

REVIEW ARTICLE

Complications and treatment errors in periodontal and implant therapy

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1 | INTRODUCTION

During the last 50 years the assortment of periodontal and implant-related treatments has been continuously improved. The idea of applying a well-known/established procedure, developing a new type of therapy, or even modifying a preexisting one is initially based on a clinical scenario: the condition a patient has and how the clinician can handle the problem. Typically, the development of new or alternative treatment approaches or techniques is the primary target of therapy when definitive information is scarce.¹

The current standard of periodontal and implant treatment aims to promote a patient's overall health that is governed by: "selection of the best treatment options available for each patient individually, based on the expected results, potential complications/adverse effects, acceptances of the treatment plan by the patient and costs."² Once the decision-making process has been established and the treatment procedure applied, the partial or complete resolution of the problem (eg, periodontal probing depth reduction, clinical attachment level gain, gingival recession reduction, dental hypersensitivity decrease) and a diagnosis change with no or minimal occurrence of adverse events (ie, complications, harms, technical errors, or adverse/side effects) can be expected. The current version of the American Academy of Periodontology's *Glossary of Periodontal Terms*³ does not encompass "clinical definitions" of these important circumstances, but with reference to the Merriam-Webster dictionary⁴ these may be defined as follows.

- Error: "an act involving an unintentional deviation from truth or accuracy"⁴ or "an act that through ignorance, deficiency, or

accident departs from or fails to achieve what should be done."⁴ Thus, in periodontal and implant therapy it might be defined as "an action or practice originated of an unintended deviation of the preestablished objectives and precision of a treatment procedure, caused by an accident, imprudence, or the lack of knowledge technical skills."

- Complications: "a difficult factor or issue often appearing unexpectedly and changing existing plans, methods, or attitudes"⁴ or "a secondary disease or condition developing in the course of a primary disease or condition."⁴ In periodontology and implant dentistry they might be defined as "those unexpected interurrences occurring during or after the execution of a treatment procedure that have potential of modifying or jeopardizing the wound healing process and the anticipated effect of treatment."
- Harm: "physical or mental damage."⁴ A periodontal definition may be the "mechanical, chemical, or thermal injuries or damage inflicted to the periodontal tissues."
- Side (adverse) effect: "a secondary and usually adverse [‘acting against or in a contrary direction’⁴ or ‘causing harm’] effect (as of a drug)."⁴ Similarly, periodontal side effects may be defined as "those unexpected effects and events occurring following the delivery of a procedure or therapy." Side effects may not necessarily be considered as adverse events, as these may not lead to a detrimental effect on the foreseen treatment results. Thus, the adverse effects definition should account for both "unexpected and undesirable detrimental effects."

Errors and complications are not only part of professional experience, but of the iatrogenic one as well.⁵ It has been described that

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the occurrence of unexpected adverse events can typically generate an initial surprise or negation reaction,⁵ but an extensive disclosure of these issues is important for researchers, clinicians, and patients in order to anticipate clear answers to the following questions:

- What are the potential adverse events expected with the proposed therapy?
- Why do they occur?
- Are they important (and to which extent)?
- How can they be prevented?

Treatment complications can happen during and following both nonsurgical and surgical treatment procedures, and these may lead to several emotional conditions (ie, guilt feelings, reduced job satisfaction, shame, traumatic stress, anxiety, depression, and insecurity) that can impair a clinician's ability to perform his/her job.⁵

The clear identification of the potential types of adverse effects, complications, or even errors is important for contemporary decision-making processes as they may be related to different local, systemic, and technical aspects. Furthermore, these issues shall influence the predictability of treatment (or, in other words, the results of therapy anticipated by both the clinician and the patient). As a result, the fundamentals of reporting and understanding the clinical evidence regarding adverse effects, errors, and complications are mandatory and cannot be neglected. Since 1993, when *Periodontology 2000* was first published, this is the first volume to be exclusively devoted to treatment errors and complications in both periodontal and implant dentistry. A clear assessment of all the potential conditions having an influence on the treatment outcomes is mandatory, and this should not only be based on what a technique or procedure can do to improve the patient's well-being or esthetics. Thus, why is it important to focus on these treatment interferences? Because current standards of periodontology and implantology should also involve the assessment of both clinical and patient-reported disadvantages and any other potential detrimental responses associated with therapy.

The series of review articles included in this volume of *Periodontology 2000* focuses on five important big scenarios where complications and treatment errors may originate:

1. Periodontal or peri-implant soft-tissue therapies (ie, nonsurgical periodontal treatment, periodontal plastic surgery, palatal soft tissue harvesting, and peri-implant soft tissue management).
2. Periodontal or peri-implant hard-tissue therapies (ie, periodontal regenerative surgery, implant positioning, alveolar ridge preservation, peri-implant hard tissue management, sinus lift procedures, and peri-implantitis).
3. Interdisciplinary approaches affecting the periodontium (ie, orthodontics, prosthetic and restorative dentistry).
4. The patients' systemic conditions (ie, age-related factors, and periodontal and implant therapy in medically compromised patients).

5. The availability and interpretation of the evidence (ie, lack of information about adverse events, and poor understanding/interpretation of published research).

2 | DEFINING THE TYPES OF RISK AND THE CLINICAL IMPACT OF ADVERSE EFFECTS, ERRORS, AND COMPLICATIONS

Different types of risk factors, adverse effects, and complications can alter the course of the wound healing process of both nonsurgical and surgical periodontal treatments, as well as of implant-related therapies. These complications and/or adverse effects can be initially categorized based on the timing they occur, as early (≤ 14 days) and late (> 14 days) adverse events. A comprehensive investigation of these risk factors, adverse effects, and complications is important for proper decision-making, not only for patients but also for treatment clinicians. Typically, the most common risk factors, adverse effects, and complications can be categorized as follows:

- Local and systemic-related risk factors, including traumatic habits (ie, toothbrushing), poor plaque control, smoking, uncontrolled diabetes, antibiotic prophylaxis neglect, and many others.
- Technical related-risk factors, such as improper selection of treatment tools and materials (eg, instruments, surgical blades, and suture materials).
- Operator-related complications, such as improper flap management/handling (eg, wrong incision and flap designs) and poor flap elevation, position, and suture. Others include, but are not limited to, excessive trauma, wrong management of tools/instruments, improper treatment choice, and inadequate training for performing treatment procedures.
- Wound-healing adverse events. The occurrence of adverse events during wound healing can be grouped into:
 - adverse effects, such as pain, tenderness, swelling, and bruises/ecchymosis; and
 - complications, such as bleeding, suture/wound dehiscence, involuntary exposure of a surgical site or grafts/biomaterials, infections, and tissue necrosis.

Moreover, the overall clinical impact of the extension of these effects' undesirable influence in the wound-healing process, as well as the detrimental impact on the final treatment outcome, cannot be fully anticipated, but they may be classified as with or without potential for harm:

- Without potential harm. These are within the factors that may not influence or cause a detrimental impact on the outcome of interest following complete wound healing of the treated site (ie, treatment predictability), but they are related to changes in the patient-reported outcomes during the early phase of healing (ie,

<21 days posttreatment) and can lead to potential discomforts. Pain, bleeding, swelling, and bruising are the most common types of interurrences.

- With potential for harm (deleterious effect). Their occurrence may reduce (or even completely preclude) the achievement of potential gains anticipated by the periodontal or implant therapy upon complete wound healing of the area (ie, 4-6 months posttreatment). Mechanical trauma, suture/wound dehiscence, inadequate flap adaptation (ie, wrong positioning and excess of tension), graft displacement, membrane/barrier exposure, and infection may be considered harmful interurrences.

Additionally, other types of "positive side effects" were also described in the literature, such as the occurrence of creeping attachment⁶⁻⁸ (ie, coronal migration/displacement of the gingival margin) and bone exostosis^{9,10} (ie, peripheral localized benign bone overgrowth), but their development has been reported to occur following complete wound healing (>6 months) of sites submitted to soft-tissue augmentation procedures (ie, keratinized tissue augmentation and root coverage) through free gingival grafts or connective tissue grafts.⁶⁻¹⁰ However, the reasons for additional hard- and soft-tissue improvements (and the amount of such improvements), the exact period(s) of development, and what exact circumstances may lead to them are not clear.

3 | ACCIDENTAL ERRORS VERSUS THE LACK OF A PROPER TREATMENT PLANNING

The question of whether an error occurred by an accident or not may be the starting point of more profound thoughts about the binomial formed by knowledge and skills. Over the course of a clinician's professional life, it is expected that there will be a gradual improvement in his/her technical knowledge and manual skill levels: the "learning curve." On the one hand, the balanced combination of these two factors will allow the clinician to "upgrade" to more complex techniques, as well as better safety and mechanical refinement. On the other hand, neither theoretical knowledge nor skills alone should be used to define a treatment plan (ie, improvement of theoretical knowledge does not necessarily mean improvement of skills, or vice versa).

Consequently, and in order to prevent the occurrence of "accidental errors," clinicians must ask themselves the following questions:

1. Do I have sufficient technical knowledge to identify the main characteristics associated with the disease or condition of interest, such as its etiology, anatomical features, and clinical behavior over time?
2. What are the best treatment options available to solve the patient's clinical scenario?

3. Do I have sufficient clinical skills and training to manage the case properly?

These questions are very important and must be answered prior to establishing any treatment plan. Why? Because professionals who are unaware of these perceptions (and their own limitations) tend to be more fearless and to make more mistakes (the more knowledge a clinician acquires, the more fearful he/she will become about the potential risks associated with an inadequate decision-making).

For instance, theoretical knowledge alone may not allow the clinician to perform a surgical procedure adequately (eg, performing incisions, harvesting a graft, or suturing a flap), whereas the most talented and skilled surgeons may not know when, where, or why they should perform (or not) a specific type of incision or suture. For sure, anatomic discrepancies or other local or systemic conditions may alter the behavior of periodontal tissues, but these aforementioned basic examples (ie, lack of theoretical knowledge, skills, or both), most of the time, may be the source of most of "accidental errors." As a result, it is important to base every treatment plan on the combination of the highest/best level of information available (so-called evidence-based therapy), patient-reported outcomes (oral/medical history conditions, and individual needs and preferences), and the clinician's knowledge and skills. With these, it is expected that both the "brain" and the "hands" should receive proper training to reduce the sources of errors and complications.

4 | NET BENEFIT RATIO BETWEEN CLINICAL IMPROVEMENT AND POTENTIAL ADVERSE EVENTS

In deciding which outcome measures should be used to base the periodontal and implant therapy decision-making process, the clinician will need to go a little deeper into the "net benefit ratio" (ie, the balance between clinical improvements promoted by the therapy and the occurrence of potential adverse events).¹¹⁻¹⁴ This issue is essential to restrict the application of therapies that, although effective in solving the patient's problems (those who stimulated them to seek periodontal/implant therapy), might lead to new complaints and functional or esthetic restrictions. Therefore, the extension, direction, and balancing level of confidence in the benefit estimate with potential for harm (ie, benefits versus adverse events) deserves attention as follows:

- If the additional clinical benefits achieved with therapy may outweigh potential harms (adverse events), there is no doubt that the preestablished procedure might be applied to improve the patient's condition (ie, change the original periodontal diagnosis).
- If the clinical benefits anticipated by a treatment procedure are considered modest, or even uncertain, but with potential harms, the clinician must think about the available alternative treatment options and mainly consider whether his/her knowledge and

skills may be sufficient to support the proposed treatment plan. However, for situations where the benefits are balanced with potential harms, the same knowledge and skills may be used to question the use of a particular therapy.

- In cases where no clinical advantage has been identified by previous published evidence or where potential harms may outweigh benefits, the use of this procedure should be discharged and alternative treatment options (eg, gold standard procedures) must be implemented.

As part of professional experience, for both experienced and inexperienced clinicians, it is anticipated that everyone will have to deal with these adverse events. The issue is how to properly avoid them or even anticipate and take care of these problems when they occur. It also seems important to highlight that complications and adverse events may affect patient perception of the treatment and may have negative effects on future treatment. Therefore, the main message of this special volume of *Periodontology 2000* is to call attention to the importance of preventing, reporting, and adequate handling of these adverse events. In summary, the final proposed treatment plan should only be established after critical appraisal of the benefits and risks ratio of the procedure, as well as assessing the extent of the clinician's knowledge, training, and clinical skills. Hopefully, the extension of potential adverse events associated with a therapy can be prevented and thus proper treatment provided if these events happen.

CONFLICT OF INTEREST

The authors report no conflicts of interest related to this review.

DATA AVAILABILITY STATEMENT

Data sharing not applicable - no new data generated.

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