



# Treatment Planning Challenges in Cases with Root Proximity: An Interdisciplinary Approach

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## ABSTRACT

Root proximity is defined as a situation where the distance between the roots of adjacent teeth on radiographs is  $\leq 1.0$  mm. This important situation should be detected by clinicians before definitive restorative treatments and they should be well aware of different approaches available for the management of this situation. The purpose of this study was to collect and review the available literature on this topic by searching the PubMed, Google Scholar, Scopus, Embase, and Cochrane Library in order to summarize the complications and treatment plans for root proximity in cases requiring restorative procedures.

**Keywords:** Tooth Root; Tooth Movement Techniques; Dental Prostheses; Dental Restoration, Permanent

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## INTRODUCTION

The term “root proximity” refers to a situation where the distance between the roots of adjacent teeth on radiographs is  $\leq 1.0$  mm [1]. Root proximity is favorable when more than 1 mm of bone is present between the roots, and unfavorable where less than 1 mm of bone is present [2]. Artun et al. [3] described root proximity as where adjacent roots are apart by  $\leq 0.8$  mm as measured on periapical radiographs. The inter-radicular distance (IRD) is of great importance because it affects the inter-root bone quality and quantity. According to Heins and Wieder [4], in case of presence of less than 0.5 mm IRD, only lamina dura without cancellous bone is present between the roots, and when the IRD is less than 0.3 mm, the adjacent roots are separated only by the periodontal ligament. It has been shown that absence of cancellous bone

between two cortical bone plates leads to low regenerative capacity and consequent horizontal bone loss [4]. Also, root proximity may result in poorly shaped gingival embrasure, jeopardize the health of interproximal space, and lead to faster periodontal breakdown [5,6]. Vermynen et al. [2] presented a two-digit system for classification of root proximity. In this system, the roots are categorized into three locations of A (apical), B (between) and C (coronal), which is a modification of the Schei ruler. Each location has the possibility of three different severities of root proximity: Severity score 1 indicates the presence of small amount of cancellous bone between the adjacent roots ( $\leq 0.8$  and  $>0.5$  mm), severity score 2 indicates the presence of only cortical bone and connective tissue attachments between the adjacent roots ( $\leq 0.5$  and  $>0.3$  mm), and severity

score 3 shows only connective tissue attachments between the adjacent roots ( $\leq 0.3\text{mm}$ ) [2,5,7].

The most common location of root proximity is between the maxillary first and second molars and between the central and lateral incisors. Also, in the mandible, it is more prevalent between the central and lateral incisors and between the central incisors. These sites account for 68% of all root proximity sites in the oral cavity. Moreover, these locations correspond to the teeth that are also more sensitive to periodontal disease and attachment/tooth loss [2,7,8]. Based on the study by Artun et al, [3] the most common location of root proximity is between the maxillary central and lateral incisors (72%). They reported that only 15% of the root proximity areas were in the posterior region [3].

Root proximity may complicate instrumentation and plaque removal, and lead to deterioration of oral health [6,9,10]. For this reason, root proximity is considered as one of the factors that can result in questionable periodontal prognosis [6,11]. Furthermore, this condition may lead to incorrect form of interdental papilla and complicate the restoration of juxtaposed teeth [5, 6,9,10].

Radiography is a valuable tool for detection of this condition. Despite some shortcomings of panoramic radiography, it is probably a reasonable screening tool in general. Although in specific situations, it is beneficial to take supplemental periapical radiographs to accurately assess root angulations and proximities [12]. Since the ability to maintain periodontal health and accessibility for restoration of adjacent teeth may be compromised in case of root proximity, the clinicians should take into account some considerations before definite restorative treatments. To the best of the authors' knowledge, no comprehensive study is available in this respect in the literature. Therefore, the aim of this review was to present the possible treatment plans considered to restore teeth in case of root proximity.

## METHODS

For this review, the PubMed, Google Scholar, Scopus, Embase, and Cochrane Library databases were searched for relevant articles published before July 2020. No language limitation was considered, and the following keywords were searched: "tooth root", "tooth movement techniques", "dental prostheses", and "dental restoration, permanent". The selected articles were then obtained in full-text, and text reading was done by two reviewers. Also, a manual search was performed through the reference list of the included studies. Articles were reviewed with a focus on treatment modalities of teeth with root proximity.

## Treatment Options

Some of the included studies presented the classifications related to root proximity [2,5,7], and some others addressed root proximity as a problematic factor in periodontal, orthodontic or restorative treatments, which complicates clinical decision making [3,6,13,14]. As mentioned earlier, a comprehensive study regarding this situation is lacking. Based on the search of literature, the proposed treatment options in case of root proximity were assorted into four categories as follows:

### *Orthodontics treatment:*

During orthodontic treatment, roots of the adjacent teeth can be separated and bone deposits between them. This approach improves the periodontal condition and oral health by creating an embrasure space, providing enough bone support, and improving the patient's ability to clean the interproximal area [6,13]. Separating roots by orthodontic treatment should be considered before bracket placement so that the required root divergence can be achieved after the alignment phase by some modifications in bracket positioning. Typically, positioning of the brackets perpendicular to the longitudinal axis of the teeth would result in root parallelism, and is recommended to avoid root proximity. In case of normal crown-root angulation, this method of bracket placement simplifies the correction of root proximity,

increases root alignment, and leads to even marginal ridges. If more divergence is needed between the adjacent roots, brackets should be positioned with exaggerated angulation or a V-bend should be made in the archwire. For monitoring of the progress of orthodontic root separation, radiographs should be taken. Principally, 2 to 3 mm space is essential between the adjacent roots to allow sufficient bone deposition and provide sufficient embrasure space to preserve periodontal health. Following orthodontic treatment and because of tooth movements, some occlusal adjustments may be needed to relieve premature occlusal contacts [6].

On the other hand, root proximity may occur as a consequence of orthodontic treatment. The anterior segment is one of the most common areas for the occurrence of root proximity following orthodontic treatment. The most possible reason for this incident is incorrect initial bracket placement or lack of sufficient precision in the finishing stage of orthodontic treatment. However, in some cases, tooth crowns do not have a correct angulation with the roots and consequently, repositioning of the crowns in a good angulation leads to inappropriate root angulations. Moreover, interproximal enamel reduction is a common procedure in orthodontic treatment which is mostly done to achieve enough space and sometimes is done to improve tooth morphology (especially in teeth with tapered crowns and black triangles in interproximal embrasures).

Stripping brings the teeth into a closer distance; thus, root proximity would be inevitable. Also, because of difficulty in bonding of brackets in relation to the marginal ridges or occlusal planes (which should be parallel) especially in premolar areas, bonded appliances may commonly cause root proximity specially in the posterior segments [3]. Furthermore, in cases of missing of lateral incisors, adequate space should be created for implant placement. This action would require orthodontic treatment in order to adjust the roots parallel to slightly divergent, which would avoid complications

related to root proximity [12,15]. Therefore, considering these points is of great importance during orthodontic treatment in order to prevent consequent root proximity.

#### *Tooth reshaping:*

Root reshaping in combination with minimal removal of the supporting alveolar bone is an alternative approach to conventional crown lengthening that creates space for restoration, corrects unacceptable root surface anatomy, smoothens the root surface, diminishes class I and II furcation lesions, and is a technique that provides hygienic gingival contour and space for restorative material. Additionally, root reshaping improves cleaning with dental floss, enhances scaling during maintenance visits, and forms normal gingiva in cases with root proximity. Finally, root reshaping is a remarkable method that can be used to prevent unnecessary extractions [14].

#### *Surgery:*

Some clinicians believe that severe root proximity may be an indication for root removal to improve the periodontal condition and provide space for restorations [14]. Root resection is one of the treatment options in which roots of two close teeth are in a situation that the embrasure space is obliterated. Resection of a root improves retention and prognosis of the two adjacent teeth. After root resection, the remaining tooth structure can be used as an abutment for fixed partial dentures, splints, or vertical stops for cantilever fixed partial dentures. When a divergent distobuccal root of a maxillary first molar is close to the second molar and it is difficult for the patient to access the area for cleaning, some complications such as periodontal involvement of distal furcation may occur. Thus, the distobuccal root of maxillary molars is among the most frequently removed roots [16].

#### *Restorative treatment:*

Interim restorations after completion of endodontic treatment are a useful option to avoid drifting of the treated tooth and also the adjacent or opposing teeth. This point is of great importance that during the temporary phase, proximal contacts should be meticulous

in order to prevent tooth movement, which would result in undesirable root proximity [17]. Accurate contact points in restorations is highly important to avoid proximal caries since inter-proximal caries and the anterior component occlusal force vector will reduce the interradicular distances and consequently transform the shape and thickness of inter-radicular bone [2]. On the other hand, the clinicians encounter some problems in case of root proximity during prosthetic treatment planning such as difficulty in making acceptable impressions because there will not be enough space to place the retraction cord. Also, proper thickness of impression material cannot be applied, and placement of retraction cord in such cases would lead to irreversible damage [12]. It is noteworthy that designing splinted crowns in such cases would cause some complications for proper maintenance [18]. Some of the prosthodontic solutions in case of root proximity are as follows:

1. Prepare and restore some parts of the tooth which are far off the root proximity such that the design of definitive restoration will be partial instead of full-coverage. Also, some treatment options such as onlay and endocrown restorations are preferred.
2. Prepare the margin of restoration deeper and more apically if the root trunk tapers apically; otherwise, it is suggested not to place the finish line subgingivally.
3. It is recommended to select an appropriate bur (e.g. knife edge or flame) in order to prevent damage to adjacent tooth structure in addition to enhance the amount of space between the adjacent teeth [13]. Furthermore, if the proximity of the adjacent teeth inhibits the placement of bur in the gingival area, a flat, soft and thin-bladed hand instrument can be adjusted against the external surface of the tooth in the gingival area to demonstrate the proper angulation of the bur [19].

## CONCLUSION

Since root proximity leads to complications with respect to periodontal health, prosthetic rehabilitation, and maintenance phase of involved teeth, dental clinicians should have

adequate knowledge about the management of this situation. Different approaches such as orthodontic or restorative treatments or even extraction may be adopted based on the case which were discussed in this review.

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## CONFLICT OF INTEREST STATEMENT

None declared.

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