a certain city reached 70%. In the following year, it steadily increased to 90%. However, during the first half of the first year, the statistics on rubber dam utilization were manually collected, which resulted in insufficient reliability of the data and high time costs for data collection. In the second half of the first year, during the application research phase, after communication, coordination, and attempts, it was determined that a fee should be charged for using the rubber dam isolation technique during root canal preparation and filling steps. In case of omissions, both manual statistics and data exported from the outpatient data system were used, and the system statistics data closely matched the manually collected data. In the second year, the entire implementation process relied on data exported from the outpatient system, which facilitated monitoring. Monitoring was conducted in the early part of each month, and reminders were given to doctors with lower utilization rates.

The PDCA cycle consists of four interrelated stages that constantly repeat and reflect the regularity of quality management activities. By continuously improving through this cycle, while ensuring medical safety, it can reduce the risk of treatment-related infections and promote the improvement of root canal treatment outcomes. Through the implementation of the PDCA cycle, problems or deficiencies are identified and iteratively improved, which greatly enhances management efficiency.

4.3.2 Logical analysis of PDCA cycle management widely used in the development of pharmaceutical industry

PDCA cycle management, in terms of its underlying logic and idea, has certain attributes of project management and general management. It is a theoretical method that has been recognized and summarized based on long-term practice and research. It has extensive application in the pharmaceutical industry and possesses the following characteristics: (1) Practicality: PDCA cycle management plays a beneficial role in overcoming bottlenecks in the development of the pharmaceutical industry. Although significant achievements have been made in China's healthcare reform and development, it is also necessary to acknowledge that there is a need to improve the governance system based on the laws of medicine. The foundation of pharmaceutical development and talent cultivation is relatively weak, which leads to issues such as insufficient inheritance of excellent pharmaceutical practices, inadequate innovation, and underutilization. Addressing the bottlenecks in the development of the pharmaceutical industry requires a long-term and continuous process. However, if each reform period is divided into stages, the practicality of implementing PDCA cycle management may serve as a good solution. For example, in establishing multidisciplinary integrated research platforms, developing key technologies and equipment in the pharmaceutical field, conducting research and interpretation of fundamental theories, diagnostic and treatment laws, and mechanisms of action, as well as planning and managing pharmaceutical research, the strong practicality of PDCA cycle management can effectively promote the resolution of various issues related to the development of the pharmaceutical industry. (2) Process-oriented: PDCA cycle management emphasizes continuous and cyclical process improvement management. According to the Project Management Institute's (PMI) "A Guide to the Project Management Body of Knowledge," fifth edition, project management consists of five process groups[8]: initiation, planning, execution, monitoring and controlling, and closing. These process groups correspond to ten knowledge areas, including project integration management, scope management, schedule

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management, cost management, quality management, human resource management, communication management, stakeholder management, risk management, and procurement management. These ten knowledge areas encompass a total of 47 processes, which can be classified into the five process groups with precise correspondences. This aligns well with the connotation and underlying management logic of PDCA cycle management, making it suitable for the gradual and continuous optimization and reform process of the pharmaceutical industry. (3) Goal-oriented: The target of PDCA cycle management is the goals of each stage, which are a series of temporary tasks. The term "a series" highlights the unique meaning that the object of PDCA cycle management consists of a series of tasks that form a complete system, rather than just a part or a few parts of a whole. From this perspective, in addressing the bottlenecks in the development of the pharmaceutical industry, it is crucial to identify key or difficult points and set them as the goals of PDCA cycle management. By utilizing the cyclic improvement management methods of PDCA cycle management, it is possible to accurately focus on each goal of the management cycle, facilitating the progressive resolution of issues in the development of the pharmaceutical industry. (4) Innovativeness: PDCA cycle management requires the application of various knowledge, skills, tools, and techniques to the management activities of the target cycles. This necessitates the comprehensive use of innovation, not only in terms of technology but also in management, processes, human resources, finances, matching mechanisms of rights, responsibilities, and interests, among others. Through innovation, the development of the pharmaceutical industry can be propelled in a creative manner.

5. Conclusion

In summary, PDCA cycle management can effectively improve the utilization rate of rubber dams, enhance the efficiency and effectiveness of root canal treatment, and reduce complications in root canal therapy. Therefore, it is worth further clinical promotion. PDCA cycle management possesses management attributes such as practicality, process orientation, goal-orientation, and innovativeness, making it suitable for addressing issues in medical technology, management, and industrial development.

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References

[1] Li Mei, Chen Yifan, Cheng Fanping, et al. Administrative strategy of dental clinic during the epidemic of Corona Virus Disease 2019 [J]. Journal of Prevention and Treatment for Stomatological Diseases, 2020, 28(7):409-415

[2] Zhang Xiaohuan, Zhong Fan, Xiang Yuanyuan, et al. The strategy and management of infection control in dental practice in duration of the COVID-19 epidemic [J]. Chinese Journal of Stomatological Research (Electronic Edition), 2020, 14(2):82-87

[3] HanawaT, MomoK. PDCA cycle for the development of clinical formulation thinking in actual example [J]. Yakugaku Zasshi, 2019, 139(10):1267-1268.

[4] Tong Fangli, Zeng Xiongqun, Li Mei, et al. Application of PDCA in the Quality Control of Root Canal Obturation [J]. Journal of Oral Science Research, 2015, 31(10):1029-1031

[5] Endodontics Professional Committee of Chinese Stomatological Association. Technical Guidelines for root canal therapy [J]. Technical Guidelines for root canal therapy, 2014, 49(5):272-274.

[6] Gu Lisha, Gong Qimei, Zhou Yuzhu, et al. Suggestions for clinical diagnosis and treatment for acute toothache during the COVID-19prevention and control period [J]. Chinese Journal of Stomatological Research (Electronic Edition), 2020, 14(1): 9-13.

ISSN 2616-5791 Vol.4, Issue 7: 8-13, DOI: 10.25236/AJMHS.2023.040702

[7] Ahmad IA. Rubber dam usage for endodontic treatment: a review [J]. Int Endod J, 2009, 42(11):963-972.
[8] Tan Zhibin, Liu Chunlu. Information System Project Manager Tutorial [M] (3rd edition). Beijing: Tsinghua University Press. 2017.