



New Challenges in Treatment Planning

Shifting the Paradigm Toward Risk Assessment and Perceived Value—Part 1

John C. Kois, DMD, MSD

Abstract

The fundamental rationale for a comprehensive treatment approach is a long-term strategy for dental health commensurate with an enhanced level of wellness for patients. Understanding parameters of disease expression can be confusing due to inaccurately implemented science or a lack of diagnostic information available to the patient. Formulating specific treatment needs based upon an individual's risk assessment can be challenging without objective data and better metrics. This two-part article (Part 2 will be published in the Spring 2011 *JCD*) will help to eliminate confusion in the diagnostic process by outlining a systematic approach for treatment planning; by reviewing the five most important diagnostic categories; and by detailing how to develop critical risk parameters that can minimize failure and maximize successful outcomes. These articles also discuss protocols that can be implemented during treatment-planning strategies.



Introduction

Many dentists have become more astute about and very efficient when evaluating the dental health of a new patient or reevaluating an existing patient. An interaction that involves examining a radiograph for five seconds and the patient's mouth for five seconds does not provide enough value. Ironically, instead of perceiving the doctor as better trained, many patients believe the doctor is uncaring, uninvolved, and lacking in expertise.¹ Transcending such perceptions requires clinicians to provide care that exceeds patient expectations² and to cultivate patient understanding of what is being reviewed, evaluated, and diagnosed in those crucial five seconds.

When patients understand the "why" behind the "do," they are better equipped to make decisions about their treatment and are more likely to perceive their dentist as a healthcare provider.

To this end, the careful incorporation and utilization of "disruptive technologies" that enable precise diagnosis and, subsequently, predictable and effective therapies valued by patients have the potential to transform the practice.³ Typically viewed as a financial and competitive threat by the major pharmaceutical companies, a shift in market leaders is plausible as new companies adopt and deploy these technologies more efficiently.³ However, these so-called disruptive technologies (e.g., new machinery, production methods, risk analysis) can enable doctors to provide comprehensive explanations of a patient's condition, along with options for treatment and the risks involved with each.^{2,4,6} When patients understand the "why" behind the "do," they are better equipped to make decisions about their treatment and are more likely to perceive their dentist as a healthcare provider.

While technologies that provide diagnostic information are making headway in the dental arena, they already are in place in other areas of healthcare to help start making universal care a reality.⁷ All health records will eventually be in digital format, and there may come a day when public kiosks can provide individuals with diagnostic data indicating whether a physician visit is necessary.^{4,6}

Such precision medicine lends itself to the concepts of "the healer" and "the hit-man," which are significant to the manner in which patients respond to dentists when presented with treatment options. Today, dentists still are considered "the hit-man" or bearer of bad news.⁸ When patients present with no data and are informed of problems, the practitioner is to blame in the patient's mind.

Functional Disorders Checklist: Nine Questions

Conditions of the temporomandibular joints (TMJs) are among the most difficult to diagnose and manage. Therefore, a complete understanding of the patient's oral and overall health is required. To help dentists and patients understand functional disorders, the nine questions allow for simple risk assessment of conditions of the TMJ and occlusion. By using these questions as diagnostic tools, dentists can gain better insight into what may be causing their patient's pain and functional disorders.

If the patient answers affirmatively, they do not necessarily need treatment; rather, their responses indicate that their occlusion is in some way incorrect. The focus should be on risk assessment and quantifying the facts so the patient can develop an understanding of their conditions and why certain treatments may be necessary.

- ✓ **1. Do you/would you have any problems chewing gum?**
If the patient cannot chew gum, there is a functional problem with the patient's occlusion and TMJ and the patient is at risk. This should be quantified to inform them that although it may not be a problem requiring immediate attention, it is one that may need correcting in the future.
- ✓ **2. Do you/would you have any problems chewing bagels or other hard foods?**
When asked this question, the majority of patients feel that they do not. In actuality, the patient may have been avoiding foods that bother their TMJ. By doing so, the patient has actually begun a form of treatment for their specific problem, reducing the risk of pain and discomfort. The cause of this problem is occlusal.
- ✓ **3. Have your teeth changed in the last five years, becoming shorter, thinner, or worn?**
This question is of paramount importance to diagnosing and treating a patient's condition. If the patient has an old yearbook or wedding photograph, it can provide a historical timeline of tooth changes that have occurred.
- ✓ **4. Are your teeth crowding or developing spaces?**
The spacing of the teeth should not change much as patients age. If they are, an underlying functional issue is likely to blame. Patients should understand that no matter what condition has caused the change, orthodontics will need to be involved to some extent.

However, if technology and the subsequent data they provide were to first explain the clinical situation, then technology becomes the "hit-man" and the dentist becomes "the healer," since the patient now schedules the appointment with full knowledge of his or her condition and possible solutions.⁸

Preparing for the Paradigm Shift

Acknowledging and accepting a shift in the paradigm of dental practice requires adaptation to maintain success.⁹ Unfortunately, creating change is very difficult in practice because it must be justified, similar to the manner in which a patient's need for treatment must be supported by diagnostic data.²

Six Sigma, a concept designed by Motorola, is a business model that promotes change and working smarter with simple tools and practices.^{10,11} An example of its application to dentistry is eliminating the likelihood of chipped porcelain through the use of data and systematic diagnostic/treatment processes that assess and reduce risk. "Six Sigma dentistry" therefore is a concept aimed at removing what causes added stress or risk throughout the workday, even if it involves the simplest procedures.^{10,11}

Six Sigma dentistry also involves predictability, which can be improved with technology and repeatable procedures, as well as a smarter workflow that enables practitioners to embrace opportunities for expansion, efficiency, and cost effectiveness. By solving small problems first, correcting large issues is less daunting.^{10,11}

Guiding Patients with Technology and Risk Assessment

Dental practitioners following a Six Sigma model are leading a paradigm shift of addressing patient and practice problems from a systematic perspective. In the process, they are improving their lives and practices by removing even the smallest obstacles.^{10,11} Among the tools that are useful for systematically examining both practice and patient "conditions" are checklists that can help identify why situations occur. For example, a part of my dental history form helps to uncover problems that can be evaluated by a traditional exam that evaluates morphology (see sidebar, **Functional Disorders Checklist**, beginning on page 69).¹² In the context of diagnosing and evaluating patients, a risk assessment checklist that encompasses evaluation of five key areas (periodontics, biomechanics, function, dentofacial, medical) is fundamental to necessary data collection, regardless of the technologies used.

For example, consider the case of restoration breakage. It is well known that most patients do not break restora-

✓5. Do you have more than one bite, or do you clench (squeeze) to make your teeth fit together?

If the patient is clenching or squeezing, a functional problem needs to be addressed. Equilibration will likely be the required treatment for this condition.

✓6. Do you have any problems with sleep or wake up with an awareness of your teeth?

Studies have found that, in some populations, 15% of people with restless leg syndrome have sleep bruxism. When patients experience restless sleep, the condition is actually one of the central nervous system, not local to the teeth. Therefore, a nightguard will not fix the problem; it will simply ameliorate the symptoms.

✓7. Do you have problems with your jaw joint? (pain, sounds, limited opening, locking, popping)?

Even if the patient is experiencing no pain in the joint, except when loading, it is still an unhealthy joint when these symptoms are present. With clicking and popping, the patient is at future risk for more damaging conditions that will cause functional disorders.

✓8. Do you have tension headaches or sore teeth?

A patient presenting with these symptoms is more likely than not experiencing symptoms of a functional disorder of occlusion or the TMJ. The added stress on the tooth structures and joints can cause problems elsewhere in the body, leading to headaches and soreness.

✓9. Do you wear or have you ever worn a bite appliance?

If the patient has, it should be brought to the office so it can be read. The marks on the appliance should be examined and should be linear, with no chewing marks. A splint, used not to stop nocturnal bruxism but to prevent further tooth damage, should have a pattern to the marks. By examining this pattern, the dentist should be able to develop a better understanding of the patient's functional disorder.

tions when sleeping.¹³ For the most part, breakages occur while eating. Many times restoration failure also is directly related to parafunction.¹³ This issue could be solved by simply questioning the cause, studying why it occurs, and quantifying it. Once this problem is assessed systematically and understood, a solution can be developed.

However, presentation of the patient's condition and possible treatment options also must be approached systematically and appropriately.¹⁴ Once patients are advised of the problems, focus should shift to what is clinically relevant to enhance understanding and comprehension.¹⁴

For example, consider that teeth should not wear more than 11 μ per year, which means it would take 100 years to lose 1 mm of tooth structure. A patient who has lost 4 mm of tooth structure needs to be told that the amount of wear they present is equivalent to 400 years of use. Based on this explanation, any occlusal restoration or treatment can be viewed as an anti-aging strategy and more likely to be accepted by the patient, since the problem can be more clearly understood.¹⁴

Unfortunately, many times a lack of clear and objective data allows one dentist to determine a treatment that another dentist may deem inappropriate.^{14,15} The result of this emotionally-driven decision making creates much of the stress experienced in the dental practice and that Six Sigma dentistry and systematic approaches aims to eliminate.^{14,15} As a result, things may happen in the practice and treatment process that should not. When risks are known and ignored due to emotions, the final outcome often is compromised.¹⁵

By utilizing a better technologically-based metric, much of the dentist's clinical decision making can be removed from an emotionally-driven state. With better metrics and a systemic approach to risk assessment and evaluation, patients can be offered significantly improved treatments.^{14,15}

Conclusion

The paradigm of systematically approaching patient examinations, risk assessment, diagnosis, and treatment planning emphasizes the need to prevent oral health problems from progressing in the future.¹⁶ Because the burden of responsibility rests with the dentist, problems should not be corrected with solutions that will not be permanent.²

All health records will eventually be in digital format, and there may come a day when public kiosks can provide individuals with diagnostic data indicating whether a physician visit is necessary.

Although it is generally accepted that most choices are never perfect, they should be, at the least, well calculated.² In dentistry, calculating risk and predicting the outcome many times may involve the lesser of two evils. The critical objective is to utilize systems that eliminate subjectivity so patients receive the best in care at the lowest functional, periodontal, biomechanical, dentofacial, medical, and financial cost while simultaneously increasing reward.² After all, part of what patients pay for is guidance from their dentists toward the best treatment options for their case, whether for longevity or esthetics.^{2,14}

Risk assessment is beneficial not only for patients, but also for dentists.¹⁷ The struggle, however, is not in understanding the risk. The problem most dentists face is in implementing risk-reducing protocols. Although implementing science into practice remains a challenge, using evidence enables dentists to better predict and control the outcome.²

Part 2 of this article will elaborate on the process of risk assessment and the categories to be addressed therein.

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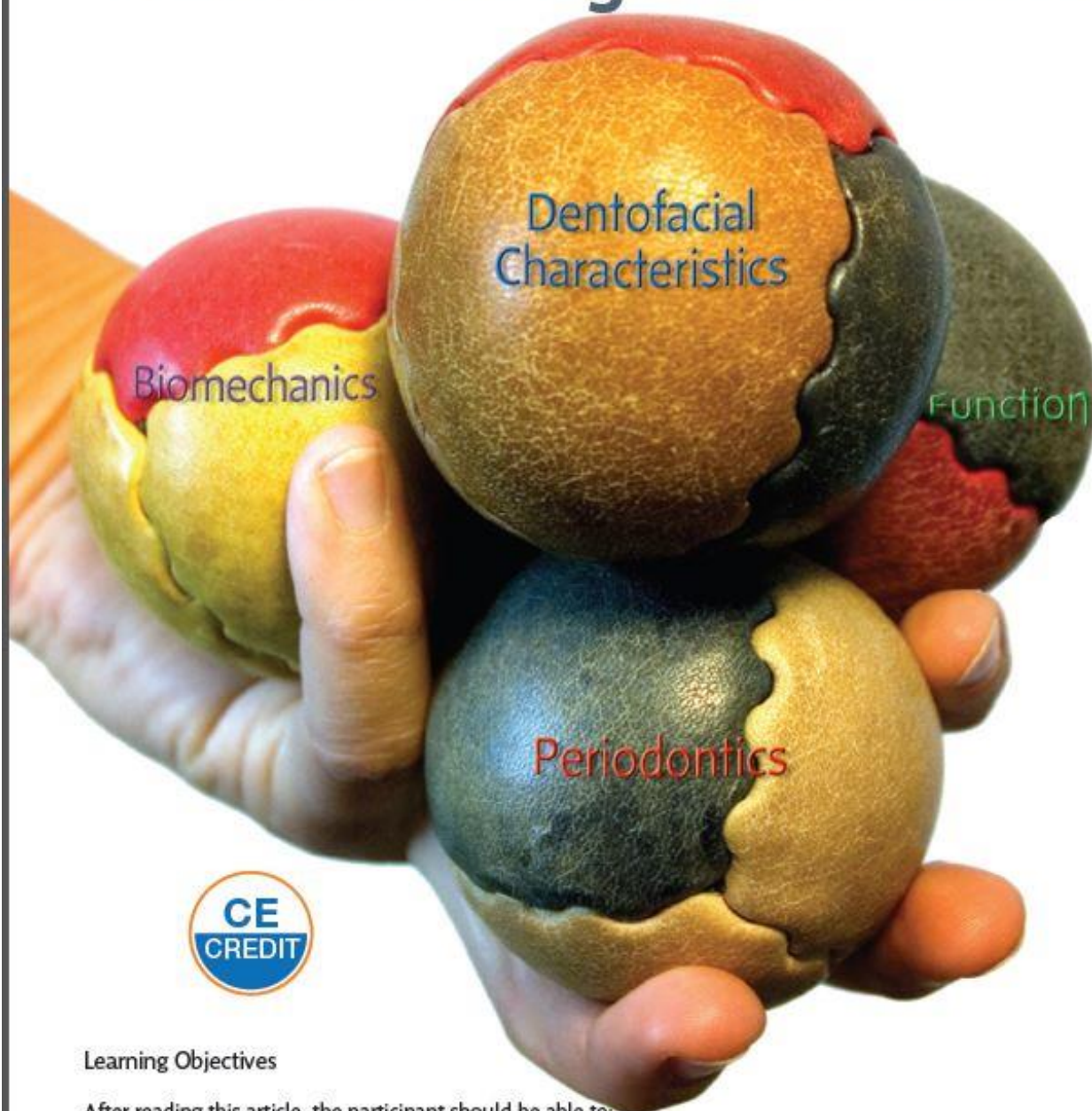


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New Challenges in Treatment



Learning Objectives

After reading this article, the participant should be able to:

1. Develop a systematic approach for treatment planning every patient.
2. Focus on the four most important diagnostic categories.
3. Develop and utilize critical risk parameters to minimize failure and maximize successful treatment-planning strategies.

Planning—Part 2

Incorporating the Fundamentals of Patient Risk Assessment

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Abstract

The fundamental rationale for a comprehensive treatment approach is a long-term strategy for dental health commensurate with an enhanced level of wellness for patients. Understanding parameters of disease expression can be confusing due to inaccurately implemented science or patient adaptation. Formulating specific treatment needs based on risk assessment of an individual can be challenging without objective data and better metrics. This second article in a two-part series will help to eliminate confusion in the diagnostic process by outlining a systematic approach for treatment planning by reviewing the four most important diagnostic categories, and by detailing how to develop critical risk parameters that can minimize failure and maximize successful outcomes. Strategies that can be implemented during treatment planning will also be reviewed.

NAME		DIAGNOSTIC OPINION		AGE	DATE
RISK ASSESSMENT LOW Acceptable MODERATE May require further attention HIGH Requires immediate attention					
PERIODONTAL LOW MODERATE HIGH Risk Assessment					
☐ Gingivitis (Bleed) Modified by: LOW MODERATE HIGH					
☐ Attachment Loss / Chronic Periodontitis (Bone Loss) LOW MODERATE HIGH					
☐ Ulcer (LAP) Moderate (LAPM) Severe (LAPSM) LOW MODERATE HIGH					
☐ Periodontitis LOW MODERATE HIGH					
☐ Secondary Endodontic Infection LOW MODERATE HIGH					
☐ Abscess LOW MODERATE HIGH					
☐ Recession LOW MODERATE HIGH					
PROGNOSIS EXCELLENT GOOD FAIR POOR HOPELESS					
Generalized (Non-vitality Test) Specific (Individual Teeth)					
BIOMECHANICAL LOW MODERATE HIGH Risk Assessment					
☐ Caries LOW MODERATE HIGH					
☐ Defective Restorations LOW MODERATE HIGH					
☐ Occlusal Interference LOW MODERATE HIGH					
☐ Malocclusion / Compromised LOW MODERATE HIGH					
☐ Period Pathology LOW MODERATE HIGH					
☐ Trauma LOW MODERATE HIGH					
PROGNOSIS EXCELLENT GOOD FAIR POOR HOPELESS					
Generalized (Non-vitality Test) Specific (Individual Teeth)					
FUNCTIONAL LOW MODERATE HIGH Risk Assessment					
☐ Interferes / Normal Force LOW MODERATE HIGH					
☐ Minimal Moderate Severe LOW MODERATE HIGH					
☐ Horizontal / Vertical / Buccal / Buccal Force LOW MODERATE HIGH					
☐ Minimal Moderate Severe LOW MODERATE HIGH					
☐ Occlusion LOW MODERATE HIGH					
☐ Primary Occlusal Trauma LOW MODERATE HIGH					
☐ TMJ LOW MODERATE HIGH					
☐ Maxillofacial Neuromuscular Abnormalities LOW MODERATE HIGH					
☐ Compromised Occlusal Vertical Dimension LOW MODERATE HIGH					
☐ Missing Teeth LOW MODERATE HIGH					
☐ Other LOW MODERATE HIGH					
PROGNOSIS EXCELLENT GOOD FAIR POOR HOPELESS					
Generalized (Non-vitality Test) Specific (Individual Teeth)					
DENTOFACIAL LOW MODERATE HIGH Risk Assessment					
COLOR Acceptable Notably					
☐ Developmental Discolorations Acceptable Notably					
FACIALLY RELATED TOOTH POSITION					
1. Mesial / Lateral Incisor Position Acceptable Notably					
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Figure 1: Diagnostic Opinion checklist outlining the dentist's critical risk assessment of the four primary oral parameters (i.e., periodontal, biomechanical, functional, and dentofacial) in terms of low, moderate, and high risk, as well as prognosis (i.e., excellent, good, fair, poor, or hopeless).

Periodontics, biomechanics, function, and dentofacial characteristics are parameters that must be assessed during the patient examination to ensure that existing and potential risks are identified.

Introduction

When patients present to the dental office seeking treatment, ensuring the long-term function and stability of the dentition or restorations associated with treatment is predicated on recognizing, understanding, and managing four categories of risk that affect oral health. Periodontics, biomechanics, function, and dentofacial characteristics are parameters that must be assessed during the patient examination to ensure that existing and potential risks are identified, and then reduced and/or eliminated within the most appropriate and cost-effective treatment plan.

Risk Assessment

Risk assessment begins by determining each patient's risk for future disease within each of these four main categories, even before they may have expressed signs or symptoms. Risk can be described as the likelihood that injury, damage, or loss will occur. Assessing patient risk can be accomplished by analyzing the conditions with which an individual presents and assessing the potential implications of those conditions based on the doctor's knowledge and scientific evidence.¹⁻³ Risk in any given category can be classified as low (i.e., acceptable), moderate (i.e., may require further attention), and high (i.e., requires immediate attention).

Risk assessment is inherently associated with the prognosis of a patient's condition and prospective longevity of any planned treatment. Prognosis needs to be described as predicting disease outcomes without treatment, in any given category, and can be classified as excellent, good, fair, poor, or hopeless.

Subsequently, risk/prognosis evaluations of possible treatment options need to focus on risk reduction or prognosis improvement to decide which alternatives are best. These evaluations are essential components of the Diagnostic Opinion (Fig 1) and critical to determining the most appropriate treatment plan. The value of these evaluations is essential despite the fact that there may be multiple available treatment options for lowering the risk.

It is imperative that all four categories of risk be considered when determining risk and prognosis. Neither the risk categories, nor the contributing factors within each category, influence oral health exclusively or in isolation of the others. By reducing risk across all of these parameters (i.e., periodontal, biomechanical, functional, dentofacial), dentists can lower the burden to the oral environment, improve treatment prognosis, and enhance long-term predictability. Therefore, by systematically assessing patient risk, dentists also avoid consideration of treatments that might other-

wise add risk to the overall oral health of their patients and are not supported by scientific evidence.³⁻⁵

Assessing Periodontal Risk

Assessing periodontal risk involves assessing an individual patient's gingival health, attachment loss or chronic periodontitis (bone loss), aggressive periodontitis, secondary occlusal traumatism, abrasion, recession, posterior bite collapse, oral pathology, impaction, and missing teeth due to bone loss. Establishing the periodontal risk of the patient's presenting situation provides value for predicting future outcomes. An understanding of how each diagnostic factor is affecting the patient's overall oral health guides the development of an effective treatment plan for reducing or eliminating disease and preventing future risk.

In combination with biofilm management and patient-specific responses, periodontal risk factors impact the severity of the disease, how it manifests, and how the patient will respond to treatment.^{4,5} Therefore, factors such as genetics, diabetes, smoking, mobility at the tooth level, and infra-bony components at the site level are important indicators of disease and risk and among the contributors to periodontal risk that should be assessed during the patient evaluation.⁶

Therefore, individual patients and even specific tooth sites vary in terms of disease susceptibility, making it necessary to collect periodontal data through a variety of scientifically based methods. To date, these include assessments based on probing depths, calculus, plaque levels, bleeding on probing, current state of inflammation, occlusion, periodontal pathogens, biomarkers, and systemic risk factors.

Typically, periodontal low-risk patients are those with minimal bone loss consistent with the American Academy of Periodontology (AAP) 0, I, or II classification. Periodontal moderate-risk patients present with 2 to 4 mm of horizontal bone loss and/or isolated infra-bony defects; they would be classified as AAP III. Periodontal high-risk patients exhibit severe bone loss greater than 4 mm, an AAP IV classification (Figs 2a & 2b).

Assessing Biomechanical Risk

Biomechanical risk assessment incorporates evaluation of caries, defective restorations, questionable restorations, structural compromises, pulpal pathology, erosion, crown margin location concerns, and missing teeth. Essentially, the biomechanical risk assessment examines tooth structure loss from two primary causes: caries, a biofilm-mediated disease; and erosion, a chemical-mediated disease.

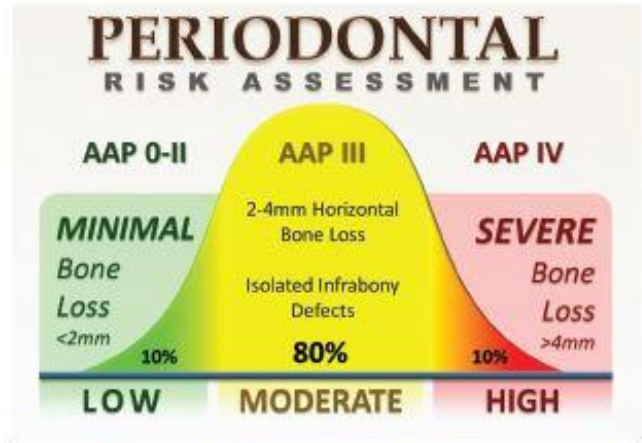


Figure 2a: Periodontal risk assessment—distribution of periodontal health and disease.



Figure 2b: Clinical example of high periodontal risk.

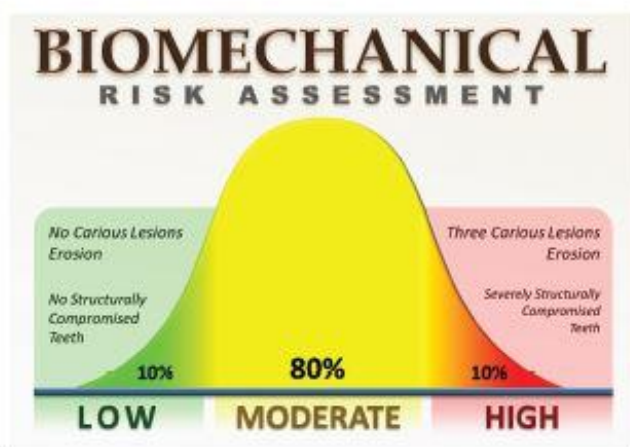


Figure 3a: Biomechanical risk assessment—distribution of biomechanical health and disease.



Figure 3b: Clinical example of high biomechanical risk.

Biofilms are a common denominator among characteristics in both periodontal and biomechanical risk categories. The organisms contained within biofilms can promote a healthy oral environment, produce by-products that destroy oral hard and soft tissues, and/or alter the pH of the oral cavity, resulting in increased susceptibility to decay and erosion.^{6,7} Saliva, which neutralizes oral pH, is also significant to caries risk assessment and control. Creating an ecologic shift in the biofilm from acidic to an alkaline environment would reduce caries risk.^{8,9} Biomechanical low-risk patients present no carious lesions or erosions and no structurally compromised teeth. Biomechanical high-risk patients present with at least three carious lesions, moderate to severe erosion, or severely structurally compromised teeth. Patients at moderate biomechanical risk demonstrate signs and symptoms that fall in between (Figs 3a & 3b).

When clinicians can identify high caries risk patients versus low caries risk patients, those at high risk can be treated with protocols to lower their risk, such as dietary counseling, sealants, fluoride application¹⁰ and alkaline rinses to train the biofilm to shift to an alkaline environment. Assuming extensive restorative treatment is also required in patients at high risk for caries, those restorations should be designed in ways to better ensure a successful long-term prognosis, rather than be susceptible to the ongoing challenge of recurrent caries and structural breakdown.

Recurrent caries is a leading cause of crown and bridge failure. However, the cause is very significant. Caries apical to the margin of the restoration is caused by caries susceptibility, but caries inside the restoration may be caused by cement fatigue, which is an occlusal etiology or a structural compromised tooth preparation that has too much flexure.

In the context of biomechanical risk/prognosis, it is incumbent upon dentists to inform patients of the impact their oral hygiene habits and occlusal management can have on the longevity of the restorations.

Many acid-related issues can present with similar symptoms. Therefore, different contributing factors require consideration. For example, the acid erosion associated with bulimia is accompanied by projectile vomiting and tongue striking that is extremely erosive to enamel and dentin and creates a smooth look to the back of the teeth.^{11,12} On the other hand, if the enamel is perforated first and the dentin is damaged, bulimia is not likely the underlying cause; excessive consumption of fruit juice or modern beverages ("power drinks") might be to blame.¹³⁻¹⁵

Pre-existing enamel damage complicates risk assessment, diagnosis, and prognosis. The use of technology could help to quantify the problem sufficiently to ensure patient understanding of the issues

involved. This would open the door for advanced treatment planning and possible solutions to erosion problems.¹⁶

Assessing Functional Risk

Assessing functional risk involves evaluating an individual patient's attrition, abfraction, primary occlusal traumatism, temporomandibular disease, abnormal neuromuscular habits, and compromised occlusal vertical dimension. It is important to realize the static relationship of the teeth does not provide comprehensive insight into the influences functional forces have on the teeth because they do not completely explain how the teeth are being used.^{7,18} Inefficient chewing systems can place frictional contact on the teeth that cause wear with acceptable levels of force. The most important treatment decision is whether the patient has current or previous disease activity. The patient may have adapted to the current situation and breakdown is no longer occurring or is occurring at a much reduced rate. In other words, the visual perception of the disease may be worse than the actual disease. In addition, a morphologic malocclusion is not the same as a functional malocclusion.

Patients with low functional risk demonstrate an acceptable function. However, those with moderate functional risks demonstrate some problem in their occlusion (i.e., dysfunction or constricted envelope of function). Those with higher functional risk, on the other hand, experience more brain-mediated problems (i.e., parafunction and/or neurological disorders) (Figs 4a & 4b).

Assessing Dentofacial Risk

Dentofacial risk assessment incorporates evaluation of color, facially related tooth position, and maxillary and mandibular gingival symmetry, scallop/form, and reveal. When dealing with dentofacial aspects of treatment, it is important to consider where the teeth should be positioned in the face, where the tissue should display, and how much the lip should move.¹⁹⁻²¹

Patients find symmetry, whiter teeth, and overall harmony within their mouth pleasing.²²⁻²⁴ Medium lip dynamics and full-tooth display are necessary to achieve this appearance.

Patients with low dentofacial risk demonstrate minimum tooth display and no tissue display, while those with moderate dentofacial risk demonstrate the ideal tooth position. High dentofacial risk patients present with maximum tooth display and maximum tissue display (Figs 5a & 5b).

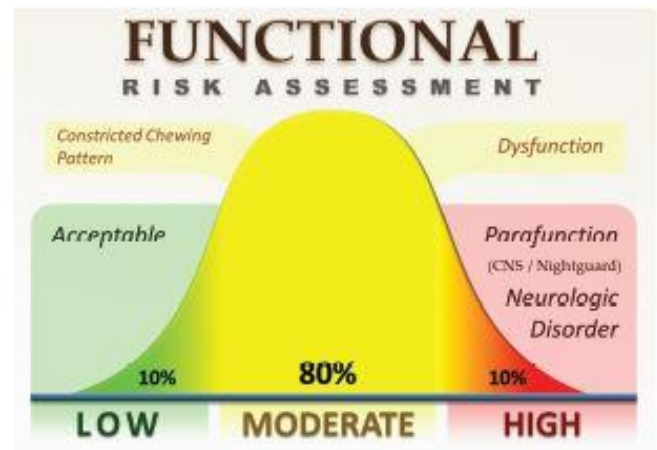


Figure 4a: Functional risk assessment chart—distribution of functional health and disease.



Figure 4b: Clinical example of high functional risk.

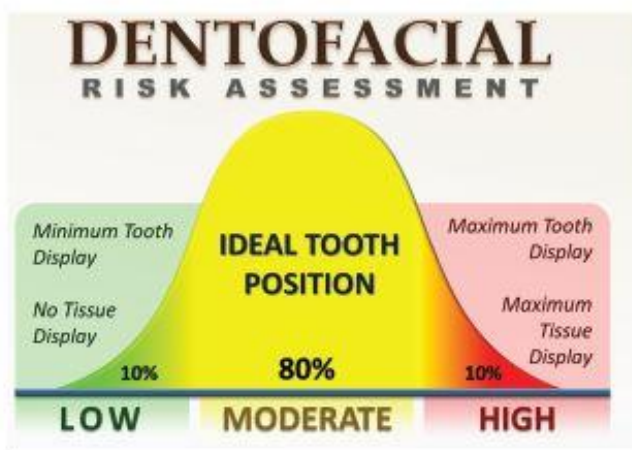


Figure 5a: Dentofacial risk assessment chart—distribution of dentofacial health and disease.



Figure 5b: Clinical example of high dentofacial risk.

Risk assessment is inherently associated with the prognosis of a patient's condition and prospective longevity of any planned treatment.

Case Study

Findings

A 30-year-old non-smoking woman presented with no bone loss, no mobility, no history of diabetes, and no other shared risk factors for the progression of periodontal disease (Figs 6-8). Therefore, the risk for progression of periodontal disease was low and the prognosis was good. The treatment selected to maintain periodontal health was six-month continuous care and gingival management with oral hygiene products.

The patient did, however, present with three carious lesions, erosion, and structural compromises. For someone her age, she had excessive restorative dentistry, and many teeth that had been previously restored were structurally compromised (Figs 9 & 10). The biomechanical risk was determined to be high and therefore required restorative dentistry to reduce the progression of existing disease, and a caries management protocol to reduce risk of future disease.

Functional disorders also caused some of the patient's problems (Figs 11 & 12). Her front teeth were getting shorter, and the patient found she was squeezing to make the teeth fit together (Fig 13). After determining that the problems were not caused by parafunction or a neurological disorder, the condition was attributed to dysfunction with an associated moderate functional risk. This would require occlusal treatment to lower the risk, which, in this case, involved equilibration and the establishment of the occlusal parameters to ensure stability.

With lip movement, the patient exhibited excessive gingival tissue display. The degree of tooth and gingival display categorized the patient as high-risk dentofacially.

Treatment Options

Three treatment options were presented to the patient. The first option incorporated anterior veneers to make the teeth appear longer. Anterior veneers, with posterior full-coverage restorations, and an occlusal equilibration would have limited the structural compromises. The compromise would be in the dentofacial result (Fig 14).

The second option included crown lengthening to move the teeth up within the framework of the facial structures, and full-coverage crowns. The patient was informed that exposure of the root surfaces with crown lengthening would dictate the need for full-coverage crowns throughout the maxillary arch. In addition, the desire to raise the maxillary occlusal plane would further increase the need for tooth reduction and the scenario would increase the probability of future endodontic therapy (Fig 15).

The third option involved orthognathic surgery to impact the maxilla within the framework of the face, anterior veneers, and posterior full-coverage restorations. The



Figure 6: The patient, before treatment.



Figure 7: There was no bone loss, no lip mobility, no history of diabetes, and no other shared risk factors for the progression of periodontal disease.

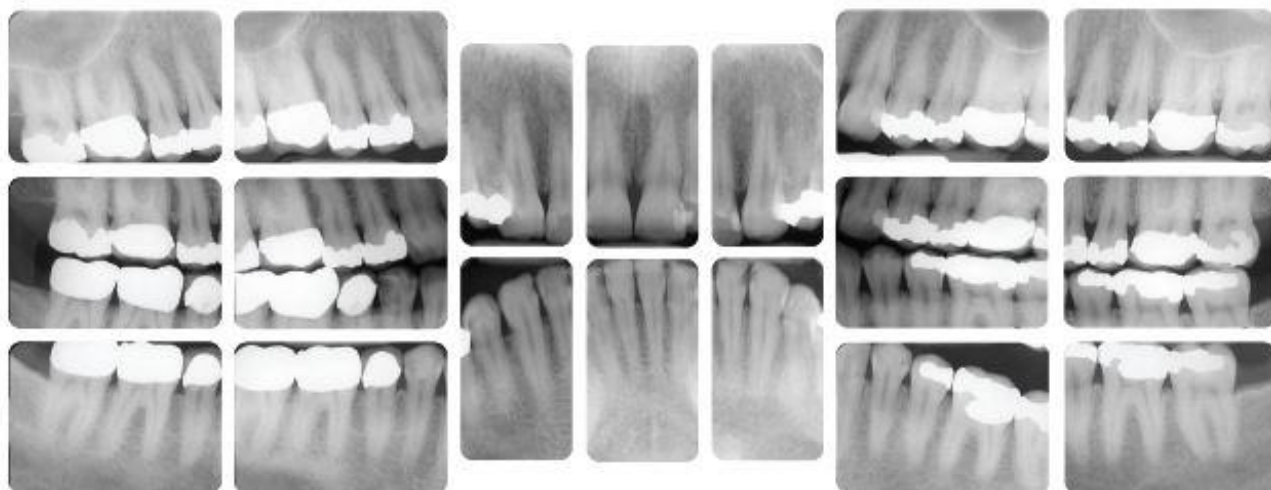


Figure 8: The risk for progression of periodontal disease was low and the prognosis good.

The new treatment philosophy is not about "rescuing," but rather about managing the conditions with which a patient presents.



Figure 9: Clinical exam revealed three carious lesions, erosion, and structural compromises.



Figure 10: For someone her age, the patient had excessive restorative dentistry, and many teeth that had been previously restored were structurally compromised.



Figure 11: Functional influences were contributing to the patient's problems.



Figure 12: The diagnosis of dysfunction established moderate functional risk.



Figure 13: The front teeth were getting shorter, and the patient found she was squeezing to make the teeth fit together.



Figure 14: The first treatment option involved equilibration, anterior veneers to add length without reducing the teeth, and posterior full-coverage restorations.



Figure 15: The second treatment option was maxillary arch crown lengthening (exposes root surfaces and contraindicates veneer option), decreased vertical dimension, and anterior and posterior full-coverage restorations.



Figure 16: The third treatment option called for orthognathic surgery to impact the maxillary arch, increase vertical dimension of occlusion, anterior veneers to add length to ideal incisal edge position, and posterior full-coverage restorations.



Figure 17: Final smile utilizing the first treatment option.

third option carried the risks and associated morbidities of the surgery but would provide the best dentofacial option and reduce biomechanical compromises to the teeth (Fig 16).

All three options could achieve health in terms of periodontal, biomechanical, and functional considerations but they would not look the same dentofacially (Figs 14-16). Each option requires different areas of treatment periodontally, biomechanically, and functionally, and some areas require more invasive treatment than others and therefore increase risk.

After weighing the prognosis with no treatment and the associated risks and potential outcomes of the various treatment options, the patient opted to proceed with the first option (equilibration to treat the dysfunction, anterior veneers to lengthen the anterior teeth, and posterior full-coverage restorations to treat the biomechanically compromised posterior teeth) (Figs 17-19).

Proper risk assessment/prognosis, diagnostics, and treatment planning contributed to a treatment that corrected the patient's functional disorders and achieved pleasing, although not ideal, esthetics.

Conclusion

Based on a greater understanding of the risk categories coming to bear on a patient's overall oral health, dentists may now focus their treatment planning on how to achieve predictable outcomes and reduce the risk of future disease.²²⁻²⁴ The new treatment philosophy is not about "rescuing," but rather about managing the conditions with which a patient presents.²²⁻²⁴ Ultimately, the patient's presenting situation provides prognostic value and treatment plans can be designed to reduce risk before the consequences of the disease processes become a major problem.

As demonstrated in Figures 2a, 3a, 4a, and 5a, a Gaussian bell curve represents the distribution of disease/risk (i.e., periodontal, biomechanical, functional, dentofacial) in our patients. Using periodontics as an example, low-risk patients (green) require re-care every six months; moderate-risk patients (yellow) require re-care every four months; and high-risk patients (red) will likely develop or have already developed periodontitis and require re-care every three months.

As a matter of good practice, it is best for dentists to do all they can to maintain their patients in the low-risk (green) zone, or just into the moderate-risk (yellow) zone. In situations where a patient's risk is attributable to their susceptibility to disease, it may not be possible to reduce the risk without sacrificing the teeth and it may be necessary to consider implant-supported restorations. When risk cannot be effectively reduced, our efforts are focused on improving prognosis by minimizing the contributing



Figure 18: Final maximum intercuspation position utilizing the first treatment option.

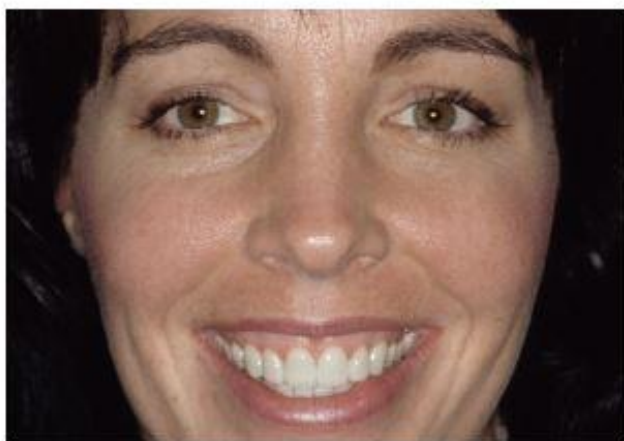


Figure 19: The first treatment option corrected the patient's functional disorders and achieved pleasing, although not ideal, esthetics.

When risk cannot be effectively reduced, our efforts are focused on improving prognosis by minimizing the contributing factors of disease that can be managed.

factors of disease that can be managed. Instead of allowing further breakdown that necessitates the need for constant treatments, treatment outcomes can be designed for predictability and affordability and can provide patients with predictable solutions.²⁵

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Functional Occlusion: Science-Driven Management



by Presented by John Kois, D.M.D., M.S.D.
Reported by Nancy Hartrick, D.D.S.
www.koiscenter.com

"Wisdom is not a product of schooling, but a lifelong attempt to acquire it"

—Albert Einstein

Among the handful of clinicians and educators who have determinedly followed Einstein's formula for acquiring wisdom, John Kois stands out as a master. This past May in Atlanta, the Academy had the great pleasure of hearing Dr. Kois speak about the occlusal system from his unique perspective.

A predictable approach to the management of occlusion... is always about a correct diagnostic approach.

SYSTEMATIC APPROACH TO RISK ASSESSMENT

Dr. Kois states that a predictable approach to the management of occlusion is *always* about a correct diagnostic approach. For Dr. Kois, a systematic approach to risk assessment in all four areas—periodontal, biomechanical, functional, and dentofacial—ensures that the clinician is clear about the clinical factors he or she faces. An appropriate treatment plan is only possible when considering these factors. Managing the occlusal parameter, however, is made more difficult because of the three-dimensional nature of the face. Changing the vertical dimension in the patient also changes the horizontal components; therefore, understanding how these fit together and how this system works is critical to predictable restorative results.

THREE P's

Dr. Kois proposes a fresh and straightforward approach to defining the parameters of the occlusal system, by considering his "Three P's."

KOIS/HARTTRICK

P1 represents the *position* of the joint. Due to the articular disk and the fact that there is a certain amount of soft tissue around it, it is difficult to precisely locate the position that some call centric relation (CR). P1 may be the maximum intercuspal position (MIP), or existing occlusion in patients with acceptable function. It also may be CR, the orthopedic position of the joint, or the myocentric position.

P2 relates to how the teeth fit together in the posterior aspect of the mouth. P2 also impacts the relationship of the teeth within the framework of the smile and the face (i.e., making the teeth longer affects occlusal vertical dimension and increases tooth display).

P3 is the *pathway*, or guidance system in the front. The masticatory system actually works or chews from the outside in.

FIVE KEY QUESTIONS TO DETERMINE RISK LEVEL

According to Dr. Koïs, there are five possible occlusal risk diagnoses, ranging from (at the lowest risk level) acceptable function, to constricted chewing pattern and occlusal dysfunction, to (at the highest treatment risk level) parafunction or sleep bruxism, and neurologic disorders. Patients who are low risk can tolerate almost any restorative treatment, whereas treatment of those patients with sleep bruxism or neurologic disorders has a much poorer prognosis. It is important to know the risk level prior to treatment. Dr. Koïs teaches how to determine this diagnosis by *always* asking patients five key questions.

1. *Do you have a problem chewing gum?* (A "yes" answer indicates

a possible constricted chewing pattern.)

2. *Do you have problems chewing bagels or dry chewy food?* (A "yes" answer indicates possible occlusal dysfunction.)
3. *Have your teeth changed in the past five years?* Ask about wear, shorter or thinner teeth, looseness or mobility, or development of open spaces. This question helps to assess change, and is extremely important in determining whether the disease is active or has adapted from previous activity. Enamel wears approximately 11 microns per year; under normal circumstances, it should take 100 years to wear through one millimeter of enamel. This question helps the patient become aware of any changes and it helps determine whether their teeth are wearing out faster than their chronological age dictates. The key is knowing if the change is active or whether the patient has adapted and therefore is no longer breaking down. If the patient has adapted, however, that adaptation has been at a price. If the anterior teeth are worn and veneers are placed, without managing the occlusion, the veneers will be at risk.

The patient might say "no" to the first three questions if they have already adapted, but Dr. Koïs cautions us to remember that the adaptation has been made at a price. For instance, if they answer "no" to the first two questions but have changed their diet to soft food, they have adapted by altering their diet. These questions not only help the dentist diagnose, but also create patient awareness, helping them understand that their occlusion has

had an impact on their quality of life. Some patients are indifferent about dietary adjustments or visual changes to their teeth, yet their answers to the questions still give the dentist a sense of the rate of adaptation. Are the teeth breaking down at a rate that is unacceptable? Dentistry need not treat every little change, but the goal is to recognize what is getting worse and breaking down. If the adaptation is incomplete and the breakdown is active, treatment may be indicated to help control or eliminate the haphazard adaptation that is occurring.

4. *Do you have more than one bite?* (An affirmative answer may indicate dysfunction.)
5. *Do you have any problems with sleep?* Ask about restless leg syndrome, movement disorders, or if the patient kicks the covers off at night. (If the answer is "yes" consider parafunction [sleep bruxism] or neurologic disorder as a possible diagnosis.) Look to see if the teeth are really flat. Dr. Koïs urges us to remember that only 4 to 8% of the population has true sleep bruxism. In considering neurologic disorders, look at the patient's medical history, ask about all medications, and be cognizant of drug use. Remember, equilibration will not help these patients. To protect their dentition, an occlusal guard is recommended.

If a patient answers "yes" to *any* of these five questions, he or she does not have acceptable function. Affirmative responses indicate that the patient is breaking down and there is a definite risk and an associated decreased prognosis.

Additionally, these questions provide an excellent opportunity

to engage the patient in conversation regarding the condition of their teeth and various options for their protection. Patients do not always realize that their teeth are designed to outlast them. It is the clinician's responsibility to help the patient understand that the consequences of inefficient chewing may lead to a disability—including unfavorable esthetics, pain in the muscles or joints, sensitivity in the teeth, or tooth mobility—that could negatively affect their quality of life.

Remember, however, that problems do not always indicate a need for treatment. It is the *magnitude* of the problem that determines the level of risk and need for treatment. For example, the patient's age is an important factor. If the patient is a teenager, wear on the teeth is of a much greater concern than in an older patient. What will the teeth look like in 10 years, and is that acceptable? If the level of tooth mobility and the symptoms and history of the joints and muscles are all acceptable, but the patient answers "yes" to any of the five questions, function is not acceptable and the patient must be informed that their dentition is at risk. In patients over age 50, the risk may be minor and may not warrant treatment. If the patient is younger, however, and needs veneers due to chipped or broken-down front teeth, the occlusion must be managed first.

CENTRIC RELATION

Centric relation, Dr. Kois reminds us, is only about the joint; it has nothing to do with the teeth. The first point of contact when the mandible rotates into CR is centric occlusion (CO). The difference between CO and MIP is called the *slide*, but

the slide has no diagnostic meaning and does not indicate how the system chews. For treatment purposes, CR is only a starting point and not a diagnostic concept. It is acceptable if the patient is not in CR, if they have acceptable function, and the vertical remains stable. These patients can be restored in MIP.

Only 4 to 8% of the population has true sleep bruxism.

In health, the jaw mechanics work from the outside in. The mandible comes forward, bites into food, and goes behind the front teeth to chew food in the back. The most important aspect of occlusion is having a stable P2, or "home." Difficulties in achieving P2 are encountered in patients who do not have acceptable function, because of problems in trying to orient the system. CR is a therapeutic—not a diagnostic—protocol and is used to refine the occlusion to a place that the brain can find using P1 (the orthopedic position of the jaw). If the goal is to open the vertical or change the occlusion, a reference position or starting point like CR is needed. Once CR or P1 is established, P2, where the teeth fit together, is determined. Finally, P3, the guidance system for the anterior teeth, is worked out. It must be done in that order.

OTHER DIAGNOSTIC CLUES

In addition to asking the five questions previously discussed, diagnostic clues also can be found by examining the teeth or utilizing a cephalometric radiograph. Radiographs are helpful in determining the position of the maxilla and the mandible. Wear on the teeth can be

an indicator of constricted chewing envelope (wear on the lingual of maxillary anteriors and labial of mandibular anteriors, but little to no wear on posterior teeth); dysfunction (wear on posterior occlusal surfaces and edges of anterior teeth); or parafunction and neurologic disorders (severe wear throughout, where the facets line up together on the casts). Additionally, patients with dysfunction do not have a good P2, which provides bilateral equal intensity contacts from left to right and from cuspids back. These patients may complain of "clenching."

FINDING P1 OR CR

Dr. Kois' system for finding P1 or CR is the deprogrammer appliance. It is similar to a Hawley Bite Plane, NITL, or Lucia jig, except that the deprogrammer has a single point of contact in the front to factor out flexure of the mandible and it allows for treatment of the patient in that reference position. Prior to treatment, the spot must be reproducible and the patient must be comfortable (which may take several weeks of appliance use). Once this spot is established, P1, the reference position, is maintained and the vertical can be either opened or closed at that position. If the spot is reduced on the deprogrammer until a tooth touches, this initial spot of contact is called CO (it should be the same tooth that touches when the patient removes the deprogrammer).

The deprogrammer is a means of equilibrating if the CO contacts are on the posterior teeth, as is often seen in dysfunction. If the initial point of contact in CR is on the front teeth (as is typically seen with constricted chewing patterns), equilibration is not an option; either

orthodontics or an additive procedure for the posterior teeth must be considered. In treatment, the goal is for bilateral equal intensity contacts on shimstock from the cuspids back and no contact on the incisors. Once P2 is established, P3 is worked out by having the patient sit up and chew on thick (200-micron) articulating paper. The key is to look for blue streaks or guidance interferences on the lingual surfaces of the maxillary anterior teeth and adjust them out. This is best accomplished with a high-speed electric handpiece at one-quarter to one-half the output, using a fine diamond with water and final polish with a brownie point.

The facebow by Panadent (Grand Terrace, CA) is a system for transferring functional and esthetic information from the patient to the articulator. It allows the casts to communicate the way the teeth look in the face, and provides a functional reference as well. It is designed to

easily record the midline, esthetic plane, and vertical/horizontal position of the teeth from the patient to the articulator on a plastic piece that attaches to a platform on the articulator. This is extremely helpful in guiding treatment decisions and communication to the laboratory technician, as the platform can be dialed up or down to achieve the desired result and allow a wax-up at this position. The vertical position of the teeth is actually determined by how the teeth look in the face, much like a denture. The horizontal position is determined by the diagnosis. The greater the force the patient generates and the higher the diagnostic risk, the flatter the guidance should be. Treatment also can be planned in phases so that financial limitations are minimized, while the three P's are all maintained. P2 can be managed in composite or with 'snap-on smiles' until more permanent on-lays or crowns can be done.

SUMMARY

There is a great deal of talk about concepts in dentistry, but not about specific parameters on how to treat the patient. Once a specific occlusal diagnosis is made, the system for treatment is the "Three P's." The goal is for bilateral equal intensity contacts from a reference position, after first evaluating how the front teeth look in the face. This article has presented a system for accurate analysis and treatment planning of incisal edge position, occlusal plane, P2, and P3 (which, again, is guidance from the outside in).

Remember, as Einstein said, *"The significant problems we face cannot be solved at the same level at which we created them."* It does indeed require a different thought process. *AP*

