

Surgical Risk Factors in Implant Dentistry: Influence on Failures and Bone Loss

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Implant failures, peri-implant bone loss and other complications do occur, so it is vital for dentists to be aware of the risk factors that may be significant. This article will be the first of a series to be published in Oral Health on this subject. In this first article, the overall categorization of risk factors will be summarized and the concept of evidence-based information, including the author's private practice results, will be introduced. This initial article will establish an important base of information for the future articles, where risk factors and multiple clinical cases will be covered in detail. Finally, a single case will be presented with a discussion of the potential risk factors that should be taken into consideration.

Surgical risk factors can be classified into broad four categories:

- 1) **Patient Related: "Systemic" Risk Factors**
- 2) **Patient Related: "Local" Risk Factors**
- 3) **Operator Related: Extrinsic Risk Factors**
- 4) **Biomaterials Related: Extrinsic Risk Factors**

These four categories are comprised of many sub-categories and each with many associated *potential* risk factors as outlined below:

1. Patient related: "Systemic" Risk Factors:

- Age
- Gender
- Health
- Disease condition
 - Absolute Contraindications:
 - Pregnancy
 - Alcoholism
 - Drug abuse
 - Severe infection
 - Diabetes: "uncontrolled"
 - IV bisphosphonates
 - Renal failure

- Severe liver disease
- Current chemotherapy
- High-dose radiation
- Psychiatric instability
- Unrealistic expectations
- Non-compliance
- Relative Risk Factors:
 - Parkinson's Disease
 - Osteoporosis, osteopenia
 - Post-menopausal hormone therapy
 - Hyperparathyroidism
 - Malabsorption metabolic bone disease e.g. Pagets
 - Auto-immune: e.g. AIDS, Sjogren's, Lupus, Scleroderma, Lichen Planus
 - Genetic/Immunologic e.g. genetic polymorphisms ("IL-1")
 - Diabetes: "controlled"
 - Smoking: dose dependent, cessation effectiveness
- Medications:
 - Bisphosphonates-oral, corticosteroids, immune suppressants, anticoagulants
- Periodontitis History:
 - Chronic disease, aggressive disease
 - Periodontal treatment vs untreated before implants

2) Patient Related: "Local" Risk Factors:

- Alveolar Bone: quality/quantity
 - Resorption/anatomic location/short implants/narrow implants/grafted bone
- Soft tissue quality and quantity: e.g. keratinized gingiva, recession, thin biotype, etc.
- Esthetic risks: e.g. bone resorption, thin biotype, keratinized gingiva, high lip line, etc.
- Poor plaque control: "early" effects/"late" effects
- Occlusal loading: "early" and "late" effects: (see more details)

in section three: “Prosthetic Related Protocols”)

3) Operator Related: Extrinsic Risk Factors:

- Experience level: treatment planning/clinical expertise
- Surgical techniques:
 - Sterile vs aseptic vs contaminated
 - Prophylactic antibiotics
 - Surgical incision: crestal vs mucobuccal vs flapless
 - Surgical trauma: e.g. excessive: heat/bone compression/poor implant to bone congruency
 - Implant position: malpositioned/intentionally tilted/anatomic invasion, e.g. sinus, nerve
- Surgical Protocols:
 - Implant placement: one stage (non-submerged) vs two stage (submerged)
 - Implant placement: post-extraction: “immediate” vs “early” vs “delayed”
 - Implant placement into “infected” sites (periapical infection/periodontal infection)
 - Implant placement with *adjacent* “infected” sites (periapical lesions/periodontal lesions)
 - Re-placement of failed implants: post implant removal: “immediate” vs “early” vs “delayed”
- *Prosthetic Related Protocols: (Prosthetic Risks and Biological Risks)
 - Removable vs fixed prostheses/splinted vs unsplinted
 - Prosthetic loading: “early” and “late” effects for “fixed” and “removable” prostheses (see section two)
 - Number of implants/cantilevers/occlusion/restorative materials/crown to implant ratio/splinting/parafunction/occlusal guards
 - “Temporization” protocols: biological, prosthetic or esthetic benefits?
 - Connection of implants to natural teeth: Indications? Contraindications?
 - Cemented vs screw retained: biological, prosthetic and esthetic benefits and risks
 - Impression and lab techniques: e.g. digital impressions, CAD-CAM, etc.
- Maintenance: program/treatment, e.g. for peri-implantitis/compliance responsibilities of patients and professionals.

4) Biomaterials Related: Extrinsic Risk Factors:

- Material: biocompatibility/strength: titanium-pure vs alloyed/others: e.g. ceramic
- Manufacturer/supplier: are there significant differences?
- Implant microstructure: surface: smooth vs rough/nano-additives
- Implant macrostructure:
 - Length/diameter/shape: e.g. straight walled vs tapered
 - Thread design: e.g. “V”, buttress, reverse buttress, square, self-tapping, etc.

- Crestal module: e.g. smooth/rough/mini-threads/micro channels, etc.
- Prosthetic connection: “flat to flat” vs “conical”/“flush” vs “platform shift”

“Evidence-Based” Concepts

The reality of dentists in private practice is that they carry out treatments that have been shown to work not only in studies, but also that work in their own hands. The individual needs of the patient also play an important role. In fact, this is what practicing “evidence-based” dentistry is, i.e. a combination of the available evidence, the clinician’s experience and the needs of the patient. One should be wary, however, that there is a risk of “bias” in many studies, especially if it is funded by a commercial entity that is interested in publishing the best results for their products.

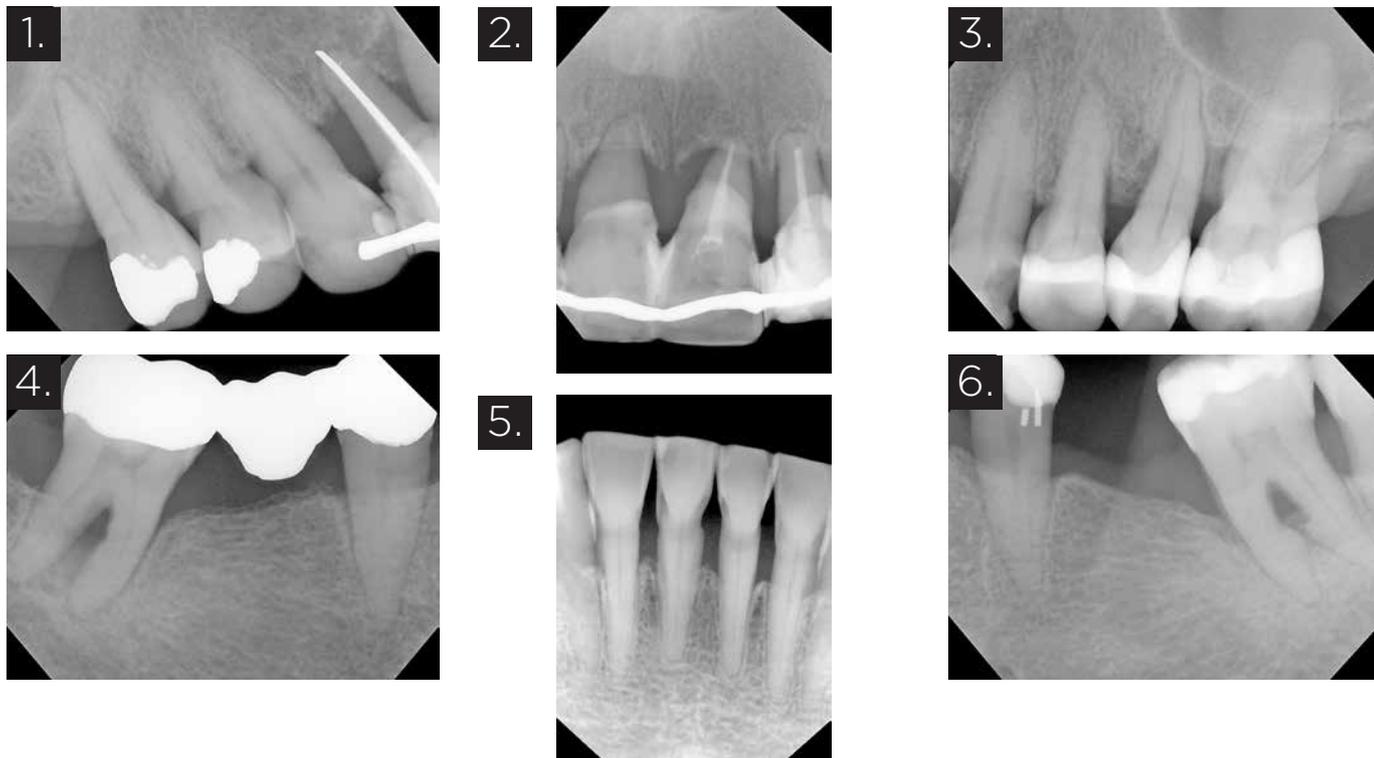
It is difficult for studies, and a full-time private practice dentist, to evaluate the more subtle risk factors that may influence long-term results. However, this is especially critical in implant dentistry where problems may become evident years down the road and can have disastrous consequences. Therefore, it is critical to try to evaluate risk factors both obvious and subtle.

Long-term published studies are rare as they are very difficult and expensive to carry out. Long-term clinical practice allows the opportunity for the clinician to evaluate results over longer periods but only if the clinician is willing to make the effort to properly document the results. Private practice studies may more closely replicate the conditions of what can be expected in a private practice, as many funded studies are carried out in controlled environments. Unfortunately, there are very few long-term private practice clinical studies that have been published with meaningful data that is presented in a statistically and scientific relevant manner.

Private Practice Results of Dr. Murray Arlin from 1989 to 2015 and “Triton-DIMS”

The author has carefully documented every implant placed starting in 1989 and still ongoing. The results from well over 13,000 implants placed to date have been documented with clinical and radiographic images, and also documented with many of the detailed attributes relating to every implant, with data entry on a specifically designed implant tracking software program called “Triton-DIMS” (“Triton Dental Implant Management Software”, Martin Lumish, USA).

The details of the “Triton-DIMS” program is not within the scope of this article, but it is a relational data base and is programmed to be able to produce statistically and scientifically relevant reports. *In the series of articles that will follow, several of these statistical reports will be presented as part of “evidence-based” information when evaluating risk factors, both obvious and subtle.*



Pre-treatment periapical radiographs demonstrating advanced periodontal bone loss.

Case Presentation and Discussion

A case is presented illustrating the transition from pre-treatment to one-year post completion of the implant dentistry restoration (Figs. 1-17). Some of the risk factors that have been outlined in this article, and that that should be considered for this particular case are discussed below and are summarized as they pertain to the specific images.

Case Presentation Discussion: Risk Factors:

Discussion / Questions re: Risk Factors (categorized as described above #1 to #4):

- #1-What is the age of the patient, and is that an independent risk factor?
- #1-Does the patient have any significant medically related conditions or medications?
- #1-Does the patient smoke? How much? Is she receptive to smoking reduction or cessation?
- #1-What is the Periodontal history?: i.e. oral hygiene status, genetic susceptibility, previous treatment, compliance
- #1-Will the patient be more susceptible to implant related bone loss and failures?
- #2-What is the bone quality and quantity available for implants? Is grafting needed?
- #2-What are the esthetic considerations e.g. smile line,

anticipated recession etc.

- #2-Does the patient have realistic expectations and is she psychologically a good candidate?
- #2-What type of interim and definitive prosthesis and loading is anticipated?
- #3-What periodontal and multidisciplinary treatments are indicated and what is the sequence?
- #3-Does the complexity of the case suggest referral to specialists?
- #3-How many extractions? How many implants? Position of the implants? Is an implant placement guide needed? Implants to be placed 1 or 2 stage?, immediate or delayed post extraction?
- #4-What implant system, design, length, diameter, positioning etc. is anticipated?

Figures 7 and 8: “Periapical radiographs of implants at #1.2 and #2.2 immediately after initial placement”

Discussion/Questions, re: Risk Factors:

- #1-The patient was deemed to be a reasonably good candidate to proceed with treatment
- #1-The patient was advised of the “relative risk factor” for future Implant bone loss and failure based on her apparent

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7. Periapical radiograph of implant at #1.2 immediately after initial placement



8. Periapical radiograph of implant at #2.2 immediately after initial placement



9. Periapical radiograph of implant at #1.2 six months after initial placement



10. Periapical radiograph of implant at #2.2 six months after initial placement



11. Periapical radiograph of implant at #1.2 six months after restoration



12. Periapical radiograph of implant at #2.2 six months after restoration



13. Periapical radiograph of implant at #1.2 twelve months after restoration



14. Periapical radiograph of implant at #2.2 twelve months after restoration

genetic predisposition to aggressive periodontal disease.

#2-The “informed decision” on the treatment plan decided upon after a discussion benefits, risks, alternatives and option of no treatment, was to extract 1.2, 1.1, 2.1 and 2.2, fabricate an interim removable prosthesis and several months later, a definitive four unit fixed splint with implant abutments at the 1.2 and 2.2 (and “try” to maintain the rest of the natural dentition).

#2-The patient accepted the potential esthetic result of longer looking teeth in the definitive restoration, so vertical and or horizontal ridge augmentation were not required.

#3-Periodontal treatment was completed and a diagnosis was made that there was no residual “active infection” and therefore “immediate implant placement” was considered a good option.

#3-After removal of the four teeth and removal of any chronic residual granulation tissue, an immediate post extraction and one stage surgical protocol was utilized with implants placed at the 1.2 and 2.2 sockets. An immediate interim removable prosthesis was inserted after being adjusted

to avoid excessive transmucosal loading.

MIS “Seven” implants were utilized only at 1.2 and 2.2 because of the author’s good overall excellent experience with this design and system, in part because of their high resistance to implant fracture as these implants are manufactured with titanium alloy grade material.

The implants were placed towards the palatal aspects of the extraction sockets, and at or very slightly coronal to the crestal bone level, and after confirming excellent initial stability, 4mm height transmucosal healing abutments were immediately attached. The residual extraction socket peri-implant spaces were negligible so socket bone grafting was deemed not necessary.

Figures 9 and 10: “Periapical radiographs of implants at #1.2 and #2.2 six months after initial placement”

Discussion/Questions re: Risk Factors:

About four months after initial implant placement the patient was evaluated for osseointegration clinically via percus-



Smile view six months after restoration



Retracted view six months after restoration



Retracted view 12 months after restoration

sion, pocket depth measurements and torque testing and as well with follow up radiographs, which revealed excellent bone apposition. Some very minor crestal bone remodelling with a range of 0 to 0.5mm was observed.

Figures 11, 12, 13 and 14: “Periapical radiographs of implants at #1.2 and #2.2 six months after restoration (Figs. 11, 12) and at 12 months after restoration (Figs. 13, 14)

Discussion/Questions re: Risk Factors:

At six and 12 months after prosthetic restoration, the patient was evaluated for any clinical signs or symptoms, or radiographic signs of problems. The patient had no complaints and the follow-up radiographs showed excellent crestal bone stability with only some minor crestal bone remodelling in the range of 0 to 0.5mm.

Figure 15: “Smile view six months after restoration”

Discussion/Questions re: Risk Factors:

The patient was very pleased with the function, phonetics and aesthetics of her

natural smile.

Figures 16 and 17: “Retracted view six months (#16) and 12 months (#17) after restoration”

Discussion/Questions re: Risk Factors:

The retracted view at six and 12 months respectively after restoration, revealed good stability of the soft tissues. The patient was very pleased with the functional and aesthetic result. The high degree of patient satisfaction with the aesthetics may have been enhanced as we had anticipated and warned the patient at the initial consultation of potential aesthetic compromises and specifically of longer teeth (due primarily to the significant periodontal bone loss).

Summary

This article has been the first of a series to be published in Oral Health on the subject of surgical risk factors in implant dentistry. An overview of a categorization of risk factors was presented, the concept of evidence based information including the author’s private practice was introduced and a single case was

illustrated with a discussion of the potential risk factors that needed to be taken into consideration. A future series of articles in Oral Health is planned where the details of many risk factors will be covered and illustrated with multiple clinical cases. **OH**

Dr. Murray Arlin received his DDS at McGill University in 1977, his Diploma in Periodontics at the University of Toronto in 1980, and his Fellowship in the Royal College of Dentists of Canada in 1983. Dr. Arlin has taught at the University of Toronto at the undergraduate and postgraduate levels. Dr. Arlin has numerous publications in the fields of Periodontics and Implant Dentistry and has lectured internationally. He maintains a full-time practice in Toronto, ON. Dr. Arlin is co-founder of the Toronto Implant Study Club. He is also founder of the Dental Hygienist Periodontal Study Club of Toronto.

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