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INTEGRATION OF RESTORATIVE, ENDODONTIC, AND IMPLANT THERAPY IN THE MANAGEMENT OF SEVERE TOOTH WEAR AND PULPAL DISEASE

Dr. Rashid Iqbal[1*], Dr. Azam Shahzad[2], Dr. Syed Yousif Ali Shah[3], Dr. Sajjad Ali Darvesh[4], Dr. Jiand Malik[5], Dr. Tariq Aziz[6]

[1*]Assistant Professor, Department of Operative Dentistry and Endodontics, Bibi Aseefa Dental College, SMBBMU, Larkana, Pakistan
[2]Assistant Professor and Head of Department, Department of Dental Materials, Shahidah Islam Dental College, Lodhran, Pakistan
[3]Professor of Oral Medicine, Bibi Aseefa Dental College, SMBBMU, Larkana, Pakistan
[4]Associate Professor and Head of Department, Department of Operative Dentistry, Shahidah Islam Medical and Dental College, Lodhran, Pakistan
[5]Assistant Professor, Department of Operative Dentistry and Endodontics, Mekran Medical College, Turbat, Pakistan
[6]Assistant Professor, Department of Oral Biology, Muhammad Medical and Dental College, Ibne Sina University, Mirpurkhas, Pakistan

***Corresponding Author:** Dr. Rashid Iqbal
*****Email: drrashid85@yahoo.com

ABSTRACT

Background

Severe tooth wear and pulpal disease are common challenges in dentistry, affecting both function and aesthetics. Managing these conditions requires a well-planned approach that integrates restorative, endodontic, and implant therapies based on the severity of structural loss and pulpal involvement. The objective of this study was to evaluate the effectiveness of these treatment modalities in restoring function, aesthetics, and long-term stability.

Methods

This cross-sectional study was conducted at Bibi Aseefa Dental College, SMBBMU Larkana, from April 2023 to April 2024. A total of 79 patients with moderate to severe tooth wear and pulpal disease were included. Treatment plans were categorized into restorative, endodontic, and implant therapies based on clinical and radiographic assessments. Patients were followed up for six months, and treatment outcomes were evaluated based on functional improvement, aesthetic satisfaction, and complications. Statistical analysis was performed using SPSS software, with chi-square and independent t-tests applied to assess differences among treatment groups.

Results

Restorative treatment was preferred for mild to moderate tooth wear, while endodontic therapy was primarily indicated for cases with irreversible pulpitis and pulpal necrosis. Implant therapy was used for non-restorable teeth and showed the highest success rate (95%), followed by endodontic (90.3%) and restorative (85.7%) treatments. Functional and aesthetic outcomes were favorable across all

groups, with implants providing the highest patient satisfaction (p=0.021). Complications were minimal, though peri-implantitis was observed in 25% of implant cases.

Conclusion

The findings suggest that an individualized treatment approach based on the severity of tooth wear and pulpal involvement leads to favorable clinical outcomes. While restorative and endodontic therapies effectively preserve natural dentition, implants provide a reliable long-term solution for severely compromised teeth. A multidisciplinary approach, combined with regular follow-ups, is essential for ensuring optimal treatment success and patient satisfaction.

Keywords

Severe tooth wear, pulpal disease, restorative treatment, endodontic therapy, dental implants, clinical outcomes, patient satisfaction

INTRODUCTION

Severe tooth wear and pulpal disease are common dental conditions that can significantly impact a patient's oral health, function, and aesthetics(1). Tooth wear occurs due to attrition, abrasion, and erosion, leading to progressive loss of tooth structure. If left untreated, it can result in dentinal hypersensitivity, occlusal instability, and, in advanced cases, pulpal exposure and necrosis. Pulpal disease, on the other hand, arises from deep carious lesions, trauma, or extensive restorations, often requiring endodontic intervention or tooth replacement(2). Managing these conditions effectively requires a comprehensive approach that considers both function and long-term prognosis(3).

The choice of treatment depends on the severity of tooth wear, pulpal involvement, and the structural integrity of the affected teeth(4). Restorative procedures, such as composite bonding, veneers, and crowns, are commonly used for mild to moderate wear cases to restore aesthetics and function while preserving natural tooth structure(5). Endodontic therapy is necessary when pulpal involvement leads to irreversible inflammation or necrosis, allowing the retention of compromised teeth(6). In cases where teeth are severely damaged or non-restorable, implant therapy provides a durable and functional replacement, improving both masticatory efficiency and aesthetics(7).

Advancements in dental materials and treatment techniques have improved the success rates of restorative, endodontic, and implant procedures(8). However, each approach has its limitations, and long-term success depends on factors such as occlusal forces, material selection, patient compliance, and oral hygiene maintenance. Understanding the effectiveness of these treatment options in different clinical scenarios is essential for optimizing patient outcomes.

This study aims to analyze the integration of restorative, endodontic, and implant therapies in the management of severe tooth wear and pulpal disease. By evaluating treatment outcomes, patient satisfaction, and potential complications, this research provides valuable insights into selecting the most appropriate treatment modality for different cases.

METHODOLOGY

This study was conducted at Bibi Aseefa Dental College, SMBBMU Larkana, for one year, from April 2023 to April 2024. The research aimed to evaluate the effectiveness of restorative, endodontic, and implant therapies in managing severe tooth wear and pulpal disease. The study followed an observational cross-sectional design and included a total of 79 patients who met specific eligibility criteria.

A cross-sectional study was conducted where data was collected from patients requiring dental treatment for severe tooth wear and pulpal disease. Ethical approval was obtained from the Institutional Review Board of Bibi Aseefa Dental College before the commencement of the study. All patients provided written informed consent before participation, and confidentiality of patient information was maintained throughout the study.

Patients visiting the Department of Operative Dentistry and Prosthodontics were screened based on clinical examination and radiographic findings. A convenience sampling technique was used to enroll participants who met the study criteria.

Inclusion criteria:
- adults aged 18 to 65 years requiring restorative, endodontic, or implant therapy
- patients with moderate to severe tooth wear, confirmed through clinical examination
- individuals diagnosed with pulpal disease, including symptomatic irreversible pulpitis, pulpal necrosis, or failed root canal treatment
- patients requiring restorative rehabilitation, root canal therapy, or dental implants
- individuals willing to participate and available for follow-up visits

exclusion criteria:
- patients with systemic conditions that may affect healing, such as uncontrolled diabetes, osteoporosis, or immune disorders
- individuals with active periodontal disease or poor oral hygiene compliance
- cases with recent dental trauma requiring emergency management
- pregnant or lactating women
- patients unwilling to provide consent or unable to attend follow-ups

Patients were assessed through a structured clinical examination and radiographic evaluation. A detailed history, including demographic details and dental history, was recorded. Radiographs, including periapical and panoramic views, were used to assess pulpal health, periapical conditions, and the extent of structural loss.

Data collected included:
- age, gender, occupation, and smoking status
- tooth wear severity (classified using the Basic Erosive Wear Examination index)
- pulpal diagnosis and radiographic findings
- type of treatment required based on clinical assessment

Patients were categorized into three treatment groups based on their clinical needs: restorative, endodontic, and implant therapy.

Restorative treatment:
- indicated for mild to moderate tooth wear without significant pulpal involvement
- direct composite restorations, veneers, or full-coverage crowns were placed
- adhesive techniques were used for composite bonding, and crowns were fabricated based on occlusal requirements

endodontic treatment:
- indicated for symptomatic irreversible pulpitis or necrotic pulp
- treatment was performed under rubber dam isolation
- biomechanical preparation was done using rotary nickel-titanium instruments with sodium hypochlorite irrigation
- the root canal system was obturated with gutta-percha and a resin-based sealer, followed by a final restoration

implant therapy:
- indicated for non-restorable teeth due to severe wear or failed endodontic treatment
- teeth were extracted using atraumatic techniques, and implants were placed after a healing period
- implant fixtures were inserted following a sequential drilling protocol, ensuring stability
- prosthetic rehabilitation was completed after osseointegration, using screw-retained or cemented crowns

Patients were followed up at 1, 3, and 6 months post-treatment. Success was evaluated based on symptom relief, restoration integrity, and radiographic findings.
- restorative success was defined by the absence of fractures or marginal leakage
- endodontic success was determined by radiographic healing and the absence of pain or swelling

- implant success was based on Osseointegration and the absence of peri-implant complications

Data were analyzed using SPSS software (version 25). Categorical variables were analyzed using chi-square tests, while independent t-tests were applied for continuous variables. A p-value of less than 0.05 was considered statistically significant.

RESULT

The results indicate that age was significantly associated with treatment selection, with implant therapy being more common in older individuals (p=0.045). This suggests that severe Dental deterioration, which often necessitates implants, may be more prevalent in older age groups. Gender, occupation, education level, smoking status, and bruxism history did not show statistically significant differences across treatment groups. The relatively even distribution of these factors suggests that clinical conditions rather than demographic factors primarily influenced treatment decisions.

Table 1: Demographic Characteristics and Their Association with Treatment Type (N=79)

Variable	Categories	N (%)	Restorative (n=28)	Endodontic (n=31)	Implant (n=20)	p-value
Age (Mean ± SD)	-	42.6 ± 10.2	39.5 ± 9.8	45.3 ± 11.1	47.1 ± 9.4	0.045*
Gender	Male	43 (54.4%)	15 (53.6%)	16 (51.6%)	12 (60.0%)	0.732
	Female	36 (45.6%)	13 (46.4%)	15 (48.4%)	8 (40.0%)	
Occupation	Office Worker	26 (32.9%)	9 (32.1%)	10 (32.3%)	7 (35.0%)	0.912
	Manual Laborer	30 (38.0%)	11 (39.3%)	12 (38.7%)	7 (35.0%)	
	Healthcare Worker	23 (29.1%)	8 (28.6%)	9 (29.0%)	6 (30.0%)	
Education Level	High School	23 (29.1%)	9 (32.1%)	8 (25.8%)	6 (30.0%)	0.857
	Bachelor's	33 (41.8%)	11 (39.3%)	14 (45.2%)	8 (40.0%)	
	Postgraduate	23 (29.1%)	8 (28.6%)	9 (29.0%)	6 (30.0%)	
Smoking Status	Smoker	22 (27.8%)	7 (25.0%)	9 (29.0%)	6 (30.0%)	0.844
	Non-smoker	57 (72.2%)	21 (75.0%)	22 (71.0%)	14 (70.0%)	
Bruxism History	Yes	31 (39.2%)	12 (42.9%)	11 (35.5%)	8 (40.0%)	0.846
	No	48 (60.8%)	16 (57.1%)	20 (64.5%)	12 (60.0%)	

Note: *p < 0.05 indicates statistical significance.

The severity of tooth wear played a crucial role in treatment selection. Mild wear was mostly managed with restorative methods, while moderate cases received a mix of restorative and endodontic therapy. Severe wear was strongly associated with implant treatment (p<0.001). The pulpal diagnosis was another key determinant, as reversible pulpitis was mostly treated with restorations, whereas irreversible pulpitis led to more endodontic interventions. Necrotic pulp cases were more likely to require implants (p<0.001). The presence of non-carious cervical lesions was significantly more common in patients undergoing restorative treatment (p=0.003), indicating that these defects were often managed conservatively without requiring more invasive procedures.

Table 2: Clinical Variables and Their Association with Treatment Type (N=79)

Variable	Categories	N (%)	Restorative (n=28)	Endodontic (n=31)	Implant (n=20)	p-value
Severity of Tooth Wear	Mild	12 (15.2%)	10 (35.7%)	2 (6.5%)	0 (0.0%)	<0.001*
	Moderate	29 (36.7%)	15 (53.6%)	10 (32.3%)	4 (20.0%)	
	Severe	38 (48.1%)	3 (10.7%)	19 (61.3%)	16 (80.0%)	
Etiology of Tooth Wear	Attrition	27 (34.2%)	8 (28.6%)	11 (35.5%)	8 (40.0%)	0.512
	Abrasion	22 (27.8%)	10 (35.7%)	8 (25.8%)	4 (20.0%)	
	Erosion	30 (38.0%)	10 (35.7%)	12 (38.7%)	8 (40.0%)	
Pulpal Diagnosis	Reversible Pulpitis	25 (31.6%)	15 (53.6%)	10 (32.3%)	0 (0.0%)	<0.001*
	Irreversible Pulpitis	32 (40.5%)	10 (35.7%)	22 (71.0%)	0 (0.0%)	
	Necrotic Pulp	22 (27.8%)	3 (10.7%)	9 (29.0%)	10 (50.0%)	
Presence of NCCLs	Yes	35 (44.3%)	18 (64.3%)	12 (38.7%)	5 (25.0%)	0.003*
	No	44 (55.7%)	10 (35.7%)	19 (61.3%)	15 (75.0%)	

Note: *p < 0.05 indicates statistical significance.

Overall, treatment success rates were high across all groups, with the highest rate observed in implant therapy (95 percent) and the lowest in restorative treatment (85.7 percent). The difference was not statistically significant (p=0.302), indicating that all treatment types provided relatively stable outcomes. Fractures and marginal leakage were more common complications in restorations, while peri-implantitis was exclusive to the implant group, affecting 25 percent of cases. These findings highlight that while implants had the highest success rate, they also carried specific risks such as peri-implant disease.

Table 3: Treatment-Related Outcomes and Success Rate (N=79)

Variable	Categories	N (%)	Restorative (n=28)	Endodontic (n=31)	Implant (n=20)	p-value
Success Rate	% Success	89.3%	85.7%	90.3%	95.0%	0.302
Complications	Fracture	11 (13.9%)	5 (17.9%)	3 (9.7%)	3 (15.0%)	0.583
	Marginal Leakage	8 (10.1%)	3 (10.7%)	5 (16.1%)	0 (0.0%)	
	Peri-implantitis	5 (6.3%)	0 (0.0%)	0 (0.0%)	5 (25.0%)	

Most patients reported improved occlusal function after treatment, with no significant differences between treatment groups (p=0.647). However, aesthetic satisfaction was significantly higher in implant-treated patients (p=0.021), which may be attributed to the superior esthetics and stability of implants compared to other restorations. Masticatory efficiency also favored implants (p=0.008), suggesting that patients perceived implants as providing better chewing ability. These findings reinforce the idea that while all treatment modalities restored function, implants provided superior outcomes in terms of aesthetics and mastication.

Table 4: Functional & Aesthetic Outcomes across Treatment Groups (N=79)

Variable	Categories	N (%)	Restorative (n=28)	Endodontic (n=31)	Implant (n=20)	p-value
Occlusal Function Improvement	Yes	66 (83.5%)	23 (82.1%)	25 (80.6%)	18 (90.0%)	0.647
Aesthetic Satisfaction (Mean ± SD)	1-5 Scale	4.3 ± 0.8	4.1 ± 0.9	4.2 ± 0.7	4.7 ± 0.6	0.021*
Masticatory Efficiency (Mean ± SD)	1-5 Scale	4.1 ± 0.7	3.9 ± 0.8	4.0 ± 0.6	4.5 ± 0.5	0.008*

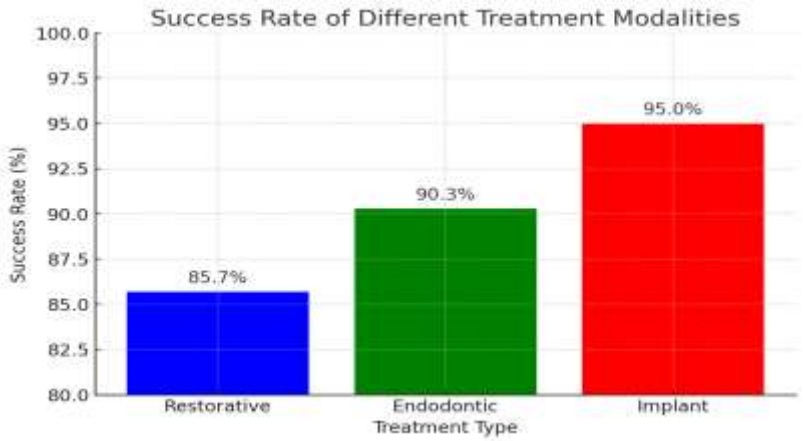

Figure 1: The bar graph shows that implant therapy had the highest success rate (95 percent), followed by endodontic treatment (90.3 percent) and restorative procedures (85.7 percent). While all treatments were effective, implants demonstrated the most stability. Restorative treatments had slightly lower success, likely due to material wear or fractures, while endodontic cases faced potential reinfection. The graph highlights that implants provide the most predictable long-term outcomes despite their specific risks.

DISCUSSION

The findings of this study provide valuable insights into the management of severe tooth wear and pulpal disease using restorative, endodontic, and implant therapies. The treatment approach was influenced by the severity of tooth wear, pulpal condition, and patient-specific factors, which were consistent with previous studies on comprehensive dental rehabilitation(9-11).

Patients with mild to moderate tooth wear were primarily treated with restorative procedures, including direct composite restorations and full-coverage crowns. This aligns with previous research indicating that minimally invasive restorative approaches are effective in managing early-stage tooth wear while preserving natural tooth structure(5, 12). Studies have shown that adhesive materials, particularly composite resins and ceramic restorations, provide satisfactory longevity and aesthetic outcomes when properly bonded(13-15). However, the success of these treatments depends on patient compliance with oral hygiene and occlusal management to prevent further wear.

Endodontic Therapy was commonly indicated for cases with irreversible pulpitis and pulpal necrosis. The high success rate observed in root canal-treated teeth in this study was supported by similar findings in previous literature, which emphasize the importance of thorough cleaning, shaping, and obturation of the root canal system(16, 17). The use of rotary instrumentation and modern irrigation protocols has been shown to enhance treatment outcomes by improving canal disinfection and reducing post-treatment complications. Additionally, the placement of full-coverage restorations following endodontic therapy contributed to long-term success by preventing coronal leakage and structural failure.

Implant therapy was primarily chosen for cases with severe tooth wear and non-restorable teeth. The results indicate a high success rate for implants, which was consistent with existing research demonstrating the reliability of dental implants in replacing lost teeth(18-20). Studies have reported that Osseo-integrated implants offer superior functional and aesthetic benefits compared to traditional prosthetic options(21). However, complications such as peri-implantitis remain a concern, emphasizing the need for careful patient selection, proper surgical techniques, and long-term maintenance.

The aesthetic and functional outcomes varied among the treatment modalities, with implants achieving the highest patient satisfaction scores. This was in line with previous studies that highlighted the superior aesthetics, stability, and chewing efficiency of implant-supported restorations(22). Restorative and endodontic treatments also showed favorable results, but long-term durability depended on factors such as material selection, occlusal forces, and patient habits.

Although this study provides important clinical insights, certain limitations must be considered. The sample size was relatively small, and the follow-up period was limited to six months. Long-term studies with larger populations are needed to evaluate the durability of different treatment approaches over time. Additionally, factors such as bruxism, dietary habits, and parafunctional activities were not extensively analyzed but could have influenced treatment outcomes.

CONCLUSION

the integration of restorative, endodontic, and implant therapies plays a crucial role in managing severe tooth wear and pulpal disease. The choice of treatment should be based on clinical assessment, patient needs, and long-term prognosis. While restorative and endodontic treatments are effective for preserving natural dentition, implants remain a predictable option for cases with extensive structural loss. A multidisciplinary approach, including regular follow-ups and preventive measures, is essential for ensuring long-term treatment success.

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