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SPECIFIC FEATURES OF FIXED DENTAL PROSTHESES

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Abstract. Fixed dental prostheses (FDPs) play a critical role in restoring oral function, aesthetics, and patient quality of life. Over the past decade, advancements in dental materials, digital workflows, and minimally invasive techniques have significantly transformed FDP design, fabrication, and clinical performance. This literature review aims to summarize recent developments and highlight the specific features that distinguish fixed prostheses from other treatment modalities. Topics include biomechanical considerations, material selection, longevity, biocompatibility, and patient-centered outcomes. The review also addresses current challenges and future directions in prosthodontics, based on an analysis of scholarly sources published in the last ten years. Findings suggest a shift toward more personalized, durable, and esthetically pleasing solutions supported by evidence-based protocols.
Keywords. Fixed dental prostheses; dental materials; prosthodontics; crown and bridge; digital dentistry; biocompatibility; restoration longevity.

Introduction. Tooth loss remains a significant global health concern, affecting both functional and psychosocial aspects of individuals' lives. Fixed dental prostheses (FDPs), including crowns and bridges, have long been integral in restoring masticatory function, aesthetics, and speech. In Europe, approximately 45% of adults in Sweden and 34% in Switzerland have received FDPs, reflecting a growing preference for fixed over removable solutions in prosthodontic care [12].

The past decade has witnessed transformative advancements in dental materials and digital technologies, reshaping the landscape of fixed prosthodontics. The global digital dentistry market, encompassing technologies such as computer-aided design/computer-aided manufacturing (CAD/CAM), intraoral scanners, and 3D printing, was valued at USD 6.8 billion in 2023 and is projected to grow at a compound annual growth rate (CAGR) of 9.9% from 2025 to 2030. These innovations have enhanced the precision, efficiency, and patient satisfaction associated with FDPs [13].

Material science has also evolved, introducing high-strength ceramics like zirconia and lithium disilicate, which offer improved biocompatibility and aesthetic outcomes. CAD/CAM technology facilitates the fabrication of these materials, allowing for consistent quality and reduced production times. Moreover, digital workflows have streamlined clinical procedures, enabling same-day restorations and minimizing patient visits [14].

Despite these advancements, challenges persist, particularly in terms of accessibility and cost. The high initial investment required for digital equipment, such as CAD/CAM systems, which can range from USD 90,000 to USD 112,000, poses a barrier for many dental practices, especially in low- and middle-income countries . Additionally, limited reimbursement policies for dental procedures can hinder the widespread adoption of advanced prosthodontic solutions.

This literature review aims to synthesize findings from the past decade concerning the specific features of fixed dental prostheses. By analyzing recent studies, the review will explore advancements in materials, digital technologies, clinical outcomes, and patient satisfaction, providing a comprehensive understanding of the current state and future directions of fixed prosthodontics.

Literature Analysis. The analysis of the selected literature revealed significant insights into the performance and characteristics of various FDPs:

- **Material Performance**: Zirconia-based FDPs have gained popularity due to their aesthetic appeal and biocompatibility. However, a systematic review and meta-analysis indicated that bilaminar zirconia FDPs exhibited higher failure rates (Relative Risk [RR]=3.64, p=0.009) and increased ceramic chipping (RR=2.92, p<0.0001) compared to metal-ceramic (MC) FDPs [16].
- **Survival Rates**: A large-scale analysis of 124,660 FDPs over a six-year period reported cumulative survival rates of 83.0% for single-unit FDPs, 78.1% for two-unit FDPs, and 74.0% for three-unit FDPs, highlighting a decrease in longevity with increased prosthesis span [17].
- **Complications**: Mechanical complications, such as porcelain fractures, were reported in 89.0% of studies, while biological complications like caries and periodontal disease were noted in 79.1% and 58.1% of studies, respectively [18].
- **Digital vs. Conventional Techniques**: A systematic review comparing digital and conventional impression techniques found that digital methods offered improved internal fit (Standard Mean Difference [SMD]=-0.80; 95% Confidence Interval [CI]: −1.49 to −0.10; p=0.02), though marginal fit differences were not statistically significant [19].
- **Design Considerations**: Resin-bonded fixed dental prostheses (RBFDPs) with cantilever designs demonstrated higher five-year success rates (95.4%) compared to two-retainer designs (85.2%). Material choice also influenced outcomes, with glass-ceramic RBFDPs achieving a 100% five-year success rate [19].

These findings underscore the importance of material selection, prosthesis design, and fabrication techniques in determining the success and longevity of FDPs. The integration of digital technologies appears promising, though further long-term clinical studies are warranted to establish their efficacy fully.

Methodology. A comprehensive literature review was conducted to analyze the specific features of fixed dental prostheses (FDPs) over the past decade. Electronic databases, including PubMed, Scopus, Web of Science, and the Cochrane Library, were systematically searched for relevant studies published between January 2015 and December 2024. The search strategy employed a combination of keywords and MeSH terms such as "fixed dental prostheses," "crowns," "bridges," "zirconia," "metal-ceramic," "digital dentistry," and "prosthodontic complications."

Inclusion criteria encompassed randomized controlled trials (RCTs), cohort studies, systematic reviews, and meta-analyses focusing on the clinical performance, material properties, and patient outcomes associated with FDPs. Studies were selected based on their relevance, methodological rigor, and the availability of quantitative data. Articles not published in English, studies with less than a two-year follow-up, and those focusing solely on removable prostheses were excluded.

Data extraction was performed independently by two reviewers, focusing on study design, sample size, follow-up duration, types of materials used, fabrication techniques, survival and success rates, and reported complications. Discrepancies were resolved through discussion or consultation with a third reviewer. The quality of included studies was assessed using appropriate tools such as the Cochrane Risk of Bias Tool for RCTs and the Newcastle-Ottawa Scale for observational studies [15].

Results.

Survival and Success Rates. A comprehensive analysis of recent studies indicates that metal-ceramic (MC) fixed dental prostheses (FDPs) exhibit superior long-term survival rates compared to zirconia-based FDPs. A systematic review reported a 5-year survival rate of 94.4% for MC FDPs, whereas densely sintered zirconia FDPs demonstrated a 5-year survival rate of 90.4% . Another study found that zirconia-ceramic FDPs had a 5-year survival rate of 93.0%, which was significantly lower than the 98.7% observed for MC FDPs [20].

In terms of success rates, a retrospective study over a 10-year period showed that MC FDPs had a success rate of 55.3%, while zirconia-based FDPs had a significantly lower success rate of 30.2% [21].

Complication Rates. The incidence of technical complications, particularly ceramic chipping and framework fractures, was notably higher in zirconia-based FDPs. A meta-analysis revealed that bilaminar zirconia FDPs had a relative risk (RR) of 3.64 for failures and 2.92 for ceramic chipping compared to MC FDPs . Furthermore, the rate of framework fractures in zirconia FDPs was reported at 1.9%, compared to 0.6% in MC FDPs [5,16].

Biological complications, such as secondary caries and periodontal issues, were also more prevalent in zirconia-based FDPs. The same meta-analysis indicated a higher risk of secondary caries (RR=1.25) and endodontic complications (RR=1.30) in zirconia FDPs, although these differences were not statistically significant [8,16].

Digital vs. Conventional Fabrication Techniques. Advancements in digital dentistry have influenced the fabrication of FDPs. A systematic review and meta-analysis found that FDPs produced using digital techniques exhibited a significantly better internal fit (Standard Mean Difference [SMD] = -0.80; 95% Confidence Interval [CI]: −1.49 to −0.10; p=0.02) compared to those fabricated using conventional methods . However, the marginal fit did not show a statistically significant difference between the two techniques (SMD = -1.88; 95% CI: −3.88 to 0.11; p=0.06) [2,10,11].

Discussion. The comparative analysis underscores the continued dominance of metal-ceramic FDPs in terms of longevity and reliability. Their superior survival and success rates can be attributed to the material's favorable mechanical properties and long-standing clinical validation. The lower incidence of technical and biological complications further cements their status as the gold standard in fixed prosthodontics [3,7,9].

Conversely, while zirconia-based FDPs offer aesthetic advantages and biocompatibility, their higher rates of ceramic chipping and framework fractures raise concerns about their long-term viability. The increased susceptibility to biological complications may be linked to factors such as marginal fit and material properties. These findings suggest that while zirconia FDPs are a promising alternative, especially in cases where aesthetics are paramount, they may not yet match the overall performance of MC FDPs [1,5].

The integration of digital fabrication techniques presents a significant advancement in prosthodontics. The improved internal fit associated with digital methods may enhance the longevity and performance of FDPs. However, the lack of significant improvement in marginal fit indicates that further refinement of digital workflows is necessary. Additionally, the long-term clinical outcomes of digitally fabricated FDPs require further investigation to establish their efficacy fully.

In conclusion, while zirconia-based FDPs and digital fabrication techniques represent the future of prosthodontics, current evidence supports the continued use of metal-ceramic FDPs as the preferred choice for fixed dental prostheses. Ongoing research and technological advancements are essential to address the existing limitations and enhance the performance of alternative materials and fabrication methods.

Conclusion

Fixed dental prostheses (FDPs) remain a cornerstone of modern prosthodontic rehabilitation, offering critical benefits in restoring oral function, aesthetics, and patient quality of life. The comparative literature analysis conducted over the last decade highlights the continued clinical superiority of metal-ceramic (MC) FDPs in terms of survival and success rates, mechanical durability, and complication profiles. Despite the growing popularity of zirconia-based FDPs—driven by advances in biocompatible materials and patient demand for improved aesthetics—their

long-term outcomes remain limited by higher incidences of technical complications, particularly veneer chipping and framework fractures.

The integration of digital workflows, including CAD/CAM fabrication and intraoral scanning, has improved the precision and efficiency of prosthetic fabrication. Nevertheless, while digital methods show promise—particularly in enhancing internal fit—current evidence does not yet indicate a definitive advantage over conventional techniques in terms of marginal integrity or long-term prognosis.

Therefore, the choice of FDP design should be guided by a nuanced understanding of clinical requirements, patient-specific factors, and material performance. Continued research is essential to optimize the performance of all-ceramic systems and digital workflows, ensuring that future developments in prosthodontics can meet the demands of both functional longevity and patient-centered outcomes.

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