# The Orthodontic-Periodontal Risk Assessment (OPRA) in developing Periodontal Disease

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## Abstract

**Fifty percent of the adult population suffers from periodontal disease. Patients with Stage IV periodontal disease have altered physiological dental relationships such as masticatory dysfunction, secondary occlusal trauma, increased tooth mobility, bite collapse, tooth migration and flaring. Occlusal forces can alter and adversely affect the outcome of periodontal therapy, thus orthodontic treatment can be considered to re-store occlusal harmony as well as improve smile aesthetics. The objectives of this article were 1) to underline the possible factors involved in the relationship between systemic conditions and periodontal disease during orthodontic treatment in patients with periodontal issues; 2) to propose an Orthodontic-Periodontal Risk Assessment model (OPRA) to account for risk factors associated with orthodontic treatment, estimating their impact on periodontal health in susceptible patients.**

**Keywords: Interdisciplinary therapy, risk assessment, Ortho-Perio strategies, periodontal diseases, orthodontics, orthodontic appliances, dental plaque, biofilms**

## Introduction

As highlighted by the new periodontal classification, secondary occlusal trauma can negatively influence the course and expression of periodontal disease, attributing to it a greater degree of complexity of treatment (Stage IV Interdisciplinary approach) [1,2]. In an interdisciplinary orthodontic-periodontal approach, treatment aims to rebalance occlusal function and facilitate the long-term maintenance of the corrected periodontal condition [3].
Lang and Tonetti [4] described the Periodontal Risk Assessment (PRA) through the use of a functional diagram, evaluating factors which influence the risk of disease progression at an individual level. It would be useful to have a similar diagram for an Orthodontic-Periodontal interdisciplinary approach for guidance in choosing the appropriate orthodontic treatment plan to preserve the periodontal health. As suggested and underlined by several Authors[5-8-9-10-11], there is evidence indicating that orthodontic appliances can alter this delicate balance between defense and host.
However, we can only infer a negative influence of risk factors related to the accuracy of the forces exerted on the tissues by orthodontics appliances [12-15].
In patients with high susceptibility to periodontal disease, these orthodontics risk factors need to be considered and managed appropriately or they have the potential to cause an imbalance in the orthodontic-periodontal interface [16].

## Methods

In order to explain the adverse effects occurring on patients susceptible to periodontitis during orthodontic treatment, we hypothesized that some factors common to periodontitis (device cleanability and periodontitis susceptibility) combined with those specific to orthodontics (treatment duration, device force system accuracy and device extension and gingival phenotype) may influence periodontal health conditions in interdisciplinary ortho-perio therapy:

A. Periodontal anchorage teeth preservation
B. Device cleansability
C. Treatment time
D. Force system accuracy
E. Gingival Phenotype
F. Patient susceptibility to periodontitis

The Alveolar Bone Housing [17] has not been directly included amongst the previous factors for several reasons later explained in the discussion, but is still indirectly considered within the Gingival Phenotype.
For simplicity, these factors can be categorized into three areas:

A) Device (related to the infectious stimulus group)
B) Load (related to the mechanical stimulus group)
C) Periodontal aspect (related to the involved periodontal teeth group)

### a. Periodontal anchorage teeth preservation

Orthodontic movement of teeth alters the homeostatic environment in both a healthy and reduced (healed)

periodontium. During orthodontic treatment, it would be desirable to move only the teeth that are planned to be moved, and avoid placing additional stress on the other teeth, especially if there is already reduced periodontal support.

Orthodontic appliances commonly incorporate all teeth in both dental arches, as dental arches must be coordinated. As a result, position of all teeth changes in order to facilitate this. The orthodontic management of segments with reduced residual periodontium presents considerable difficulties with regards to the force intensity and direction of movement. Errors are often made, creating periodontal disorder as seen in occlusal trauma.

Careful planning and selection of teeth to be moved will help avoid unwanted and undesirable movement on the teeth we do not want to move or stress with high-risk force systems. Despite decreasing the magnitude of force application in teeth with reduced periodontal support, there will still be a vertical extrusive effect (due to the "cone effect") [18] as well as unpredictable movements (due to the sudden change in position of the Center of Resistance). Physiologic bone resorption on the already thin and fragile cortical bone in periodontally-compromised dentitions can occur in orthodontic tipping movements due to the concentration of tensile and compressive stresses on the alveolar margins and root apex [19].

With the introduction of mini-screws in orthodontics [20, 21], undesirable forces and movement of anchor units have been reduced. Mini-screws, mini-plates or conventional implants are recommended for better control of three-dimensional tooth movements [22]. Through time and development, the use of these anchoring devices have become more specific, limiting the extension of orthodontic appliances as well as minimizing the duration of treatment. Thus with the use of TADs, it is now possible to avoid unnecessary biological stimuli or round-tripping movements on compromised anchor teeth without undermining efficacy on the reactive unit (teeth that need to be moved).

**b. Cleansability of Device**

This is based on the assumption that the increase in bacterial mass on tooth surfaces can easily lead to the worsening of periodontal health - gingivitis and recurrence of periodontitis [23, 24].

The most widespread orthodontic device is the fixed multi-bracket appliance. A single wire (with or without loops) or several wires involving different sectors of the arch can be inserted into the brackets. Maintenance of oral hygiene with fixed metal appliances is very difficult and without proper hygiene, the increase in bacterial load around the brackets leads to a higher gingival bleeding index [25-27]. Greater oral hygiene problems including plaque deposits were also found with the lingual bracket system [28].

Previous reports show that clinical periodontal parameters partly normalized in three months following the removal of fixed appliances [11]. However, it can sometimes take between six months to two years post-treatment for levels of supra- and subgingival Colony Forming Units (CFU) to reach pre-treatment values. It is worthwhile noting that these studies were conducted on patients with an average age of fourteen years [8,29, 30], but we know that the peak in incidence of severe chronic periodontitis is around 38-40 years of age [31]. From a biological point of view, it is easier for the periodontium of younger patients to revert back to a healthy condition after debonding.

Clear aligners and other types of minimally invasive appliances have recently appeared in the orthodontic landscape. It has been shown that clear aligners simplify oral hygiene measures for both the individual and professional [32]. Minimally invasive orthodontics use wires with or without brackets bonded in a limited area within the dental arches by which precise forces through a statistically determined system can be applied [33, 34].

**c. Treatment Time**

It is best to minimize the duration of orthodontic treatment in patients susceptible to periodontitis as orthodontic treatment is considered a sterile inflammatory process. Not only do orthodontic devices lead to a greater accumulation of biofilm, but they also result in a biofilm composition change towards periodonto-pathogenic bacteria. Therefore, a prolonged period of orthodontic therapy becomes a co-factor in the risk for periodontal recurrence [35].

The duration of orthodontic therapy also represents the period in which the periodontium of a patient susceptible to periodontal disease is exposed to mechanical stimuli – further activating the inflammatory mediators implicated in orthodontic tooth movement. The duration of treatment is associated with the complexity of the initial malocclusion, the effectiveness of the orthodontic appliances chosen and the desired treatment outcomes.

In conventional orthodontic therapy, the goal is to obtain an Angle Class I occlusion, in line with the Andrew's Six Keys of Occlusion [36]. The achievement of this treatment outcome is one of the most used reference parameters by orthodontic institutions around the world where the ideal occlusion is perceived as the most aesthetic and most stable. Meta-analysis has shown that the average duration of orthodontic treatment is approximately 24.9 months [37] with no major differences between adolescents and adults [38]. In the context of fixed devices, treatment which include dental extractions are often of longer duration than those without dental extractions [39]. In reality, this concept is changing, as many studies have shown that post-orthodontic stability is not guaranteed [40]. For this reason, orthodontic treatment outcomes involving a compromised occlusion may need to be considered, as long as the occlusion is stable. In the orthodontic-periodontal interface, longer treatment durations are associated with greater periodontal stimulus from prolonged orthodontic forces and pro-inflammatory factors within the periodontium.

**d. Accuracy of Force Systems**

Different orthodontic appliances create different force vectors on the periodontium [41]. Ideally, knowledge of the magnitude and direction of the force systems acting on the teeth will lead to treatment with more predictable outcomes [42, 43], however in reality, it is not possible to know or maintain the applied force vector for most orthodontic appliances between appointments. As

a result, there is an automatic variability in orthodontic force systems, capable of changing the direction of dental movement (the phenomenon of "dental fluctuation") [44], leading to treatment not completely identical to the programmed alignment ("indiscriminate alignment") [44]. Among these variables, we can mention the anchorage value deriving from the occlusion and the musculature of the patient, the soundness of the residual periodontium and the occlusal sensitivity of the patient to the occlusal changes occurring during tooth movements. Swinging movement of the teeth (jiggling) linked to the unpredictable creation of occlusal prematurities in patients with a reduced vertical pattern results in tooth mobility very similar to those present in secondary occlusal trauma [45]. This method of managing orthodontic movements is the prerogative of a group of techniques that we could classify as "continuous arch techniques". The name is inspired by the fact that there is often only a single wire engaging all the brackets of each arch. Clear aligners work with a similar force system treating entire dental arches with a single device with the same characteristics of elasticity.

An alternative to this approach is the "segmented arch technique" [46-48]. This is characterized by brackets on all teeth connected by different wire segments (also with different Load/Deflection characteristics). With a segmented arch approach, we tend to differentiate the active units (teeth to be moved) from the reactive units (teeth that are stationary), using carefully applied forces for more predictable movements.

A third method of working with more calculated, accurate and longer-lasting force systems, allowing extremely delicate movements is the Statically Determined System [49]. A statistically determined system implies "that the law of statics (equilibrium) is sufficient to solve" and they provide us with the most predictable knowledge of force systems [41, 44-49]. Therefore, this force system could be the most suitable for teeth or groups of teeth with very small residual periodontium.

**e. Gingival Phenotype**

Gingival phenotypes are distinguished into three categories - thin, medium or thick but currently, a simple method to identify gingival phenotype in patients does not exist. The available evidence indicates that subjects with thin and narrow gingiva tend to have more gingival recession compared with those with thick and wide gingiva. [50, 51]. This risk is increased with orthodontic therapy and may be clinically apparent over time after orthodontic treatment [2]. To prevent gingival recession, many authors have suggested modifying the gingival phenotype prior to, or during orthodontic treatment.

The benefits of phenotype modification therapy involving soft tissue augmentation (PhMT-s) during orthodontic treatment remain undetermined due to the limited number of studies available in the literature, however, PhMT via corticotomy with particulate bone grafting (PhMT-b along with corticotomy-assisted orthodontic therapy - CAOT) may provide clinical benefits. Augmenting periodontal phenotypes expand the scope of incisor movement [52]. Furthermore, Kao et al. suggests that Bone phenotype modification therapy (PhMT) should be pursued prior to orthodontic treatment in patients with thin phenotype when the necessary orthodontic tooth movement will compromise the bony housing. Similarly, soft tissue PhMT may be needed to perform CAOT (Corticotomy-assisted orthodontic therapy), or in conjunction with bone grafting. Thus, there are clinical situations in which both bone and soft tissue augmentation are necessary [51]. A study also explored the labial gingival thickness using CBCT imaging and found a moderate association with the underlying bone radiographically [53].

It is important to clinically assess and record findings regarding the gingival phenotype prior to commencing orthodontic treatment as it is not only to reduce the risk of gingival recession, but also to be aware of the alveolar bone housing and the boundaries of orthodontic tooth movement.

**f. Patient susceptibility to periodontitis**

Periodontitis is a complex, chronic inflammatory disease as a result of an imbalance of the oral microbiota and the host response leading to inflammation and destruction of the periodontium in susceptible individuals [54]. Although bacterial presence is essential, there are also other contributing factors such as individual susceptibility, certain systemic diseases (i.e. diabetes), smoking and the presence of excessive occlusal stress. These can all act as co-factors for the disease onset and progression [55, 56]. In recent years, there has been greater attention from the international scientific consensus on occlusal aspects and masticatory dysfunction, where these factors are now included and characterize the staging of the new periodontal classification [57]. In addition to periodontopathogenic bacterial elimination and lifestyle changes, therapeutic strategies must also focus on controlling malpositioning of the dental elements and abnormal occlusal forces. At each stage of inter-disciplinary treatment, the lack of control can affect treatment outcome [58].

In 2018 a new Classification scheme for periodontal and peri-implant diseases was proposed as part of the World Workshop on Classification of Periodontology [1, 54], establishing the stage, extension, complexity and severity of periodontitis through the attribution of the grade, risk of progression and susceptibility of the disease. This new classification incorporates many factors that were previously evaluated in other procedures (Periodontal Risk Assessment) [56], designed to monitor and evaluate health and/or disease characteristics of the patient.

In order to reflect on the intrinsic periodontal characteristics of the orthodontic patient, this periodontal parameter has also been included in the synoptic table. The work of Heitz-Mayfield et al 2020 [59] placed the least compromised values (with the least risk of progression [1A]) towards the center of the polygon and those with greater impairment of the periodontal status (with an increased risk of progression ([4C]) towards the external part. We propose to quantify the six discussed variables to create a functional diagram which will help clinicians in their treatment with regards to the orthodontic-periodontal interface (Figure 1).

Scores for the Orthodontic-Periodontal Risk Assessment

In order to make the following graph more availabe and easier to reproduce, a numerical scale from 1 to the 10 has been chosen, attributing the value 10 to a maximum

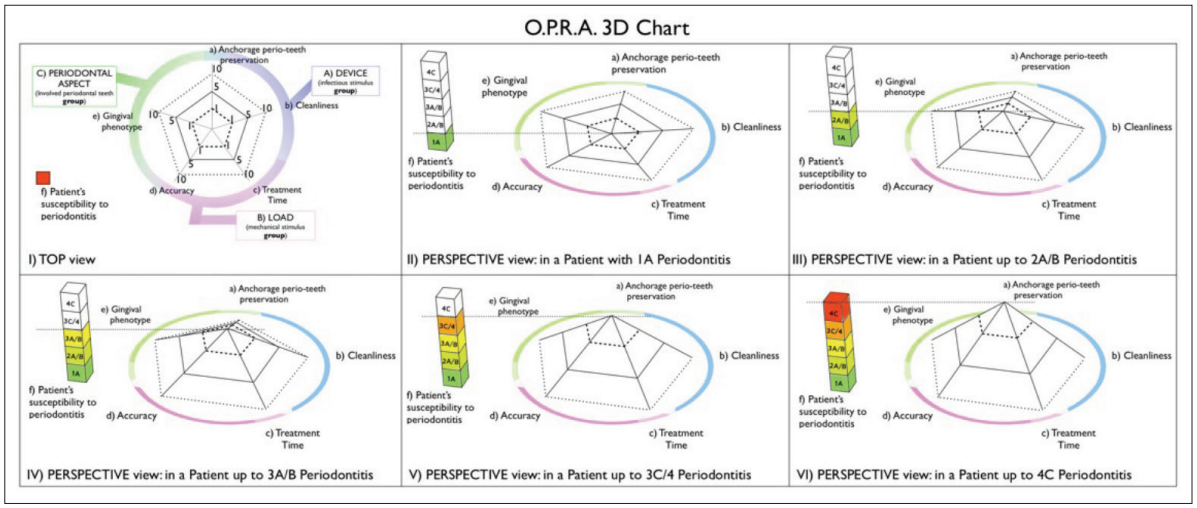


**Figure 1.** Ortho-Perio Risk Assessment: I) TOP view. The chart is on a plane with macro areas: A) DEVICE (belonging to the infectious stimulus group), B) LOAD (belonging to the mechanical stimulus group, C) PERIODONTAL ASPECT (belonging to Involved periodontal teeth group). Inside there are five vectors that describe the risk factors associated with the orthodontic device: a) Periodontal anchorage teeth preservation, b) Kind of Orthodontic Appliance (device cleanliness), c) Orthodontic Treatment Time, d) Force System Accuracy, e) Gingival Phenotype. The following PERSPECTIVE view (II, III, IV, V and VI) show the sixth vector and how it can increase the vertical dimension of the 3D chart: f) Periodontal Susceptibility.

risk, the value 5 to an average risk and the value 1 to a minimum risk.

*a) Periodontal anchorage teeth preservation*
10: all reactive forces are applied to teeth with reduced but healthy periodontium (no miniscrews are used)
5: the side effects on the anchorage teeth are limited by the use of miniscrews (use of biomechanically oriented skeletal anchorage) OR anchorage teeth are not involved with the orthodontic appliance OR if anchorage teeth are involved, they have intact periodontium
1: the teeth with healed but reduced residual periodontium that we do not want to move are not involved by the orthodontic device (Minimally invasive therapies with the use of miniscrews)

*b) Cleansability of Device*
10: when the appliance is placed on the lingual side
5: when the appliance is placed on the labial side (splints on lingual side included)
1: when the appliance is a Clear Aligner or Minimally Invasive Orthodontics

*c) Treatment time*
10: for therapies with an expected duration beyond two years
5: for therapies with an expected duration greater than one year and less than two years
1: for therapies with an expected duration of less than a year

*d) Accuracy of force systems*
10: continuous archwire and aligners
5: segmented archwire approaches
1: Minimally Invasive Orthodontics (statically determined systems)

*e) Gingival Phenotype*
10: Thin phenotype
5: Medium phenotype
1: Thick phenotype

*f) Patient's susceptibility to periodontitis (Stage and Grade)*
4C: Up to Stage 4, Grade C
3C/4: Up to Stage 3, Grade C
3A/B: Up to Stage 3 Grade A/B
2A/B: Up to Stage 2 Grade A/B
1A: Stage 1 Grade A

The assignment of values of the first five vectors of OPRA defines an area whose extension is directly proportional to the risk this device can induce a recurrence of periodontal disease in periodontally susceptible patients. It is important to note that the grading includes patients with different periodontal susceptibility, as indicated in the new periodontal disease classification [1]. Thus, it is empirical to pay attention to the first five OPRA vectors (related to the appliance) in relationship with the sixth OPRA vector (related to the host susceptibility to periodontal disease).

*Calculating the patient's orthodontic-periodontal risk assessment*
The OPRA is a three dimensional chart where the first five vectors lie on a flat polygon and the Periodontal Susceptibility (PS), the sixth vector lies in the centre.
The first five vectors considered are exclusively related to the device and they potentially express nociceptive stimuli capable of influencing the state of periodontal health.
General results from the first five vectors (Fig 2):
- Low-risk: all parameters in the low-risk category (Fig 2c)

- Moderate-risk: at least one parameter in the moderate-risk category (Fig 2b)
  High-risk: at least one parameter in the high-risk category (Fig 2a)

General considerations following integration of all six vectors:
When PS (the sixth vector) is 1A (Stage 1 grade A), all the other parameters are on the flat plane (Fig 2a), meaning a high-risk orthodontic approach is possible with low periodontal susceptibility. On the other hand, when PS (the sixth vector) is 4C (Stage 4 grade C) the centre is raised (the PS vector) (Fig 2c); meaning that it is advisable to treatment plan using a low risk orthodontic approach due to the high periodontal susceptibility of the patients in developing periodontal disease.

Figure 2 shows three types of OPRA related to three different types of orthodontic devices and three different type of periodontal susceptibility. In Figure 2a, a fixed vestibular orthodontic appliance on both arches according to the continuous arch technique without the use of skeletal anchorage, in a patient with a Stage 1 grade A. It presents three of the five vectors (Periodontal anchorage teeth preservation, Accuracy, Gingival phenotype) in the high-risk category, one vector (Cleanliness) in the moderate-risk category and one vector (Treatment time) in the low-risk category. Figure 2b shows a fixed orthodontic appliance on a single arch according to the segmented technique with the use of skeletal anchorage in a patient with a Stage 2 grade B. It presents four of five vectors (Periodontal anchorage teeth preservation, Cleanliness, Accuracy and Gingival phenotype) in the moderate-risk category and one vector (Treatment Time) in the low-risk category. Figure 2c shows an orthodontic appliance without fixed brackets with a statically determined system with use of skeletal anchorage in a patient with a Stage 4 grade C, presenting all vectors in the low-risk category.
In order to fully express its potential and simplify orthodontic treatment decisions, the OPRA must address the patient's existing periodontal health status as well as the teeth undergoing orthodontic displacement.

## Results

Although this procedural algorithm (OPRA) is based partly on scientific evidence and partly on the opinion of authoritative clinicians, it has allowed us, in the last few years of our clinical activity, to simplify the therapeutic choices in Orthodontic-Periodontal stage IV cases, making them more effective while reducing the risk of progression and recurrence of periodontal disease in this particular type of patient.
The three types of sample patients shown below have the sole purpose of making the international scientific consensus understand what options they can take in carrying out these complex clinical cases.
That is, the sample shows how the patient's periodontal characteristics at the systemic level, at the tooth level and at the site level have influenced orthodontic choices in terms of choice of device, direction and duration of the forces.

## Explanatory Clinical Case

The three clinical cases presented in Figures 4, 5 and 6 show the importance of selecting the appropriate orthodontic appliance with regards to the patient's periodontal status.

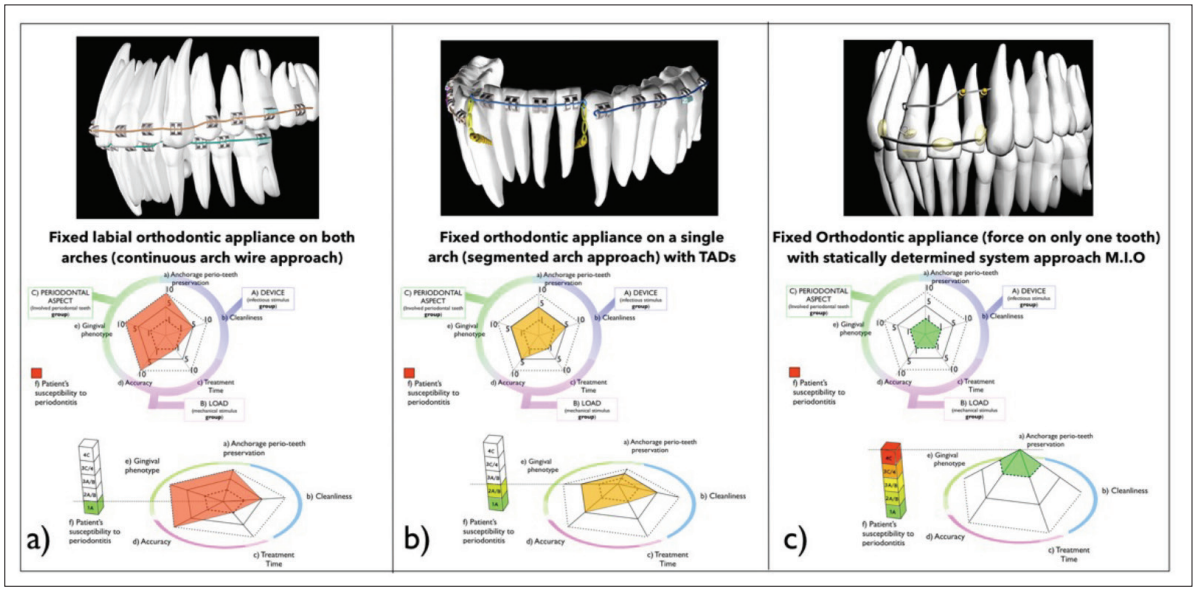


**Figure 2.** a) Fixed vestibular orthodontic appliance on both arches according to the continuous arch technique, without the use of skeletal anchorage, in a patient with a Stage 1 grade A. b) Fixed orthodontic appliance on a single arch according to the segmented technique, with the use of skeletal anchorage, in a patient with a Stage 2 grade B. Miniscrews help to reduce side effects on anchorage teeth that have a reduced but healed periodontum c) Orthodontic appliance without brackets with a statically determined system with use of skeletal anchorage (Minimally Invasive Orthodontics), in a patient with a Stage 4 grade C. Due to the use of miniscrews, no anchorage teeth with a reduced but healed periodontum are involved.

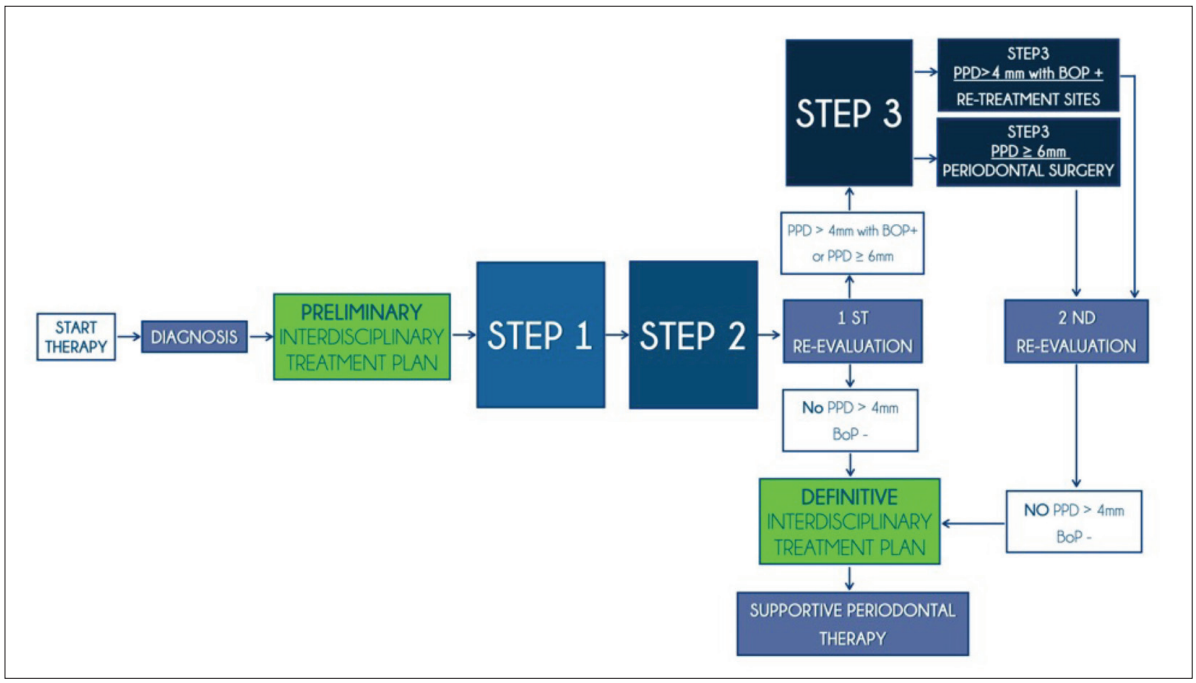


**Figure 3.** Procedural flowchart summarizing all the diagnostic and therapeutic steps of the interdisciplinary approach in periodontal patients who must undergo orthodontic therapy. When and how to evaluate orthodontic therapy.

OPRA gives us a tool to evaluate various orthodontic appliances and their effect on periodontal relapse. When the patient has a Stage 1 Grade A periodontitis or a low PRA, we can use any orthodontic device - high, medium or low OPRA (Figure 2a). If the patient has a Stage 4 Grade C periodontitis or a high PRA it is preferable to use an orthodontic device with low OPRA (Figure 2c). It would be better to choose an appropriate OPRA to periodontitis Stage and Grade of the patients but in some cases this is not possible, especially when there are problems associated with the cleansability of the device or accuracy of the force system. In situations where it is not possible to avoid involving teeth with healthy but reduced periodontium, a solution could be to increase the frequency of professional oral hygiene, decreasing the magnitude of delivered forces or more frequent orthodontic appointments. For example, Case 1 (Figure 4) and Case 2 (Figure 5) have the same periodontal stage with a minor difference in Grade. The solution from the OPRA point of view is to apply a medium risk appliance as shown in Case 2 (Figure 5). When it is not possible to select the most appropriate appliance, it is recommended to increase the frequency of orthodontic appointments and professional hygiene visits.

## Discussion

The Alveolar Bone Housing is an important factor which warrants some discussion. This concept, previously suggested by Tweed, refers to the positioning of teeth above the basal bone [60, 61] and is quite well demonstrated by Wennstrom's primate studies [62]. It is understood that moving the teeth beyond the thickness of the alveolar bone is strongly correlated to the onset of gingival recession, especially in conditions of thin gingival phenotype. The most recent orthodontic techniques have instead decreased dental extractions as a procedure for relieving crowding by expanding the dental arches both sagittally and transversely, in the hope of an expansive remodeling effect of the buccal alveolar bone. The concept is similar to that of the growth induced by functional appliances but with a lack of evidence in the literature [63, 64]. Subsequent studies by Melsen and Coll [65] have verified with pre and post CBCT imaging that this effect cannot be guaranteed. As a result, it is increasingly believed that tooth movement in the labial direction must be contained within the thickness of the alveolar bone, even if its pre-therapy evaluation cannot be routinely performed on all patients, for evident ethical reasons related to excessive radiation exposure. Ultimately, it is once again the common sense of the orthodontist to avoid excessive expansions, perhaps referring clinically to the gingival phenotype [62 - 67].

Since Alveolar Bone Housing is not an easily parameterizable factor, nor is it valuable for all patients (due to radiation and ethical reasons) [68] as the regulation of dental movement within its scope is linked to the sensitivity and prowess of the clinician, the authors have decided not to include it amongst the elements of the OPRA chart, intending that tooth movement beyond the boundaries of the basal bone is limited as much as possible. Instead of an Alveolar Bone Housing vector, we intended to use the Gingival phenotype as a vector as it is more frequently related to the Alveolar Bone Thickness and is more easily detectable by the clinicians [69].

With the new Periodontal Diseases classification [1] we can consider a number of parameters that will allow us to easily attribute the stage of impairment and the risk of periodontitis progression.

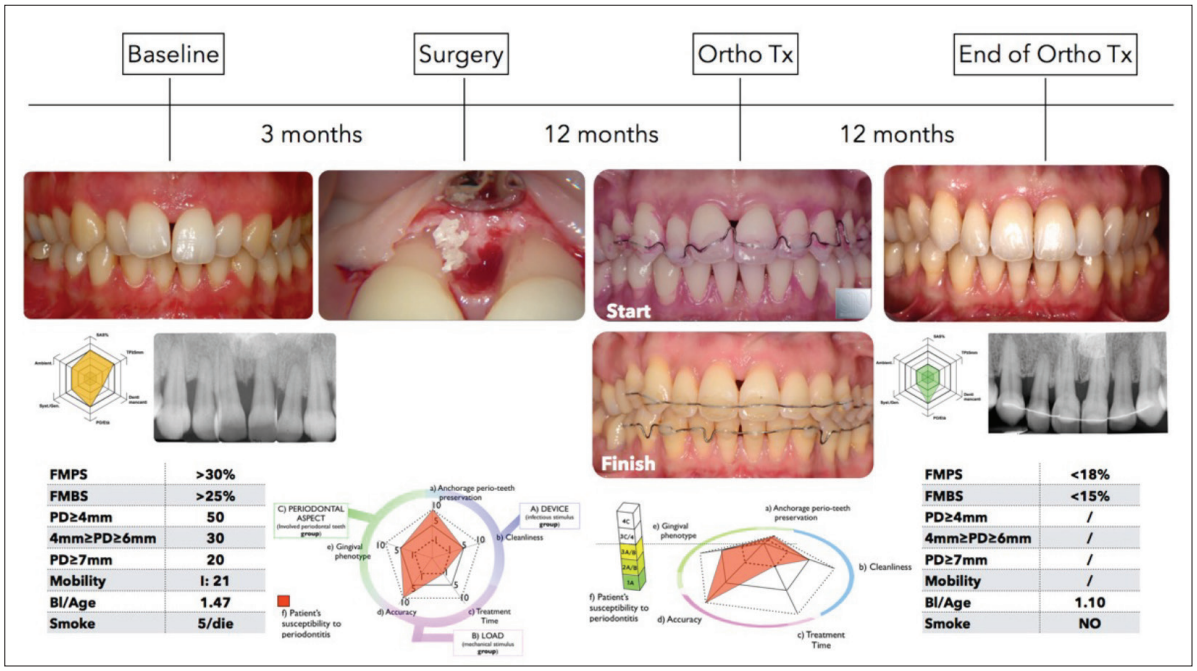


**Figure 4.** CASE 1: Periodontitis: STAGE III - GRADE B. Relationship of Class I on both sides. Need for interdisciplinary treatment to correct the misalignment and extrusion of the 21 that caused functional disorders. The initial Scores (included Full Mouth Plaque Score [FMPS] and Full Mouth Bleeding Score [FMBS]) are too high to proceed with an orthodontic therapy. At the re-evaluation after 3 months from Step 1 and 2, we proceeded with regenerative surgery from 13 to 23 to correct the periodontal defects. We waited about 1 year (until all periodontal scores indicate stable healthy conditions), and then orthodontic therapy began using a Definitive Orthodontic treatment plan: Alignment on both arches and OVB correction. At the end of the move which lasted about 12 months, the patient was given an increase in the volumes of the incisors, using a composite to improve the aesthetics of the smile. OPRA scores: Periodontal anchorage teeth preservation = 10 (all teeth are involved including teeth with reduced but healed peridontium, no miniscrews were used); Cleanliness = 5 (fixed appliances placed on labial surfaces of the teeth on both arches); Treatment Time = 1 (expected duration of less than 1 year); Accuracy = 10 (continuous archwire approach used through bracket free fixed appliance); Gingival phenotype = 5 (medium phenotype).

Given the complexity in the management of patients with periodontal disease [22], it is essential to intervene with an extremely cautious interdisciplinary approach using a procedural algorithm such that all required multi-disciplinary treatment is performed with the correct timing. Therefore, we consider it useful to implement the guidelines of Stage I-II-III [70] with additional steps, presenting these cases a degree of complexity of the major treatment (Figure 3).

It should be noted that in the PRELIMINARY Phase, any orthodontic and gnathological strategies are envisaged in order to evaluate the ideal approach to control malocclusion, mobility and para-functions in periodontal patients.

It is only in the phase of the DEFINITIVE interdisciplinary treatment plan following comparison of the patient's periodontal risk profile with characteristics of the ideal orthodontic device and stabilisation of all inflammatory parameters can the most appropriate orthodontic treatment modality be ascertained.

During active orthodontic therapy, important procedures are performed to control the inflammatory values of the periodontal patient undergoing orthodontic treatment. Monthly reassessment of periodontal vestments, mechanical control of risk factors (if necessary) and motivational reinforcement to correct home plaque control.

The most complex Orthodontic-Periodontal steps are characterized by:

1- Choosing the most appropriate orthodontic strategy.

2- Timing of orthodontic tooth movements.

3- Maintaining good periodontal control during orthodontic therapy.

*Choosing the appropriate orthodontic strategy*

To establish an individualized therapeutic plan, it is essential to know the periodontal status of patients at the initial consultation appointment. From this information we can develop a Preliminary Orthodontic Treatment Plan (Figure 3), evaluating the occlusal relationships and identifying factors that may hinder the normal conduct of therapy. Examples include:

- the presence or absence of tooth mobility [71]
- the presence or absence of parafunctions (wear facets or muscle pain)

We should firstly state our "ideal orthodontic goal". This will be dependent on the patient's periodontal status. In this phase, any necessary stabilization of hypermobile elements with the use of a splint, as well as occlusal adjustments in patients with increased tooth mobility [72] is carried out. This may allow for any necessary non-surgical periodontal therapy to be performed more easily and reduce the risk of worsening periodontal health [73].

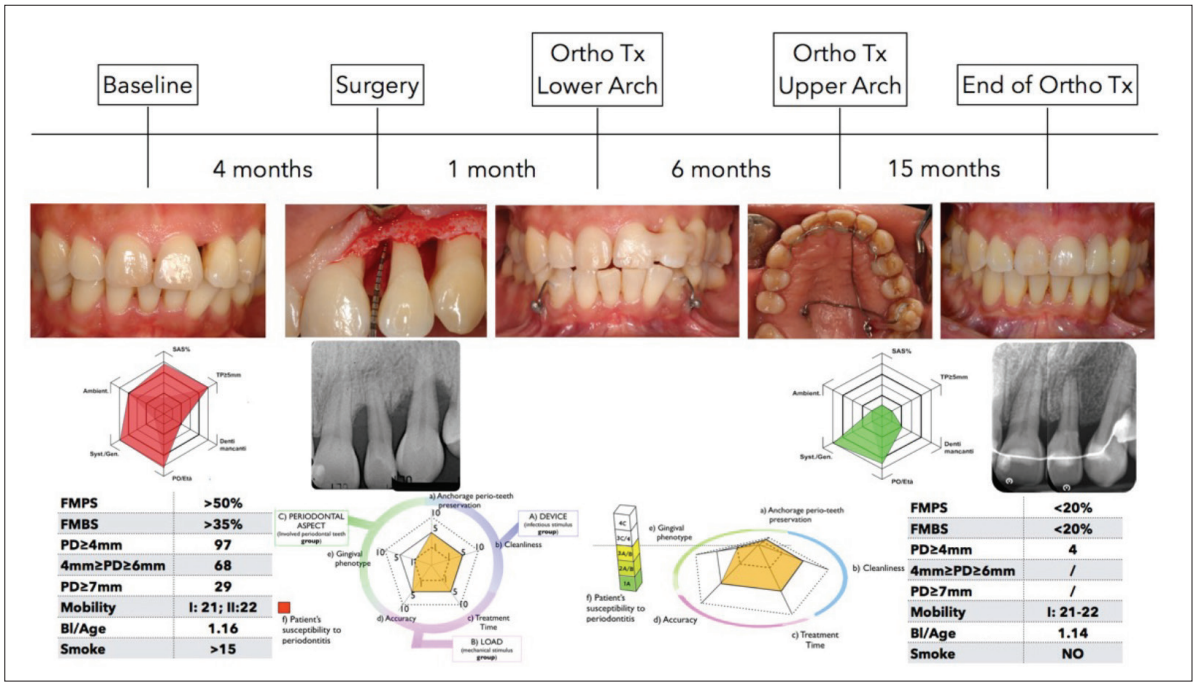


**Figure 5.** CASE 2. Periodontitis: STAGE IV - GRADE C. Class I Relationship on both sides, with increased OVB (due to lower frontal teeth extrusion), increased OVJ with flared upper frontal teeth on the left side and diastema between them. Over-erupted 26 as a result of the missing 36. Need for interdisciplinary treatment to correct the misalignment of both the upper and lower arches. The initial Scores (including FMPS and FMBS) are too high to proceed with an orthodontic therapy. After Step 1 and 2, the residual defects were corrected at Step 3 with regenerative surgery using amelogenins and synthetic biomaterial scaffolds. We waited only one month (until all periodontal scores indicated stable healthy conditions) to proceed from the surgery as movements began in the lower arch, without initially involving the upper arch affected by the surgery. Only after one year did we proceed with the move to the upper arch (mature healing achieved after surgery). The case finished with an additive ameloplasty in composite to reduce the imperfection of the lack of papilla between the 21 and 22. . OPRA scores: Periodontal anchorage teeth preservation = 5 (use of skeletal anchorage bio-mechanically oriented); Cleanliness = 5 (placement of fixed splints on lingual surfaces of the teeth); Treatment Time = 5 (expected duration greater than one year and less than two years); Accuracy = 5 (segmented arch wire approach); Gingival phenotype = 1 (thick phenotype)

Orthodontic treatment should only commence following the active phase of periodontal therapy and then determining the most appropriate orthodontic strategy using the value of the OPRA (Figure 3).

Example: when a patient needs correction of the anterior deepbite, if posterior anchorage will compromise the posterior dentition (due to teeth with poor residual periodontal support), clinicians can opt for the exclusion of these sectors by using skeletal anchorage (temporary anchorage devices).

If more than one treatment method is available to treat a malocclusion, clinicians should choose the shorter treatment option as well as one that facilitates easier oral hygiene.

*Timing of orthodontic tooth movements*

The literature remains unclear and somewhat controversial on the exact timing to start tooth movement after periodontal therapy [74]. However, there is clear clinical evidence showing tooth movement enhancing the rate of inflamed connective tissue attachment destruction for teeth with infra bony pockets [75, 76] and thus orthodontic treatment should only be performed on periodontally-stable patients.

It is also important to note that there are variations in the maturation and healing following different periodontal procedures. These range from a few days for Resective Surgery (ORS), to six months for Scaling, Root Planing and Access Flap (AF), and up to one year for Regenerative Surgery (GTR and EMD) [71, 77-79].

*Maintaining good periodontal control during orthodontic therapy*

The presence of orthodontic appliances induces a change in the normal saprophytic bacterial flora towards more pathogenic species [80] and increases the difficulty for patients to maintain good oral hygiene [81]. During orthodontic treatment, there are simultaneously areas of bone neo-apposition and bone resorption in the periodontium around teeth that are being moved. In the absence of plaque and inflammation, bony apposition and resorption is defined as a sterile pseudo-inflammatory process. The mediators RANK, RANKL, OPG, IL-1 / IL-6, MMPs that regulate these movements also intervene during the inflammatory processes of bone lysis as a result of the inflammatory response [35].

There is a need to formulate an individualized professional plaque control program for patients undergoing orthodontic treatment to avoid the recurrence of peri-

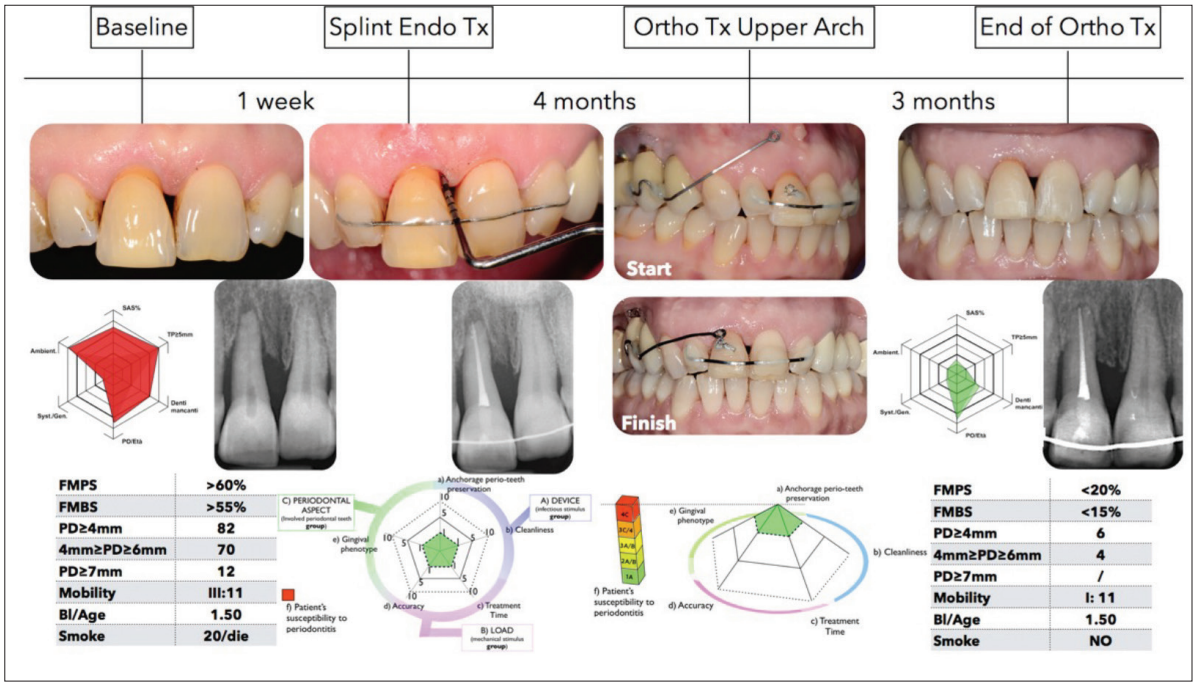


**Figure 6.** CASE 3. Periodontitis: STAGE IV - GRADE C. Class I relationship on both sides misaligned upper frontal teeth, 11 over-erupted. Need for interdisciplinary treatment to correct the extrusion of 11 that caused functional disorders. The initial Scores (included FMPS and FMBS) are too high to proceed with an orthodontic therapy. The 11 was necrotic with considerable mobility. We proceeded initially with splinting of the frontal group at the same time as the endodontic treatment of the 11. In this case, steps 1 and 2 were sufficient to eliminate periodontal defects. Therefore, only 4 months after the start of therapy (all periodontal scores indicated stable healthy conditions), the orthodontic shift was carried out using a bracket free segmented approach with a Minimally Invasive Orthodontic appliance. A cantilever (statically determined system) on implant as anchorage on the upper right side and a 10 gram single force on tooth 11 with a stainless steel rigid splint on the labial surface of the front teeth, preventing proclination on 11 during the intrusive movement. OPRA scores: Periodontal anchorage teeth preservation = 1 (orthodontic anchorage on implant); Cleanliness = 1 (Minimally Invasive Orthodontics); Treatment Time = 1 (expected duration of less than a year); Accuracy = 1 (statically determined system); Gingival phenotype = 1 (thick phenotype).

odontal disease (Figure 3). Our experience leads us to suggest regular 30-minute hygiene appointments once a month, especially for patients with Grade B and C periodontitis. The following procedures should be carried out:

- Periodontal re-examination
- Supra and subgingival instrumentation
- Reinforcement of oral hygiene motivation

During these monthly evaluations, if periodontal parameters such as Full Mouth Bleeding Score (FMBS) are greater than ten percent and probing depths of orthodontically-involved teeth show increased values, there is a risk of periodontitis progression [82]. We will implement a procedure defined by us as “STOP and GO” whereby the orthodontic treatment is stopped, motivational oral hygiene is reinforced, and professional re-instrumentation is performed by the dental hygienist. Orthodontic treatment only restarts when the periodontal parameters return to ideal conditions. This will make it possible to establish an individualized interdisciplinary procedure with extreme precision, reducing the risk of recurrence or unexpected clinical events. Following treatment, patients should be placed on individualized maintenance programmes that include three month recalls in patients with high PRA and six month recalls in patients with low PRA [83].

## Conclusions

Periodontal procedures are based on robust scientific evidence whereas expert opinions are often relied on in the orthodontic field. The intrinsic limits of the OPRA are currently linked to the arbitrariness of the selected factors as they are based only on years of clinical experience. We hope to be able to share its long-term effectiveness in the future.

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