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Assessment of the efficacy and long-term outcomes of minimally invasive techniques in dental restoration

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Abstract---The purpose of this study is to evaluate the effectiveness and long-term effects of minimally invasive dental repair procedures. Using SPSS, 400 patient records from a supplementary dataset were examined. Examined were the patient satisfaction levels, success rates, durability of the restoration, kind of restoration, material used, and complications. The findings showed that Dental Crowns and Composite Fillings were the two restoration kinds that were most frequently used, with Composite Resin being the favored substance. An important portion of cases had complications, like dental caries and fractures. However, the majority of restorations were effective and left patients with high levels of satisfaction. The statistical studies, which included chi-square tests and ANOVA using SPSS version 2021, revealed no significant correlation between the kind of restoration and problems as well as no significant variation in the longevity of the restorations among the various restoration techniques. These results imply that the selection of a minimally invasive procedure might not have a substantial impact on restoration results. When planning dental restorations, it's crucial to take the preferences and circumstances specific to each patient into account. To validate these results, additional research using bigger sample sizes and detailed databases is advised.

Keywords---dental restoration, minimally invasive procedures, effectiveness, long-term results, problems, success rates, restoration durability, and patient satisfaction.

Introduction

Background

Dental restoration, which aims to repair and restore the function, aesthetics, and structure of broken or destroyed teeth, is an essential component of oral health care (Sommerfeldt et al., 2023). Dental restoration has traditionally relied heavily on invasive procedures like dental bridges and crowns. These operations frequently necessitate significant removal of the sound dental structure, which may jeopardize the tooth's long-term health and integrity. However, with improvements in dental technology and methods, minimally invasive treatments have become viable options for dental repair, potentially giving better patient outcomes. Utilizing cutting-edge supplies, tools, and techniques, minimally invasive dental restoration treatments try to preserve as much of the original tooth structure as possible while providing a successful restoration (González et al., 2023). These procedures concentrate on keeping the healthy tooth tissue, which can lengthen the restoration's lifespan, lower the chance of problems, and improve the restoration's aesthetic results. The main goal of minimally invasive dental restoration is to maximize the preservation of the tooth's structural integrity while minimizing the amount of tooth preparation. The use of adhesive methods is one of the major advances in minimally invasive dental restoration. Dental professionals no longer need to perform extensive tooth preparation since adhesive restorative materials, including resin composites, allow them to glue the restoration material directly to the tooth structure. This adhesive bonding method

improves retention and lifespan of the restoration by forging a solid and long-lasting link between the tooth and the repair. Digital technologies, like computer-aided design and computer-aided manufacture (CAD/CAM), which enable accurate and effective repair production, are also frequently used in minimally invasive treatments. Several reasons have contributed to the trend in dental repair toward minimally invasive procedures (Barbato et al., 2020). First of all, people now prefer conservative treatment choices that protect their natural teeth and involve little to no intervention. The patients' wish to preserve their natural dentition and prevent the needless removal of tooth structure is in line with minimally invasive treatment methods (Hasmun et al., 2018). Second, the possibilities for minimally invasive restorations have increased thanks to developments in dental materials and technology, giving dentists more options to give their patients. These materials, like composite resins and high-strength ceramics, provide better aesthetics, durability, and biocompatibility. Beyond maintaining tooth integrity, minimally invasive dental restoration has further benefits (Lempel et al., 2019). There is less postoperative discomfort and a quicker recovery with these treatments since they frequently involve less time in the chair and may be less upsetting for patients. Because they may need fewer supplies and appointments than more conventionally invasive approaches, minimally invasive procedures may also be more affordable. The effectiveness and long-term results of minimally invasive methods need to be thoroughly evaluated despite their rising popularity. Although preliminary research and clinical experiences have yielded encouraging outcomes, more solid scientific data is required to support their widespread adoption in dentistry practice (Kattan et al., 2021). Insights into the efficiency and safety profile of minimally invasive methods can be gained by evaluating the success rates, restoration lifespan, patient satisfaction, and potential issues related to them (Torres et al., 2021).

By evaluating the effectiveness and long-term results of minimally invasive procedures in dental repair, this study attempts to close this information gap. We want to offer evidence-based information that can assist dental professionals in their treatment decisions by assessing a cohort of patients who underwent dental restoration utilizing these approaches over five years (dos et al., 2023). The results of this study will advance our understanding and help dentists make well-informed decisions, which will eventually improve patient outcomes and satisfaction.

Objectives

This study's goal is to evaluate the success rates, restoration lifespan, patient satisfaction, and potential issues related to these treatments over five years to determine the effectiveness of minimally invasive dental restoration techniques.

Methodology

In this quantitative investigation, secondary data gleaned from patient records will be analyzed using a retrospective cohort approach. Patients who had minimally invasive dental repair over five years will make up the sample. The patient records will be retrieved for pertinent information, such as the kind of restoration done, the materials utilized, and any related issues. Information on restoration success rates, lifespan, and patient satisfaction will be gathered

through clinical examinations, patient interviews, and follow-up sessions (Yazigi & Kern, 2022). With the use of descriptive statistics and the appropriate inferential tests, the effectiveness and long-term effects of the minimally invasive procedures will be statistically evaluated using SPSS 2021.

Results

The study participants' demographics offer important details on the traits of the sample. The prevalence of different dental restoration kinds among the patients is shown by the variable "Type_of_Restoration". The most frequent restoration type, accounting for 35.30% of the cases, was discovered to be a Dental Crown, closely followed by Composite Filling at 34.50%. Inlay restorations constituted 30.30% of the cases. Regarding the "Material_Used" variable, the majority of the restorations utilized Composite Resin (52.30%), while Ceramic was used in 47.80% of the cases. The "Complications" variable reflects the occurrence of complications associated with the restorations. The results indicate that 33.50% of the cases had no reported complications, whereas both Caries and Fracture complications were observed in 33.30% of the cases (Ohrvik & Hjortsjö, 2020). The variable "Success" assesses the success rates of the restorations. Only 8.30% of the repairs were determined to be unsuccessful, which is a huge majority (91.8%). The "Restoration_Longevity" variable offers information on how long the restorations took. The mean of 12.24 years and the standard deviation of 4.188. Patient satisfaction was measured using the "Patient_Satisfaction" variable, the mean satisfaction score was 5.39, with a standard deviation of 2.823. This suggests a moderate level of patient satisfaction overall (de et al., 2018). These demographics shed light on various aspects of the study population, including the distribution of restoration types, materials used, occurrence of complications, success rates, restoration longevity, and patient satisfaction. Understanding these demographics is crucial for interpreting and discussing the results of the study accurately.

Table 1: Descriptive Statistics and Demographics

Demographic Variable	Frequency	Percent
Type_of_Restoration		
Dental Crown	141	35.30%
Composite Filling	138	34.50%
Inlay	121	30.30%
Material_Used		
Ceramic	191	47.80%
Composite Resin	209	52.30%
Complications		
None	134	33.50%
Caries	133	33.30%
Fracture	133	33.30%
Success		
FALSE	33	8.30%
TRUE	367	91.80%
Restoration_Longevity		
Mean	12.24	
Std. Deviation	4.188	
Patient_Satisfaction		
Mean	5.39	
Std. Deviation	2.823	

The chi-square tests indicate that there is no statistically significant association between Type_of_Restoration and Complications (Pearson Chi-Square: $p = .870$, Likelihood Ratio: $p = .868$).

Table 2: Chi Square test

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.250 ^a	4	.870
Likelihood Ratio	1.261	4	.868
Linear-by-Linear Association	.053	1	.817
N of Valid Cases	400		

a. 0 cells (0.0%) have an expected count of less than 5. The minimum expected count is 40.23.

The link between restoration lifetime and the various restoration treatments (dental crown, composite filling, inlay) was investigated using an ANOVA analysis. The findings showed that there were no statistically significant variations in the lifespan of restoration between these approaches ($F = 0.504$, $p = 0.605$). With two degrees of freedom, the factor "Type_of_Restoration" had a Type III Sum of Squares of 17.716. The component only partially explained the variation in restoration longevity, according to the low R-squared value of 0.003. The model did not adequately fit the data, as indicated by the adjusted R-squared of -0.002. Overall, the investigation found no discernible difference in the longevity of restoration amongst the various restoration approaches.

Table 3: Analysis of Variance (ANOVA)

Tests of Between-Subjects Effects					
Dependent Variable: Restoration_Longevity					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	17.716 ^a	2	8.858	.504	.605
Intercept	59655.847	1	59655.847	3393.149	.000
Type_of_Restoration	17.716	2	8.858	.504	.605
Error	6979.762	397	17.581		
Total	66949.000	400			
Corrected Total	6997.477	399			
a. R Squared = .003 (Adjusted R Squared = -.002)					

Discussion

The study's findings offer important new information about the outcomes and demographics of minimally invasive dental restoration surgeries (Kanzow et al., 2018). The demographic analysis shows that the most often utilized restoration kinds were Dental Crown and Composite Filling, making up roughly 70% of the cases, and Inlay restorations making up the remaining 30%. With slightly more than half of the examples using Composite Resin, it was the material of choice. Examining the incidence of complications, the data shows that while Caries and Fracture were each found in roughly one-third of the cases, one-third of the cases had no recorded complications. This emphasizes that complications should be carefully monitored and controlled because they are common with dental restorations. Over 90% of the instances were deemed successful, indicating that the restoration success rates were fairly high. This demonstrates how less invasive approaches can produce effective results in dental restoration surgeries (de et al., 2018). When the longevity of the restorations was examined, the mean time was 12.24 years, with a standard deviation of 4.188. The data showed a wide range in the longevity of the restorations, from 5 to 19 years. These results imply that while the majority of restorations have long-term durability, a small percentage of them might have shorter lifespans and might need additional treatment. The average patient satisfaction score among the study participants was 5.39, which suggests a moderate level of satisfaction. However, the standard deviation, which was rather high at 2.823, indicates that patient experiences and views vary significantly (Collares et al., 2018). This emphasizes the significance of taking unique patient circumstances and expectations into account to get the best patient satisfaction results. There is no statistically significant correlation between the kind of restoration and the occurrence of problems, according to the results of the chi-square test. This shows that the restoration procedure selected may not have played a substantial role in the emergence of difficulties in the sample at hand. The ANOVA study looks at the connection between the longevity of restoration and the various restoration methods (Shu et al., 2018). According to the findings, there is no statistically significant difference in the lifetime of restoration between the various restoration approaches. This result implies that the restoration procedure selected may not have a major effect on the long-term endurance of the restorations in the sample. It is crucial to take into account this

study's constraints (Pieralli et al., 2018). There may be inherent biases or restrictions in data collecting because the data analysis was based on a secondary dataset. The 400-patient sample size may also have an impact on the statistical power and generalizability of the findings. The study is also restricted to the variables in the dataset, and the results could be affected by additional, unmeasured factors.

Conclusion

Based on the available data, an evaluation of the effectiveness and long-term results of minimally invasive dental restoration treatments yields numerous significant conclusions. A significant correlation between the type of restoration and the occurrence of problems was not shown by statistical analysis. Furthermore, no statistically significant difference in restoration lifetime was discovered by the ANOVA test across the various restoration process types. These results imply that, despite potential variations in restoration longevity and problems, the selection of a minimally invasive approach does not seem to have a major impact on these results. It is crucial to recognize the study's shortcomings, though, including the use of secondary data and the study's small sample size, which could have affected the findings.

Recommendation

Future studies should be conducted to examine the effectiveness and long-term effects of minimally invasive dental repair procedures using larger sample sizes and more thorough datasets (LZ et al., 2023). In the end, this study advances our knowledge of the variables affecting the effectiveness and durability of minimally invasive dental restorations and offers helpful advice to dental professionals on patient care and decision-making.

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