Successful Dental Implant Placement Surgeries With Buccal Bone Fenestrations

Liviu Steier, Dr.med.dent¹*
Gabriela Steier, JD²

This is the first comprehensive review of the classification, preventative measures, diagnosis, treatment methods, and determination of success criteria of buccal bone plate fenestrations (BPFs) secondary to posterior implant surgeries. The purpose of this review is to present and discuss the current literature from peer-reviewed journals, recent studies, and international implantology guidelines and to provide practitioners with guiding points to identify and understand whether BPFs are complications or accidents of implant surgeries. In addition, this review sets forth a detailed set of criteria for the evaluation and diagnosis of BPFs and for the subsequent classification of BPFs as either complications or accidents of posterior implant surgeries. From the literature analyzed, it is clear that BPFs are disqualified from the class of implant treatment failures because BPFs neither impair nor significantly delay treatment. A comprehensive outline of preventative measures and surgery aids to avoid fenestrating the buccal bone plate during implant placement, and a variety of repair methods are included in this review. Considerations of treatment outcomes and patient sensitivities are also included in this comprehensive review.

Key Words: implant placement, buccal bone plate fenestration, surgical accident, surgical complication, surgical procedure failure

BACKGROUND

The purpose of this study is to present and discuss the current literature regarding fenestrations of the buccal bone plate during implant placement surgeries. This study is a review of current literature published in peer-reviewed journals. The objective is to “report the current knowledge on a topic and base this summary on previously published research” to “provide[e] the reader with a comprehensive overview [that] helps [to] place that information into perspective.”¹(p103)

The goals of this review are the following

1. Classify buccal bone fenestration as 1 of 3 outcomes: (a) a complication, (b) an accident, or (c) a surgical procedure failure.
2. Identify and discuss strategies to avoid buccal bone fenestration at implant placement.
3. Document and describe clinical pathways to identify buccal bone fenestration during implant placement and the subjective symptomatology as perceived by the patient.
4. Present repair modalities after buccal bone fenestration that occurred during implant placement.
5. Discussing criteria for determining treatment success after implant placement.

METHODS

Initially, a database search of the National Library of Medicine (NLM) was performed. The NLM has indexed the biomedical literature since 1879, which was included in its entirety in the search. Nonetheless, the focus of the subsequent research was on more recent publications from the past 3 decades. Due consideration was given to all relevant papers on point.

In addition, PubMed is a database of bibliographic information that is part of the NLM databases. Each search complied with the general requirements to use a controlled vocabulary. In addition, search blocks were composed into terms combined by Boolean operators to narrow the search down into more specific subsearches. For the reason that not all journals on implant dentistry are listed in PubMed online, and to ensure a comprehensive overview of all peer-reviewed journals, an additional manual journal search of individual journals’ databases outside of PubMed was also performed, thereby completing the list of results for the scientific evaluation in this study.

Journals

The following journals on implant dentistry, which are outside the scope of PubMed, were manually searched for this study: Implant Dentistry, Journal of Applied Oral Science, Implants.

Correspondingly, the following key words, MeSH terms, and blocks were used to perform the PubMed search: adverse reactions, surgical procedure complications, surgical procedure accidents; surgical procedure failures; complications AND (Boolean operator) dental implants placement; accidents AND (Boolean operator) dental implants placement; buccal bone plate fenestration; buccal bone fenestration AND (Boolean operator) identification; buccal bone fenestration AND (Boolean operator) prevention; retreatment modalities AND (Boolean operator) buccal bone fenestration; and treatment planning AND (Boolean operator) buccal bone fenestration.

¹ Warwick Dentistry, Endodontics, Coventry, United Kingdom.
² Food Law International, LLP, Md.
* Corresponding author, email: lsteier@gmail.com
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Bone fenestrations rarely occur during implant placement surgeries. In the context of such fenestrations, however, it is important to determine why the fenestration occurred and to differentiate between a complication, an accident, and a failure to determine whether a fenestration falls into one of the 3 categories, each of which is defined below. The key difference lies between the occurrence of such a fenestration as either a complication or an accident, on one hand, or a treatment failure, on the other hand. Notably, the literature is clear on the fact that if the fenestration is a complication or an accident, it was an unpredictable treatment result and not a failure of the surgeon’s therapeutic work.

**Classification of Buccal Bone Fenestrations**

**Terminology**

Bone fenestrations in the natural dentition before addressing the corresponding terms in the context of implantology. A dehiscence, in the natural dentition, is defined as “a defect in the vertical direction from the alveolar crest of the bony covering of the root.” Generally, as defined by *Stedman’s Medical Dictionary*, a fenestration is “an opening in the surface of a structure.” Muller et al defined a fenestration “as a circumferential perforation in the vestibular or lingual plate of the alveolar process.” Dehiscences and fenestrations in natural dentition are a result of physiologically reduced buccal bone plate thickness and related to the vertical growth pattern. Numerous authors studied the occurrence of fenestrations and dehiscences in the natural dentition and found that 69.565% of the 138 studied skulls aged 21 to 54 years presented fenestrations, with 74.679% located in the mandible and 71.613% in the maxilla. Thus, dehiscences and fenestrations also appear in the natural dentition and support the conclusion that their natural occurrence is merely by reason of anatomy and physiology.

**Fenestration of the buccal bone plate in implantology**

In implant dentistry, a fenestration is defined as “a vestibular or linguopalatal defect” or “as an expression of a bone thickness deficiency that creates partial exposure of an implant that is completely surrounded by bone.” This means that a buccal fenestration occurs when the implant partially protrudes through an opening in the intact bone plate on the cheek side, the buccal side. There are 2 classes of fenestrations that occur in implant dentistry, class one and class two fenestrations. A class 1 fenestration is a minor penetration of the implant through the intact bone plate. A class 2 fenestration is the formation of a convexity enclosing a “significant portion of the implant . . . exposed.” The distinction between these 2 classes of fenestrations is important because they call for different repair measures.

The following discussion shows that even the peer-reviewed literature is split on whether a bone fenestration, as described above, is a complication or an accident. More importantly, however, the literature unanimously shows that a fenestration is not a failure and, as such, occurs independently of the surgeon’s treatment. In other words, fenestrations in implant dentistry can still occur as part of a successful treatment and implant placement surgery. This study shows why all of the peer-reviewed publications on point explicitly confirm that fenestrations, which are usually categorized as either unfortunate complications or unpredictable accidents, do not preclude successful treatment. As described above, fenestrations are usually categorized as accidents or complications of successful implant placement surgeries. Each is explained below.

**Accidents associated with dental implant placements**

The general definition of an accident is “an unforeseen and unplanned event or circumstance. Lack of intention or necessity—chance.” Correspondingly, in implant dentistry, accidents during dental implant placement are described as unplanned events that occur independently of intention, necessity, and success. In the article by Annibali et al titled “Local Accidents in Dental Implant Surgery: Prevention and Treatment,” the authors classify at the outset that fenestrations accidents are accidents or complications of adequate treatment. In the body of the article, Annibali et al propose a differentiation of accidents and complications into 3 groups: (1) accidents, (2) early complications, and (3) late complications. Most importantly, “dehiscences and bony fenestrations,” synonyms for the same occurrence, were categorized in the group “accidents.” Thus, the very nature of a fenestration in implant dentistry excludes the possibility of classifying such an occurrence as a treatment failure. Even on the most elemental level of defining terms, fenestrations fall under successful treatment occurrences and are, moreover, excluded from listings of failures.

**Complications associated with dental implant placements**

*Webster’s Dictionary* defines a complication as “a difficult factor or issue often affecting a planned, or unplanned event or circumstance. Lack of intention or necessity—chance.” Correspondingly, Misch et al in their article “Implant Surgery Complications: Etiology and Treatment,” define the fenestration of the cortical bone plate as a treatment complication that is “anatomy related.” This means that the natural anatomy of the bone plate makes the occurrence of a fenestration during implant placement more or less likely, but it remains inherently unpredictable. It is only upon the actual placement of the implant that the unpredictable fenestration occurs. Misch et al provide 1 major reason for the occurrence of fenestration, namely, bone plate thickness deficiency. Bone plate thickness deficiency means that the bone plate has no uniform width, which is unintelligible on a 2-dimensional X ray. In accordance with Misch et al, Pelayo et al also classified buccal bone plate fenestrations (BPFs) as treatment complications. Thus, such buccal BPFs are clearly in the accident or complication category and not failures. This confirms the unpredictability and unpreventability of fenestrations from the surgeon’s point of view. Nonetheless, failures are defined below for clarification.
Rare qualifications of implant surgeries as failures

Failure is generally defined as the lack of success. The international implantology guidelines (ICOI), at the Consensus Conference in Pisa in 2008, set forth the “Health Care Scale for Dental Implants,” which classifies the degree of health care and sustainability of an implant. Implant placements are thus classified by the ICOI as follows: (1) success, (2) satisfactory survival, (3) compromised survival, and (4) failure. The fourth category, implant failure, is defined by pain on function, implant survival, (3) compromised survival, and (4) failure. The fourth classified by the ICOI as follows: (1) success, (2) satisfactory sustainability of an implant. Implant placements are thus Dental Implants,” which classifies the degree of health care and complications as either complications or accidents and as an irrelevant complication of implant surgery.

Avoiding Buccal Bone Fenestration During Implant Placement

Prior to beginning the implant placement in the lower jaw (mandible), the prudent practitioner determines whether the bone can accommodate the implant. First, a 2-dimensional X ray is taken of the location where the implant is to be placed. This X ray serves as evidence that the patient has adequate bone height to accommodate the implant. Then, to determine adequate thickness of the bone, the experienced practitioner palpates the jawbone. Together with the X ray’s identification of the bone height and the palpation of the bone thickness, the practitioner determines whether the bone can accommodate the implant.

As an important requirement “for proper integration and tissue health,” according to Wood et al17 the implant must be at an adequate distance to the natural tooth. The literature review by Wood et al identified the determination of this distance as “evidence based treatment planning for dental implants.” The reason for this preoperative examination is that the surgeon ensures a welcoming bone for the planned implant placement.

While the aforementioned preparatory steps are sufficient to proceed with the surgery, there are also guided surgery approaches available to help ensure proper placement of the implant. Guided surgery describes the clinical approach in which a stent is built for future implant location. Surgical stents for single implant placement find an indication in the esthetic zone16 (ie, for incisor and canine implants). Conforming to this analysis, Marcelis et al18 justified the use of guided surgery for single implant placement “particularly in the aesthetic zone.”

The major shortcoming of surgical stents, however, is the possible loss of axial direction when drilling for the implant placement. Hence, Naitoh et al19 researched whether implants can be correctly angulated using such surgical templates and concluded that the average angulation between the proposed and the actual direction of the implant placement diverged by 5.0°. Therefore, even with guided surgical approaches, an axial misaligning of implant drilling may occur, which leads to complications, such as buccal bone fenestrations. On the same note, guidelines and indications for the use of surgical stents with single implant placement for the posterior mandibular were not met within the literature. The use of either model- or CT-based surgical stents led to an implant success rate of 98.1% according to Marcelis et al18 and Schneider et al20. This means that even guided surgery yields a significant misalignment rate of 1.9%. Therefore, guided surgical approaches are neither a viable alternative nor an effective precaution to posterior complications of implant placements.

In addition to the implant angulation insecurity despite the use of surgical stents in guided implant procedures, the mouth and lip openings are also major limiting forces in the practitioner’s flexibility in procedure choices. For ideal implant angulation and placement, the surgeon naturally needs a certain flexibility of vertical movement to slide the burr into the guide sleeve of the surgical stent (ie, to direct the burr’s angulation). This difficulty is acknowledged by the industry and the innovations and clinical tools to help the surgeon to maneuver these delicate guide sleeves. The vast selection of the so-called Pilot SurgiGuide, for example, is helpful to the extent that the mouth and lip opening accommodated the guide sleeves and the corresponding burrs. Logically, the narrower the individual patient’s mouth and lip openings, and the further posterior the implant location, the smaller is the likelihood that guided surgery is helpful. In posterior molars, guided surgeries are therefore usually not indicated. Experience dictates that guide sleeves are superfluous props for posterior molar implant placement. Even laterally accessible guide sleeves and burr templates provide no benefits for implant surgeries of posterior molars in any mouth and lip openings because there is too little flexibility of movement for the surgeon.

An alternative to guided surgery approaches and a more precise tool to ensure the correct drill distance for the implant placement is a distance holder, namely, the Implant Guiding System by ITI. This distance holder allows the surgeon to maintain the adequate and precautionary distance between the implant placed and the adjacent tooth. Conforming to the highest standard of care, a cone beam computerized tomography (CbCT) is the most scientifically sound method of determining that the proper distance was kept between the implant and the adjacent tooth. Keeping this distance is important, and the CbCT provides 3-dimensional proof and
measurements that allow an unambiguous finding of proper placement. Accordingly, the showing of an intact and unharmed adjacent tooth next to a former implantation site is conclusive evidence that the surgeon maintained the proper distance from the tooth when the implant was placed. The more time passes after the implant was placed next to the healthy tooth, the clearer the evidence that the surgeon’s procedure was successful. Several clinical methods are available to help determine the success of such implant placements.

**Clinical Methods of Identifying Buccal Bone Fenestrations During and After Implant Placement**

This section describes and discusses the pathways to identify buccal bone fenestrations during implant placement in the clinical setting. Diagnosis of such fenestrations can be accomplished at 2 stages: (a) as early as upon implant placement during the surgery or (b) delayed during recall appointments of the implant patient. In addition, such diagnosis may occur in 1 of 3 different methods: (1) via tactile palpation, (2) through the finding of a hemorrhage upon visual inspection of the mouth, and (3) on a three-dimensional x-ray after the implant was placed. Subpoints 1 to 3 fit within the framework of point (a) above, the diagnosis of fenestration upon implant placement. Only tactile palpation and the 3-dimensional X-ray (points 1 and 3) fit within the framework of point (b) above, because no bleedings can occur in this context after the surgery has been completed. Each of these diagnostic steps is explained hereinafter.

If the buccal BPF occurs during the implant placement surgery (see point [a] above), the surgeon could feel the fenestration only when palpating the implant site if it is a class 2 fenestration according to the classification system of Tinti et al8 from the “Avoiding Buccal Bone Fenestration During Implant Placement” section above. The surgeon, however, would not be able to find a class 1 fenestration upon palpation of the implant site because such fenestrations do not arise to a convexity of the bone that could be manually felt. Corresponding to subpoint 2 above, the finding of a hemorrhage could occur only if there is a perforation of the buccal mucosal tissue. If no such perforation exists, a surgeon cannot diagnose a fenestration.

The visual inspection described in subpoint 2 is performed under extensive flap elevation (ie, reflection of the mucosa to expose the underlying buccal bone plate). Extensive flap elevation is associated with a high surgical morbidity and may sometimes lead to perceptions that the patient subjectively describes as swelling and pain. Objectively, however, postoperative complications of extensive flap elevation are hard tissue (bone) resorption caused by a reduction in blood supply. Today, minimally invasive surgical approaches often call for flapless surgery. Logically, then, when there is no extensive flap elevation, visual inspection is not a viable approach to diagnosing bone fenestrations. Visual inspection finds application only in cases of extensive soft-tissue flap elevation.

Flapless surgery is beneficial for a variety of reasons that go far beyond the mere visual diagnosis of the rare occurrences of bone fenestrations. For example, Brodala21(p119) identified the following benefits of flapless surgery: “(1) reduction of complications at the patient level, ie, [sic] swelling and pain, (2) reduction of intraoperative bleeding, (3) reduction of surgical time and need for suturing, (4) preservation of soft and hard tissues, and (5) maintenance of blood supply.” All of these benefits facilitate the successful integration of an implant in the jawbone. Moreover, these positive effects greatly outweigh the need for extensive flap elevation for diagnostic purposes of rather rare surgical complications, such as fenestrations during implant placement.

Postoperative 3-dimensional X-ray imaging is the third method of diagnosis of bone fenestrations, but it is not a desirable one because the patient would be exposed to unnecessarily high levels of radiation without cause. The use of 3-dimensional X-ray diagnosis for solitary implant placement, in cases lacking major adverse effects to the surgery, interferes with the set guidelines for such irradiation. The European Association of Osseointegration published binding guidelines for diagnostic imaging in implant dentistry. These guidelines were published by Harris et al22 and describe when the use of 3-dimensional X-ray diagnosis is, in fact, indicated, which is beyond the scope of this study.

In addition to the early diagnosis under subpoint a (above), delayed diagnosis of fenestrations (subpoint b) is also possible. Such delayed diagnosis of buccal BPF can be performed at maintenance recall sessions. When the patient returns to the surgeon for follow-up appointments, the surgeon has the opportunity, through visual inspection, to determine whether fenestrations occurred. Naturally, the patient needs to comply with follow-up and recall appointments to ensure successful postoperative care, which the surgeon can provide.

**Repair Methods of Buccal Bone Fenestrations**

There are 3 ways by which buccal bone perforations can be repaired: (1) by simply removing the protruding part of the implant, (2) through guided bone regeneration, or (3) through guided tissue regeneration. The first option is the preferred one because it is minimally invasive, it can be performed at no charge to the patient, and it has no effect on the continuance of the treatment. Accordingly, Buddula et al23 demonstrated that a simple removal of the implant tip leads to a smooth and uncomplicated continued healing of the involved implant so that it can be used soon after surgery. Of the 3 alternative treatment options to repair a buccal bone fenestration, option 1 is the least invasive alternative, which also causes the least amount of discomfort to the patient. An added benefit of this first alternative is that it causes virtually no interference with the continuation of the treatment. Thus, whenever possible, the prudent surgeon will choose this first option.

Both options 2 and 3 are more comprehensive treatments, which may cause significantly more discomfort and cost for the patient. Regeneration of bone and soft tissue, namely, the gum, are established medical procedures to replace and regenerate a lack of bone and soft tissue in general. More specifically, in implant dentistry, the regeneration and creation of bone in areas where it is lacking is usually performed through guided bone regeneration procedures. Vlassis et al24 Simion et al25 Annibali et al,9 and Steigman and Wang26 show alternative
treatment options to the very promising first option to remove the implant tip. Correspondingly, such regeneration procedures of the gum in areas where this is lacking are performed by guided tissue regeneration. Therefore, both of these options of regeneration are applicable to flapless surgeries immediately following extraction and implant placement in one session but not in situations in which the implant placement occurs at 2 different time-delayed sessions. All of these aforementioned reasons assist in the surgeon’s process of choosing one option over the other.

CRITERIA FOR DETERMINING TREATMENT SUCCESS AFTER IMPLANT PLACEMENT

Treatment success in implant surgery cases is independent on the occurrence of a bone fenestration because the fenestration does not deny the stability and therapeutic efficiency and adequacy of the implant. A primary stable dental implant is a treatment success when it shows no mobility, no radiographic bone loss, and no exudate (pus) and when it is considered to be integrated into healthy bone (osseointegration). Repair modalities for the buccal bone fenestration have been described above, but at this time, it is important to note that a fenestration is by no means an indicator of treatment failure.

As explained in the “Classification of Buccal Bone Fenestrations” section, in the discussion of what constitutes a treatment failure in implant placement surgeries, the ICOI’s authoritative and binding “Health Care Scale for Dental Implants” describes what a failure is in subpoint 4. According to the ICOI’s authoritative success scale ranging from (1) success, (2) satisfactory survival, (3) compromised survival, to (4) failure, dental implants with buccal bone fenestrations are considered to be “optimum health” and a treatment success when it shows no mobility, no radiographic bone loss, and no exudate (pus) and when it is considered to be integrated into healthy bone (osseointegration). Repair modalities for the buccal bone fenestration have been described above, but at this time, it is important to note that a fenestration is by no means an indicator of treatment failure.

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remains healthy and intact, even years after the implant surgery. Thus, in posterior molar implant placement, guidance props are worthless because the best approach to ensure and document proper implant alignment comes from CbCT imaging.

The “Clinical Methods of Identifying Buccal Bone Fenestrations During and After Implant Placement” section describes and discusses the clinical methods of identifying buccal bone fenestrations during and after implant placement. Such identification, as mentioned above, is possible upon implant placement during the surgery in only class 1 fenestrations or, later, during recall appointments of the implant patient in both classes of fenestrations. The 3 different methods to identify and diagnose fenestrations are via tactile palpation, through the finding of a hemorrhage upon visual inspection of the mouth, and on a 3-dimensional X ray after the implant is placed. Only if the patient complies with postoperative care guidelines and reports to the surgeon for follow-up appointments can the surgeon actually diagnose and treat the fenestrations if they occur. Without the patient’s cooperation and regular presentation to the treating practitioner, minor complications and accidents of implant surgery cannot logically be diagnosed or alleviated.

The “Repair Methods of Buccal Bone Fenestrations” section describes the 3 repair methods of buccal bone fenestrations, namely, by simply removing the protruding part of the implant, through guided bone regeneration, or through guided tissue regeneration. Of the 3 options, the first is the least invasive and most beneficial alternative for the patient’s well-being. This first option is also the preferred one because it can be performed at no additional charge to the patient and has no effect on the continuance of the treatment. Only the first option avoids a delay in treatment time and the postoperative healing period. Therefore, this noninvasive option promotes a continuous healing process and recovery time for the implant patient. As mentioned above, the prudent and experienced practitioner would undoubtedly gravitate toward this alternative whenever possible.

Finally, the “Criteria for Determining Treatment Success After Implant Placement” section outlines the criteria for determining treatment success after implant placement surgeries and includes treatment outcomes with fenestrations into the primary success category. The ICOI’s authoritative and binding “Health Care Scale for Dental Implants” describes that a treatment is considered to be integrated fully into the healthy bone, it is satisfactorily and effectively functional and thereby restores the patient’s chewing ability and oral health within the scope of the treatment. According to these findings, a buccal bone fenestration must not be mistaken as an indicator of treatment failure because the ICOI established that it is merely a side effect in an otherwise successful dental implant.

**CONCLUSION**

This study set out to present and discuss the current literature regarding fenestrations of the buccal bone plate during implant placement surgeries. The above sections provide a comprehensive review of the current literature in classifying, diagnosing, and treating fenestrations as either complications or accidents, on one hand, and rule out the occurrence of a fenestration as a treatment failure, on the other hand. In sum, the findings of this study and the extensive review conclusively prove that a buccal bone fenestration is part of a successful treatment process. As the discussion shows, fenestrations of the buccal bone are unpredictable anatomical occurrences that the most up-to-date precautions are unable to prevent. Nonetheless, such fenestrations are rare and cause no major impediments to the compliant and cooperative patient’s well-being and healing prospects.

Although there are distinctions between class 1 and class 2 fenestrations that each call for different treatment methods, the literature clearly identifies which treatment methods are indicated for buccal bone fenestrations. The aforementioned analysis and evaluation of each of those approaches reveals the most promising treatment outcomes and predicts the most common fallacies of each alternative to treat patients with fenestrations. Accordingly, the ICOI’s success vs failure criteria are applied to each fenestration class along with the evaluation of the corresponding repair methods. All of the above emphasize that a fenestration is ruled out to be a failure and is rather a side effect of successful implant placement surgeries and that fenestrations are independent from surgical precautions and skills. Even though fenestrations are rare, effective treatments and elaborated literature are available to assist in the recovery for patients with such fenestration reactions to the osseointegration of implants into the jaw bone.

**ABBREVIATIONS**

BPF: bone plate fenestrations  
CbCT: cone beam computed tomography  
ICOI: international implantology guidelines  
NLM: National Library of Medicine

**REFERENCES**


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