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REVIEW ARTICLE

Grade C molar-incisor pattern periodontitis classification and its challenges

Yasmin Teixeira das Graças[1] | **Manuela Maria Viana Miguel**[1] | **Renato Corrêa Viana Casarin**[2] | **Mauro Pedrine Santamaria**[1] | **Pratishtha Mishra**[1] | **Luciana Macchion Shaddox**[1]

[1]Center for Oral Health Research and Division of Periodontology, Department of Oral Health Practice, College of Dentistry, University of Kentucky, Lexington, Kentucky, USA

[2]Department of Periodontics and Endodontics, School of Dental Medicine, University at Buffalo, Buffalo, New York, USA

Correspondence
Luciana Macchion Shaddox, 1095 VA Dr., Lexington KY, 40536.
Email: lshaddox@uky.edu

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Abstract

Background: The classification of periodontitis has changed, establishing not just the severity and extent of disease but also more comprehensive risk assessment for patients and hopefully guiding more tailored treatment approaches. Although the new classification presented several benefits to the severity and risk of progression of disease, some limitations remain. This review highlights key gaps in the grade C and molar-incisor pattern (C-MIP) classification, particularly the exclusion of primary dentition involvement, which limits early awareness, diagnosis, treatment, and research. Additionally, the current "grade C" category includes a broad spectrum of patients, ranging from systemically healthy young individuals with early onset and rapid disease progression to older adults whose disease is associated with modifying factors. This overlap masks key clinical and biological differences, complicating efforts to identify susceptibility profiles and tailor treatment. Moreover, cases extending beyond the molar-incisor pattern, including premolars or atypical presentations, pose challenges to the current classification system. These patients often exhibit early onset, familial aggregation, rapid progression, and absence of systemic risk factors, suggesting a unique susceptibility profile that may not be adequately captured by the current classification and deserve proper categorization to be better studied and treated.

Conclusion: In the conclusion of this paper, we suggest expansion and clarification of the current classification system to: (1) recognize periodontitis in the primary dentition; (2) distinguish patients with grade C periodontitis by the presence or absence of modifying factors; and (3) introduce a subclassification for grade C cases predominantly affecting young patients. These refinements may improve diagnostic accuracy and support more targeted research, prevention, and treatment for at-risk youth.

KEYWORDS
incisor, molar, patients, periodontitis

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Plain Language Summary

Periodontitis is a serious gum disease that is not only prevalent but may lead to tooth loss. In young people, this disease sometimes can progress quickly and behave differently from how it does in adults. Although experts have updated how periodontitis is classified, there are still important gaps in this classification, especially when it comes to young patients. For example, current guidelines do not include periodontitis that affects baby teeth, even though it can also be aggressive. In addition, the category called "grade C" includes very different types of patients, such as healthy young individuals with fast disease progression and older adults whose gum disease is associated with other factors such as smoking or diabetes. This makes it harder for dentists and researchers to better understand and treat this disease properly. In this review, we suggest improvements to the current system, including the recognition of periodontitis in baby teeth, a subclassification of "grade C" cases including or not modifying factors, and a new subgroup classification for young patients with aggressive forms of the disease. These changes could help dentists diagnose gum disease more accurately, and researchers to study the disease more appropriately, which can result in better treatments, especially for young people with higher risk for early disease initiation and rapid progression.

1 | INTRODUCTION

Why do we classify diseases? If not to provide distinct clinical and etiological characteristics of a disease to support an individualized treatment approach. The question we need to ask is: are we properly doing this?

The terminology for aggressive periodontitis has evolved significantly over the years (Figure 1). Initially referred to as *Diffuse Alveolar Atrophy* in 1923,[1] the condition was later termed *periodontosis* to describe severe periodontal destruction in young individuals.[2] Gottlieb (1946)[3] further distinguished it as a clinical entity, primarily affecting first molars and incisors with rapid progression. In 1969, Butler introduced the term *juvenile periodontitis*,[4] emphasizing its aggressive and rapidly progressive nature, unique lesion distribution, familial aggregation, and minimal presence of subgingival biofilm.[5]

In response to increasing reports of periodontitis in prepubertal children, Page (1983)[6] proposed the term *prepubertal periodontitis*, describing a rare but severe condition occurring soon after the eruption of primary teeth. Recognizing the broad clinical spectrum of early-onset periodontal diseases, the American Academy of Periodontology (AAP)[7] introduced the term *early-onset periodontitis* in 1989 to cover conditions characterized by rapid periodontal destruction in otherwise systemically healthy young individuals. This category included *prepubertal periodontitis* (localized and generalized), *juvenile periodontitis* (localized and generalized), and *rapidly progressive periodontitis*.[7]

However, as accumulating clinical and biological evidence revealed significant overlap among different forms of periodontitis, it became clear that an age-based classification alone was inadequate.[8] Thus, the 1999 classification[9] aimed to distinguish slowly progressing (*chronic*) from rapidly progressing (*aggressive*) periodontitis. However, differentiating localized (LAP) from generalized aggressive periodontitis (GAP), and generalized *chronic* from *aggressive* forms, remained challenging due to overlapping features. LAP was defined by circumpubertal onset with attachment loss mainly on first molars and incisors, involving no more than two additional teeth. GAP involves attachment loss on at least three permanent teeth beyond the first molars and incisors, reflecting a more widespread, rapidly progressing disease.[9]

Finally, in 2018, the AAP and European Federation of Periodontology (EFP) revised the classification system, merging chronic and aggressive periodontitis under a single category of "*periodontitis*", due to their similar pathophysiology. This framework also introduced a staging (I–IV) and grading (A–C) system to define severity and progression risk designations, respectively.[10–12] Under this current system, cases previously classified as LAP are now referred to as *Grade C Molar-Incisor Pattern Periodontitis* (C-MIP), while GAP cases are now categorized as *Grade C*

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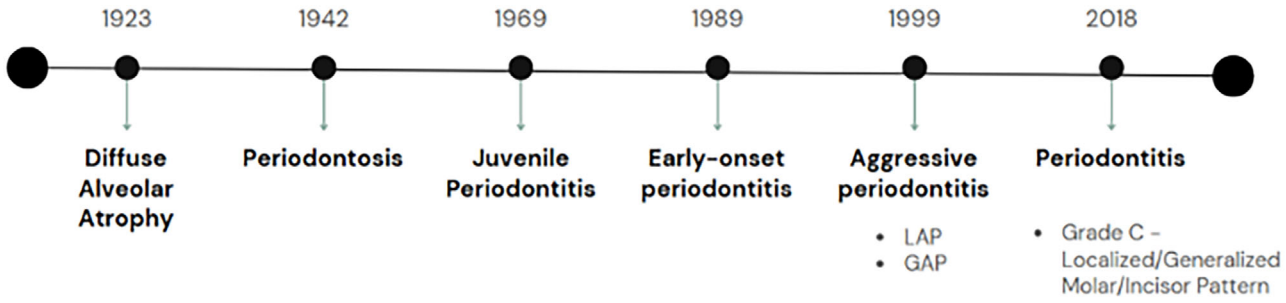

FIGURE 1 This timeline illustrates the historical changes in nomenclature and classification of aggressive periodontitis over time.

Periodontitis. The proposed staging and grading system for periodontitis offers an individualized patient assessment that considers not only the severity and extent of the disease but also the complexity of case management and the likelihood of future disease progression or reduced responsiveness to standard periodontal therapy.[11] However, the grading component has sometimes been misapplied as not only a label for the "old" aggressive forms of periodontitis, but also to attribute higher risk of disease to previously chronic forms of periodontitis but with modifying factors. Thus, these two groups of patients are placed within the same "*grade C bucket*" but do not necessarily have the same susceptibility to disease progression.

Although no biomarkers currently offer enough accuracy to distinguish periodontal conditions, some individuals clearly show greater susceptibility to rapid disease, suggesting distinct conditions.[13] As we apply the new classification in clinics and research studies, its limitations become more evident, potentially reducing research precision and leading to unclear treatment recommendations. First, it does not acknowledge the manifestation of early aggressive periodontitis in the primary dentition, leaving a critical gap in the identification and management of very early-onset cases, before permanent dentition eruption. Based on retrospective analyses,[14] timely intervention *may* potentially prevent progression to permanent dentition. Therefore, it is crucial to address this limitation for better awareness, diagnosis, treatment, and research of periodontitis in very young individuals.

The second limitation, or what could be considered a "misuse", of the current classification focuses on the broad "*grade C bucket*" that now exists, where advanced disease in young individuals without contributing factors, characteristics of CMIP patients, is classified within the same disease category as older individuals with sometimes not as severe stages of periodontitis, however, presenting modifying factors, such as heavy smoking or uncontrolled diabetes. This grouping may hinder research efforts focused on properly understanding etiology, pathogenesis, and treatment for this at-risk groups. Consequently, it may limit accurate clinical diagnosis and individualized treatment approaches early in life, as well as proper classification late in life, when modifying factors are indeed present.

Finally, through years of clinical observation, we have identified aggressive forms of periodontitis in young individuals that extend beyond the classic *molar-incisor pattern* (MIP), sometimes involving other teeth, such as premolars, yet still presenting a localized and aggressive form of disease, as we will discuss in this manuscript. These findings highlight a subset of patients who present an 'unusual' distribution of periodontal destruction, suggesting that there may be some variations in the *MIP* disease presentation, and the current nomenclature may thus be confusing and possibly precluding proper classification of these at-risk patients into the same disease category.

The purpose of this review is to present an important discussion of the current classification and its limitations and suggest not only the inclusion of primary dentition into the grade C category, but also support an aggressive (grade C) periodontitis category as a distinct disease entity, primarily affecting *younger individuals*, with *no other contributing factors*, which has been previously documented, may have a different susceptibility pattern, and may indeed require a differentiated treatment approach. Its unique clinical presentation and rapid progression, starting at early ages, clearly shows a *distinguished susceptibility pattern* that certainly deserves to be better investigated.

2 | IMMUNOLOGICAL, GENETIC, AND MICROBIAL FACTORS

C-MIP pathogenesis involves a complex interplay between immunological, genetic, and microbial factors. From an immunological standpoint, it is characterized by an exaggerated host response to a dysbiotic biofilm,[15,16] also previously associated with neutrophil dysfunction,[17] including impaired chemotaxis,[18] hyperactivity[19] due to reduced membrane receptor[20] and altered sensitivity to bactericidal activity.[17,19] Several inflammatory biomarkers linked to

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periodontal tissue breakdown, such as IL-12p40, IL-6, IL-12p70, IL-2, IL-1β, GMCSF, TNF- α, INFγ and MIP-1α, have been found at significantly higher levels in diseased sites of patients with LAP/C-MIP compared with healthy sites, but also systemically in response to bacterial stimuli.[15,21,22]

Along with the cellular response, humoral activity also plays a significant role in this disease. Papantonopoulos et al[23] has reported that serum IgG titers against *Aggregatibacter actinomycetemcomitans* (*Aa*) and *Porphyromonas gingivalis (Pg)* can be one of the immunological exacerbations that discriminate early onset periodontitis from late onset periodontitis. This evidence is in accordance with previous studies[24–26] in the literature showing that IgG/IgG2 is correlated with aggressive forms of periodontitis and immunological response against *Aa*. However, it is important to highlight that confounders' factors may have an influence on this outcome. For instance, IgG2 serum has been highly detected in Black patients diagnosed with C-MIP/LAP compared with White subjects.[27] In addition, it seems that IgG2 concentration may increase in puberty.[27] Thus, this individual host response certainly deserves further investigation.

Although inflammatory responses vary among family members, certain cytokines tend to exhibit strong intra-familial correlations. This, alongside segregation analysis studies[15,28] supports a genetic predisposition and hyperinflammatory responses in aggressive forms of periodontitis,[29] with family members often exhibiting similar disease patterns.[28–31] Additionally, several polymorphisms in immune-related genes have been associated with increased susceptibility to aggressive periodontitis, such as toll-like receptors (TLRs), particularly TLR-2 and TLR-4 which play a critical role in the exaggerated immune response observed in LAP/C-MIP[15,31] - as well as IL-1α, IL-1β, lactoferrin, and cathepsin C.[31,32] Nibali et al. reported that the IL-6 gene polymorphisms − 1363G > T and − 1480C > G were also linked to LAP.[33] Interestingly, an allelic difference (− 1363 G > T) was observed in White patients with LAP/C-MIP compared with control and generalized cases. These variants may influence immune response and microbial colonization. However, the genetic basis remains unclear due to polygenic involvement and population differences.

Genome-wide association studies have also attempted to give a better insight into populations presenting aggressive disease, although studies have mixed populations of generalized and localized forms of diseases.[32] Further studies involving affected families are needed to identify variants linked to this aggressive disease in young adults. In addition to genetic variants, epigenetic mechanisms such as DNA methylation have been implicated in the regulation of the host immune response and may likewise contribute to this disease. Specific methylation patterns have been associated with altered cytokine production, suggesting a potential impact on disease severity.[34] The role of microRNAs (miRNAs) in immune regulation has also gained increasing attention. Certain miRNAs, including miR-9-5p, miR-155-5p, and miR-147a, have been found to be upregulated in individuals with C-MIP and are known to respond to bacterial stimulation via TLR activation, thereby contributing to the amplification of inflammatory signaling.[35]

Concerning microbiological contributions, *Aa* has been long associated with C-MIP, affecting both the primary and permanent dentitions,[36–39] suggesting that early colonization may drive disease onset and progression.[40,41] Virulent strains like the JP2 clone are consistently detected in affected sites reinforcing Aa's role in early pathogenesis.[42] Other microorganisms, such as *Pg*,[43–47] *Tannerella forsythia*,[45,47,48] and *Filifactor alocis*[48,49] have also been implicated in this disease and in different populations. The selective involvement of first molars and incisors may be associated with eruption timing, potentially increasing likelihood of breakdown of these initial teeth during this critical window, where an inflammatory process begins and opportunistic bacterial growth may occur. *Aa*'s ability to invade the periodontium has been observed in young individuals.[50–52] Without early and effective treatment, these organisms may resurface at later eruption of permanent molars and incisors and re-initiate disease, reiterating the importance of early diagnosis and treatment of this disease.[53]

Although the pathogenic mechanisms and susceptibility factors underlying this rapid tissue breakdown remain incompletely understood, a distinct etiology and susceptibility is suggested for this disease. The clinical features, discussed further below, warrant a separate classification to facilitate future research into its unique pathogenesis and to guide personalized treatment approaches.

3 | CLINICAL AND RADIOGRAPHIC FEATURES

3.1 | Usual MIP pattern

C-MIP is characterized by a severe form of periodontal disease including rapid clinical attachment loss (CAL) and bone destruction, including frequently symmetrical and arc-shaped intrabone defects[29,54] (Figure 2). It is most prevalent among individuals of African descent, followed by those from the Middle East[55] and countries with mixed populations.[56] In contrast, its prevalence is much lower (usually less than 1%) in White patients.[57,58]

Recent familial research has reinforced that the typical presentation of aggressive periodontitis overwhelmingly

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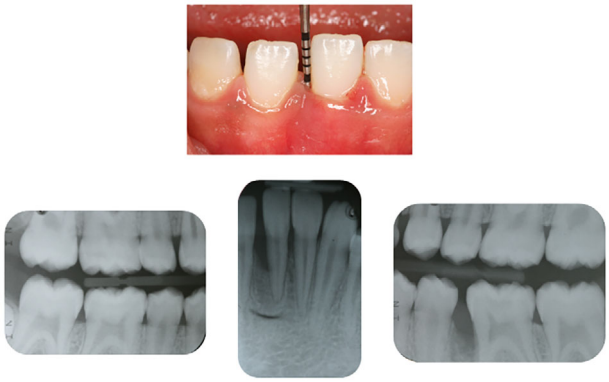

FIGURE 2 Clinical and radiographic presentation of a 13-year-old Black female diagnosed with C-MIP. Note PD of 10 mm observed in the worst site, and severe alveolar bone loss localized around the first molar and incisor. The clinical and radiographic findings are consistent with the diagnosis of a rapidly progressing form of periodontitis in a very young individual.

affects mostly first molar and incisors (Figure 3), following the MIP pattern.[29] In this study looking at the characterization of 69 siblings from 28 families, Tabaa et al.[29] demonstrated that 55.3% of cases involved both first molars and incisors while 42.1% affected only the first molars, indicating that MIP cases are not necessarily molar and incisors, but it could very well affect only first molars (Figure 4) and less frequently incisors only (Figure 5).

3.2 | Primary dentition cases

Although studies remain heterogeneous regarding the age of onset for aggressive periodontitis[3], several case reports/series have demonstrated that the condition can be clearly identified in the primary dentition (Figure 6), involving healthy children between 3 and 10 years of age, across males and females, and in several ethnic backgrounds.[59–65] This growing body of evidence underscores the importance of recognizing and classifying periodontal disease in the primary dentition to enable proper early diagnosis, guide appropriate management, and importantly promote consistency in research reporting. However, early diagnosis is challenging, as periodontal probing and radiographic imaging are not routinely performed during pediatric dental visits.[14,61,66]

Radiographic interpretation during the exfoliation phases of deciduous teeth poses diagnostic challenges, often leading to under or misdiagnosis of disease. This absence of standardized assessments often delays or prevents timely disease recognition and intervention. When radiographs are obtained, they may reveal advanced bone loss around primary teeth, often resulting in premature exfoliation of teeth with intact roots at an unusually early age (Figure 7). Differentiating pathological from physiological exfoliation, where alveolar crest remains intact, and apical root resorption is evident, is essential for accurate diagnosis (Figure 8).

It is important to note that the pathological cases, when probed, do show routine clinical signs of periodontitis, such as deep pockets, CAL, and bleeding on probing. Pediatricians should recognize these conditions to ensure early diagnosis and treatment, as recommended by the American Academy of Pediatric Dentistry guidelines,[67] which recommend probing to start upon eruption of first permanent molars, or earlier if suspicion of radiographic bone loss is observed. Effective management of aggressive pattern includes oral hygiene education, mechanical biofilm removal, adjunctive systemic antibiotics,[14,68] and regular periodontal maintenance.

Previous studies have shown that aggressive disease can progress rapidly if not diagnosed and treated early.[14,66,69,70] Failure to manage the disease in the primary dentition may increase the risk of recurrence or progression in the permanent dentition (Figure 9), particularly in genetically predisposed individuals.[66] Pathogenic bacteria colonizing the primary teeth may persist in the oral cavity and subsequently infect newly erupting permanent teeth, thereby perpetuating disease activity.[71] The lack of early diagnosis and timely intervention may play a key role in the transition to a more extensive and destructive periodontal condition. In fact, studies evaluating retrospective radiographic images in children with juvenile periodontitis revealed that 85%–90% of patients with C-MIP in the permanent dentition had prior bone loss in the primary molars.[14,66] This indicates that LAP may indeed start in primary dentition and progress to other teeth and to the permanent dentition if not promptly managed. Thus, early detection and treatment are crucial, as younger children respond more favorably than older children and adolescents.[68,72]

3.3 | Localized (MIP) and generalized disease: same disease but different susceptibility patterns?

Another relevant consideration is that C-MIP may progress to a generalized form, which may mask the possible initial MIP for younger individuals, at least in some cases. Longitudinal evidence has shown that early-onset periodontitis does not always remain localized.[73] A 6-year follow-up study of 34 adolescents initially diagnosed with LAP showed that about one-third of these patients progressed to a GAP, indicating a possible shift in both the extent and severity of the disease over time, at least in a few cases.[73] These few cases that generalizes

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FIGURE 3 Clinical presentation of a 16-year-old male diagnosed with a typical pattern of C-MIP. Note severe alveolar bone loss localized around the first molars and incisors. Tooth #24 and #25 exhibited Grade III mobility, while tooth #23 presented Grade II mobility. Clinical and radiographic findings are consistent with rapidly progressing periodontitis characteristics of C-MIP in a young individual.

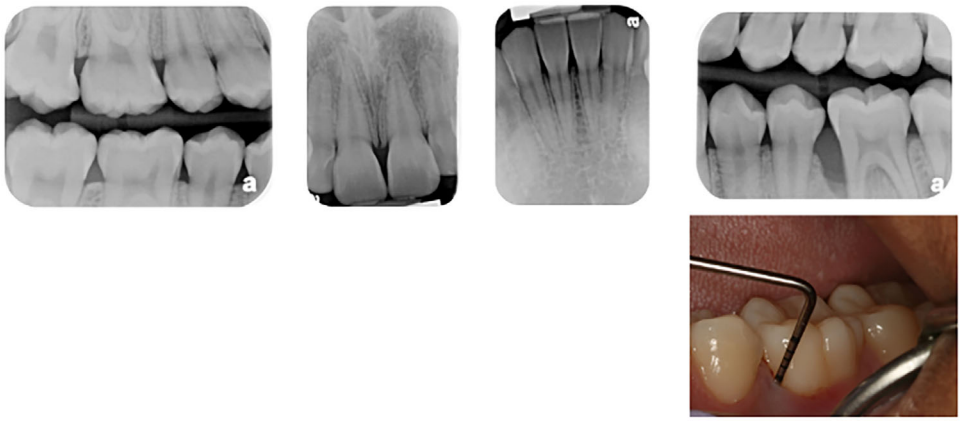

FIGURE 4 Radiographic and clinical images of a 13-year-old Black female diagnosed with localized aggressive periodontitis (LAP), demonstrating isolated severe bone loss on tooth #19. This case exemplifies a rare molar-only pattern, with no other teeth clinically or radiographically affected.

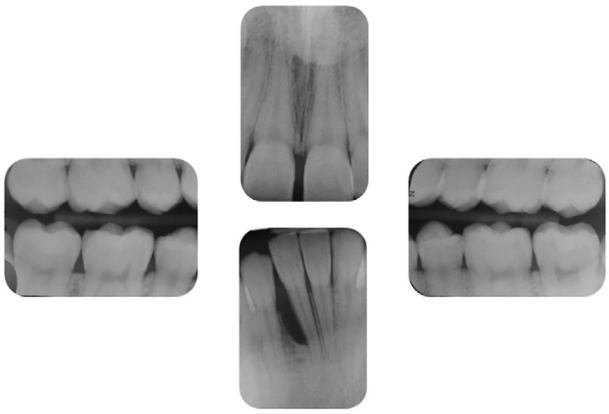

FIGURE 5 Radiograph of a 17-year-old Black female diagnosed with localized aggressive periodontitis (LAP), showing isolated severe bone loss on tooth #25. Clinical examination revealed a probing depth of 10 mm, with no other teeth affected. This case illustrates an incisor-only pattern of LAP.

may show a different susceptibility pattern or immune processes than the cases that remain localized. Figure 10 shows a 25-year-old female with generalized stage III, grade C periodontitis, characterized by extensive bone loss around the maxillary incisors and involvement of first molars, premolars, and canines. Determining whether such cases begin as localized disease or represent distinct entities is challenging and not supported by evidence currently. Proper evaluation requires strict inclusion criteria, onset before age 25–30, severe bone loss, rapid progression (bone loss/age > 1), and *absence of modifying factors*. Ideally, retrospective radiographic analysis should be used to assess initiation patterns, though this is often unfeasible due to limited access to care in affected low-income populations. By referral, disease is typically generalized. Clarifying whether MIP progresses in susceptible individuals demands

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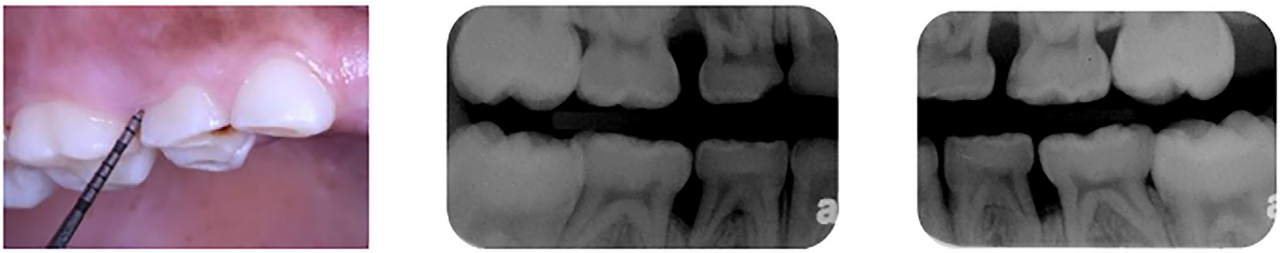

FIGURE 6 Clinical case of an 8-year-old male diagnosed with C-MIP. PD of 7–8 mm and CAL up to 5 mm observed at the most severely affected sites. Note: no clinical signs of gingival inflammation and low plaque accumulation, despite the 7 mm PD here. This is typical in these cases in both primary and permanent dentitions. All primary first molars exhibit radiographic bone loss, consistent with the early-onset and localized pattern characteristic of C-MIP in primary dentition. Note breakdown already migrating to the second primary molar on the left side, which has been previously reported.[24] Note the distal symmetrical pattern of the disease on the first primary molars (distal defects present in all four).

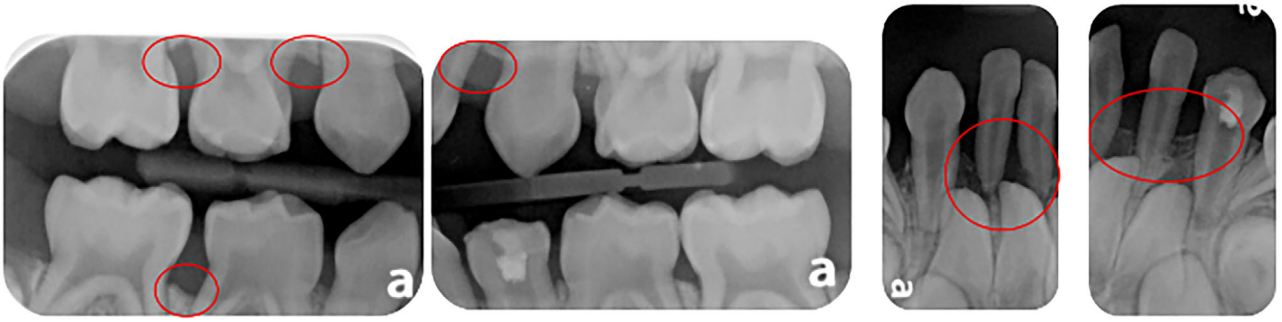

FIGURE 7 Radiograph of a 5-year-old Black child diagnosed with grade C disease in the primary dentition. Note severe bone loss evident around the primary incisors, which show mostly intact roots. These teeth will be lost early. Also note first primary molars already showing signs of bone loss (right side only - red circles), while the left side remains with healthy bone levels (usually 1–2 mm from the cemento-enamel junction, with good crestal radiopaque contour).

further investigation into pathogenesis and genetic factors, as progression patterns remain poorly understood.

Initial studies suggested that localized aggressive periodontitis elicits higher antibody levels against *Aa*, predominantly an IgG2 response,[74–79] compared to generalized, which is inversely correlated with attachment loss and tooth involvement, and its been hypothesized that this immunological difference has been attributed to a "protective" role against "generalization" of the disease. This response also seems to be higher in Black individuals and runs within families similarly as well.[32,80,81] Additionally, patients with LAP had the highest concentrations.[27] Similar patterns were later observed in a Taiwanese population.[82] These findings suggest immunological differences between localized and generalized forms, reinforcing the need for clearer disease definitions to distinguish the two diseases progresses. Additionally, both localized and generalized aggressive forms of periodontitis show favorable responses to subgingival debridement combined with systemic antibiotic therapy. Nevertheless, better clinical outcomes, including greater PD and CAL reduction, are generally observed in localized diseases.[83] This supports the hypothesis that differences in susceptibility patterns may influence not only disease onset but also patterns of progression and response to treatment.

3.4 | Grade C "bucket"

According to the latest classification, grading reflected the rate and risk of disease progression and the expected response to standard therapy.[10] Grade C is characterized by rapid progression, defined as ≥ 2 mm of CAL over a 5-year period or severe tissue destruction in the presence of minimal plaque deposits, or generally, in case of lack of history, a bone loss to age ratio over 1. Although the *'aggressive"* pattern is frequently observed in young adults, the same grading may also apply to older patients with specific risk factors, such as heavy smoking (over 10 cigarettes a day) or diabetic patients with HbA1c ≥ 7.0%. This overlap of

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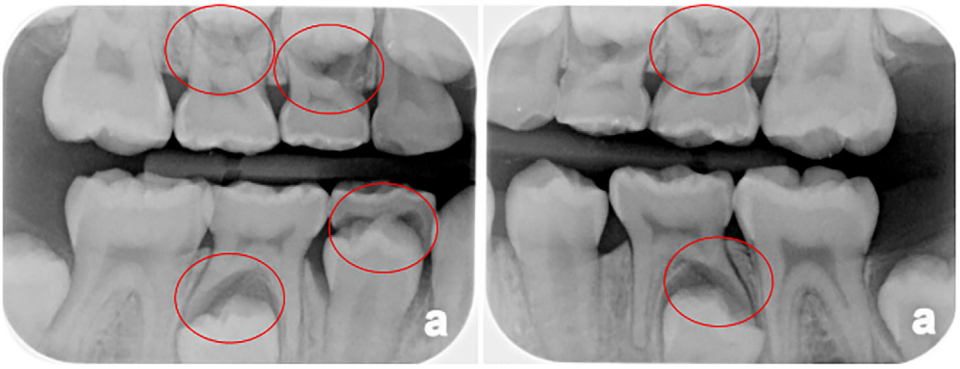

FIGURE 8 Radiograph of subject (healthy control) illustrating normal exfoliation of primary first and second molars. Progressive root resorption is observed, particularly at the apices and inter-radicular areas. The roots appear shortened and blunted as the permanent premolar begins to erupt beneath the primary tooth. The alveolar bone crest remains intact, with no signs of bone loss (1–2 mm from the cemento-enamel junction). The developing permanent successor is visible below the resorbing roots, enclosed within a well-defined follicular space. This radiographic presentation is consistent with a physiological exfoliation process, without evidence of pathological involvement.

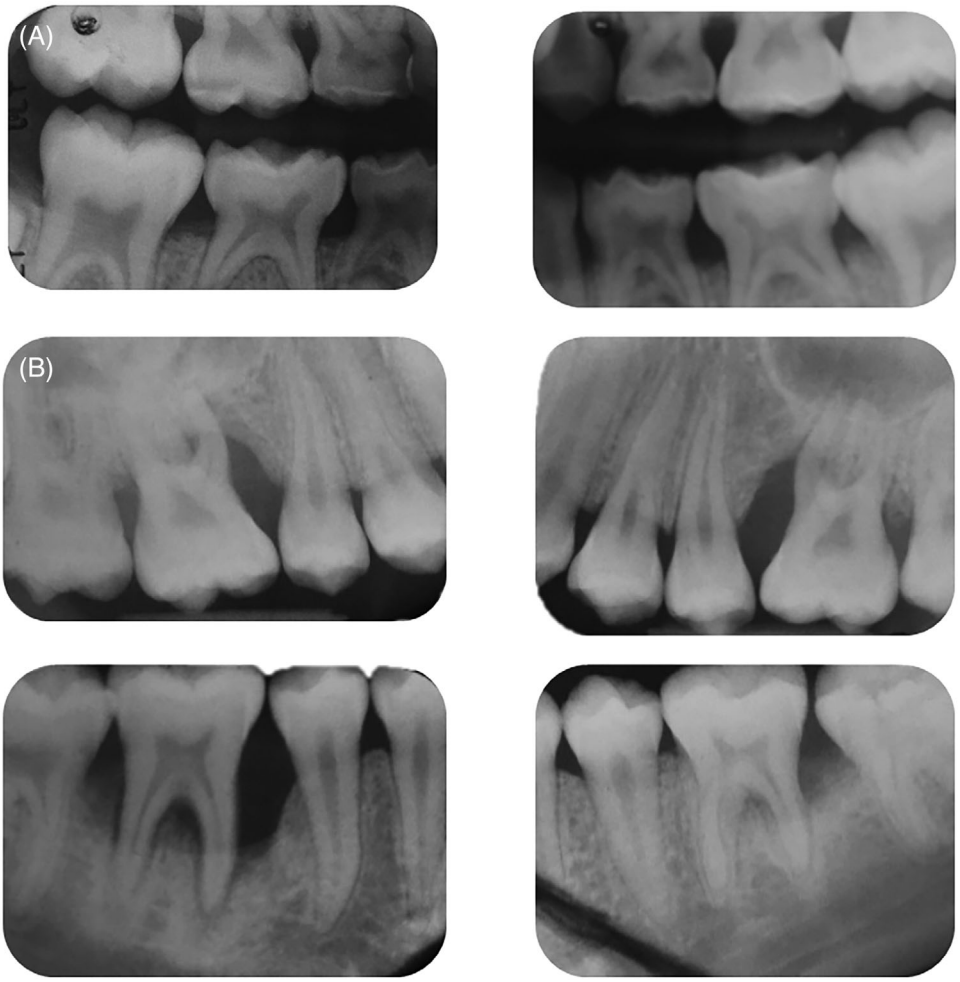

FIGURE 9 Retrospective evaluation of a systemically healthy female patient showing bone loss around the primary dentition at age 7 (A) and 7 years later (B) C-MIP in permanent first molars, when she was referred to our group for treatment, at age 14 years. She had already lost 24 at this point.

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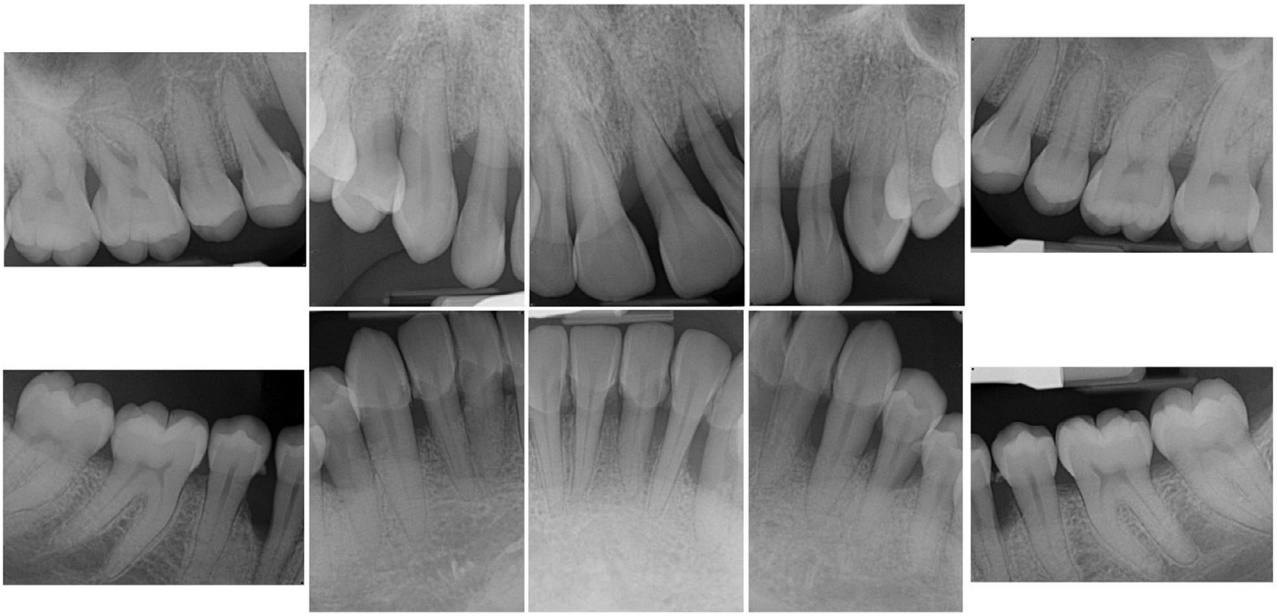

FIGURE 10 25 year-old Black female referred to periodontics for treatment. Note severe bone loss affecting more severely the upper incisors and first molars but already generalizing to premolars and canine. This is a clear case of what could have started as an MIP distribution at a younger age but currently falls into a generalized grade C category. Due to early age and severe bone loss, this case clearly may have distinct susceptibility patterns that need to be further investigated.

older adults with the presence of risk factors with younger adults with no risk factors but a higher susceptibility to bone breakdown *blurs* the distinction between inherently susceptible young patients with rapid breakdown from an young age and those whose disease progression may be driven by modifiable risk factors, underscoring a *critical limitation* in the current cla*ssification system, and for upcoming studies, as these patients are often placed in the same "grade C bucket*".

This broad inclusion *dilutes* the specificity of high risk of progression and what factors may be associated with this high risk and thus, creates a large diagnostic "bucket" that conflates possibly distinct pathophysiologic pathways. For instance, in smokers, the cytotoxic effects of nicotine impair host immunity, delay healing, and promote dysbiotic microbial communities, all contributing to disease acceleration.[84] In individuals with uncontrolled diabetes, chronic systemic inflammation and impaired metabolic regulation amplify inflammatory cascades and ultimately periodontal tissue breakdown.[85] Despite different underlying mechanisms, these patients are now often grouped under the *same grade* as otherwise healthy young adults with a rapidly progressing periodontitis, though treatment approaches differ. This hinders research on susceptibility, treatment strategies, and response patterns across populations.

Clinically, grade C periodontitis may be classified in terms of extent into localized, generalized, or molar and incisor pattern disease. However, the current classification system eliminates age as a diagnostic criterion, masking critical distinctions between young, otherwise healthy individuals, and older patients with systemic risk factors. The use of bone loss/ratio is useful to understand progression risk, but clinicians as well as researchers are automatically "*bucketing*" heavy smokers and uncontrolled diabetics into the grade C category, unfortunately, without much attention to this ratio of true progression risk of the disease. The "bucketing" of young individuals with no systemic factors and severe bone loss with older diabetics and smokers into the same category is very problematic and may confuse clinicians when it comes to treatment choices as well. This, coupled with the absence of age-based stratification, poses significant limitations, compromising precision in clinical management and obscuring biological and prognostic differences in research. Failing to differentiate between these distinct patient populations hinders our ability to tailor therapies, interpret outcomes accurately, and advances our understanding of the disease's etiology and trajectory.

As illustrated in Figure 10, this case depicts a 25-year-old female with severe bone loss consistent with stage III, grade C periodontitis, where no systemic or local contributing factors were identified. In contrast, Figures 11 and 12 present two cases of 41-year-old male patients diagnosed with grade C periodontitis, each with distinct modifying factors. The Figure 11 patient had a smoking habit (11–12 cigarettes per day). Radiographic evaluation revealed calculus onto enamel and crestal bone resorption. Figure 12

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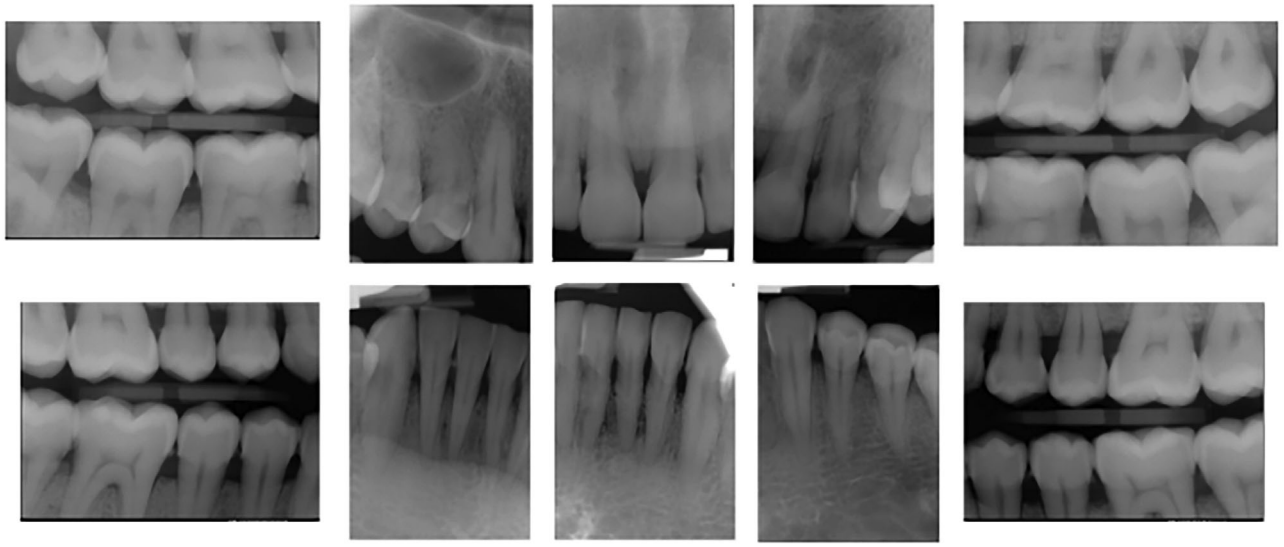

FIGURE 11 Radiographic presentation of a 41-year-old Nepalese (South-East Asian) male referred to the periodontics clinic for "cleaning." The patient had never undergone professional dental cleaning. Radiographs reveal generalized mild-moderate horizontal bone loss, with calculus noted in several interproximal regions. The patient has a 4-year history of smoking 11 to 12 cigarettes daily and reports uncontrolled hypertension. Based on clinical and radiographic findings, an initial diagnosis of stage II generalized grade C periodontitis was made due to the significant smoking history.

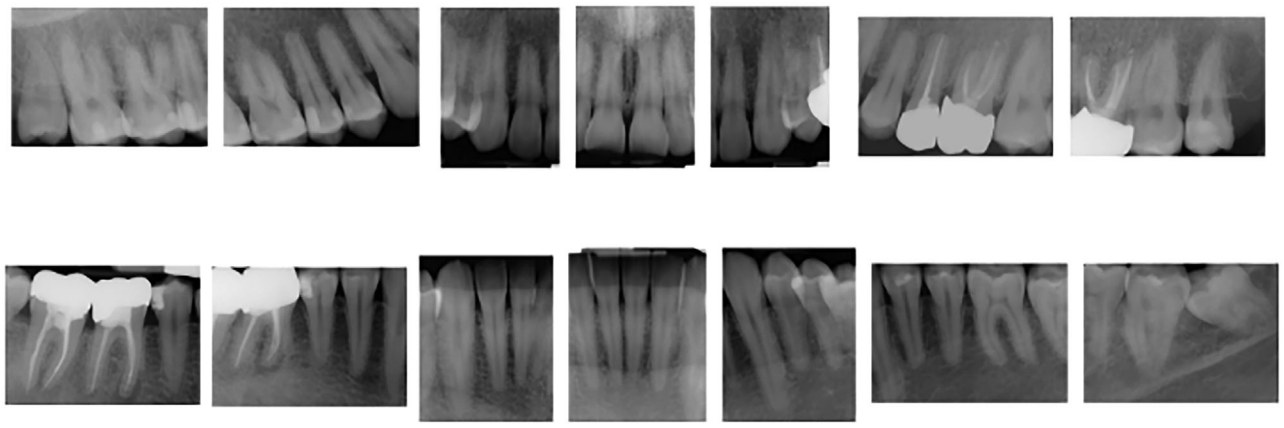

FIGURE 12 Radiographic presentation of a 41-year-old White male with a diagnosis of type II diabetes (HbA1c: 8.6% at the time of periodontal evaluation). The patient was initially diagnosed with stage I localized grade C periodontitis based on the presence of uncontrolled diabetes.

shows a 41-year-old White male with poorly controlled diabetes (HbA1c: 8.6%), in whom the grade C classification was attributed to the elevated glycemic level, although bone levels were at a very localized stage I disease, at best, not quite fitting a high progression rate bone-loss/age over 1. His history of diabetes is recent, thus, if continued to be uncontrolled, this strong risk factor could indeed be contributing to increased progression of disease and maybe to poor response to treatment, although evidence is lacking here.[85] However, at the present state, we cannot say that it will increase risk for this particular patient. Both cases were treated with SRP, OHI, and counseling on smoking and diabetes control, while the patient in Figure 10 was treated with SRP, OHI, and systemic antibiotics.[86,87] The automatic *bucketing* of cases into grade C needs to be carefully evaluated, and the treatment plan should be made according to disease risk and proper control of contributing factors, when needed. While the classification does acknowledge that smoking and diabetes are grade modifiers that *may increase risk of disease, not all patients will show progression of disease consistent with high risk of progression (i.e bone loss/age may not be above 1)*, like the cases

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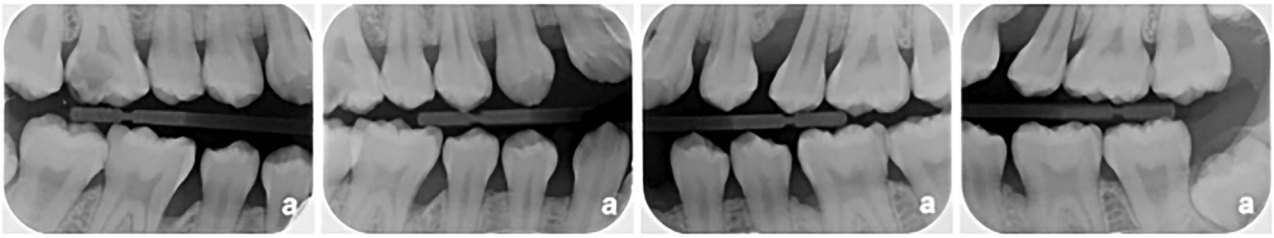

FIGURE 13 Radiographic evidence of a C-MIP case deviating from the classic MIP (molar-incisor pattern). Bitewing radiographs reveal localized alveolar bone loss on a female 19 years, involving two first molars (both lower left and right mesial surfaces) and the upper left second premolar, illustrating a clinical presentation that extends beyond the traditional distribution of C-MIP. This case highlights the potential diagnostic variability of the disease and reinforces the need to consider clinical and radiographic evidence beyond strict tooth pattern criteria when identifying grade C molar-incisor pattern periodontitis.

above. Thus, the mere presence of risk factors should not *automatically* place patients into the grade C category. This oversimplified "bucketing" of the grading C risks masks critical biological distinctions and may hinder the development of targeted therapeutic strategies for truly aggressive forms of periodontitis seen in younger patients.

3.5 | Unusual cases of C-MIP

Another important misuse of the classification has to do with unique and rare cases of C-MIP that fall outside the typical *MIP*. Most cases indeed fall into the pattern of molar and incisor distribution, as shown in Figures 2, 3, and 9 above. Other cases, even less frequently, have shown a pattern of a first molar and a premolar, as illustrated in Figure 13, demonstrating that the disease may, *very rarely*, present different than the *expected molar-incisor* pattern. These deviations underscore the importance of not relying solely on tooth distribution when diagnosing C-MIP and relying instead on a very localized severe rapid-destruction pattern in a young healthy individual. Such variations may reflect early dissemination of disease or differences in host susceptibility and specific microbial colonization or even specific local factors that may contribute to exaggerated destruction in different sites on a susceptible individual, which emphasizes the need for ongoing refinement in classification and diagnostic criteria.

An important consideration in diagnosing C-MIP disease lies in determining how many teeth must be affected before the condition is classified as having a generalized or MIP distribution. Should the threshold be set at 30% of teeth affected by bone loss to define a localized/generalized distribution? Or, if the bone loss clearly follows a MIP, even with involvement of a few adjacent premolars, should it still be classified as C-MIP? For example, if all incisors and all first molars are affected in a young adolescent with only 24 teeth, should this still be considered MIP, even though it involves more than 30% of the dentition? Should we limit the involvement to no more than two teeth outside the first molars and incisors to maintain the C-MIP classification? Or if most of the destruction is in molars and incisors, it should be considered MIP? These questions become especially relevant in cases that may eventually progress to generalized disease. What criteria should guide the classification at the time of diagnosis? See the case example in Figure 13, where a 19-year-old female shows a clear C-MIP pattern with involvement of two first lower molars and an unusual involvement of the upper second premolar. She should fall under C-MIP even though she has a premolar affected. If we focus on the pattern and rate of bone destruction, she clearly fits a C-MIP profile. In any case, treatment for this young patient should certainly differ significantly from that of the older smoker shown in Figure 11.

4 | CONCLUSION & FUTURE DIRECTIONS

This paper underscores the need for clearer guidance on applying the grading component of the new periodontal classification, particularly concerning modifying factors and primary dentition. Although the updated system promotes individualized patient management, gaps in how modifying factors are interpreted limit its practical utility. Future efforts should aim to standardize these criteria and provide clinicians with more precise tools to support accurate diagnosis and effective treatment planning.

Thus, some suggestions for classification improvement/clarifications include but are not limited to:

- Inclusion of primary dentition into the classification with specific guidance on how to diagnose early disease. When affecting primary dentition, usually the first affected teeth are the first primary molars, extending to the second primary molars, rapidly. Suggestions to probe specific teeth should be recommended, espe-

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cially upon signs of true radiographic bone loss, that are inconsistent with eruption patterns or other local factors. The absence of a diagnosis for primary dentition disease inflates lack of awareness and diagnosis of the disease early in life.

- Clarification on bone loss/age-*associated or not* with modifying factors to classify high-risk patients into the grade C category. Recommend possibly adding a subclassification of grade C patients to include: "*with and without modifying factors (diabetes/smoking)*".
- Clarifications on C-MIP category to add "predominantly starting at a young age and *usually* involving first molars and/or incisors". When the disease is not treated timely, some patients with MIP will present extension of the disease to other teeth, usually adjacent to the first molars and incisors. However, in *most* cases, destruction is evident *around first molars and/or incisors*, consistent with MIP. The disease *may* also begin in the primary dentition, typically affecting first primary molars and potentially spreading to second primary molars. Generalized grade C cases in young individuals should be classified as grade C generalized periodontitis without modifying factors.

AUTHOR CONTRIBUTIONS

Yasmin das Gracas contributed to the conception and design of the study, drafted the manuscript, and critically revised its content. Manuela Viana Miguel contributed to manuscript drafting and critical revision. Renato Casarin, Mauro Santamaria, and Mishra Pratishtha contributed to manuscript drafting and critical revision. Luciana Shaddox contributed to conception and design, data acquisition, interpretation, manuscript drafting, and critical revision.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available upon request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ORCID

Yasmin Teixeira das Graças https://orcid.org/0000-0002-0731-9570
Manuela Maria Viana Miguel https://orcid.org/0000-0003-4828-3487
Renato Corrêa Viana Casarin https://orcid.org/0000-0003-1743-5855
Mauro Pedrine Santamaria https://orcid.org/0000-0001-9468-0729
Pratishtha Mishra https://orcid.org/0000-0001-9898-4121
Luciana Macchion Shaddox https://orcid.org/0000-0003-0948-1667

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