The Prevalence of Overhanging Restorations, Effects and Prevention

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Abstract

Overhanging dental restorations (ODRs) are defined as a horizontal discrepancy on smooth and approximal surfaces of the restorations.

This paper reviews the available literature on the prevalence of ODRs, their effects on periodontium, their relation to secondary caries, and ways of prevention.

ODRs have been linked to significant periodontal diseases, including significant attachment loss, bone loss, inflammation, and a deeper pocket. In addition, the presence of ODRs considers a significant risk factor in the etiology of secondary caries.

The incidence of ODRs may decrease when marginal adaptation improves using stiff flexible metal bands and flexible (wooden or plastic) wedges with sectional matrix and V-shaped separation rings. Besides the use of magnifying glasses and Teflon tape, which help optimize the matrix's adaptation to the cavity margins.

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Introduction

Literature Data

The literature on overhanging restorations and their effects on the periodontium, relation to secondary caries, and prevention methods does review in this paper, research found through searches on PubMed, Wiley, and ScienceDirect (with no date restrictions). Each article's reference list did carefully search for other pertinent articles. To synthesize the variables that impact overhanging restorations and those that do not, and bring out the most therapeutically pertinent findings and conclusions while highlighting any areas that need more study.

ODRs Prevalence

Overhang prevalence in amalgam and/or composite restorations has been investigated widely in the literature with a wide range of results (Table 1). [1–11] Some explanations about possible variability of the results were probably due to different methodological techniques used to detect overhanging restorations. The identification techniques used in the literature include Intra-oral examination using different types of explorers, radiographically (bitewing radiograph or orthopantomogram), scanning electron microscopy (SEM), or a combination of these methods. Despite these differences, the prevalence of overhanging restoration is very significant.

Many factors may contribute to the formation of ODR, including operator expertise, unusual dental morphology, location and type of the tooth, and restoration type. *Kells & Linden*, in 1992, evaluated the bitewing radiographs of 100 patients aged 20 to 29 years, and they found a total of 710 restored proximal surfaces, 178 (25%) surfaces had a measurable amalgam overhang. [2] *Kheyzaran et al.* (2018) reported almost similar frequency by examining panoramic radiographs (22.2%). [9] However, a higher prevalence was recorded in two studies in which restorations were done by undergraduate dental students [1,7] The higher frequency of overfilled restorations could be related to the operator skills. [1,7,12] *Pack et al.* examined 100 patients clinically and radiographically (bitewing radiographs) who had received their restorations by final year dental students; they reported that every patient had at least one amalgam

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overhanging restoration (56%).[1] Q*uadir et al.* reported comparable findings (58%) by evaluating 150 patients who also received the amalgam restorations by final-year dental students.[7]

The ODR may also occur due to anatomical reasons. In a study done by *Opdam et al.,* they evaluated the bitewing radiograph and scanning electron microscopy (SEM) to detect overhang in 72 upper premolar teeth. [3] They found a higher incidence of ODR on the mesial surfaces than the distal surfaces, which was explained by the concavity on the mesial approximal surfaces of upper premolar teeth at the cervical area. This concavity often interferes with the matrix's tight fit, allowing the bonding agent's escape and even composite material resulting in ODR. [3]

In a comparison of the incidences regarding the location and type of tooth*, Quadir et al.* [7]*, Tavanger et al.*[8]*, Kheyzaran et al.* [9], *Najm et al.*[10]*,* and *Atay et al.*[11] reported the highest frequency of overfilled margins in the maxillary molar teeth (13.3 % - 72 %). The presence of more overhanging restorations in the maxilla did contribute to the difficulty of indirect sight and limited access to this area during treatment. [3] In contrast, the least overhanging restorations were in the mandibular premolar teeth (1.3 % - 6.4%). [9,11,13]

Based on the results reported in the literature [1,7,8,9,11], ODRs occur more frequently in the distal surfaces of posterior teeth, and that could be explained by poor accessibility during restoration packing. *Quadir et al.* indicated more frequent ODR on the distal surfaces (64%) and only (35%) on mesial surfaces.[7] Furthermore, *Atay et al.* reported that more than half (57.3%) of the ODR margins in the Class II cavities were on the distal interfaces, while 42.7% were on mesial interfaces.[11]

On the other hand, the detection method shows to affects the frequency of ODRs on the proximal surfaces. *Pack et al.* found that the clinical data alone revealed that 42% of distal and 36% of mesial restored surfaces had overhanging margins. However, when they evaluated the bitewing radiographs taken on the same day, mesial overfilled margins were detected with higher frequency (47% vs. 44%).[1] The same authors found that of all the approximal overhanging margins, 74% founded radiographically, and 62% founded clinically. The difference in frequency may be attributed to the restriction of probe manipulation during clinical assessment.[1]

In some cases, ODRs can be detected clinically; though they may not be recognized radiographically because of the margin's position to the X-ray angle; this emphasizes the importance of combining radiographic and clinical exploration to diagnose overhanging margins accurately. In 1998, *Opdam et al.* studied 144 class II composite restorations in upper premolar; they found significantly more overhanging restorations (43%) detected by SEM inspection, whereas only (4%) were detected on bitewing radiograph evaluation.[3] The difference in the occurrence of ODR between SEM and bitewing radiographs was explained by the excess of radiolucent bonding agent beyond the margins of the preparation, forming an overhang that often underwent undetected radiographically.[3] Moreover, evaluation of the quality of the cervical margin is difficult to assess from radiographs.[3]

Overhanging amalgam interproximal restorations were reported with significant frequency compared to composite restorations, and that could be because of the forces required for amalgam condensation. [4,8] *Levin et al.* evaluated bilateral bitewing radiographs of 459 patients with amalgam or resin-based composite interproximal restorations, and they found overhanging margins in 21 (4%) and only 1 (1%), respectively.[4] *Tavanger et al.* found the same result regarding the type of restoration, and it should be noted that most of their samples had amalgam restorations instead of composite ones.[8] Furthermore, ODRs have been reported with higher prevalence in class II cavities compared to MOD cavities.[9,11]

In summary, despite differences in measurement and identification methodologies, prevalence studies of ODR strongly suggest the following.

- The prevalence of ODR considers very high, ranging from 22% to 72%.
- When only one method was used to detect ODR, prevalence findings were lower than when combined with other identification techniques.

ODRs Effects on the Periodontium

One of the critical restorative criteria that must be fulfilled when restoring proximal cavities is marginal adaptation being compatible with

dental and periodontal integrity.[14] Defective marginal adaptation may result in ODRs, potentially increasing the risk of secondary caries and periodontal disease.[14] ODRs have been linked to significant attachment loss, bone loss, less bone density, inflammation, and a deeper pocket.[2,5,6,10,13,15,16] Figure 1 shows a case comparing the bone levels adjacent to an overhanging restoration and a control tooth.[13]

Studies have shown that bulky and irregular overhanging restorations may trigger periodontal diseases through an accumulation of bacterial plaque rather than mechanical irritation.[17] It is essential to early diagnose and treat overhanging restorations to avoid all possible complications. *Highfield and Powell* reported that following the removal of restoration overhangs, the conditions of the periodontal tissues improved significantly.[18]

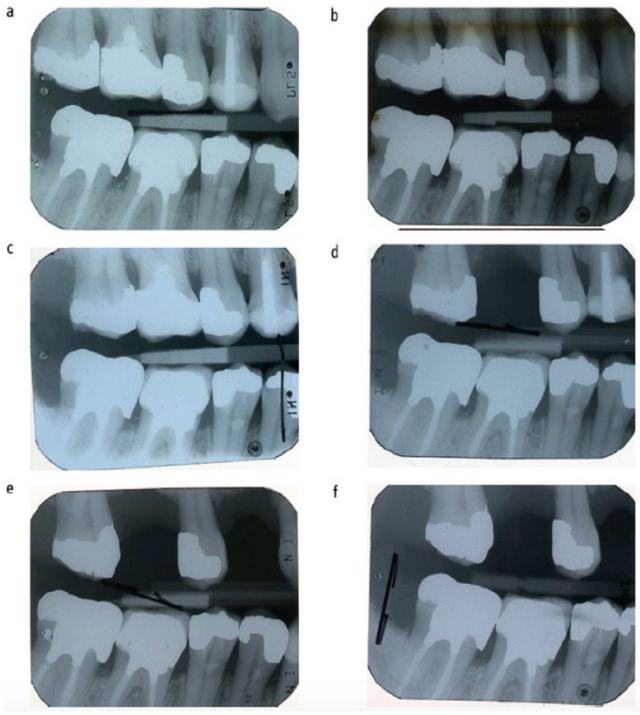

Figure 1. This case shows analysis comparing bone levels adjacent to an overhang and a control tooth. The restoration overhang being studied was the mesial overhang at the 47. The control site was the mesial surface of the 46. The mean change per year for the subject tooth with the overhang was 0.26 mm compared with 0.025 mm for the control tooth.
a) 2001; b) 2005; c) 2006; d) 2009; e) 2012; f) 2013.

ODRs and Recurrent Caries

Secondary caries consider the most common reason for replacing amalgam and composite restorations.[19,20] The presence of ODR is a significant risk factor in the etiology of secondary caries.[20,21] Composite resin has been demonstrated to support and favor the growth of a cariogenic biofilm on their surfaces, potentially increasing the risk of secondary caries in overhanging composite restorations. [21] However, a comparative in vitro and in vivo study by *Ferrari et al.* concluded that a slightly overfilled margin might reduce the microleakage, resulting in reduced secondary caries development.[22] In addition, *Schwendicke et al.* found that the occurrence of overhangs was not relevant in determining the presence of secondary caries.[23] More studies are required to determine whether ODR impacts tooth decay and helps in recurrent caries development.

ODRs Prevention

Establishing a well-contoured proximal surface and a tight proximal contact without overhang is important to maintain a healthy periodontium following teeth restoration and reduce the incidence of recurrent caries. During restorative procedures of Class II cavities, an anatomically contoured proximal wall can be achieved using pre-contoured (sectional or circumferential) matrix bands and dental wedges.[24,25,26,27]

Literature showed that the type of matrix might affect the proximal overhang formation.[24,25,26,27,28] *Loomans et al.*[24] in 2009 and *Chuang et al.*[25] in 2011 both found that the sectional matrices resulted in more overhanging restorations compared to circumferential matrices. However, in more recent studies, *Sadaf et al.*[26] in 2018 *and Shaalan et al.*[27] in 2021 concluded that the use of a sectional matrix band system in Class II cavities resulted in statistically significant optimum proximal contact and reduction of overhanging margins as compared to the use of the circumferential matrix system.[26, 27]

The overhang is also affected significantly by the type and placement technique of the separation ring used with the sectional matrix.[17] The configuration of the ring tines (parallel, divergent, V-shaped), results in a variable adaptation of the matrix band to the tooth surface. The "Triodent" V-Ring had the least amount of overhang.[17,29] This could be explained

by the V-configuration of the tines, which results in a better adaptation of the matrix to the tooth when compared to the other systems. Regarding placement technique, tines positioned "occlusally of the wedge" and "on back end of the wedge" resulted in the least overhang. In contrast, tines positioned "between adjacent tooth and wedge" resulted in a statistically significant higher overhang. [14,17,30]

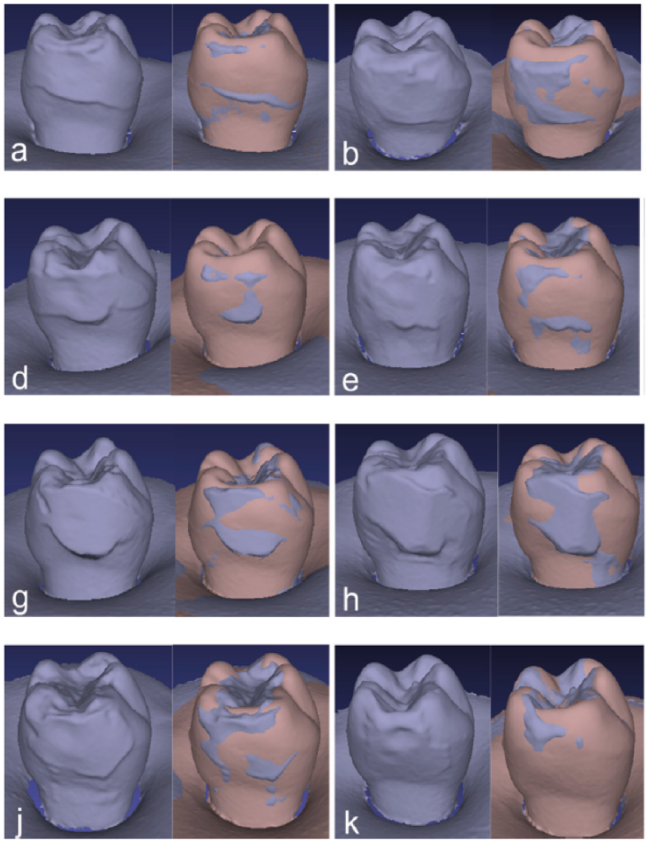

Figure 2. Representative scanned images of approximal surfaces of class II restorations in primary molars.
First row: Tofflemire retainer (a, Filtek Z500; b, Filtek Bulk Fill Posterior).
Second row: AutoMatrix (d, Filtek Z500; e, Filtek Bulk Fill Posterior).
Third row: a matrix band with separation ring (g, Filtek Z500; h, Filtek Bulk Fill Posterior).
Fourth row: a contoured sectional matrix (j, Filtek Z500; k, Filtek Bulk Fill Posterior).

The type of matrix band and wedge may also affect the formation of ODR. *Müllejans et al. and Dinesh et al.* reported that restorations made with metal matrices and wooden wedges resulted in significantly fewer overhanging restorations than transparent matrices and reflective wedges.[31,32] This is probably because the tight adaption can be easily accomplished with thin metal matrices and flexible (wooden or plastic) wedges compared to the use of thick transparent matrices and stiff reflective wedges.[25] Also, *Loomans et al.* found that using a stiff flexible metal matrix band resulted in significantly less marginal overhang than dead-soft metal matrix bands.[24] This could be because the flexible band is more resilient and stiffer. In contrast, the dead-soft band deforms easily, affecting the matrix's adaptation to the cavity floor and resulting in ODR.. [33]

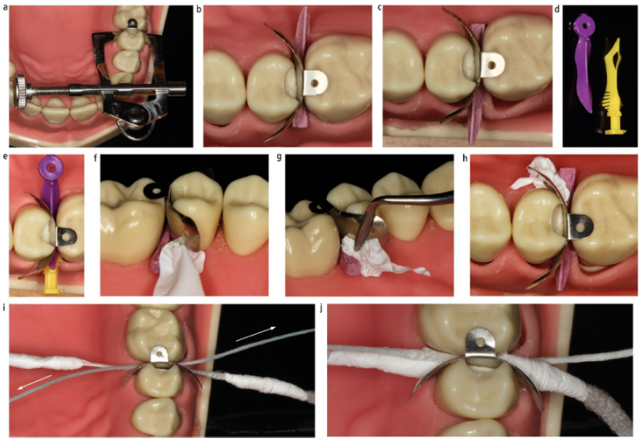

Figure 3. a) Elliott Separator. b, c) Wedge placement direction affecting cervical seal. d, e) Plastic contoured wedges allowing engagement around cervical curvature and synchronous placement from both sides providing improved cervical adaptation. f, g, h) Packing of PTFE tape to provide cervical seal and stabilization of matrix. i, j) Teflon-floss technique. Teflon-floss pulled simultaneously in directions of arrows creating seal.

The effect of different composite materials on marginal adaptation and ODR formation was studied by *Cerdán et al.* on primary artificial molars using different matrix systems.[29] Unfortunately, both types of composite (Conventional incremental nanohybrid composite and Full-body bulk-fill composite) exhibited marginal overhang in the majority of the restorations, with bulk-fill showing a slightly better performance (Figure 2).[29]

Regarding the influence of the composite viscosity, some studies demonstrated that using flowable liner may result in a higher percentage of ODRS compared to packable composite alone.[31,34,35]

However, overhangs caused by flowable composite appeared to be smooth, continuous, and clinically acceptable.[35] Additional studies are needed to investigate the effect of restoration type on overhang formation.

Literature shows that magnifying glasses and Teflon tape help minimize the occurrence of ODRs. Magnification is a simple way to improve the accuracy of dental procedures.[36] *Frankenberger et al.* found that using magnifying glasses reduced the percentage of excess material buildup by as much as 40%.[34]

Other studies found that using Teflon tape can improve the adaptation between matrix band and cavity margins.[14], which results in a minimal excess of the composite at the cavity margins and reduces the finishing time of the restoration (Figure 3).[14, 28]

Ref	Methods of Detection	Type of Restoration	% of Overhangs
Pack *et al.* (1990)	-Intra-oral examination -Bitewing radiograph	Amalgam	56%
Kells *et al.* (1992)	-Bitewing radiograph	Amalgam	25%
Opdam *et al.* (1998)	-Bitewing radiograph -Scanning electron microscopy (SEM)	Composite	In radiographs: 4% In SEM pictures: 43%
Levin *et al.* (2007)	-Bitewing radiographs	Amalgam and composite	3%
Kuonen *et al* (2009)	-Intra-oral examination -Bitewing radiographs	Amalgam and composite	14.1%
Vladimir *et al.* (2012)	-Intra-oral examination -Retroalveolar radiographs	Amalgam and composite	50.83%
Quadir *et al.* (2014)	-Intra-oral examination -Bitewing radiographs	Amalgam	58%
Tavanger *et al.* (2016)	-Intra-oral examination -Bitewing radiographs	Amalgam and composite	36.6%,
Kheyzaran *et al.* (2018)	-Intra-oral examination -Digital panoramic radiograph	Amalgam and composite	22.2%
Najm *et al.* (2018)	-Intra-oral examination -Digital panoramic radiograph	Amalgam and composite	3.2%
Atay *et al.* (2020)	-Digital panoramic radiograph	Amalgam and composite	5%

Table 1. Overhang Prevalence.

Conclusions

The prevalence of overhanging dental restorations shows to be very high, ranging from 3% to 58%. Many factors may contribute to the formation of ODRs, including operator expertise, unusual dental morphology, location, and type of the tooth, and restoration type. ODRs were found to be more common in the distal surfaces of the maxillary molars due to the challenges of indirect sight and limited access to this location during treatment. Operators should take careful consideration when restoring such teeth. Immediate detection of ODR following the restoration can be done effectively using intra-oral examinations in conjunction with a bitewing radiograph.

ODRs have been linked to significant attachment loss, bone loss, less bone density, inflammation, and a deeper pocket. Removing restorative overhang has been shown to enhance periodontal tissue conditions significantly.

In addition, the presence of ODRs is considered a significant risk factor in the etiology of secondary caries, especially with composite restoration, which has been demonstrated to support and favor the growth of a cariogenic biofilm on their surfaces.

The incidence of ODRs may decrease when marginal adaptation improves using stiff flexible metal bands and flexible (wooden or plastic) wedges with sectional matrix and V-shaped separation rings. Teflon tape may also help optimize matrix adaptation to the cavity margins, in addition to use magnifying glasses to enhance visualization of the operating field and improve the quality of work.

Declaration of Interest

The authors report no conflict of interest.

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