Risk Factors and Management of Dehiscent Wounds in Implant Dentistry

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Implant dentistry is showing increased acceptance and practice among general practitioners. The percentage of general practitioners who said they surgically place implants increased 50% in just 1 year. Preoperative, intraoperative, and postoperative misadventures are critical factors that determine the healing process and treatment outcome. Wound is defined as an injury to the body caused by physical means. Wound healing refers to the restoration and union of wounded parts. Surgical wound is the wound produced by surgical incision. Open wound is the one that communicates with the atmosphere, whereas septic wound is the one that is infected. Dehiscent wound is equivalent to a splitting wide-open or fissured wound. It is also defined as development of a separation of the layers of a surgical wound, which results in an absence of primary coverage.

Implant dehiscence is known as premature exposure of the cover screw or mucosal proliferation when the implant head does not remain buried beneath the gingival tissues. There might not be signs of distress or infection, but a distinct implant component, usually the healing cap or cover screw, is seen. This does not indicate failure, and it is not necessarily portentous of loss of the implant. A good chance of achieving osseointegration remains despite this "complication."

Successful implant dentistry is based on adequate training, proper selection of patients, careful surgery, preplanned restorations, and postoperative and supportive care. Although implant therapy is highly successful and predictable, it is not without possible early and/or late complications. The aim of this article is to highlight the importance of a relatively neglected subject of dehiscent wounds in the dental implant literature. This article covers the definitions of wound healing and wound dehiscence and some of the common risk factors related to suture line opening as an immediate postoperative complication. These factors appear to be largely iatrogenic in nature and partly related to patient neglect. Hence, it deserves documentation to confirm a strategy for their avoidance and management. A management protocol is presented on how to deal with different types of dehiscence and causal factors.

Key Words: wound dehiscence, implant therapy, postoperative complications

In implant dentistry, during the immediate 10-day postoperative period, incisions sometimes breakdown and the underlying bone or implants, or both, become exposed. Dehiscence of the incisions probably is the most common postoperative complication of implant surgery.

An attempt has been made in this article to review some of the most common risk factors of wound dehiscence in implant therapy. Clinical examples encountered are shown. Emphasis is placed on their avoidance and how to deal with it following a proposed protocol based on the type of dehiscence and wound condition.

WOUND HEALING

The day-to-day clinical practice of surgery, whether it be in the operating room or in the office, must be based on knowledge of the biochemical and mechanical aspects of the tissue reparative phenomenon. When the 2 wound edges are adjacent to one another and when they knit together with little loss of tissue and minimal formation of new tissue, we speak of primary wound healing. Repair is unimpeded because exudates and necrotic debris are minimal. When the 2 wound edges are separated, then wound closure progresses through a stage of wound secretion termed granulation and macroscopically visible new tissue formation. This is called secondary wound healing or healing by second intention.

A wound closes through the new formation of vascular connective tissue; the formation of "granulations" through wound contraction and through epithelialization when the inner, or outer, body surfaces are involved.

Very small wounds can be covered over in a few hours by migration of the surrounding epithelium. The cover of greater areas of granulation proceeds in the same way by migration of epithelial cells, which have accumulated at the wound edge during the first few days of wound healing by mitotic reproduction. The base of the...
wound appears red; many clinicians use the term "granulation tissue" when referring to chronic inflammatory tissue, whereas granulation tissue is the hallmark of healing.\(^{1}\)

**Factors Interfering With Wound Healing**

Healing is influenced by a number of local and systemic factors. Superficial infections can occur along the suture line. Postoperative infection of soft tissue sometimes can be attributed to insufficient tightening of the cover screw, preoperative contamination, or retained sutures.\(^{13,14}\) Infection, if present, could prevent connective tissue repair and perpetuate the inflammatory response, causing neutrophils to release lysosomal enzymes, which result in proteolysis (tissue breakdown). Furthermore, local bacteria of the granulating surface occasionally inhibit epithelialization, especially certain streptococcus and pyogencus.\(^{15}\)

General factors interfering with wound healing include age, low serum protein, vitamins C, A, and K, reduced number of erythrocytes, histamine liberators, and hormones.\(^{12}\) Pathologic conditions that cause poor vascularity and decrease inflammatory response like diabetes mellitus, anemia, uremia, collagen disorders, and jaundice have been reported to play a role in wound healing impairment.\(^{10}\)

In general, the most important cause of delay in wound healing is interference with the microcirculation. This can result either from local damage to the vessels (crushed wound edges, eg, pressure from the provisional dentures or if the denture is inadequately relieved over the implant site)\(^{13}\) or it is a consequence of diminished circulation caused by traumatic prolonged surgical technique, prior vestibuoplasty with skin grafting, radiation therapy, guided tissue regeneration materials, removal of subperiosteal implants, or bone or hydroxyapatite grafting can impair the blood supply to the mucoperiosteal tissue and compromise soft tissue healing.\(^{14,15}\)

**Suturing Fault**

The primary objective of dental suturing is to position and secure surgical flaps to promote hemostasis and optimal healing. The security of the wound suture lies in the suturing techniques, needles, materials, and closure protocol. The failure of a suture to secure a wound closure or maintain a ligature of a blood vessel is usually the result of undoing or tearing of a knot.\(^{12}\) Excessive force tears a stretched thread at its weakest place, which is most commonly the knot. The knot pull strength always depends on the linear tensile strength of the unknotted thread. This varies with the size of the knot loop, the type of suture material, and the diameter of the thread. The suture line opening can be avoided by good practice of tension-free suturing and selection of correct suturing material.\(^{12}\) Inadequate suturing could result in the flap skipping-up onto the tooth. Also, the inability to approximate tissue flaps could result in an exposed area of alveolar bone, contributing to necrosis, pain, significant bone loss, and delayed healing.\(^{16}\)

Wound margin dehiscence or mucosal perforation caused by sutures that are too tight can inhibit blood flow in the flaps and lead to wound margin necrosis with dehiscence formation. If there is no band of keratinized tissue in the area of the proposed implant site, approximating the surgical flap edges is difficult because these edges become inflamed and lose the majority of their tensile strength 24 to 48 hours after surgery. Therefore, the tensile strength of the surgical thread can exceed the tensile strength of the tissues and the suture threads tear through the flap edges, especially if the flaps were not freely mobile and mattress sutures were not used to offset any muscle or flap pull.\(^{16}\)

Continuous sutures are used to join 2 or more interdental papillae of the same flap and are usually chosen when the buccal flap is sutured separately from the lingual flap or when no lingual flap is performed. The advantages of continuous sutures include: 1) they could involve as many teeth as required; 2) they minimize the utilization of multiple knots; 3) they use teeth to anchor the flap; 4) they enable precise flap placement; 5) they avoid utilization of periosteal sutures; and 6) they enable independent placement and tension of buccal, lingual, or palatal flaps.\(^{17}\)

The continuously locking suture is indicated primarily for long edentulous areas, tuberosities, or retromolar areas. The continuous horizontal mattress suture technique enables greater flap security by approximating the everted surgical flap edges while concomitantly resisting any tension of the flaps from the associated muscle attachment. Mattress sutures are used for greater flap security and control, and enable more precise flap placement, especially when combined with periosteal stabilization. The mattress sutures are mostly used to resist muscle pull; adapt the surgical flaps to the underlying bone, with a regenerative barrier, implant, and/or tooth; and evert the surgical flap edges. They also facilitate good papillary stabilization and placement. The vertical slings mattress suture is recommended for utilization with bone regeneration procedures, because it resists muscle pull in the surgical area and permits maximum tissue closure while avoiding suture contact with the implant material.\(^{17}\)

Many suture materials and suturing techniques are advocated for use in dentistry for most purposes; sterile black silk, thread size 4-0 or 3-0, is the material of choice. Mattress sutures are more troublesome to insert, but it does not cut out of friable tissues so readily.\(^{18}\) Reverse cutting needles are the most commonly used needles in periodontal, oral maxillofacial, and implant surgery. Reverse cutting needles are used for tough, difficult-to-penetrate tissues, have their cutting edge on the outer curve, and they make a small cut in the tissue to allow smooth passage of the needle and the suture. Because the cut is made in the direction away from the wound edge, the suture does not tend to tear out so readily as when conventional needles are used.\(^{17}\) A 3/8-circle suture needle is most commonly used in implant surgery. A 1/2-circle suture needle is used in areas of restricted space or when suturing a soft tissue graft.\(^{17}\)

**INCISIONS AND FLAP DESIGNS**

The 2 most popular incisions for placement of implants into the anterior mandible are crestal and vestibular incisions. The crestal incision is useful when the mandible has sufficient height and the mentalis and lip mus-
culturate insert below the alveolar crest. For the patient with an adequate (at least 4 mm) band of attached gingiva, a crestal incision bisecting the keratinized gingiva provides excellent access to both the labial and the lingual regions for visualization during implant placement. The crestal incision is easier to perform and less likely to interfere with the blood supply to the flap. Also, it preserves the vestibular depth and keratinized tissue and reduces the postsurgical sequelae.

Although not well documented, disadvantages of crestal flap designs include higher incidence of wound dehiscence and increased difficulty in managing knife-edge ridges and the possibility of flap perforation. Vestibular incisions could offer advantages in having the implant not located directly under the incision. Therefore, there is less chance that dehiscence will result in implant exposure. However, there is generally more edema and greater patient discomfort with this type of incision. Also, suture placement and removal are more difficult, and the flange of any transosseous prosthetic impinges on the incision.

In the edentulous posterior mandible, the residual band of keratinized gingiva tissue could be only 2 mm wide. It is important to preserve this thin band of keratinized tissue and plan on repositioning it along the labial aspect of the implants at the time of exposure of the implant and abutment placement. Vertical releasing incisions with flap reflection allow excellent access and direct visualization of the mental foramen. A crestal incision is also useful when using membranes and guided tissue regeneration techniques for alveolar ridge. After the mucosa is reflected, the membrane is placed along with the graft material, and the incision is closed without tension along the crest. If a proposed implant or bone augmentation site has no keratinized tissue that would facilitate proper flap closure, some clinicians would perform soft tissue augmentation before implant placement using either subepithelial or connective tissue grafts. A wide band of attached keratinized tissue can be created using freeze-dried skin or a cellular dermal matrix with an appropriate flap design.

The use of membranes and oversized grafts changes the conditions for the healing of a soft tissue wound because the flap is separated from the bone by the membrane itself. Primary healing of the soft tissues is therefore completely dependent on an adequate blood supply from the soft tissue flap because a supply of blood from the subjacent bone is precluded.

Any necessary vertical releasing incisions should be made approximately one tooth-width from the anticipated margin of the membrane to prevent any disturbances of wound healing.

The most commonly used maxillary incision is slightly palatal to the alveolar crest. This incision is placed into fixed, keratinized gingiva. By placing the incision slightly palatal to the crest, the surgeon can easily visualize palatal bone contours without the aid of additional retractors. For full arch maxillary implant placement, the anterior portion of the incision should trace around the incisive foramen to avoid cutting through its accompanying structures.

Inadequate soft tissue flaps for implant coverage could occur after incision and flap reflection even if the tissues have been handled with great care. If the incision is not made directly on the crest of the ridge through the linea alba, the tissue between the incision and this ubiquitous avascular white line of scar tissue could pull away. Novel or unique crest incisions such as S-shaped or vestibular "visor" designs are discouraged. Recent investigation has indicated that lingual and facial flap capillaries do not anastomose at the ridge crest. Therefore, noncrestal incisions could result in a loss of vascularity to the tissues of the elevated flaps. In addition, when placing implants into sites immediately after tooth extraction or in cases of ridge expansion maneuvers, a paucity of the tissue repaired for primary closure exists. If the implant presents enough bulk so that the tissue from facial and lingual sides cannot be brought together, the buccal or facial flap needs to be undermined. This involves the elevation of the mucosa from the underlying buccinator or orbicularis oris muscle using a pair of sharp, curved scissors or a no. 15 BP blade. In this manner, release of the mucosal flap from its underlying muscle fibers allows it to be brought over the implant and ridge crest. Long incisions and aggressive undermining, as previously described, is required to allow sufficient mobilization and tissue relaxation before suturing. This technique works better than palatal mucosal grafts to solve the problem.

An incision that is too small results in excessive retraction on the flap and increases the risk of tearing the mucosa. Torn mucosal flaps will likely undergo necrosis, delay healing, and possibly contribute to implant failure.

Excessive deep flap reflection in the lingual aspect of the anterior mandible or when the lingual cortex is perforated during preparation of the implant site could damage the sublingual artery or one its branches. A life-threatening hemorrhage and submental swelling could arise requiring immediate extraoral iigation in the operating room and possibly intubation to maintain airway.

Wound breakdown has been also associated with the number of implants placed at the site. This might be attributed to larger mucoperiosteal stripping, more compromised blood supply, increased perioperative time, and more wound site contamination than might be found with single implant placement.

INTERIM PROSTHESIS

During the extended healing period, clinical support is needed for most implant patients. The interim prosthesis should allow for some degree of masticatory function as well as speech and esthetics. Trauma from an inadequately relieved denture or trauma by antagonistic teeth are 2 of the most frequent causes of early infections and wound breakdown during the healing period for both the edentulous and partially edentulous situations. Ideally, it is recommended that the implant site should remain undisturbed for approximately 2 weeks postoperatively to allow for wound healing. Insertion of the interim prosthesis too early also could affect the healing process.
adversely, resulting in gingival perforation and implant exposure. The patient must be fully aware of the need for dietary changes and be prepared not to wear the denture. The patient must be warned of the risks and potential consequences of early denture use."

After the second week of uneventful healing, the old denture is relieved excessively and relined with a tissue conditioning material or a soft denture liner. Relining provides comfort for the patient by acting as a cushion that reduces the transmitted forces on the underlying tissues by 20% to 40%. Several tissue conditioners and temporary soft liners are available on the market. Tissue conditioners are more resilient than soft liners but they do not last for more than 1 week for reasons such as hardening, odor absorption, and microbial growth, whereas the soft liners serve for several weeks.9

**SMOKING AND ALCOHOL**

Smoking has been shown to have a deleterious effect on the oral cavity and has been associated with oral cancer, periodontal disease, leukoplakia, stomatitis nicotina, and impaired gingival bleeding.6 It has been observed that use of tobacco correlates with impaired wound healing that includes dehiscence and increased infection rates. Cigarette smoking, as well as having a direct effect on exposed tissues, has acute and chronic systemic effects that decrease tissue perfusion and oxygen delivery. Related to this, less response to conventional and regenerative periodontal treatment was found in smokers.27 Recent research on endosseous dental implants indicates a similar deleterious effect of smoking on the mucosal seal around these implants.2829 Although it is difficult to relate increase implant failure to any single factor, delayed wound healing and peri-implant infection are thought to be significant in the increased failure rate in smokers in the short term.2829

The association of alcohol with oral mucosal pathology is well known. Concentrated alcohol sometimes causes a chemical burn in the mucosa and increases its fragility. For example, the application of 70% ethanol directly on oral mucosa has been shown to cause epithelial desquamation in animal studies.3132

**RISK FACTORS**

Based on this review and clinical cases encountered by the authors, and cases reported by colleagues, risk factors that might impair the healing process and could result in wound breakdown are summarized as follows:

1. Elderly debilitated patients with systemic conditions that cause poor vascularity and decrease inflammatory response.
2. Contamination and infection of the wound site.
3. Abused oral mucosa caused by denture stomatitis or radiation mucositis.
4. Prior vestibuloplasty, skin grafting, or previous multiple surgeries at the site.
5. Lack of keratinized mucosa on severely reduced residual ridge or extremely thin knife edge compound by high frenal attachment, particularly in the mandibular 4 anterior teeth and first premolar areas.
6. Overly tight or loose suturing techniques using inappropriate size and suture material.
7. Careless or improper selection of incision designs that do not follow bone topography, location of vital structures, and the amount of keratinized gingiva.
8. Large mucoperiosteal stripping with insufficient mobilization and lack of total relaxation of the flaps with increased perioperative time before suturing.
9. Immediate implant placement at recent extractions sites of posterior teeth.
10. Overbulking or sharp-edged graft material with gaps left in the surgical site.
11. Thick, poorly fixed nonbiodegradable guided tissue membrane that is vulnerable to infection and sloughing if it is slightly exposed.
12. Premature overloading of the interim prosthesis by early denture use by the patient, or inadequately relieved and relined denture compromised by trauma from the opposing occlusion.
13. Cigarette and pipe smoking delay wound healing, increase infection rate, and create intraoral negative pressure causing a deleterious effect on wound healing.
14. Alcohol consumption that can cause chemical burn, epithelial desquamative, fragility, and wound contraction.
15. Lack of detailed postoperative instructions to the patient or failure by the patient to comply with the instructions or to inform the dentist about any changes that took place.
16. Poor communication between the surgeons and restorative dentist and or other team members who directly impact the concerns of the actual surgery.
17. Ignorance and poor background on sound surgical and prosthetic principles or inattentiveness to details surely can lead to misadventure.

**MANAGEMENT OF DEHISCENT WOUND**

In the incidence of wound dehiscence, the dentist should take it seriously and be careful to prevent further complications and consequences that could cause bone necrosis or implant loss resulting from infection. There are 2 trends in dental implant literature on how to handle wound breakdown. First, any attempt to resuture the dehiscent wound might not succeed and could aggravate the problem. This trend requires vigorous daily debridement and wound toilet using antibacterial mouthwash until the tissue closes by secondary intention.8

The second trend recommends the immediate effort to resuture the wound after the margins are freshened with a scalpel. This redemption might be accompanied by bone reduction maneuvers to prevent bone necrosis.22

The authors have developed a protocol to deal with each type of dehiscence and causal factors independently (Table 1). However, the following factors are worth recognizing before considering the successful management of dehiscence wounds.

1. The cause of the dehiscence should be determined.
## Table 1. A Protocol for Management of Dehiscent Wound in Implant Therapy

<table>
<thead>
<tr>
<th>Protocol (P)</th>
<th>Wound Treatment</th>
<th>Wound Condition and Patient Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-1</td>
<td>Immediate resuturing</td>
<td>• Any site in the mouth</td>
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<tr>
<td></td>
<td></td>
<td>• Small dehiscence around 1-2 cm</td>
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<td></td>
<td></td>
<td>• Within 24-48 hours</td>
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<tr>
<td>P-2</td>
<td>Excision of wound margins before resuturing</td>
<td>(P-1 was unsuccessful)</td>
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<td></td>
<td></td>
<td>• Time elapsed more than 2-3 days</td>
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<tr>
<td></td>
<td></td>
<td>• Large dehiscence 2-3 cm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Exposed bone but not necrotic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Wound margins not abused or fragile</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Even in the presence of bone graft or membrane</td>
</tr>
<tr>
<td>P-3</td>
<td>1. Wound debridement with antibiotic added to the isotonic solution</td>
<td>(P-2 was unsuccessful)</td>
</tr>
<tr>
<td></td>
<td>2. Thorough irrigation and mouthwashings with chlorhexidine or iodine solution every other day</td>
<td>• Healthy, young, and nonsmoking patient</td>
</tr>
<tr>
<td></td>
<td>3. Cover denuded bone with dressing iodine</td>
<td>• Wound margin traumatized and abused</td>
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<td></td>
<td>4. Gradual reduction in dressing size and wound monitoring for 3-6 weeks until healing by secondary intention</td>
<td>• Anterior region of the mouth</td>
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<tr>
<td></td>
<td>5. Excision of the wound before resuturing</td>
<td>• Exposed bone but not necrotic</td>
</tr>
<tr>
<td></td>
<td>6. gm + ve and gm — ve antibiotic regimen for a minimum of 10 days</td>
<td>• Nonbone graft or membrane</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Abused nonattached gingiva</td>
</tr>
<tr>
<td>P-4</td>
<td>1. Bone graft removal</td>
<td>(P-2 and/or P-3 was unsuccessful)</td>
</tr>
<tr>
<td></td>
<td>2. Trimming yellowish or grayish necrosed bone until fresh bone is reached or bleeding/oozing</td>
<td>• Oversized graft</td>
</tr>
<tr>
<td></td>
<td>3. Implant explantation if it is infected or becomes mobile or interferes with tissue closure</td>
<td>• Denuded necrotic bone</td>
</tr>
<tr>
<td></td>
<td>4. Large mobilization of the mucoperiosteal flap buccally and lingually</td>
<td>• Posterior mandibular region of the mouth</td>
</tr>
<tr>
<td></td>
<td>5. Excision of the wound before resuturing</td>
<td>• Extremely knife-edged residual ridge</td>
</tr>
<tr>
<td></td>
<td>6. gm + ve and gm — ve antibiotic regimen for a minimum of 10 days</td>
<td>• Elderly debilitated patients</td>
</tr>
</tbody>
</table>

2. Site of the dehiscence, whether it is anterior or posterior, maxillary of the mandibular.
3. The length of the dehiscence and flap design.
4. The condition of the wound margins and amount of remaining attached gingiva.
5. The anatomic shape of the ridge crest ridge, thick, broad, thin, or knife edged.
6. The presence or absence and type of bone graft and regenerative membrane.
7. The underlying and adjacent living tissue, whether it consists of vessels, muscles, or nerves.
8. The time elapsed since the wound breakdown took place.
9. The presence or absence of soft tissue infection, edema, or hematoma.
10. The presence or absence of denuded or necrotic bone.
11. The age and the underlying systemic condition of the patient.
12. Compliance to postoperative instructions and availability of the patient for frequent follow-up appointments.

### CONCLUSION

The success of osseointegrated dental implant therapy is impressive. However, it is not without some risks and complications. Dehiscence of the incision is the most common immediate postoperative complication of implant surgery. This type of complication is largely iatrogenic in nature. It is also partly related to patient ignorance or a lack of communication. Careful attention must be paid to patient assessment, applied clinical skills, judgment, and meticulous follow-up care.

Although prevention is preferable to cure, difficulties cannot always be avoided. Therefore, attention to details, early recognition of tissue reaction or destruction, and prompt initiation of appropriate treatment are essential during phase I healing. Vigilance and diligence by the surgeon and restorative dentist facilitate the future success of implant treatment.

### Disclosure

The authors claim to have no financial interest in any company or any of the products mentioned in this article.

### REFERENCES

Abstract Translations [German, Spanish, Portugese, Japanese]

Wunddehiszenz in der implantatgestützten Zahnheilkunde: Risikofaktoren und Behandlungsoppositionen


SCHLUSSELWORTER: Wunddehiszenz, Implantationsbehandlung, postoperative Komplikationen