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Key Indicators of success or survival for clinical performance of fixed partial denture

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KEYWORDS

Fixed partial dentures, longevity, success, survival.

ABSTRACT

When fixed partial dentures (FPDs) are being suggested to patients, the frequent inquiry by patients is the anticipated longevity and length of service. Previous reports have provided limited information on the accurate measurements of good clinical outcome and the length of good years in service. This confuses the clinicians as well as the patients in determining the treatment of choice. In the present article, the indicator of 'success' and 'survival' will be discussed in determining the longevity of various FPDs such as conventional, resin bonded and implant retained. After reviewing the articles, it is good if the indicator of 'success' can be used as an indicator of longevity and good clinical outcome. Besides that, studies with at least 10 years of observation are probably of higher evidence for longevity of restorations.

INTRODUCTION

For the past few decades, the availability of dental materials with improved properties and the introduction of new treatment modalities in fixed partial denture (FPD) like implant-retained prostheses have revolutionized dentistry in terms of teeth replacement therapy. Consequently, both the dentist and the patient expect high clinical performance restorations, which are simple to apply clinically, high durability, able to improve masticatory function, aesthetic and cost effective in the long-term. For that reason, the measurement of the longevity (survival) of both, there are many studies using either 'success' or 'survival' as the measurement or indicator of longevity for restorations. Survival was defined as FDP remaining in situ with or without modification and success was defined as the FDPs remaining in situ free of all complications over the entire observation period [1]. However, studies that mention which is more accurate in prediction of clinical outcome is sparse or non-existent. Therefore, the objective of this article is to study the indicators that can measure accurately the longevity of the restorations and good clinical outcome.

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CLINICAL PERFORMANCE OF FPD

FPD has been successfully used as teeth replacements for many decades. It has taken many designs and forms such as conventional, adhesive (resin bonded) and implant-retained FPD. The decision on treatment modality by dental health professional (DHP) is mainly based on the long-term

clinical data such as the survival data. There are only a few high-quality longitudinal studies being reported on the survival/success of the FPD and its' abutment teeth [2-6]. Ideally, the DHP should decide on the best treatment options based on well-performed systematic reviews. In other words, the systematic reviews should review the publications which are yielding high level of evidence e.g. randomized clinical control trials (RCT) [1, 7-9] However, it is difficult to obtain the data from randomized clinical control trials that compared the survival rate of different types of FPD, as prospective controlled trials with randomized treatment procedures may associate with ethical issues [9]. Therefore, most of the longitudinal systematic reviews reported on FPD survivals are based on lower level of evidence, observational studies like prospective and retrospective studies [9-11]. Besides that, the different ways in defining the clinical outcome, clinical and technical procedure and follow-up period may complicate the comparison of the clinical performance between different types of FPD [12, 13]. Long-term studies with observational period of 10 years or more will provide a better insight into the longevity of the FPD, by providing meaningful interpretation of the survival, complications and failures. However, the downside of it will be relatively high dropout rate where many patients are unable to return for follow-up appointment due to health issue and death [14].

DEFINITION OF SUCCESS, SURVIVAL, COMPLICATIONS AND FAILURES OF ABUTMENT TEETH AND FPD

CONVENTIONAL FPD

Conventional tooth-supported FPDs alone have various designs and forms. In order to measure its clinical performance, the definition of success, survival and failure of both the abutment teeth and the prostheses itself are important. Tan et al. 2004[9] in their study defined survival as any FPD that was in situ at the examination visit irrespective of its condition. In other words, as long as the FPD stayed inside the mouth and did not require remaking, it is considered as 'survived'. From the meta-analysis of their systematic review [14] the conventional FPD yielded 89.1% of survival rate which was similar to other meta-analyses [2, 15]. In recent systematic review of survival rates on multiple FPDs, 5 years survival rate ranging from 86% to 94% was observed according to types of materials namely metal ceramic FDPs, reinforced glass ceramic FPDs and densely sintered zirconia FPDs [1]. Meanwhile, success was defined as any FPD that remained unchanged or free of all complications and did not require any intervention over the observation period. The estimated 10-year success rate of FPDs was 71.1%. This low success rate was due to high occurrence of periodontal disease and secondary caries to the abutment that lead to the FPD failure [14]. FPD treatment was known to cause both the biological complications which were related to the abutment tooth for examples, caries, pulp necrosis and periodontal disease. It can also involve technical complications like loss of retention or abutment tooth and material related fractures ie., fractures of framework or veneer. Caries can occur on the abutment tooth, not leading to loss of FPD but requiring some repair or leading to FPD loss.[14] The 10-year survival risk for caries on abutment teeth were 9.5%, however only 2.6% of FPD were lost due to caries [14]. While preparing the abutment teeth to receive FPD, the it may become non-vital because of the mechanical trauma inflicted and various noxious stimulus on the pulp through the open dentinal tubules [14]. In some studies, pulp necrosis was diagnosed based on the presence of periapical radiolucency [14, 16-18]. The 10-year risk for loss of abutment vitality was 10%, therefore it is recommended to monitor closely the vitality of the abutment teeth especially those with extensive preparation [14, 19]. Periodontal pathology like recurrent periodontitis leading to loss of FPD was rare (0.5%) [14]. Study have shown that those abutment teeth with restoration margin that had been placed subgingivally were more susceptible to periodontal disease compared to control teeth and restorations with supragingival margin [14, 18]. The highest 10-year risk for technical complications were loss of retention (6.4%), followed by failure due to fracture of abutment tooth (2.1%) [14]. Material complications including fractures of the framework, veneers amounted to 3.2% [14].

RESIN-BONDED BRIDGE

Resin-Bonded Bridge (RBB) has been one of the advancements in modern dentistry, with the advantages of tooth structure conservation and reversibility compared to conventional FPD. Over the past 20 years, it has evolved rapidly from initially being used as periodontal splint with perforated cast to those cement retained non perforated cast [20]. The huge variations in technique, clinician skill and patient selection were known to affect success/survival of the RBB [12, 20]. Initially, Creugers et al. 1997 [21] defined survival at two levels, the RBB was considered as completely survived when there was no loss of

retention during the observation period either by the observer or by the patient; if there was loss of retention in one occasion and was treated successfully by rebonding the original RBB with no further debonds occurred, the RBB was considered as functionally survived. 10 years later in a systematic review conducted by Pjetursson et al.2008 [11] survival was defined as the RBB remaining in situ with/without modification for the follow-up period, which means it was considered survived, as long as the original RBB was able to rebond (with / without interventions) to the abutments without remaking it. While they defined success as an RBB being free of all complications (biological and technical) over the entire follow-up period. The reported survival rates of RBB were vary widely between studies, ranging from 74% -95% [22, 23] due to difference in the factors that affect the success and also difference in follow-up time. Pjetursson et al.2008 [11] mentioned a mean observation period of at least 5 years would provide a more accurate and meaningful interpretation of survival rate. In the systematic review, they reported the summary of estimation for the RBB survival after 5-year was 87.7%, while 10-year survival was dropped to 65% [11]. An updated version of the same study was conducted in 2017 [8] reported estimated survival of resin bonded bridges of 91.4% after 5 years and 82.9% after 10 years. Biological and technical complications which would lead to the failure of RBB were not reported routinely in the studies [11]. Djemal et al,1999[24] defined failure as any significant complications related to the RBB that require remedial intervention or remake. Thus, debonding of RBB even once was considered failure, but caries on the abutments which were not related to retainer margin, were not regarded as failure. In the same study, they reported 27.88% of the RBB will experience failure [24]. Pjetursson et al, 2007[25] classified the complications -occurred on the RBB into two, biological and technical. Biological complications intended in this case are caries and recurrent periodontitis. While debonding (loss of retention) and material complications like framework and veneer fractures are considered as technical failure, debonding of RBB from abutment teeth is the most frequent technical complication with an estimated rate of 15% over 5-year observation period, RBBs with zirconia framework and RBBs with one retainer tooth showed the highest survival [8].

IMPLANT-RETAINED FPD

The use of osseointegrated implants to support prosthetic reconstructions such as FPD has gained popularity as one of the treatment modalities in teeth replacement. The ability to restore missing teeth without damaging its adjacent teeth and avoiding the inconvenience of bulky acrylic dentures were among its advantages over other fixed prosthodontics options. Both the patients and their dentist perceive implant treatment as trouble-free tooth replacement, but its evidence is still lacking. Although it is believed that implant fixtures have good success rate and longevity (survival rate >90%) [26], but the restorations built up on the fixture can develop problems which are often underestimated [27]. Systematic reviews reported survival rate for implant-retained FPD after 5-year as 95.4% and 92.8% after 10-year [28], similar to an updated similar study which reported 93%-98% survival rate over 5 years observation [29]. Survival of implant retained FPD was defined as both implant and FPD present in the mouth regardless of biological and/or technical complications while success was defined as being free of all these complications over the entire observation period.[30] Pjertusson et al [31] reported after 10-year survival estimation was 86.7%, while after 5-year success estimation was 61.3% [10, 31]. This means that, 38.7% of the patients will experience minor or major complications in the first 5 years after implantation [10]. Implant-retained prosthesis may experience different forms of complications as described by Pjetursson et al in Table 1.

Table 1. Cumulative 5-years complication on implant-supported reconstructions (Pjetursson et al. 2007) [4].

Complication type	Complication Rate (%)
Soft Tissue injury	8.6
Veneer Fracture	11.9
Ceramic Chipping/Fracture	8.8
Loss Of Retention	5.7
Abutment or Occlusal Screw Loosening	5.6
Fracture of Abutment/Occlusal Screws	1.5
Framework Fracture	0.7
Implant Fracture	0.5

Traditionally, the options for tooth replacement would have been tooth-supported restorations. Since the introduction of implant-supported FPD, the role of conventional FPD has been somewhat questioned. Recently, there has been a series of systematic reviews comparing the long term clinical performance of tooth-supported restorations and implant-supported restorations (Table 2) [11, 25, 27]. The term ' long-term' has been defined as an observation period of at least 5 years [10]. Pjetursson et al. 2007 [25] has reported survival rate after 10 years of function, for conventional was 89.2%, 80.3% for cantilever, 65% for resin bonded FPD, and 86.7% for implant-supported FPD. The RBB showed the lowest survival rate after 10 years of functioning. Patients with implant-supported FPD experienced the highest complication rate (38.7%) despite the relatively high survival rates. This is compared with 15.7% for conventional FPD and 12.3% for RBB. The systematic review also reported that, the most frequent occurring complications for conventional FPD were biological complications like secondary caries and loss of pulp vitality due to mechanical trauma. For RBB, technical complications like debonding (loss of retention) were the more frequent. For implant-supported FPD, the most frequent technical complications were fracture of the veneer material (ceramic fractures or chipping) which can be up to 14%. In comparison with tooth-supported FPD, only 3.2% of veneer material fractured during the 10 years period [25] This difference is due to the lack of proprioception and resiliency of implant-supported FPD which were normally provided by the periodontal ligament around the teeth [32].

Table 2. Comparison of clinical performance of tooth supported and implant supported restoration (Adapted from Pjetursson 2007,2008) [4,7].

Meta-analysis	5 years Survival (%)	10 years Survival (%)	5 years Success (%)	Complication at 5 years (%)
Conventional tooth-supported FPD	93.8	89.2	84.3	15.7
Cantilever FPD	91.4	80.3	79.4	20.6
Resin Bonded FPD	87.7	65	NA	12.3
Implant-supported FPD	95.2	86.7	61.3	38.7

COMPARISON OF CLINICAL PERFORMANCE BETWEEN ALL CERAMIC, ZIRCONIA CERAMIC AND METAL CERAMIC IN SINGLE AND MULTIPLE UNIT FDP

As the demand for aesthetic in restorations grow stronger, the pursuit for the best material that matches the natural tooth color becomes greater. This has led to the development of tooth colored material like ceramic and zirconia. Ceramic alone has a few developments, from feldspathic, alumina, to lithium disilicate. Each has its own strength and weakness. Zirconia is well known for its strength besides providing acceptable aesthetic and over the years there are many studies that show these promising properties that enables it to be used in implant prosthodontics, both in single crowns and multiple unit FDPs [7, 29].

Table 3. Comparison of the 5 years survival rate between different ceramics, zirconia and metal ceramic for single or multiple unit tooth and implant supported FPDs

	Zirconia	**Ceramics**	**Metal Ceramics**
Single Unit FPD (implant [29] /tooth supported [30])	97.6% 96%	Litium disilicate – 96.6% Alumina – 94.6%	98.3% 94.7%
Multiple Unit FDP (tooth supported)	90.4%	Feldspathic – 89.1% Alumina – 86.2%	94.4%

With reference to Table 3, the survival rate for all three materials used for constructing single unit FPD had better performance compared to when they were used in multiple units FPD. However, there are studies [29,30] using survival rate to measure the clinical performance and only of 5 years observation time.

CONCLUSION

Treatment planning in prosthodontics should be based on evidence and it is even better if it is supported by high-quality systematic reviews which provide a reliable source of evidence. Therefore, judging from the survival and success rate of different types of FPD, planning of prosthetic rehabilitation should preferably include conventional FPD if there were suitable abutment teeth or implant-supported FPD in ideal conditions of its placement. RBB will only be considered in certain anatomical area or with certain indicating factors. Therefore, it would be good to use 'success' as an indicator for good clinical outcome and longevity of FDPs to avoid confusion and easy comparison for all FPDs.

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DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible with the content of this article.

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