

Case Report

Literature review and application of pre-treatment survival rate assessment of abutments of removable partial dentures

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Abstract

In order to obtain a successful prosthetic outcome, we need to consider the prognosis of each abutment tooth. Because a poor prognosis of abutments will make the removable partial denture (RPD) failure, it is important to check each abutment tooth condition to prolong a longevity prosthesis. This article reviews the current understanding of the relationship between the prognosis of abutments and their potential impact factors for achieving clinical goals, and a clinical case for introducing the application of pre-treatment survival rate assessment of abutments of a removable partial denture.

Key words: abutment, prognosis, removable partial denture, survival rate assessment

Introduction

The abutment teeth may be prepared to provide support, stabilization, reciprocation, and retention for the removable partial denture(RPD)¹. Vermeulen et al. reported of taking abutment retreatment as a failure criterion, 40% of the conventional RPDs survived five years and more than 20% survived ten years; taking replacement or not wearing the RPD as failure criteria, the survival rate was 75% after five years and 50% after ten years². Sayaka Tada et al. reported, the 5-year survival rate of abutment teeth was significantly lower (86.6%) than non-abutment teeth (95.8%) for patients wearing RPDs³. Therefore, the abutment teeth problems influenced the survival rate of RPD much more. The abutment teeth of RPDs were reported to be at higher risk of periodontitis^{4,5}, dental caries^{6,7} and root fracture⁸ than other teeth. Longitudinal studies have also shown that RPD abutments were at an increased risk of loss^{9,10}. When an original abutment is lost, it is extremely difficult to effectively modify the removable partial denture to use the next adjacent tooth as a retaining unit. Therefore, knowing the prognosis of each abutment tooth before the treatment starts is quite important. Some factors may affect the abutments' survival rate: periodontal support, endodontic treated tooth, and crown-root ratio factor.

Besides the above three factors, Sayaka Tada et al. evaluated 147 patients who were provided with 236 new RPDs ; the 856 abutments of these RPDs were analyzed and followed up for five years. The results showed that the abutment survival rate

was significantly influenced by the crown-root ratio, root canal treatment, pocket depth, and type of abutments³. Estimating individualized risk and benefit for each residual tooth is important to clinical decision-making. These influence factors will discuss more below.

Crown-root ratio

The Crown-root ratio is served as an aid in predicting the prognosis of teeth¹¹. A ratio of 1:2 was considered ideal¹², and a crown-root ratio of 1:1 was considered minimal^{11, 13}. A tooth with less bone support has a higher crownroot ratio, therefore it is less resistant to masticatory loads and lateral force especially when the tooth is an abutment in RPDs¹⁴. Tada S et al. concluded that, if the opposing prosthesis is tissue supported, then a crown-root ratio greater than 1:1 might be adequate, due to the diminished occlusal forces¹⁵. In my case an old bridge cantilever of 44-45-X, a crown-root ratio about 1:1 of 45 and 1:1.14 of 44 by the periapical film was considered minimal ratio as an abutment for RPD (fig.1).

Grossmann Y et al. reported that reducing the crown to 1 to 2 mm above the free gingival margin in abutment preparation for overdentures has the most dramatic effect on the ratio, which can improve the crown-root ratio from 1:1 to 1:2 or 1:3¹¹. The decrease in crown height shortens the corresponding lever arm length, and therefore, less lateral force is applied to the attachment apparatus, then reducing the possibility of mobility¹⁶. Renner et al demonstrated that over a 4-year period, 50% of the roots were without mobility, 25% of the roots that were initially mobile exhibited no mobility, and 25% mobility was decreased of these roots¹⁷. When we increasing the vertical dimension of occlusion for reconstruction would cause an increase in the crown-root ratio, without altering the root support¹⁸. When teeth were compromised by caries, extensive wear, or trauma, we may take surgical crown lengthening into consideration for rebuilding the ferrule effect¹⁹. Another treatment

option: slow orthodontic eruption allows the periodontal ligament to repair and the alveolar bone to remodel for preserving the biologic width^{18, 20, 21}.

Endodontic factor

The 4-year tooth survival following primary or secondary root canal treatment was 95%²². However, survival rates for endodontically treated teeth were less than for vital teeth when used as RPD abutments. Pia K. Wegner et al. reported that in case of the 410 abutment teeth of RPD after root canal treatment, the 5-year survival rate was only 51%. The retainer or the clasp of RPD caused more mechanical stress to the abutment teeth, so the risk of tooth fracture increased, if the abutment teeth were endodontically treated²³.

If a tooth with a apical lesion is included into the treatment plan as an important abutment for RPD, we may worry about the survival rate of the endodontic problem. Asymptomatic, functional teeth after initial endodontic therapy of apical periodontitis probably approaches or even exceeds 95%²⁴. In the other hand, a symptomatic apical periodontitis tooth after non-surgical root canal treatment, should take the apical surgery into consideration as a treatment option. About the prognosis of apical surgery : 37–91% of teeth can be expected to be healed, while up to 33% can still be healing several years after surgery. 80–94% of teeth can remain in symptom-free function, even if they are not healed²⁵. In view of these wide range of the prognosis of apical surgery, we should tell the patient about the possibility of extraction of the abutment tooth and further repair of RPD.

Periodontal factor

McGuire MK et al. reported that, the clinical criteria of "good" are bone loss <25%, probing depth <3 mm, without furcation involvement and mobility. Before prosthodontic treatment, the periodontal condition of a tooth is divided

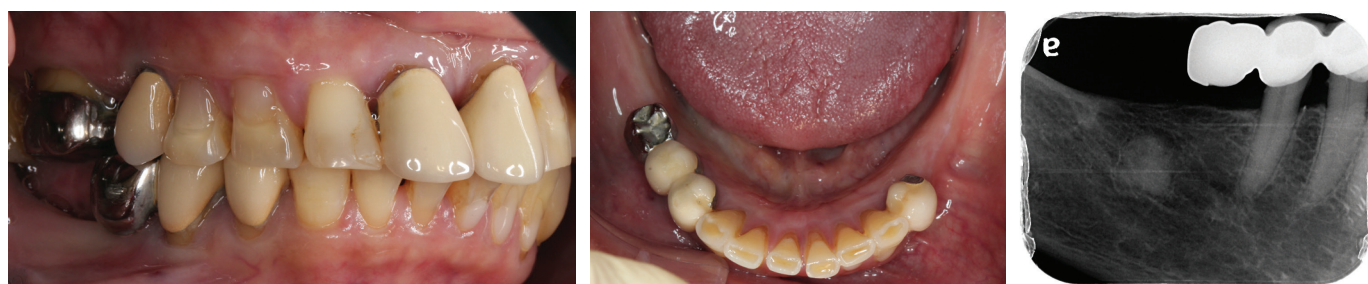


Figure 1. Intra-oral view and periapical film of cantilever 44-45-X

to clinical criteria of “good” , is significantly with lower risk of tooth loss while the follow-up period²⁶. Matuliene et al. reported that, probing depth of 5 mm and over represented a significant risk factor, compared with probing depth of 3 mm or less, from multivariate analysis of the association between probing depth and tooth loss²⁷.

If the abutment tooth is periodontal compromised, we can splint the abutment to the adjacent healthy tooth for extending the abutment lifespan. The definition of “splint” : 1. a rigid or flexible device that maintains in position a displaced or movable part; also used to keep in place and protect an injured part; 2. a rigid or flexible material used to protect, immobilize, or restrict motion in a part²⁸. Allahyar Geramy et al. evaluated splinting anterior teeth with periodontal bone loss by 3D Analysis using finite element method. And reported that fixed splinting improves the stress distribution in the surrounding bone and transfers stress from the interdental crest to the apical area of teeth where there is better resistance. Splinting

a very weak abutment to an adjacent healthy tooth might not be beneficial. The acceptable crown to root ratio for fixed splinting a weak abutment to an adjacent normal tooth was around 1.65-2²⁹. Phoenix RD et al. demonstrated that a tooth that has lost more than 50% of its bone support is a poor candidate for fixed splinting³⁰.

H G el Charkawi et al. concluded that the reduction of the number of splinted units from three to two resulted in an insignificant increase of stresses recorded, whereas reduction of the number from two to one resulted in a significant in-crease of stresses nine times greater than the three-unit splint val-ues³¹. Therefore, splinting two teeth will achieve the effect of stresses distribution. In my case, due to the sign of the periodontal attachment loss of 44 and crown-root ratio was about 1:1 by periapical film (fig.1), we decided to splint 44 and 45 together during the temporary to permanent period after removing the old bridge cantilever (fig.2 and fig.3).

Rigidity of major connectors and maximum

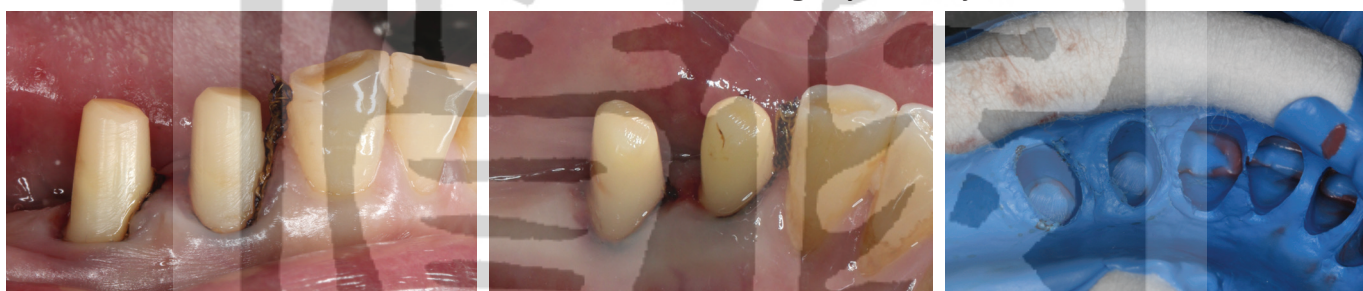


Figure 2. final impression of 44, 45

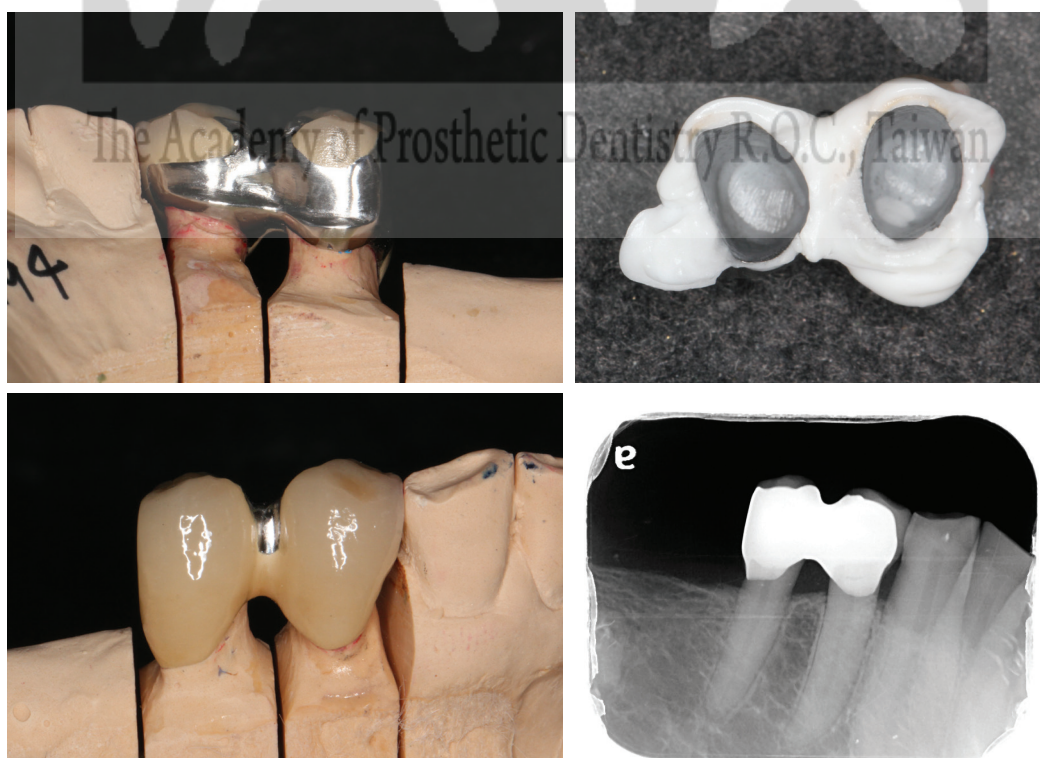


Figure 3. delivery of 44-45 and periapical film after cementation

coverage of denture-bearing areas with denture bases are of great importance in reducing stresses on abutment teeth. Splinting of abutment teeth is indicated when the periodontal support has been reduced or when increased stresses are expected, as in the use of intracoronal attachments³². After the teeth are splinted, it will cause inconvenience for the patient to keep good oral hygiene³³. Furthermore, endodontic complications occur much more in splinted abutments than in non-abutment teeth³⁴. These must be taken into clinical considerations.

Sayaka Tada et al. concluded that the abutment teeth bearing rest, clasp, or minor connector of RPD might get more mechanical and bacterial stress than non-abutment teeth, with a higher risk to damage the periodontal tissue³. ML Almeida et al. concluded that abutment teeth with direct retainers had significantly worse plaque index, bleeding on probing and probing depth values, when compared with the remaining teeth. Prosthesis design may play an important role in periodontal status and recommended that the RPD should have a minimum distance from the gingival margin and that good oral hygiene is essential³⁵.

Maintenance

RPDs compromise oral hygiene with more plaque accumulation and increase loading stress on abutment teeth, could increase the risk for

periodontal disease, dental caries and other mucosal diseases³⁶. Tada S et al. reported that periodontal maintenance at least once in 6 months had the most favorable outcome. Frequent periodontal maintenance after RPD provision could be effective in preventing further tooth loss³⁷. Moreover, the follow up and maintenance of the RPD also important. Because the edentulous ridge keep resorption as time goes on, the RPD may lose the consistent tissue support, then destroy the abutment teeth. As a result, with much more jiggling force on periodontal tissue, higher failure rate and tendency of increasing mobility of that abutment teeth due to occlusal force and denture movement³⁸.

My case follow up

The removable partial denture was delivered. Due to the maxillary canine were severe worn out (fig.4). The mandibular RPD occlusal scheme was group function. When the occlusion is physiologically healthy, it has been recommended that the existing occlusal scheme be used, either mutual protection or group function³⁹. The 3 years follow up of the 44-45 bridge was fine intraorally. The 44 and 45 were without the sign of PDL widening by periapical film. Checking the removable partial denture with fit-checker, although with some bone resorption sign, the denture still stays in stable condition intra-orally without



Figure 4. delivery of mandibular RPD

rotation. (fig.5) Evaluation of abutments was performed during maintenance phase as (Table 1).

Table 1. abutment of 44-45 evaluation in 3 years follow up appointment

	Good	Fair	Poor
Crown-root ratio		√	
Endodontic factor	√		
Periodontal fac-tor		√	
Maintenance		√	

Conclusion

We get the point of the ideal criteria of abutment teeth, and pre-treatment sur-vival rate assessment was done of each tooth well. In spite of following the con-clusions of previous published papers, to keep the tooth or not as the abutment may not be too difficult for us to making decision while treatment planning. But the patient's teeth will not all be kept in good oral hygiene condition, regular follow-up and maintenance are much more important in my case.

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