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Review Article

Advantages and disadvantages of cantilever bridges

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ABSTRACT

Utilizing cantilever bridges to perform fixed partial prostheses has been reported in the literature based on the increasing demands in this field to improve the outcomes and relieve extensive therapeutic approaches associated with complete oral rehabilitation. The current evidence indicates that cantilever bridges can effectively replace missing teeth with more favorable outcomes than removable partial dentures. However, evidence also shows that decreasing the number and size of cantilevered pontics and increasing abutment teeth are necessary to enhance the outcomes. Furthermore, if the occlusion is harmonious and stable, it has been demonstrated that cantilever bridges can be applied with the minimal periodontal ligament, which adds to its favorable outcomes. However, it should be noted that cantilever bridges are not applicable for all patients as it needs proper oral health status to be installed. Besides, it might also be associated with complications that may lead to failure. Therefore, further studies are still needed.

Keywords: Cantilever bridges, Disadvantages, Advantages, Denture design

INTRODUCTION

Using cantilever bridges to perform fixed partial prostheses has been reported in the literature based on the increasing demands in this field to improve the outcomes and relieve extensive therapeutic approaches associated with complete oral rehabilitation. The approach has been defined as a fixed restoration approach with ≥one abutment at one end and leaving the other unsupported.[1] These modalities have been reported in the literature for many decades, which enabled them to be fully studied and validated. It was previously shown that tilting and rotational movements by the abutment teeth usually resist the forces applied to the cantilevered pontic rather than the forces generating from the long axis.[2]

In this context, it has been reported that understanding the nature of the materials of the cantilever components would be vital in preventing material failure and preserving the supporting periodontium integrity.[3]

Evidence from relevant studies in the literature indicates the validity of these approaches and their various advantages in restoring lost teeth. However, among these studies, some limitations might affect the prognosis of cantilever bridges and limit their efficacy.[1,4] Therefore, the present study will discuss the disadvantages and advantages of cantilever bridges based on information from the relevant studies.

METHODS

This literature review is based on an extensive literature search in Medline, Cochrane, and EMBASE databases on which was performed 3rd December 2021 using the Medical subject headings (MeSH) or a combination of all possible related terms, according to the database. To avoid missing poetential studies, a further manual search for papers was done through Google Scholar, while the reference lists of the initially included papers. Studies discussing advantages and disadvantages of cantilever bridges were screened for useful information, with no limitations posed on date, language, age of participants, or publication type.

DISCUSSION

Evidence shows that cantilever bridges are designated with facing with no complete occlusal surfaces. This has been approached to reduce load and forces over free-end pontics. This has been significantly associated with reducing these horizontal and vertical pressure modalities. However, clinicians should note that this might lead to over eruption of the opposing teeth secondary to reduced occlusal contact by neglecting the interocclusal relationship. This might be associated with unfavorable outcomes and significant adverse events that worsen treatment prognosis. Decreased mesiodistal spaces are also a viable advantage that can enhance esthetics after using a cantilever prosthesis. However, the surrounding gingival tissue should not be subjected to excess pressure from the related cantilever pontics. Exerting extra pressure to support the surrounding tissues should also be avoided because the applied rests can be associated with reduced oral hygiene and are usually prone to developing dental caries.

Many advantages and disadvantages were reported for using cantilever bridges. Evidence shows that cantilever bridges can be used with more favorable outcomes in the anterior than posterior quadrants. This has been attributed to the mal-distribution of forces over these two regions. At least two abutment teeth are required for installing successful cantilever fixed partial dentures. However, it should be noted that it has been previously reported that these modalities were used with a single abutment following replacing maxillary lateral incisor and canine being used as the abutment.[5] Evidence shows that cantilever fixed partial dentures can be successfully applied in an ideal approach via this anterior cantilever. Therefore, patients with open disorders are indicated to have anterior cantilever fixed prostheses. Besides, the exact modality is indicated for patients with normal degrees of vertical and horizontal overlap. On the other hand, it has been shown that when there is extensive vertical overlap, anterior cantilever fixed partial dentures cannot be used secondary to the extensive loading on anterior teeth by lateral and protrusive excursions.[6] Moreover, evidence shows that these modalities are not indicated for patients suffering from class III malocclusions due to extensive wear characteristics over the anterior teeth.[6]

A previous laboratory investigation demonstrated that tilting and rotational movements by the abutment teeth usually resist the forces applied to the cantilevered pontic rather than the forces generating from the long axis.[4] It has been reported that understanding the nature of the materials of the cantilever components would be vital in preventing material failure and preserving the supporting periodontium integrity. A previous article by Schweitzer et al reported that using two abutments is advisable to apply successfully single cantilevered pontics.[3] However, evidence also shows that this rule is variable based on the association between pontics and teeth arch and the underlying clinical characteristics. Forces applied to the posterior arch are significantly associated with the forces generated by muscles of mastication. Accordingly, it has been suggested that further abutments might be needed when the cantilever is applied in the posterior arch to overcome the potential excess forces.[7,8] In this context, a previous investigation by Henderson et al used two laboratory-based, and practical models of three-abutment-based posterior cantilever fixed partial dentures together with strain gauges.[4] It has been demonstrated that tilting and rotational movements of the abutment teeth strongly resisted the applied forces by cantilever bridges. The authors reported that these events were notable for both models. However, they also noticed that these events were not parallel to the vertical axis of the roots. The abutments near the cantilever bridges were responsible for absorbing more than half of the forces applied to them. Moreover, it was observed that adding an extra abutment successfully reduced the force applied to the distal abutment. Accordingly, it has been concluded that the abutment nearest the cantilever bridge is responsible for absorbing most of the forces. However, using a three-abutment cantilever will strongly redistribute the forces applied to the cantilever pontics and enhance the associated outcomes.

A previous study by Lundgren and Laurell examined the application of two-unit cantilever fixed partial dentures using a cross-matched unilateral approach.[9] Another investigation was also conducted to compare the outcomes for patients with bilateral terminal abutment and others with cross-arch fixed partial dentures. It has been reported that chewing-related activation of the voluntary muscular activity was 37% and 26% for both groups, respectively.[10,11] This has been attributed to the unilateral shortage in terminal abutments, which worsens the lateral

bending forces. The latter forces are directly responsible for influencing the temporomandibular joint and periodontal mechanoreceptors leading to the significant activation of peripheral inhibitory feedback events. Previous investigations in the literature have also reported that cantilever bridges can be used in periodontally compromised abutments to achieve successful dentition rehabilitation.[12,13] This is mediated by building a non-traumatizing and stable occlusion and conducting periodontal treatment. The application of balancing contacts also prevented increasing mobility, tilting, and migration. It has been furtherly reported that unilateral two-unit cross-arch posterior cantilever fixed partial dentures are usually associated with decreasing masticatory forces over the periodontally compromised abutments.[14] Accordingly, it has been demonstrated that cantilever bridges will be eventually subjected to extra forces in cases of stable occlusions and the presence of premature contact. Hochman et al also conducted a previous follow-up investigation to compare posterior and anterior cantilever fixed partial dentures using gold veneer crowns (early) and metal-ceramic restorations (late).[6] The authors evaluated the periodontal status in their models by adjusting them as having necessary occlusion events. Moreover, light occlusal contacts were provided for patients with posterior cantilever pontics. Observations were recorded during the study period, lasting ten consecutive years.[15] Any of the included patients reported any functional or esthetic complications. It has been furtherly shown that there were no abnormalities regarding abutment teeth compared with the baseline radiographs and the homologous teeth on the opposite side of the arch. It should be noted that adjustment of minor occlusions was also necessary for some events to intervene against the development of nutrition-related occlusal traumatic events.[6]

Many biological and mechanical features were reported for the application of cantilever bridges. For instance, it has been demonstrated that consistently influencing axially directed masticatory forces can be achieved by unilateral cantilevers with cross-arch extension fixed partial dentures.[14] Furthermore, it has been demonstrated that reduced exertion of occlusal forces is significantly associated with the periodontal ligament area. Therefore, it has been suggested that bilateral terminal abutments are correlated with less modulation of the mastication-related dentition by mechanoreceptors within the periodontal membrane than posterior two-unit unilateral cantilevers. Neuromuscular sensitivity can also be magnified by activating feedback control mechanisms secondary to the cantilever-related extensive binding forces. On the other hand, it has been demonstrated that the periodontal tissues do not impact local forces over the cantilever terminal forces.[9] A previous investigation by Randow and Glantz emphasized the importance of periodontal-influenced mechanoreceptor mechanisms.[16] The authors reported that the biomechanical reactions between nonvital and vital teeth secondary to cantilever bridges differed significantly.[17] On the other hand, when abutments were anesthetized, it was noticed that mechanical loading characteristics were similar. Reduced bending degrees and enhanced functions of mechanoreceptors were significantly associated with optimal bone health and vital teeth. In the same context, evidence shows that endodontic treatment of abutments is significantly associated with a greater mechanical failure.[7] Another investigation also concluded that root fractures were significantly more prevalent among endodontically treated teeth than vital teeth. In the same context, it has been emphasized that the prognosis of cantilever bridges is bad when combined with root canal-treated terminal teeth.[18-20]

It should be noted that variable complications and failure events were reported among relevant studies in the literature regarding the efficacy of cantilever bridges. It has been estimated that the total incidence of complications might be up to 10%. In this context, periodontal diseases, dental caries, root fractures, post loosening are the most common complications reported among the various investigations in the literature. The etiologies leading to treatment failure can either be technical or biological. Biological failures account for the majority of cases in this regard. The most commonly reported biological complication was the loss of retention regardless of dental caries. On the other hand, technical failures have been shown to include fracture of the cantilevered extension, prosthesis fracture, and abutment fractures.[21-31] One of the main disadvantages of cantilever bridges is the mechanical features of these modalities. Evidence shows that the farthest abutment teeth from the free-end pontic are subjected to tremendous dislodging force. Accordingly, it should be noted that clinicians should provide more solid cement and metal at the site where extension and compression forces are most significant to provide better outcomes. Most luting surfaces' minimal and maximum strength is tensile and compressive, respectively, with the interval value being shear strength.[3,10]

Other disadvantages of using cantilever bridges include requiring healthy oral status, including gingiva and corresponding teeth. Therefore, their use is limited to a specific population. In addition, the risk of debonding and cracking might also be high among these designs, which increases the risk of future failure and treatment-related complications. Finally, failure might occur due to the reduced support and required attachments.[2,32] There is also evidence comparing cantilever bridges and removable partial dentures. It has been demonstrated that both modalities are associated with favorable outcomes and efficacies regarding masticatory functions and esthetic outcomes.[33-36] However, a previous investigation in the literature compared fixed and removable partial dentures and found that clinical manifestations and complications were more significantly associated with removable partial dentures.[37] Accordingly, it has been demonstrated that cantilever bridges might be a more favorable option for the elderly population with decreased dentition than removable partial dentures. A 5-years longitudinal investigation was also conducted by Budtz-Jørgensen and

Isidor and reported similar outcomes that indicate the superiority of cantilever bridges over removable partial dentures.[38] A summary of their findings is presented in Figure 1. However, evidence indicates that issues regarding adaptation are usually reported among patients using removable partial dentures.[2]

Findings	FPDs with distal cantilever (27 patients)	RPDs (26 patients)
Dental caries	10	57
Endodontic complications	2	5
Tooth fractures	2	5
Denture stomatitis	15	17
Denture ulcer	4	7
Irritation from sublingual bar	—	12
Prosthesis failures	8	—
Denture failures	1	10
Clasp fractures	—	4

Figure 1: Clinical findings in a previous long-term longitudinal investigation comparing removable partial dentures and fixed partial dentures with distal cantilever.[38]

CONCLUSION

Evidence also shows that decreasing the number and size of cantilevered pontics and increasing abutment teeth are necessary to enhance the outcomes. Furthermore, if the occlusion is harmonious and stable, it has been demonstrated that cantilever bridges can be applied with the minimal periodontal ligament, which adds to its favorable outcomes. However, it should be noted that cantilever bridges are not applicable for all patients as it needs proper oral health status to be installed. Besides, it might also be associated with complications that may lead to failure. Therefore, further studies are still needed.

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