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Biological and Host Modification Factors in Periodontal Pathology and Disease Progression: Decision Making in Restorability of Periodontally Compromised Teeth.

(Restorability of Periodontally Compromised Teeth Decision Making.)

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KEYWORDS

Periodontal pathology, Periodontitis, Restorability of teeth, disease progression, tooth prognosis, biological factors, decision making, periodontally compromised teeth.

ABSTRACT:

Periodontal disease represents a significant challenge in dental health, characterized by the inflammatory destruction of supporting tissues around the teeth. Numerous biological and host-modifying factors, including genetic predispositions, systemic health issues, microbial flora, and lifestyle choices, may influence the development of this illness. When assessing whether periodontally affected teeth may be restored, doctors must have a thorough understanding of these complications. We also go over the framework for decision-making that practitioners use to determine whether periodontal repair is viable. Through a detailed discussion of how these factors can inform more effective treatment choices and improve patient outcomes, we hope to present a synopsis of recent research and clinical findings. Ultimately, this research underscores the necessity for a customized approach that takes into account the multifaceted aspects of periodontal health, emphasizing the pivotal role that both host-related and biological factors play in periodontal therapy.

Introduction:

In dental practice, the choice of whether to extract or maintain a suspicious tooth with periodontal involvement frequently arises. When making this choice, the complicated elements related to periodontal disease should be considered. Certain scenarios (such as bone loss amount, mobility, pocket depth, and clinical attachment loss) are clear-cut, whereas other scenarios (such as furcation, defect morphology, root anomalies, endodontic-periodontal lesions, and cosmetic issues) fall into the "grey" area of decision-making. Other crucial aspects to take into account are patient expectations, finances, and compliance; however, these subjects differ from patient to patient and should be addressed with each individual patient. This review article will offer recommendations for making difficult decisions on whether to extract or preserve teeth, along with variables to consider for a good long-term prognosis(1).

Mind mapping flow chart: In this review, we employed a "*mind mapping chart*" to assist professionals in analysing various factors linked to diagnosing and predicting periodontal disease. The concepts for the flow chart were partially adapted from Avila G et al. (2009)(2), with modifications made to align with the American Academy of Periodontology (AAP) classification (2018) of periodontal staging, grading, and prognosis.(3) We separated the variables and factors that may affect the diagnosis and prognosis of the condition into two primary parts. *Part-1*: Biological and Host Modification Factors influencing the course of the disease or its remission and are therefore linked to the long-term prognosis of treatment success (Figure 1). The variables in this category are generally controllable and have to do with the patient's awareness and desire to manage their illness. It incorporates other risk factors, such as smoking, systemic disorders, drug use, and medical skill, in addition to patient compliance, patient expectations, and financial capacity for care. In addition, the structural and

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aesthetic parameters of teeth with periodontitis are also discussed. In terms of diagnosis, prognosis, and treatment planning for an existing condition, these are regarded as the first level. *Part 2*: Elements linked to the etiopathogenesis and disease activity of periodontitis, including periodontal probing depth, calculus, and plaque (amount vs. quality), bone loss and defect morphology, bleeding upon probing, mobility, involvement of the furcation, abnormalities of the roots, and disease recurrence. For quicker and simpler comprehension, the final decision-making tree was colour coded into three categories: *green*, which indicates a good or favourable prognosis; *yellow*, which indicates a fair or dubious prognosis; and *red*, which indicates a poor or unfavourable prognosis.

The current literature review delves into Biological and Host Modification Factors involved in Periodontal Pathology and the progression of disease, providing detailed information to aid in making decisions regarding the prognosis and potential restoration of teeth affected by periodontal issues.

Patient compliance:

Maintaining good oral hygiene on the part of the patient is thought to be a major element in both managing periodontal disease and achieving successful outcomes following nonsurgical treatment(4), surgery and supportive periodontal therapy.(5,6) Hence, patients are motivated and included in regular maintenance programs for better prognosis.(7,8) Previous studies have shown that subjects with poor compliance with dental treatment had a greater tendency for total tooth loss due to periodontitis by 45 years of age(9). On the other hand, compliant patients had a very small tendency for caries, periodontitis, reduced bleeding on probing (10) and tooth loss(11,12). Similarly, numerous trials have shown that noncompliant individuals with poor plaque control have a greater incidence and progression of peri-implantitis around implants(13–15). Therefore, patients who comply should be given a favourable or fair prognosis (green, yellow), whereas noncompliant patients (red) should only receive palliative periodontal care or tooth extractions(2).

Patient aesthetics, treatment expectations and financial status:

Clinicians must identify patients' aesthetics and treatment expectations while designing dental and periodontal treatment plans. Smile design is associated with the tooth (white) component and gingival (pink) component. Some of the most crucial elements that characterize satisfactory aesthetics are the absence of discolouration, an appropriate tooth emergence profile, and proper symmetry of the papillary and free gingival margin(16,17). Surgical treatment for posterior teeth where aesthetics are less common should be performed if the patient has a good prognosis (green category). However, any surgical therapy in the anterior region should be planned with caution for the above soft tissue parameters(2) (yellow category). Positively motivated periodontally compromised patients can attempt therapy if they are willing to save their teeth even with short-term results (Green). When a patient with periodontal disease is not interested in having their teeth saved and is expecting long-term results, the practitioner should choose extraction over tooth preservation (Red) (2,18).

Prior to scheduling costly, specialized periodontal care, including regenerative surgery or dental implants, the patient's financial status needs to be assessed. These factors must be considered during the decision-making process. Specialized periodontal therapy or extraction combined with further implant therapy may be recommended for financially stable patients (Green). Simple conservative therapy with routine follow-ups is designed for patients with limited funds who cannot afford specialized treatment to prolong the life of their current teeth (yellow).

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Decision making in Restorability of Periodontally compromised Teeth.
Part 1: Biological and Host modification Factors in Periodontal Disease Progression.

Good
Fair
Patient Compliance
Poor
No
Yes
Parafunctional Habits
≥ 2mm
< 2mm (Repairable)
Not-involved (Posterior Teeth)
Esthetic Expectations
Involved (Anterior Teeth)
Adequate
Inadequate
Muco-Gingival Problems
Biological width
< 2mm (Irreparable)
Thick
Thin
Gingival Biotype
Patient Compliance, Expectations & Finances
Treatment Expectations
Willing to save teeth / short term results.
Willing for Extraction / Long term results.
Crown: Root <1:1
Crown: Root >1:1
Crown: Root Ratio
Structural and Aesthetic Parameters
Patient Finances
Sufficient
Limited
Class 1 & 2
Class 3
Ridge defect dimensions (Seibert[55] 1983)
Inadequate Parameters → ↑ Pd Disease Severity
Periodontally Compromised Teeth
Genetic predilection
No
Yes
Supragingival + < 1.5 mm sulcus
Sub-gingival + < 1.5 mm sulcus
Sub-gingival + > 1.5 mm sulcus
Prosthesis / Restoration Margins
Smoking
Controlled
Uncontrolled
Periodontitis Staging & Grading
Risk Determinants
Systemic Diseases
Controlled
Uncontrolled
Non- Carious
Extensive Root caries
Cervical/Root Caries
↑ Risk Index → ↑ Pd Disease Severity
Clinician's Competency
Competent
Non-Expert
Interpretations (Prognosis) → Good Fair Poor
Systemic Medication
No
Yes

Figure 1: Flow-chart of Biological and Host modification factors in Decision making of Restorability of teeth with periodontal pathology. Flowchart Partially adopted from Avila G et al (2009) and modified as per guidelines American Academy of Periodontology (AAP) classification (2018).

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Risk determinants:

Risk Determinants:

Genetic factors play a major role in the progression of this disease and the subsequent loss of tissue surrounding the roots of teeth and alveolar bone(19). Recent research on factors linked to the risk of periodontitis has focused on genes encoding immune regulatory molecules, including membrane surface receptors, chemokines, cytokines, and antigen recognition proteins(20). The presence of genetic variables makes periodontal restorability difficult, and hence, periodontal restorability is regarded as a poor prognosis (red) compared to that of periodontitis patients with no genetic predispositions (green).

Smoking is considered a significant risk factor for the progression of periodontal disease. Research has supported the claim that smokers are 2-8 times more likely than nonsmokers to progress periodontal disease (21,22). Smoking impairs neutrophil function, decreases the vascularity of the gingiva, and increases the incidence of pathogenic red complex bacteria(23–25). It also poses a greater risk of peri-implant bone loss (13). In this review, which is based on the 2018 classification of periodontitis, smoking status was divided into three categories for the purposes of prognosis and grading: nonsmokers, controlled smokers, and uncontrolled/heavy smokers. Periodontitis of grade A (slow rate) was assigned to non-smokers with a good prognosis (green); controlled smokers (<10 cigarettes per day) were assigned to Grade B (moderate rate) with a fair prognosis (yellow); and heavy smokers (>10 cigarettes per day) were assigned to Grade C (rapid rate) with a poor prognosis (red) (3).

Systemic diseases: Periodontal disease, a chronic inflammatory condition that affects the tissues surrounding teeth, has long been recognized as being influenced by systemic diseases. Systemic diseases such as diabetes mellitus (DM), cardiovascular disease, and autoimmune disorders have been shown to impact the progression and prognosis of periodontal disease.

Diabetes is one of the most well-documented systemic diseases and is closely linked to periodontal disease. Studies have shown that individuals with diabetes have a greater prevalence and severity of periodontal disease than those without diabetes(26–28). Individuals with diabetes are two to three times more likely to develop periodontitis in the general population(29). This is because diabetes can compromise the immune system and impair the body's ability to fight infections, including those in the gums (30,31). Additionally, diabetes can lead to poor blood sugar control, which can further exacerbate inflammation in the gums by intensifying pathologic microbes and their proinflammatory products and worsening periodontal disease(32). Research has shown that individuals with cardiovascular disease have a greater risk of developing periodontal disease and that the presence of periodontal disease can increase the risk of cardiovascular events such as heart attacks and strokes. The link between these two conditions is thought to be inflammation, as both periodontal disease and CVD are characterized by chronic inflammation in the body(33,34). Autoimmune disorders, such as rheumatoid arthritis(35) and lupus(36), have also been found to impact the progression and prognosis of periodontal disease. Individuals with autoimmune disorders often have an overactive immune system that can lead to increased inflammation in the gums and accelerate the progression of periodontal disease.

Overall, systemic diseases can have a significant impact on the progression and prognosis of periodontal disease. By addressing underlying systemic issues and maintaining good oral hygiene practices, individuals can help to improve their overall health and reduce the risk of complications from periodontal disease. Compared to other systemic diseases, diabetes mellitus has strong evidence for periodontal pathogenesis. Hence, DM is considered a “grade modifying risk factor” for periodontitis. Nondiabetics were classified as Grade-A periodontitis (slow rate) with a good prognosis (Green); diabetic patients under control (HbA1c <7.0%) were classified as Grade-B periodontitis (moderate rate) with a fair prognosis (Yellow); and diabetic patients beyond control (HbA1c ≥7.0%) were classified as Grade C periodontitis (rapid rate) with a poor prognosis (Red)(3).

The level of ***experience and skill of the clinician*** is an important factor to be taken into consideration when making decisions regarding specialized periodontal surgical therapy or implant placement with adjunct regenerative procedures (37), even though it is not a major factor for the survival rate of teeth involved in periodontal disease(38). Considering this, we classified this category based on a dental professional's ability to treat and preserve a compromised tooth: experienced clinicians (green) and clinicians with less experience (yellow). The yellow category has a questionable

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prognosis because the long-term success rate is uncertain(2).

Patients taking medication for systemic diseases frequently need to be assessed since these drugs may have an impact on the course and results of periodontal treatment or may be directly or indirectly linked to the progression of periodontal disease(39). We classified people as being in the "green group" if they were not taking medicine or were in good overall health. If they were taking any medications that could conflict with the treatment plan, we considered them to be in the "Yellow category" and required special care.

Structural and aesthetic parameters:

Biological width is essential for the preservation of periodontal health and removal of irritation that might damage the periodontium. To maintain proper form, function, aesthetics, and comfort of the dentition, gingival health maintenance and adequate knowledge of the link between periodontal tissues and restorative dentistry are essential. The restorative dentist must prevent disturbing the connective tissue apparatus or junctional epithelium while placing restorations with subgingival margins(40). A minimum biological width of 2 mm is essential for a healthy periodontium(41). When restorative margins have a sufficient biological width of 2 mm and no adjunct periodontal surgical therapy is needed, the prognosis is good (green). Patients with insufficient biological width (less than 2 mm) who required surgical intervention were deemed to have a fair prognosis (yellow). A poor prognosis results from inadequate biological width when surgical intervention is contraindicated (red).

Mucogingival problems (shallow vestibules, recession, insufficient keratinized gingiva, and deep periodontal pockets) greatly impair the effectiveness of periodontal therapy(42,43). Before initiating treatment, it is important to ensure that these issues are carefully assessed. Patients with mucogingival issues are categorized as having a questionable prognosis for long-term success (yellow) because they require an additional specialized treatment plan. In contrast, patients with sole gingival issues respond well to treatment (green).

The degree of the **gingival biotype** and its correlation with alveolar bone thickness and biological width can influence the results of surgical periodontal therapy. Therefore, for any of these therapies to be successful, it is essential to evaluate the gingival biotype initially. A thick gingival thickness is defined as ≥1 mm, while a thin biotype is defined as ≤1 mm(44). Thin biotypes are at risk for fenestrations and dehiscence, which can impact the outcomes of root covering, periodontal, and implant treatments(45,46). Thick gingival biotypes are classified as green in our flowchart, indicating that they have a good prognosis. When performing surgical periodontal therapy for a thin biotype, caution must be taken to prevent postoperative problems (yellow).

For prosthetic and therapeutic therapies to be successful, a healthy periodontium is typically essential. Improper positioning of ***crown contours*** and ***restorative margins***, trauma, microbial flora, and gingival tissue reactions to restorative preparations can all compromise the epithelial integrity of the dentogingival unit. Alveolar bone loss, gingival inflammation, and clinical attachment loss are usually caused by defective restorative margins within the biologic width(47,48). It is advised to determine the patient's biologic width requirement by using the patient's current sulcus depth as a guide for setting the restorative margins(49). Consequently, the prognosis is good for prostheses with supragingival restorative margins and adequate biological width (green group). The margin half the sulcus depth was placed below the tissue crest (subgingival) if the sulcus was more than 1.5 mm. If a patient is at a higher risk of recession, this positions the margin far enough below the tissue to still cover it with no further deterioration of the recession with a fair long-term prognosis (yellow). In the case of subgingival restorative margins, the restoration border was placed 0.5 mm below the gingival tissue crest if the sulcus depth was 1.5 mm or less. In a patient who is highly susceptible, this approach avoids a biologic width violation with a favourable prognosis (red)(50).

Unfavourable ***crown/root ratios*** might make it difficult to maintain a tooth over time due to insufficient alveolar bone support, which can increase mobility and/or worsen clinical symptoms (51,52). The minimum acceptable ratio in cases where the occlusion is under control and the periodontium is in good health is determined to be 1:1(53,54). As a result, we divided this category into two groups: favourable crown/root ratios <1:1 (green) and unfavourable ratios (red) >1:1.

Deficient alveolar ridges with a previous history of periodontitis need careful evaluation while planning prostheses or implants. Periodontal disease is the most common cause of alveolar ridge defects. Seibert (1983) classified ridge defects into simple class-1 defects (horizontal bone loss), class-2 defects (vertical bone loss) and class-3 defects (both horizontal and vertical bone

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loss) (55). Combined soft and hard tissue augmentation for localized alveolar ridge defects has been proposed(56). This classification has been integrated into our prognosis flowchart based on the therapeutic success rate. Class 1 and Class 2 defects have a decent prognosis because there are a number of reconstructive methods with good success rates (green)(56). However, Class 3 defects (red) have a lower success rate and are more difficult to treat.

Individuals with a ***high risk of dental caries*** could pose a threat to the progression of periodontal disease. Periodontists and restorative dentists face challenges when patients with root caries fail to maintain proper oral hygiene. Root caries patients with poor oral hygiene have a greater tendency for gingival inflammation. Complications such as abutment caries, abutment root canal treatment for fixed partial dentures and prosthesis retention loss were reported in patients with root caries(57). Furthermore, teeth with extensive caries require crown lengthening, mucogingival surgery or forced orthodontic eruption to achieve the desired crown length and maintain good biological width(58). Considering these facts, for teeth with extensive caries or root caries where restorability is desired, the prognosis is classified as questionable (yellow), and for teeth with no caries risk, the prognosis is classified as good (green).

Parafunctional habits (lip and nail biting, bruxism) are referred to as "nervous habits", as they occur more frequently and to a greater extent when one is under stress, worry, or tension(59). These habits with prolonged tension and compression forces may cause congestion and irritation of the periodontal membrane, initiating periodontal disease, or they could contribute as a secondary component to a periodontal disease that already exists(60). For the decision-making chart, in comparison to individuals without parafunctional habits (green), those with parafunctional habits have a doubtful periodontal prognosis for tooth restorability in the long run if these habits are not controlled (red).

Summary and conclusion:

Making decisions on whether periodontitis-affected teeth can be restored is a difficult, multidisciplinary procedure that requires careful consideration of a number of variables. Since effective periodontal therapy can stabilize periodontal tissues and improve attachment levels, comprehensive periodontal treatment and maintenance are crucial for maximizing the restorability of teeth with periodontitis. For teeth with periodontitis to heal as best as possible, cooperation between restorative dentists and periodontists is essential. Monitoring the success of restorations in teeth with periodontitis and lowering the risk of failure requires meticulous treatment planning and routine follow-up care. To determine methods for enhancing the restorability of teeth with periodontitis and to investigate the long-term effects of restorative treatment on these teeth, additional studies are needed.

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