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Histopathological Evaluation of Tissue Reactions to Different Dental Materials Used in Pakistani Dental Clinics: A Retrospective Study of Clinicopathological Features

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Abstract

Background: Dental materials can induce various tissue reactions, impacting treatment outcomes and patient safety.

Objective: Through a retrospective analysis of clinicopathological data, the histopathological characteristics of tissue responses linked to various dental materials used in Pakistani dental clinics will be examined.

Methodology: The retroactive research ran from January 2024 till June 2024. Included were 196 instances overall including recorded histological investigations of oral tissues connected to dental materials. From hospital records, clinical and histological data including patient demographics, type of dental material, and kind of tissue reactions were gathered. Using SPSS version 26, statistical analysis was conducted using Chi-square test assessments of relationships.

Results: After composite resin (25.51%) and glass ionomer cement (20.41%), amalgam (30.61%) was the most often used dental material. Following fibrosis (22.96%), lichenoid responses (15.31%), and chronic inflammation (40.82%), the most often occurring histological response was While fibrosis (p=0.068) and mucosal hyperplasia (p=0.170) were not statistically significant, dental materials were shown to have significant correlations with chronic inflammation (p=0.012), lichenoid responses (p=0.027), and foreign body granulomas (p=0.048).

Conclusion: The results underline the diverse histological reactivity to various dental materials, therefore stressing the importance of cautious material choice to reduce negative reactions.

Keywords: Dental materials, histopathology, chronic inflammation, fibrosis, lichenoid reaction, foreign body granuloma, Pakistan.

Introduction

Restorative and prosthetic dentistry depends critically on dental materials, which guarantee the lifetime and performance of dental procedures [1]. Nevertheless, the composition, mechanical characteristics, and host immunological response of oral tissues will affect their biological reaction to different materials [2]. Material choice still mostly depends on biocompatibility as negative tissue responses might affect patient comfort and treatment results [3]. Although many studies have shown the histopathological alterations linked to various dental materials, little information on the particular tissue reactions seen in the Pakistani population [4].

A special habitat subjected to continuous mechanical, chemical, and microbiological stresses is the oral cavity [5]. Restoring composites, dental amalgams, cements, and prosthetic components among other dental materials may set off inflammatory and immune-mediated reactions [6]. From modest inflammatory alterations like chronic mucoseis to more severe disorders like foreign body granulomas and lichenoid responses, these reactions span [7] Improving material selection and therapeutic procedures to reduce negative consequences depends on an examination of these responses [8].

Value insights on the cellular and tissue-level reactions to different dental materials come from histopathological study [9] Retroactive clinicopathological studies help to identify patterns of inflammation, fibrosis, and other tissue changes, therefore enabling a better knowledge of the biocompatibility of frequently used materials [10]. Optimizing clinical choices and guaranteeing patient safety depend on an evaluation of tissue responses in Pakistan, where a variety of materials are used in both private and public dental offices [11,12].

Though research elsewhere has shown tissue sensitivities to dental products, Pakistan lacks region-specific data. Localized study is essential to evaluate the frequency and degree of histological alterations considering variations in clinical procedures, material procurement, and patient demographics. This research seeks to overcome this gap by providing thorough histopathology information on tissue reactions to frequently used dental materials in Pakistani dentistry offices.

Research Objective

To analyze the histopathological features of tissue reactions associated with different dental materials used in Pakistani dental clinics through a retrospective review of clinicopathological data.

Methodology

Study Design and Setting

This retrospective study was conducted at the HBS Medical and Dental College, Islamabad, Islamabad**,** over a period of 6 months (January 2024 to June 2024)**.**

Inclusion and Exclusion Criteria

Patients with documented histopathological examinations of oral tissues related to dental materials, cases diagnosed with inflammatory or immune-mediated tissue reactions, and those with complete clinical and demographic data were included. Cases with incomplete histopathological or clinical records, patients with pre-existing oral pathologies unrelated to dental materials, and histopathological samples with inadequate tissue for proper evaluation were excluded.

Sample Size

A total of 196 cases were included using convenience sampling, based on available records within the study duration.

Data Collection

Relevant clinical and histopathological data were extracted from hospital records, including patient demographics, type of dental material used, nature of tissue reactions, and histopathological findings. Data were anonymized to maintain confidentiality.

Statistical Analysis

Descriptive statistics were used to summarize demographic and clinical characteristics. Categorical variables were presented as frequencies and percentages, while continuous variables

were analyzed using mean and standard deviation. Associations between dental materials and histopathological features were assessed using the Chi-square test, as appropriate. Data analysis was performed using SPSS software (version 26)**.**

Ethical Approval

Ethical approval for this study was obtained from the Institutional Review Board (IRB)**.** Patient confidentiality and data privacy were strictly maintained, and no personally identifiable information was used in the study.

Result

The demographic characteristics of the 196 participants in the study showed a little male majority with 104 males (53.06%) and 92 women (46.94%). Most patients fell between the ages of 21 and 40 with 44.90%; the 41–60 years' group came second (30.61%). The study population included of 12.76% younger patients aged ≤20 years and the lowest number, 11.73%, from those aged beyond 60 years.

Table 1: Demographic Characteristics of Patients

Characteristic		**Frequency (n)**	**Percentage (%)**
Gender	Male	104	53.06
	Female	92	46.94
Age Group (Years)	≤20	25	12.76
	21-40	88	44.90
	41-60	60	30.61
	>60	23	11.73

According to the patients' distribution of dental materials, amalgam was the most often utilized material, appearing in 30.61% of instances (figure 1). Glass ionomer cement was used in 20.41% of instances, while composite resin came in second with 25.51%. Acrylic dentures were the least

prevalent, appearing in 10.71% of instances, while metal crowns were present in 12.76% of patients.

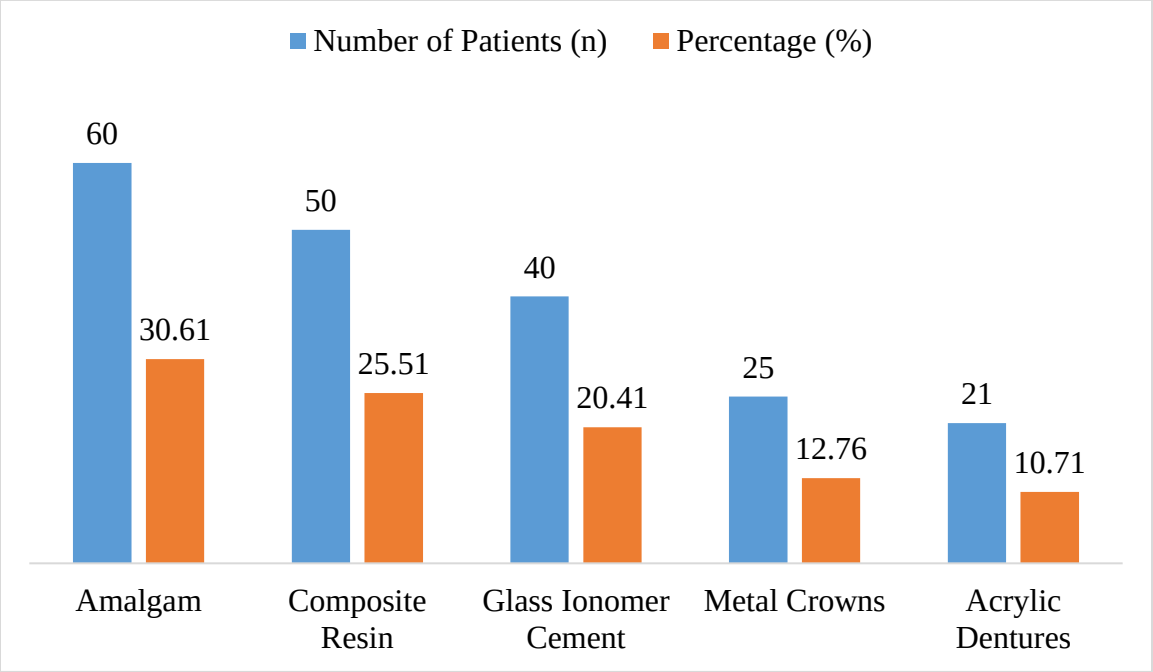

Figure 1: Distribution of Dental Materials Used

According to the histopathological results, the most common tissue response, accounting for 40.82% of cases, was chronic inflammation (figure 2). In 22.96% of patients, fibrosis was the second most prevalent histological characteristic. Foreign body granulomas were seen in 12.76% of patients, while lichenoid responses were observed in 15.31% of patients. The least common response, occurring in 8.16% of patients, was mucosal hyperplasia.

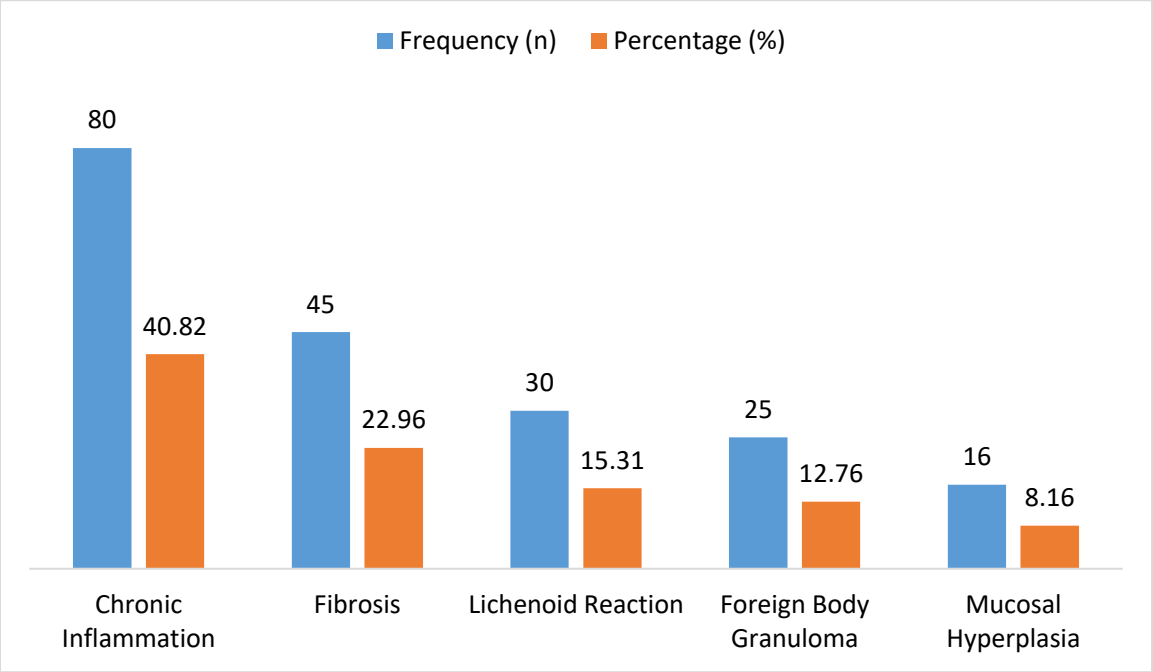

Figure 2: Histopathological Findings

According to table 2, the correlation between dental materials and histological data showed that amalgam had the highest prevalence of chronic inflammation (58.33%), followed by metal crowns (40.00%) and composite resin (36.00%). Composite resin (24.00%) and glass ionomer cement (30.00%) were most often linked to fibrosis. Foreign body granulomas were particularly noticeable in instances involving acrylic dentures (23.81%), although lichenoid responses were often seen with composite resin (20.00%) and glass ionomer cement (20.00%). Mucosal hyperplasia was comparatively rare, occurring most often in composite resin (10.00%) and glass ionomer cement (12.50%).

Table 2: Association of Dental Materials with Histopathological Findings

Dental Material	**Chronic Inflammation (%)**	**Fibrosis (%)**	**Lichenoid Reaction (%)**	**Foreign Body Granuloma (%)**	**Mucosal Hyperplasia (%)**
Amalgam	35 (58.33)	10 (16.67)	5 (8.33)	7 (11.67)	3 (5.00)

Composite Resin	18 (36.00)	12 (24.00)	10 (20.00)	5 (10.00)	5 (10.00)
Glass Ionomer Cement	10 (25.00)	12 (30.00)	8 (20.00)	5 (12.50)	5 (12.50)
Metal Crowns	10 (40.00)	5 (20.00)	5 (20.00)	3 (12.00)	2 (8.00)
Acrylic Dentures	7 (33.33)	6 (28.57)	2 (9.52)	5 (23.81)	1 (4.76)

According to table 3, significant correlations were found between dental materials and histological characteristics in the chi-square test findings for foreign body granulomas (χ^2=9.56, p=0.048), lichenoid responses (χ^2=10.95, p=0.027), and chronic inflammation (χ^2=12.84, p=0.012). In contrast, the relationships for mucosal hyperplasia (χ^2=6.43, p=0.170) and fibrosis (χ^2=8.72, p=0.068) were not statistically significant, indicating that these characteristics were not substantially associated with certain dental materials in the research group.

Table 3: Chi-square Test Results for Association Between Dental Materials and Histopathological Features

Histopathological Feature	**Chi-square (χ^2)**	**df**	**p-value**
Chronic Inflammation	12.84	4	0.012
Fibrosis	8.72	4	0.068
Lichenoid Reaction	10.95	4	0.027
Foreign Body Granuloma	9.56	4	0.048
Mucosal Hyperplasia	6.43	4	0.170

Discussion

The results of this research provide important new perspectives on the histopathological tissue responses connected with various dental materials used in Pakistani dentistry offices. Affecting 40.82% of patients, chronic inflammation was the most often seen histological response; this was especially shown in relation to amalgam restorations (58.33%). These results complement earlier research showing a high frequency of persistent inflammatory responses in tissues subjected to amalgam fillings [13]. Our results are supported by the ongoing release of metal ions and corrosion byproducts from amalgam, which is supposed to cause constant inflammatory reactions.

Observed in 22.96% of instances, fibrosis was the second most often occurring histological change; it was clearly associated with composite resin (24.00%) and glass ionomer cement (30.00%). Previous studies have also shown similar findings, wherein resin-based materials—especially composite resins—induced fibroblast proliferation and collagen deposition by means of residual monomers [14]. Nevertheless, our results show a greater fibrosis frequency than their results, which might be explained by differences in patient immune responses in the Pakistani population, clinical treatment, and material composition.

Of 15.31% of cases, lichenoid reactions were found; the most often linked materials were glass ionomer cement (20.00%) and composite resin (20.00%). Because of their cytotoxic components, including bisphenol A-glycidyl methacrylate (Bis-GMA), past studies have also shown that composite resins and certain dental cements might cause lichenoid responses [15]. The rather high frequency of lichenoid responses in our research underlines even more the importance of cautious material selection, especially in individuals prone to hypersensitive reactions.

Found in 12.76% of patients, foreign body granulomas most usually accompanied acrylic dentures (23.81%). These findings line up with earlier research showing residual monomer leaking and microbial colonization causes of persistent foreign body responses in acrylic-based prosthetic materials [16]. Local clinical elements, such as incorrect polymerization of acrylic resins or differences in dental hygiene habits, might affect the higher prevalence of granulomatous inflammation in our research.

With 8.16% of instances, mucosal hyperplasia was the least frequent response; its frequency was greatest in composite resin (10.00%) and glass ionomer cement (12.50%). These results are consistent with other studies that recorded mucosal proliferative responses to resin-based

materials, presumably from low-grade inflammatory activation or persistent irritation [17]. The very reduced frequency in our research implies that, while mucosal hyperplasia exists, it could be less important than other inflammatory reactions.

Dental materials were shown to significantly correlate statistically with chronic inflammation ($p=0.012$), lichenoid responses ($p=0.027$), and foreign body granulomas ($p=0.048$). These results strengthen the therapeutic importance of material choice in reducing negative tissue reactions. Although their existence shows some degree of material-induced tissue modification, although with varied degree, fibrosis ($p=0.068$) and mucosal hyperplasia ($p=0.170$) did not show statistically significant correlations. Variations in sample size, patient demographics, and research techniques [18] might account for the discrepancies in statistical significance from past investigations.

Our results highlight generally the need of histological investigation in determining the biocompatibility of dental materials. The observed tissue responses mostly match the body of current knowledge, which emphasizes the importance of ongoing material safety research especially in relation to regional clinical practices and patient demographics.

Study Strength and Limitations

This research fills a gap in the literature by providing useful region-specific information on the histopathological tissue responses linked to dental materials that are often utilized in Pakistani dentistry clinics. A wide variety of instances could be evaluated because to the retrospective approach, which made it possible to find important correlations between certain materials and tissue reactions. The dependability of the results is increased by using a well-researched sample from a respectable medical institution. Furthermore, histological investigation guarantees an impartial appraisal of tissue alterations, which advances our knowledge of dental materials' biocompatibility in clinical settings. This research has certain drawbacks in spite of its advantages. The retrospective approach depends on the histopathology records that are currently in existence, which may not be consistent in terms of documentation or diagnostic accuracy. Determining clear causal links between material exposure and tissue alterations is hampered by the limited sample size and lack of long-term follow-up. Furthermore, the findings may be impacted by possible confounding variables such patient oral hygiene, systemic medical problems, and differences in

material handling methods. It is advised that further prospective research be conducted with bigger sample numbers and controlled factors in order to confirm these results and improve clinical judgment.

Conclusion

Our research concludes by highlighting the important histopathological tissue responses linked to different dental materials, the most common of which is chronic inflammation. Glass ionomer cements and composite resins were connected to lichenoid responses and fibrosis, while amalgam restorations were most often linked to inflammation. The results highlight how important it is to choose materials carefully in order to reduce negative tissue reactions and enhance patient outcomes. We need further study to confirm these findings and improve our knowledge of dental material biocompatibility in a variety of populations, especially prospective studies with bigger sample numbers and controlled factors.

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