Long-term stability of retreated defective restorations in patients with vertical food impaction

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INTRODUCTION

Food impaction (FI) is the forceful wedging of food into the interproximal spaces by occlusal forces during mastication. It may occur in vertical or horizontal directions, with the former being more destructive for the periodontium, and the latter more complicated to treat. However, FI may also occur in both directions at once (mixing pattern). Weak or slightly open tooth contact is the most common iatrogenic factor related to vertical food impaction (VFI) after restoring teeth with proximal carious lesions and a frequent finding in dental daily practice. Failure to reconstruct the original contour, marginal ridge, embrasure, occlusal surface, and cusp inclination are among other iatrogenic variables in this regard. Uneven occlusal wear, loss of proximal contact, extrusion beyond the occlusal plane, congenital morphological abnormalities, and improperly constructed restorations are other known etiological factors for FI. The prevalence of VFI has been estimated between 34% and 65% in posterior mandible compared to 57%–66% in posterior maxilla. Proper proximal contact is crucial to maintaining functionality and stability of dental arch as well as periodontal health. Tightness of proximal contacts is primarily determined by occlusal forces and to a lesser extent, forces from soft tissue, musculature, and periodontal ligament exerted to the dentition. During masticatory function, occlusal forces distribute into the anterior and posterior components of force. Anterior component drives teeth medially as friction wears the interproximal contacts through independent movement of adjoining teeth. The amount of interproximal wear is believed to be dependent on the extent and frequency of the force exerted to the contact by the mesial force vector. As such, the size and location of

Abstract:

Background: Vertical food impaction (VFI) is a common complaint among patients receiving interproximal restorations. However, there is a gap in the literature regarding outcomes of treating defective restorations with VFI. This study sought to determine 10-year stability of retreated defective restorations in patients diagnosed with VFI. Materials and Methods: A total of 150 teeth (75 pair), in 38 patients comprised our study population. All the participants had been diagnosed with VFI due to faulty restorations and treated by means of redoing the restoration to build a stable contact in at least one restored tooth. The criteria for building an optimum dental contact were defined. Demographic characteristics, date and frequency of redoing the restoration, type and material of restoration, number of restored surfaces, occlusal intercuspal relationship, missing adjacent and/or opposing teeth, cemento enamel junction to alveolar crest distance, recurrence of VFI symptoms, recurrent caries, and periapical pathology as well as periodontal variables were recorded. Results: Kaplan–Meier estimator revealed that the mean ± standard deviation of 1, 3, 5, and 10-year stability of reconstructed contacts was 89/2% ± 3/6%, 79/2% ± 5%, 70/7% ± 0/06%, and 66/3% ± 7/1%, respectively. The overall cumulative stability rate was 74/4%. Further analysis predicted that over a 12-year period, restored contacts were stable for 8.86 ± 0.6 years. Cox regression model indicated that having cusp to marginal ridge occlusal relationship (95% confidence interval [CI] for hazard risk (HR) = 1/1–13/9, HR = 3/93), and being over 40 years of age (95% CI for HR = 0/88–17/66, HR = 3/95) were major determinants of contact stability. Conclusions: Long-term stability of retreated and restructured tooth contacts with a history of VFI was 66%–89% in this specific sample.

Key words:

Contact relation, dental restoration repair, food impaction, restoration failure
tooth contacts vary with age, tooth alignment, biting force, and craniofacial growth which in some individuals exceptionally continues beyond adulthood.\textsuperscript{[10]}

Pain, bleeding gums, and halitosis are the most prevalent patient complaints along with FI around faulty restored teeth.\textsuperscript{[7]} Subsequently, secondary caries, gingival abscess formation, periodontal pocket, and interdental bone loss occur if FI is left undiagnosed and/or not treated appropriately.\textsuperscript{[10,12]} Patients usually get momentarily relieved of pain and pressure in the area after using a toothpick, proximal brush, or dental floss. Frequent use of interdental aids causes frustration for the patients and aggravates the existing irritation.

The treatment of VFI is planned according to its etiology. That said, the results are often nonpredictable as the recurrence of previous symptoms at a point after treatment is an often familiar scenario. The treatment of iatrogenic cases usually includes proximal surface recontouring, occlusal surface recuring, creating shallow fossa, and groove to facilitate food escape as well as eliminating any marginal ridge discrepancy in adjoining teeth.\textsuperscript{[13,14]}

Despite the fact that the diagnosis and treatment of VFI is an inevitable task for every dentist at a time during their profession, there is limited information about a long-term stability of treated contacts and recurrence of VFI symptoms jeopardizing patient satisfaction. This study sought to determine the 1, 3, 5, and 10-year stability of reconstructed inter-proximal tooth contacts of faulty restorations in patients suffering from VFI.

**MATERIALS AND METHODS**

In this retrospective study, files of 2830 patients referring to a private dental clinic between December 2005 and January 2016 were reviewed. One hundred and forty-one patients had VFI out of which, 38 patients providing 150 teeth (75 contacts as the study population), were eligible to participate. Participants signed an informed consent upon entry. The study was approved by the ethics committee of the Guilan University of Medical Sciences which adheres to the declaration of Helsinki guidelines. The following inclusion criteria were applied with no sex or race restrictions: Having been diagnosed with VFI (by a single clinician examiner at the private clinic) due to faulty restoration and treated by means of redoing the restoration to build a stable contact in at least one restored tooth. All procedures being performed either by a specialist or an experienced general dentist (minimum 10-year experience). Composite restorations were redone by incremental technique. Amalgam restorations were redone by classical technique using tofflemire matrix band. Exclusion criteria comprised any tooth malposition (rotation, drift, tilt) abnormality in the size and/or shape of the tooth, presence of a plunger cusp, and mobility in either one of the teeth in the assigned contacts.

Eligible patients were contacted by phone and underwent clinical examination by a single, blinded examiner. To clinically check the interproximal area for any food remnants, patients were asked not to brush or floss after the meal right before their visit and only do a water rinse. Tightness of proximal tooth contact was checked by the conventional method using dental floss (GUM unwaxed, Sunstar Americas Inc., Chicago, IL, 60630, USA), where a normal contact allows floss to pass with a snap.\textsuperscript{[15,16]}

A questionnaire was used to record demographic data as well as date of redoing the restoration, type and material of restoration (amalgam, composite resin, gold, inlay, onlay, full crown), number of restored surfaces, occlusal intercuspal relationship (cusp to fossa or to marginal ridge), any missing in the adjacent and/or opposing teeth, distance from cemento enamel junction (CEJ) to alveolar crest at baseline (time of the first restorative correction) using parallel periapical radiography in the patient’s file, recurrence of VFI based on patient report, recurrent caries in the assigned teeth, and any periapical pathology. Periodontal variables including gingival index (GI, Löe and Silness), bleeding on probing (BOP, Ainamo and Bay), probing pocket depth (PPD), and clinical attachment level (CAL), were also recorded by the same examiner. Finally, parallel periapical radiographs were taken from the allocated teeth.

In a clinical examination with dental floss, interproximal contact was considered normal based on the amount of force needed to pass the dental floss through the assigned contact compared to the adjacent or contralateral intact contacts. The contact was assumed to be stable when gingiva was free of inflammation (GI: 0–1), without BOP, PPD ≤3 mm, and the patient did not report any symptoms of VFI or postmeal discomfort in the area. On the other hand, a failed or unstable contact was detected when dental floss collected remaining food from the corrected interproximal area and patient complained about recurrence of VFI and frequent need for cleaning the contact area, regardless of concomitant periodontal involvement. Data were analyzed using SPSS version 21 (SPSS Inc. Chicago, IL, U.S.A.) software. Kaplan–Meier test was used to explore the stability of reconstructed contacts, Tarone-Ware for comparing stability related to demographic and dental/periodontal variables, and Cox regression model for determining the predictive factors of contact stability. Moreover, Chi-square test was used to determine whether there is a significant difference between the expected frequencies and the observed frequencies in one or more categories. \( P < 0.05 \) was assumed to be statistically significant.

**RESULTS**

The study data showed that out of 2830 patients referring to the private reference clinic, 141 patients (5%, mean age: 42.7 ± 10.9 years), had FI (288 interproximal areas in 576 teeth). Overall, FI was found 63.2% in the upper jaw, 36.8% in the lower, 51.7% on the left side, and 48.3% on the right. The study sample comprised of 150 teeth (75 contacts) in 38 patients (mean age 42.5 ± 9.9 years), had FI (288 interproximal areas in 576 teeth). A flow diagram of participants is presented in Figure 1. The assigned teeth were free of recurrent caries, periapical pathology and mobility and were restored either with porcelain fused to metal crown (33.3%), amalgam (58%), or composite (8.6%). The restored surfaces were 28.6% disto-occlusal, 28.6% mesio-occlusal, and 42.9% mesio-occluso-distal. Six teeth (4%) had received complete crown build up. One-third of the teeth had undergone root canal treatment. At the diagnosis time point, 5 (6.6%) contacts (ten teeth) had marginal ridge discrepancy.

Radafshar, et al.: Long-term results of retreated defective contacts

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At the examination time point, 52 (69.3%) contacts had normal tightness out of which, 13 (41.9%) reported recurrent symptoms of VFI and the remaining 39 (88.6%) did not. Three (4%) contacts were very tight, and 20 (26.7%) were open. Among 20 open contacts, 17 (54.8%) were associated with the recurrence of VFI symptoms versus 3 (6.8%) having VFI without any sensation of recurrent symptoms (Chi-square test, \( P < 0.0001 \)). Thirty-three contacts (44.2%), had cusp-fossa, and 42 contacts (55.8%), had cusp-marginal ridge occlusal relationship.

Overall, 20% of sites had BOP with various degrees of gingival inflammation. At the examination time point, GI, PPD, and CAL were significantly lower for normal contacts than tight or open contacts [Table 1]. Periodontal characteristics of the allocated teeth are shown in Table 2. Paired \( t \)-test revealed significant difference in the CEJ-alveolar crest distance from baseline to the examination time point for the assigned teeth [Table 2]. Moreover, such difference was significantly higher in symptomatic versus asymptomatic contact areas (independent \( t \)-test \( P = 0.007 \)).

Table 3 reveals frequency distribution of unstable contacts by patients’ report of recurrent FI symptoms. Out of 75 interproximal contact areas over 10 years, 20 were repaired two times, 3 were restored three times and 52 interdental areas were restored once. Out of 20 interdental areas with a twice repair history, 11 showed recurrence of FI. Out of 3 interdental areas with three-times repair history, 2 showed recurrence of FI, and from 52 interdental areas with one-time repair history, 19 showed recurrence of FI.

Missing adjacent contact (either mesial or distal) to the assigned contacts was seen in 38 (24 distal missing and 14 mesial missing) out of 75 contacts. Nineteen contacts out of 38 (50%) received new restoration due to contact instability (Chi-square test, \( P = 0.05 \)).

Table 4 shows variables significantly contributing to the stability of reconstructed tooth contacts. Stepwise Cox regression model entering variables with \( P \) values between 0.05 and 0.1, showed that the type of occlusal relationships and patient age were predictive factors for the stability of reconstructed tooth contacts. In this regard, having cusp to marginal ridge occlusal relationship increases the risk of contact failure to 3/93 folds (95% confidence interval [CI] for hazard risk (HR) = 1/1–13/9 HR = 3/93), and being over 40 years increases the risk of failure to 3/95 (95% CI for HR = 0/88–17/66 HR = 3/95). Missing a mesial contact did not remain in the model. In the same way, factors such as type of restoration, missing adjacent and/or opposing teeth, CEJ to alveolar crest distance, and any other assessing variables did not show significant effect on the stability of reconstructed contacts.

The survival rate analysis and Kaplan–Meier estimator revealed that the 1, 3, 5, and 10-year stability of the reconstructed contacts were 89/2% ± 3/6%, 79/2% ± 5%, 70/7% ± 0/06%, and 66/3% ± 7/1%, respectively [Figure 2]. The overall mean stability was 74/4%. Kaplan–Meier analysis further predicted that over a 12-year period, restored contacts were stable for 8.86 ± 0.6 years (stability rate: 66.3% ± 7.1%).

**DISCUSSION**

In this 10-year retrospective study, we reviewed files of patients who had VFI as their chief complaint after receiving tooth restoration. Restorations had been re-treated to overcome VFI with records of several follow-up sessions for checking
Table 1: Frequency distribution of periodontal variables related to contact tightness

| Contact tightness | n  | GI | Mean±SD | P  | PPD | Mean±SD | P  | CAL | Mean±SD | P  |
|------------------|----|----|---------|----|-----|---------|----|-----|---------|----|
| Normal           | 52 | 52 | 0.40±0.72| 0.001 | 2.92±0.65 | 0.0001 | 4.10±0.85 | 0.011 |
| Tight            | 3  | 3  | 1.67±1.53|       | 4.00±1.00 |       | 5.33±1.53 |       |
| Open             | 20 | 20 | 1.05±0.89|       | 3.65±1.09 |       | 4.80±1.36 |       |
| Total            | 75 | 75 | 0.63±0.87|       | 3±0.87.16 |       | 4.33±1.08 |       |

1Kruskal-Wallis test, 2ANOVA. PPD – Periodontal pocket depth, CAL – Clinical attachment level; GI – Gingival index; P – P value; n – Number of contacts; SD – Standard deviation

Table 2: Periodontal characteristics of the assigned teeth with vertical food impaction

| GI score         | n (%) | PPD (mm) | CAL (mm) | CEJ-AC/B | CEJ-AC/E | P
|------------------|-------|----------|----------|----------|----------|----
| 0-1              | 60 (80)| 3.16±0.87| 4.33±1.08| 2.73±0.92| 3.03±0.85| P=0.0001
| 2-3              | 15 (20)|          |          |          |          |    

*Significant level <0.05. CEJ-AC/E – CEJ to alveolar crest at the examination time; SD – Standard deviation; GI – Gingival index; PPD – Periodontal pocket depth; CAL – Clinical attachment level; CEJ-AC/B – CEJ to alveolar crest at baseline; P – P value; n – Number of contacts

Table 3: Frequency distribution of unstable contacts by recurrence of food impaction symptoms

| Contact reconstruction | Recurrence of VFI symptoms | Total |
|------------------------|----------------------------|-------|
|                        | Yes | No |       |
| Once, n (%)            | 19  | 33 | (63.5) |
| Twice, n (%)           | 11  | 9  | (45)   |
| >Twice, n (%)          | 2   | 1  | (33.4) |
| Total, n (%)           | 32  | 43 | (57.3) |

VFI – Vertical food impaction; n – Number of contacts

Clinical experiments depict that loose or open proximal contact initiates local pocket formation or contributes to the progression of periodontal disease and subsequent bone loss. The present study showed that alveolar bone loss occurs in sites with VFI. Although failed contacts had been replaced at recalls, repeated treatment and manipulations may have had adverse effects on the periodontium. Hancock et al. suggested that the contact type per se, did not jeopardize periodontal health although favoring VFI was the key influencer for increased pocket depth and periodontal pathosis related to any contact type in their study. In line with our findings, Koral et al., reported 2.4% less relative bone height in sites with open contact compared to the contralateral normal contacts. In contrary, Byun et al. showed that loss of proximal contact significantly contributed to VFI, but not to periodontal/peri-implant conditions. We found that 15 (20%) out of 75 contacts had moderate-to-severe gingivitis and BOP. Hancock et al. reported that 841 (80%) out of 1040 contacts with VFI had moderate-to-severe gingival inflammation (GI score >2). The difference may be attributed to a smaller sample size and also history of redoing the faulty restorations in our study which may have reduced the adverse effects of VFI. To achieve more stable outcome in prevention and management of VFI, it is important for the dentist to take a holistic approach to each case. Considering etiology at the central core, other factors such as age, occlusal pattern, periodontal condition, and integrity of dentition should be regularly checked. They may cause subtle changes leading to recurrence of VFI and contact failure.

CONCLUSIONS

Stability of retreated defective restorations in patients with VFI was 66%–89% within a 10-year time frame. Patient age and
cusp-marginal ridge occlusal contact were predictive factors for contact failure in our specific sample. Periodic evaluation of dental restorations involving proximal surfaces with special attention to patient age, and occlusal pattern is recommended.

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**Conflicts of interest**

There are no conflicts of interest.

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