

# Biologic Markers of Failing Implants



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## KEYWORDS

• Peri-implantitis • Microbiological markers • Biological markers

## KEY POINTS

- The diagnosis of peri-implantitis benefits from clinical, radiographic, microbiological, and biological information.
- Practitioners and patients can use biomarkers to identify risk of disease, disease activity, disease progression, and response to therapy.
- Peri-implantitis is a biofilm-induced condition. The microbial composition of peri-implantitis lesions is mixed, nonspecific, and less diverse than that of periodontitis but includes *Fusobacterium*, *Prevotella*, *Porphyromonas*, *Streptococcus*, *Campylobacter*, and *Neisseria* species.
- Failed implants are often associated with enteric bacteria, spirochetes, and opportunistic bacteria (ie, *Staphylococcus aureus*).
- Protein biomarkers detected in peri-implant crevicular fluid provide insight into the underlying biology of the disease and specificity regarding the stage of the disease.

## INTRODUCTION

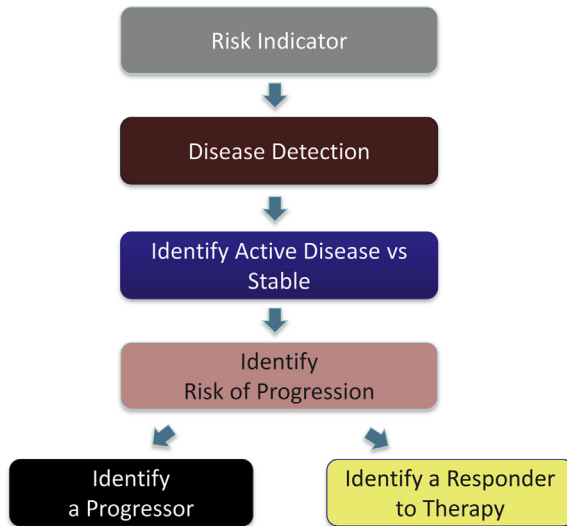
As a result of clinical translational research, biomarkers are becoming increasingly available. They supplement clinical and radiographic information, allowing clinicians to make better decisions. Patients can also use biomarkers to obtain information about their health status and the need for dental care. Although biomarkers are most commonly used to decide whether a patient has a disease, their usefulness is more expansive. As **Fig. 1** shows, biomarkers are important for identifying severity of disease, ongoing activity of disease, disease progression, and response to therapy. With respect to periodontal disease, salivary analytes interleukin 1 beta (IL-1 $\beta$ ), matrix metalloproteinase 8 (MMP-8), and macrophage inflammatory protein-1 alpha (MIP-1 $\alpha$ )

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**Fig. 1.** Potential roles of biomarkers.

have recently been shown to serve in these roles. For example, high salivary concentrations of these analytes are associated with periodontal disease,<sup>1-3</sup> whereas high salivary concentration of MIP-1 $\alpha$  is also a predictor of risk, that is, predictive of alveolar bone loss 6 to 9 months before radiographic evidence is apparent.<sup>4</sup> Oral fluid biomarkers can also be used to indicate response to therapy and have recently been shown to be useful in this role.<sup>5</sup> Together, the identification of biomarkers that have clinical utility for risk identification, disease detection, and identification of disease progression and response to therapy is the basis for establishing personalized care in the modern health care age and serve as the context for this article on peri-implantitis and failing dental implants. Specifically, this article discusses the milieu of microbes and proteins, that constitute the underlying biology of implant osseointegration and disease progression that can serve as indicators of implant health or failure.

## DEFINITIONS

Peri-implantitis is a potentially progressive condition involving infection, inflammation, connective tissue destruction, and bone resorption.<sup>6</sup> The condition is characterized by microbial infection, deep probing depths, bleeding on probing, suppuration, and radiographic bone loss.<sup>7-9</sup> Risk factors include cigarette smoking, poor oral hygiene, and a previous history of periodontitis.<sup>10</sup> Peri-implantitis does not necessarily mean that the implant will fail. The implant can be salvaged if peri-implantitis is diagnosed early, if risk factors are reduced or eliminated, and if the site is treated appropriately.<sup>11</sup> In contrast, implant failure is defined as the inability of the host tissue to establish or maintain osseointegration, which is clinically diagnosed by mobility of the implant (Fig. 2).

Implant failures are classified as early or late, depending on the time of placement and the implant's functionality. Early failure occurs before prosthetic rehabilitation and before the implant is placed into function. Early failures generally result from surgical trauma, overheating of the bone during implant surgery, insufficient bone surrounding the implant, early loading of the implant, or perioperative bacterial

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