The syndrome known as posterior bite collapse (PBC) has taken on multiple definitions over the years since its first introduction in 1964 by Morton Amsterdam and Leonard Abrams. In 2017, the World Workshop in the Classification of Periodontal and Peri-implant Diseases and Conditions proposed a staging system for periodontitis, defined by severity and extent of periodontal breakdown. Within this staging system, Stage IV periodontitis can include PBC. However, without a clear delineation regarding the clinical presentation or pathogenesis of PBC, this further obfuscates its definition. It is therefore the goal of this article to reexamine the original definition of PBC as defined by Amsterdam and Abrams, present an updated definition, and propose a clinical grading system of PBC to coincide with the 2017 staging of periodontitis.

The major outcome from the 2017 World Workshop on the Classification of Periodontal and Peri-implant Diseases and Conditions was to provide a staging system for periodontitis. The framework and proposed four stages of periodontitis, defined by severity and extent of periodontal breakdown and complexity of management, was published by Tonetti et al in the Journal of Clinical Periodontology and subsequently adopted by the American Academy of Periodontology. According to this classification, Stage IV periodontitis can include posterior bite collapse (PBC) and references a Journal of Clinical Periodontology article by Nyman and Linde.

The clinical syndrome known as posterior bite collapse first appeared in the 1964 textbook Periodontal Therapy. Morton Amsterdam and Leonard Abrams described a syndrome with multiple etiologic factors, where the loss of posterior occlusal support potentially led to the breakdown of the functional protective capacity of the entire dentition, resulting in further tooth loss (TL), increasing fremitus/mobility, secondary occlusal trauma (OT), anterior flaring (AF), and ultimately loss of occlusal vertical dimension (OVD). Unfortunately, since this is a broadly encompassing diagnosis, PBC has taken on different, often erroneous, interpretations over the years; most
common include the presence of periodontitis, AF, and loss of OVD.

Since its first publication, multiple articles have obfuscated rather than clarified the meaning and clinical course of PBC. The goal of this article is to reexamine its original definition, elucidate its multiple clinical manifestations, and propose a grading system for PBC.

Methodology

A search of the term “posterior bite collapse” using the database of the Temple University Kornberg School of Dentistry was performed, and a finite series of articles published from 1970 to 2018 was found. These articles were secondary reviews and provide cursory analyses of Amsterdam and Abrams’ publications and theses.

Historical Background

Since PBC’s first publication, multiple articles have been published attempting to elucidate PBC but have only brought greater confusion. Brayer and Stern4,5 maintained that “the flaring of the anterior teeth, whether due to excessive occlusal load and/or a pathological neuromuscular pattern, represents, together with the loss of posterior occlusal support, the most prominent clinical sign of the total posterior bite collapse.” The most common cause of PBC is the loss of molars and their nonreplacement. Conditions such as excessive occlusal wear due to parafunction, faulty dental restorations, malocclusions, inadequate orthodontic treatment, or dental caries might also be considered predisposing or initiating factors that potentially result in: drifting of the mandibular premolars and molars into the now-edentulous area; extrusion and rotation of the maxillary molar into the edentulous area; and temporomandibular dysfunction (TMD). Furthermore, occlusal discrepancies could result in infrabony defects, causing areas for food impaction and plaque accumulation,6 leading to the progression of periodontitis with increasing tooth mobility and, ultimately, AF and subsequent loss of OVD. Similar findings were published by Rosenberg7 and Rosenberg and Lever,8 adding that PBC may be found in the absence of tooth loss and periodontitis. Dersot and Giovannoli9 stated that PBC is a sequelae of advanced breakdown, influenced by periodontal inflammation and attachment loss (AL), which can lead to tooth migration as a result of occlusal forces. Mesial drifting of teeth with AF may be aggravated by the nonreplacement of missing teeth, malocclusion, or neuromuscular disorders.9 Shifman et al10 stated “although there are different definitions of PBC, only the definition by Amsterdam provides a definite diagnosis and treatment plan.” They also state that when reviewing the literature, there are incongruities in Amsterdam’s definition of PBC given to disparaging clinical situations that present with loss of OVD.

According to Tonetti et al,1 the difference between Stage III and Stage IV periodontitis is case complexity. Primary factors such as tooth mobility and PBC with drifting and flaring of teeth can add complexity to a case. The purpose of this article is to elucidate the original definition of PBC and its multiple clinical manifestations, as well as to propose a grading framework for PBC.

PBC, Defined

PBC is a means to describe a clinical syndrome with multiple, often pathognomonic factors that deviate from a normal or “ideal” occlusion (Fig 1) in which the posterior occlusion is compromised and may ultimately result in the destruction of the functional protective capacity of the entire dentition. Secondary clinical sequelae may include, singularly or in combination: the accelerated progression of periodontitis, TMD, increasing mobility/fremitus, additional TL, AF, and loss of OVD. Etiologic factors may include (but are not limited to), singularly or in combination: TL without replacement (Fig 2), orthodontic malocclusions and dental-skeletal disharmonies (Fig 3), periodontitis (Fig 4), accelerated retrograde occlusal/interproximal wear (Figs 5 and 6), severe caries, or iatrogenic and conformitive dentistry3–5,7,8,11 (Fig 7).
Fig 2  (a) Buccal and (b and c) lateral views of orthodontic malocclusion Class I (CLI) presenting with bite collapse, bilaterally missing mandibular first molars, and a reduced yet healthy periodontium. Tipping and extrusion of posterior teeth were noted, along with increasing anterior diastema, an increased intercuspal/centric relation (IC/CR) relationship, and mild loss of OVD.

Fig 3  Periodontally stable malocclusions presenting with PBC without TL. OVD loss may be seen if the rate of occlusal wear exceeds the rate of compensatory eruption. (a and b) Class II division 1 (CLIIId1) and (c and d) division 2 (CLIIId2) malocclusions. (e and f) Class III (CLIII) malocclusion.
Bite Collapse, AF, and OVD

AF and loss of OVD have always been a point of contention in the diagnosis of PBC. The literature is replete with the assumption that OVD loss and AF are requisites for PBC. The most common progression of PBC is due to the premature loss of the 6-year molar, resulting in the accelerated mesiodistal drift of teeth and loss of the stabilizing support of the posterior teeth. The loss of the natural protective capacity that the posterior teeth provide results in an extension of excessive occlusal loads to the anterior teeth as the mandible is positioned anteriorly. This positioning is to avoid premature posterior interferences and to obtain a stable intercuspal (IC) position, resulting in AF and the eventual loss of OVD.\(^3\)\(^,\)\(^11\) Marks\(^12\) states that the nonreplacement of missing posterior teeth can cause the adjacent teeth to tip into the open space, thereby shifting those portions of the teeth that support the posterior occlusion, resulting in the loss of OVD. Based on these statements, it is easy to conclude that PBC is synonymous with TL, AF, and loss of OVD.

However, Chasens\(^13\) states that the remaining dentition may be stable enough to maintain a physiologic OVD (Fig 8). Furthermore, is it possible to have PBC without loss of OVD, TL, or AF? PBC can occur in the periodontally stable patient
with primary OT, in which the dentition becomes mutilated when the rate of retrograde wear exceeds the rate of compensatory eruption, resulting in a net loss of OVD without AF\textsuperscript{14} (Figs 5 and 9). Ultimately, indicators of probable loss in OVD include increasing mobility/fremitus, displacement of teeth, increased AF, accelerated retrograde occlusal wear, and an increase in IC/centric relation (CR) relationship (Fig 10).

**Bite Collapse in the Presence of Dental/Skeletal Malocclusion**

In 1900, Edward Angle published the first classification of orthodontic malocclusions, known today as

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Fig 8 (a) Clinical and (b) radiographic view of a periodontally stable CLI malocclusion presenting with PBC, a missing mandibular right first molar without AF, and no significant loss of OVD.

Fig 9 (a) Buccal and (b) mandibular occlusal views of a periodontally stable CLId2 malocclusion presenting with PBC. Maxillary AF is not noted. However there is an increase in the anterior overbite relationship as OVD is lost due to accelerated retrograde wear of the dentition.

Fig 10 (a) Buccal and (b and c) lateral views of a CLId1 malocclusion presenting with PBC. The dentition presents with periodontitis, TL, displacement of teeth, maxillary AF, and loss of OVD, contributing to an unstable IC position. The mandible is postured anteriorly to a pseudo-dental CLIII malocclusion with an increased IC/CR relationship.
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normal occlusion and malocclusion Class I (CLI), Class II (divisions 1 and 2; CLIId1 and CLIId2, respectively), and Class III (CLIII). Although referred to as a “malocclusion,” these occlusal patterns, which deviate from the ideal, may be physiologic, and are more susceptible to periodontal breakdown, are classified as PBC (Fig 3). Although most malocclusions will follow the clinical pattern of PBC originally published by Amsterdam and others, they vary depending upon Angle’s malocclusion. Classification of malocclusion at the time of clinical presentation may prove to be difficult in cases of restored dentition where PBC had been present at the time of prior treatment but was unaddressed (“restored in PBC”; Fig 7).

Angle’s CLI Collapse

In the presence of periodontitis with AL, this malocclusion may present with increasing mobility/fremitus and AF resulting in a loss of OVD. If mandibular molars are missing, the premolars would tip distolingually into the edentulous space; if present, the second molar tips mesiolingually, and excursion of the opposing molar may be seen. As OVD is lost, increased wear and/or chipping in the teeth, increased fremitus/mobility, or TMD may be seen.

Angle’s CLId1 Collapse

Similar to the CLI malocclusion, increasing mobility/fremitus may be noted with greater AF with the progressive loss of OVD (Figs 3a, 3b, 6, and 10). Loss of OVD in the presence of AF, extrusion, and drifting of unopposed posterior teeth could likewise cause posterior cusps to function effectively steeper, which may be exacerbated by shallower articular eminence inclinations. Secondary OT may also be noted in the presence of PAL. Mandibular premolars tend to either maintain their position or tip mesially. This could be attributed to their relative position against the maxillary arch and the way in which forces are transmitted along their long axis.

In cases where there is an increased anterior overjet relation, significant AF may not be seen in PBC. As OVD is lost, the overbite would increase with a decrease in overjet due to the mandible’s anterior positioning to obtain a stable anterior contact (Fig 3). These patients may present with a dental pseudo-CLIII malocclusion with an increased IC/CR relationship.

Angle’s CLId2 Collapse

In the CLId2 malocclusion, the anterior teeth receive greater occlusal forces and there typically is little AF (Figs 3c, 3d, and 9). This is not only due to the skeletal relationship, but also due to occlusal forces directed closer to the transverse axis of rotation, thus negating the potential for off-axis forces and flaring. These patients tend to be “locked in” and are unable to easily perform excursive movements. As OVD is lost, increased wear and/or chipping in the teeth, increased fremitus/mobility, or TMD may be seen.

Angle’s CLIII Collapse

The clinical appearance of the CLIII malocclusion in PBC tends to be an extension of its appearance without PBC (Figs 3e and 3f). As this malocclusion collapses, the edge-to-edge or reverse anterior overbite relation becomes exacerbated. As OVD is lost, mandibular prognathism increases with no AF. It should be determined whether the malocclusion is a true orthodontic CLIII or a dental pseudo-CLIII due to loss of OVD and anterior positioning of the mandible at an increased IC/CR relationship (Fig 5).

Framework for Grading Bite Collapse

Since PBC encompasses a wide range of clinical manifestations and can be diagnosed with or without periodontitis, TL, AF, or loss of OVD,
a grading system was devised. This system is based upon the two most common etiologic factors that can contribute to PBC: the presence or absence of TL and the health of the periodontium with potential sequelae of AF and/or loss of OVD (Table 1).

Grade 1

Grade 1 (G1) PBC malocclusions are periodontally stable without TL (Figs 3 and 9). There is typically a lack of AF but may show signs of increasing mobility/fremitus, which may indicate a loss in OVD. The presence of accelerated retrograde wear may also indicate loss in OVD. Dentition that present with a healthy but reduced periodontium are included, as well as physiologic therapeutic dentition that have been restored in PBC.

Grade 2

Grade 2 (G2) PBC malocclusions are periodontally stable with unrestored missing teeth (Figs 2, 5, 7, and 8). These may present with or without AF or loss of OVD, and dentition in which the remaining teeth are able to maintain a physiologic OVD fall in this group. However, in the presence of occlusal wear, a net loss in OVD may be seen. G2 PBC also includes dentition that present with a healthy but reduced periodontium. Additionally, physiologic therapeutic dentition that have been restored in PBC are included.

Grade 3

Grade 3 (G3) PBC malocclusion presents without TL in the presence of active periodontitis (Fig 6). This malocclusion may or may not present with AF or concomitant loss of OVD. However, OVD loss should be suspected in the presence of retrograde wear, increasing mobility/fremitus, and AF. Physiologic therapeutic dentition that have been restored in PBC are also included.

Grade 4

Grade 4 (G4) PBC malocclusions present with both TL and periodontitis with or without AF or concomitant loss of OVD (Figs 4 and 10). This grade may best coincide with Stage IV periodontitis. In the majority of cases, this dentition presents with compromised periodontal support, which may lead to additional TL, thereby translating to progressive loss of masticatory function, increasing mobility/fremitus, and AF. In the presence of AF in conjunction with increasing mobility, there is invariably loss in OVD.

Conclusions

PBC is a clinical syndrome consisting of various alterations in the dentition that deviate from an ideal occlusion. The dental-occlusal alterations, as well as dental-skeletal discrepancies in the posterior dentition in PBC, establish an environment that is potentially more susceptible to periodontal disease and caries. In the presence of periodontitis, the attachment apparatus becomes severely compromised and results in the instability of the remaining dentition, which could subsequently become easily affect-

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<th>Table 1 PBC Grading with Associated Clinical Sequelae</th>
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<tr>
<td>Grade 1</td>
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<tr>
<td>Malocclusion</td>
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TL = tooth loss; OVD = occlusal vertical dimension; + = present; – = not present; ± = may or may not be present.
ed by occlusal forces.\textsuperscript{21,22,24} Forces generated on the periodontally and functionally compromised dentition could cause susceptible teeth to become displaced and, in the presence of AF, could exacerbate OVD loss. Alternatively, the intact dentition, in the absence of periodontitis, may also present with PBC and loss in OVD. Severe retrograde wear, where the rate of wear exceeds the compensatory rate of eruption, results in a net loss in OVD, increasing AF and/or fremitus of the maxillary anterior teeth.\textsuperscript{14}

Because PBC encompasses a wide range of clinical presentations that do not necessarily involve the presence of periodontitis, TL, AF, or OVD loss, a grading system was established to delineate these cases. When diagnosing a malocclusion based upon the proposed grades of PBC, additional notation as to whether there are unrestored missing teeth, AF, and/or OVD loss should be made. Additionally, AF that may be due to a tongue-thrust habit or a Bolton discrepancy should be evaluated. The clinician should also be cautioned that it is possible to encounter fully restored dentition (physiologic therapeutic dentition) that have been restored in PBC, masking some of the hallmark signs of collapse. It should also be noted that not all PBC cases require treatment. Early intervention and careful maintenance of these patients preventing the onset and progression of periodontitis may allow for the preservation of a stable physiologic malocclusion. However, of those requiring treatment, establishing and maintaining periodontal health should come first, followed by restoring the occlusion and re-establishing the dentition's protective capacity of form and function. Additionally, in deciding to restore PBC cases, careful consideration and evaluation should be placed on determining whether increasing or restoring the OVD is required, as well as understanding the concomitant change in mandibular position with each malocclusion in the presence or absence of AF. Any alteration in OVD would also require evaluating the presence of an increased IC/CR relation.

The periodontium requires a specific form in order to maintain its function in health. Violation of this form would compromise its function and serve as a contributing factor for the progression of disease. The decision to intervene with treatment should be dependent upon periodontal health, caries, function, occlusion, TMD, esthetics, and phonetics.\textsuperscript{7} As Granger\textsuperscript{25} states, the health of the mouth is related to the function of the mouth. The better the function, the longer natural metabolism can maintain it.

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**References**