

A Novel System for Predicting Periodontal Outcomes: Analysis of the 2017 Periodontitis Classification based on a Systematic Review

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Submitted: 22 May 2024 Accepted: 28 May 2024 Published: 03 June 2024

doi <https://doi.org/10.63620/MKJCDOC.2024.1023>

Citation: Cho, Y. J., Cho, H. W., Lee, S. M., Woo, H. N., & Kang, P. (2024). A Novel System for Predicting Periodontal Outcomes: Analysis of the 2017 Periodontitis Classification based on a Systematic Review. *J Clin Den & Oral Care*, 2(3), 01-14.

Abstract

This study assesses the 2017 Classification of Periodontitis from a prognostic perspective, extending beyond mere tooth loss. Through a systematic review, we compare this classification to previous major systems, examining their prognostic capabilities. Additionally, we introduce a new, simpler, and more efficient prognostic system.

A total of 89 articles were selected from database searches, and a color gradient scale was utilized to compare the 2017 classification with earlier prognostic systems.

The prognostic capability of the 2017 classification is comparable to McGuire's system, with various stages and grades aligning with different prognostic outcomes. We propose a novel periodontal prognostic scale (PPS) system based on 12 parameters.

In conclusion, the 2017 classification offers both diagnostic and limited prognostic capacities for assessing periodontitis. Visual comparisons with major prognostic systems indicate its potential for estimating periodontal prognosis, with the best match found in Kwok and Caton's system. The introduction of the new PPS system emphasizes convenience and simplicity, with plans for verification and updates in future studies.

Keywords: Periodontitis, Prognosis, Periodontal Risk Factors, Risk Factor, Systematic Review/Meta-analysis

Introduction

Risk and prognostic factors are critical considerations for clinicians treating periodontitis [1]. These factors must be thoroughly evaluated during treatment planning and supportive periodontal therapy, as they significantly influence disease recurrence and prognosis. Effective management of periodontitis hinges on an accurate diagnosis that accounts for the disease's etiology, various risk and prognostic factors, and the practitioner's skills [2].

Periodontal treatment can be broadly classified into nonsurgical and surgical therapies, with the latter further divided into respec-

tive and regenerative procedures. When choosing the appropriate treatment, clinicians must consider factors such as disease severity and progression rate [3]. However, despite careful assessment and optimal therapy, the long-term prognosis of periodontitis remains uncertain due to the multitude of influencing factors, making precise assessment challenging in practice.

Well-known factors affecting periodontal prognosis include smoking, diabetes, plaque levels, and tooth type [4]. Johnson et al. have claimed that a "high risk group" of periodontitis exists and that a scientific approach must be used to target these

patients for prevention and treatment, while Lang et al. have proposed a periodontal risk assessment (PRA) based on a functional diagram that includes the following 6 factors: Bleeding on Probing (BOP), Probing Depth (PD), Genetic factors, Tooth Loss (TL), Bone Loss (BL)/Age, and Environmental factors [5, 6]. Page et al. have devised a computer-based risk assessment tool to accurately predict the course of periodontal disease, and they reported that their risk calculator can be used to assist a practitioner to make a decision by predicting disease severity and tooth loss [7, 8]. Teich et al. have also reported the utility of the computer-based RABIT (risk assessment-based individual treatment) system for periodontal risk assessment, and many other attempts of using PRA to predict the prognosis of periodontal disease and applying the prediction to treatment plans, supportive periodontal therapy, as well as prognosis of periodontal disease are still being continued today [9-12].

Despite extensive research since the late 1970s, determining periodontal prognosis remains complex due to the interplay of numerous patient and practitioner-related variables [13-21]. Recently in 2021, Farina et al. used the PerioRisk model, which was devised by Trombelli et al. in 2009 and incorporates smoking, diabetes, PD, BOP, and BL/age as risk factors, to study the effects of different periodic recall check intervals on TL in 168 patients with periodontitis with different periodontal risk levels. In their research, they concluded that PerioRisk is an effective tool for determining the recall interval before conducting supportive periodontal therapy [22, 23]. In 2022, Rahim-Wöstefeld, et al. analyzed tooth-related risk factors and patient-related risk factors in order to predict TL in active periodontal treatment and reported that abutment function, diabetes, BL, furcation involvement (FI), and age can be used as prognostic tools [24].

However, despite the continued rigorous research, it is still very difficult for both general practitioners and periodontists to determine periodontal prognosis, because it depends on the combined effect of a host of variables that involves both the patient and the practitioner. Moreover, prognosis can change over time based on therapeutic methods and patient compliance, making it a dynamic and challenging task for clinicians [25]. For such reasons, classifying periodontal prognosis is exceedingly complicated and difficult for clinicians. For example, there are many cases where teeth classified as hopeless prognosis have improved to good prognosis after a long period of therapy through the efforts of the practitioner and the patient. On the contrary, the opposite is also possible where good prognosis for a tooth turns into hopeless (Figure 1). Additionally, existing prognostic tools often rely on subjective judgments, highlighting the need for a more objective and consistent system. With the increasing prevalence of dental implants, there's also a tendency to favor extractions over periodontal treatment, further underscoring the need for an effective prognostic system that helps preserve natural teeth.

The 2017 Classification of Periodontitis (the 2017 classification) incorporates some prognostic capabilities, enabling clinicians to predict disease progression to a certain extent. Recent studies, such as those by Ravida et al., have validated the predictive capacity of the 2017 classification by examining extraction rates [26, 27]. However, research specifically focused on the limitations and potential of the 2017 classification's prognostic function is scarce. This study aims to evaluate the 2017 classification's significance from a prognostic perspective beyond tooth loss and to compare it with previous major prognostic systems through a systematic review. Furthermore, we propose a novel, simpler, and more efficient prognostic system to enhance clinical practice in treating periodontitis.

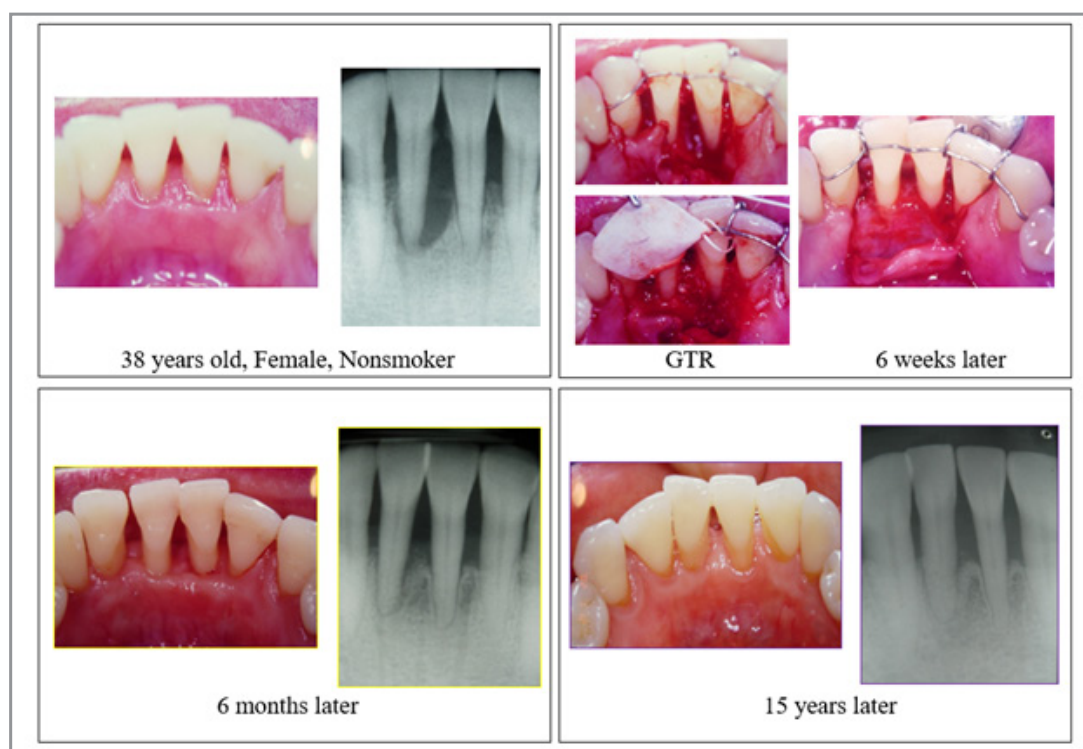


Figure 1: A. Clinical case in which the prognosis was changed from hopeless prognosis to good prognosis after regenerative surgery and complete supportive periodontal therapy (central incisor on the right mandible).

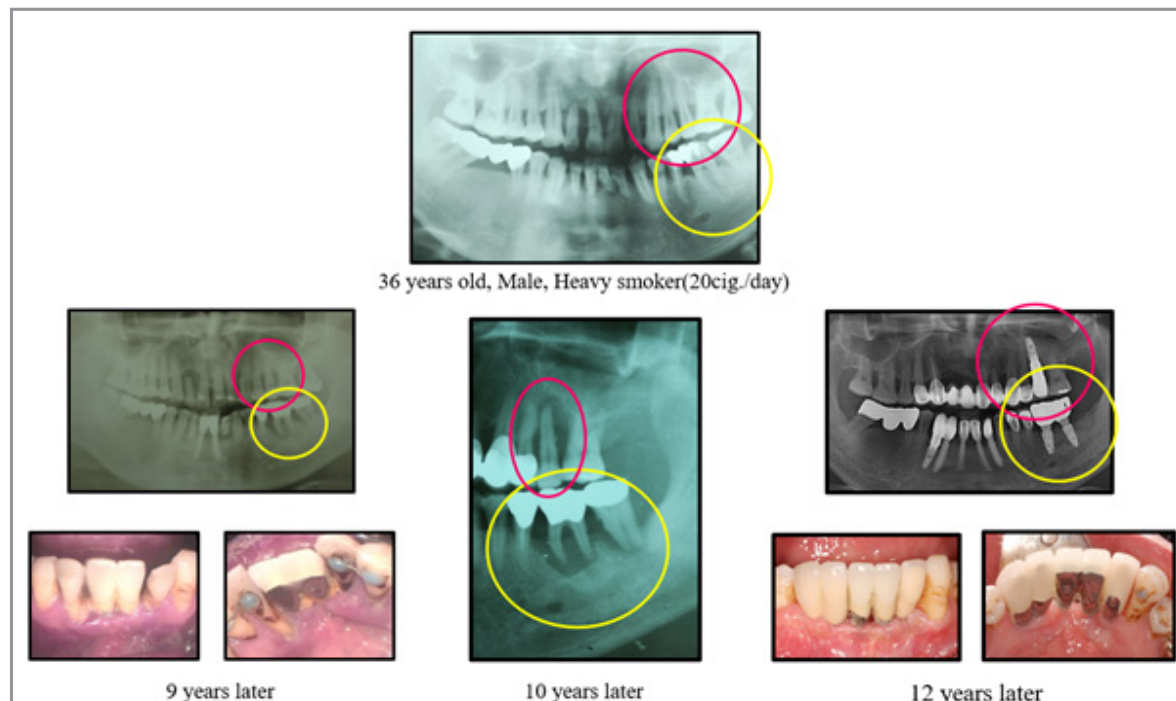


Figure 1: B. Clinical case in which the prognosis changed from good prognosis to hopeless prognosis after 10 years due to erratic compliance (second premolar on the left maxilla, first molar & second molar on the left mandible). However, with active periodontal therapy, implant treatment and complete compliance, it was possible to gain healthy periodontium again.

Methods

This systematic review was conducted following the six categories and 27 checklists of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [28]. A total of 89 articles were selected for this study (Fig. 2). A color gradient scale was used to compare the 2017 classification with previous prognostic systems.

Search Strategy

We selected articles for this study through database searches on Medline, ScienceDirect, and Google Scholar. Keywords used included "periodontal prognosis/prognosis & periodontitis/prognostication & periodontitis," "prognostic model & periodontitis/periodontal disease," "risk factor & periodontitis/periodontal disease," "risk assessment & periodontitis/periodontal disease," and "prognostic factor & periodontitis/periodontal disease." Additionally, a hand search was conducted to find related journals.

Inclusion Criteria

Articles clearly related to this topic and not related to implants were selected. Included papers focused on studies of factors affecting periodontal prognosis, evaluation methods of prognosis, systems for periodontal prognosis, short-term and long-term outcomes for prognosis, patient-level risk factors (such as age, genetics, obesity, alcohol, diabetes, and smoking), and

tooth-level risk factors (such as furcation, root proximity, and probing depth). Selected papers were divided into two groups: "periodontal prognosis" and "periodontal risk assessment."

Exclusion Criteria

Articles were excluded based on the following criteria.

1. Studies done before 1970.
2. Studies focused on periodontal materials.
3. Studies focused on epidemiology.
4. Studies focused on classification.
5. Studies focused on probing method.

Data Extraction

Two independent investigators collected articles after discussion and calibration to eliminate errors and mistakes. For the analysis of periodontal prognosis, data were extracted using a standardized protocol, including the name of the first author, publication year, study design, evaluated items for the prognostic system, classification of prognosis, criteria of each category, duration of research, patient's age, and outcomes. For the analysis of periodontal risk assessment, extracted data included the name of the first author, publication year, method of study, the name of the risk assessment system/model, the number of patients, used variables, criteria of parameters, evaluation grade, results, strengths, and limitations.

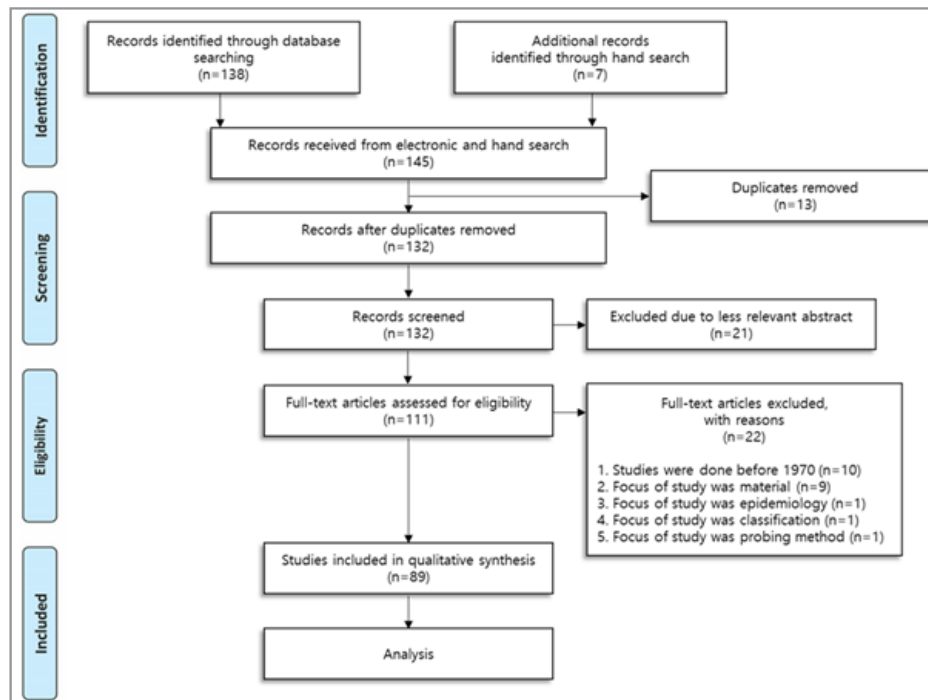


Figure 2: Flowchart of the systematic review process by following the PRISMA protocol

Results

Review of Previous Classifications for Periodontal Prognosis

Few studies have thoroughly evaluated periodontal prognosis (Table 1). This scarcity is likely due to the complexity of accurately determining prognosis for a multifactorial disease like periodontitis, where many factors are intertwined. Early taxonomy and research were simple and unsophisticated. The first known classification of periodontal prognosis was by Hirschfeld et al. in 1978, dividing the categories into favorable and questionable prognosis [13]. Becker et al. later clarified the conditions of questionable prognosis and added hopeless prognosis to their classification, emphasizing the importance of maintenance by reporting differences in prognosis with and without maintenance [15, 29]. The foundation of modern periodontal prognosis classifications was established by McGuire (Table 1, Figure 3B). He analyzed various factors to classify prognosis, dividing them into factors for individual tooth prognosis and factors for overall prognosis. Factors for individual tooth prognosis included percentage of bone loss (BL), probing depth (PD), mobility, and furcation involvement (FI), among other miscellaneous factors. For overall prognosis, the factors were age, medical status, patient cooperation, and the dentist's ability. McGuire categorized periodontal prognosis into good, fair, poor, questionable, and hopeless. Conditions for these categories were defined as follows:

- **Good:** Adequate periodontal support and assurance of easy maintenance
- **Fair:** Mild attachment loss and Class I FI
- **Poor:** Moderate attachment loss, Class I and/or Class II FI
- **Questionable:** Severe attachment loss, Class II or Class III FI, and mobility degree greater than 2 or 3
- **Hopeless:** Inadequate attachment to maintain

McGuire's significant contribution was his report on how initially determined prognosis changed over the long term. His prognostic system has been validated by other researchers who suggested similar classifications [19, 30].

Kwok and Caton advanced McGuire's concepts and classifications (Table 1, Figure 3C) [20].

They introduced three important concepts for prognosis:

1. Periodontal stability, which should be continuously evaluated by attachment loss and radiographic BL.
2. Timing for detecting dynamic changes during maintenance.
3. Consideration of both individual tooth prognosis and overall prognosis.

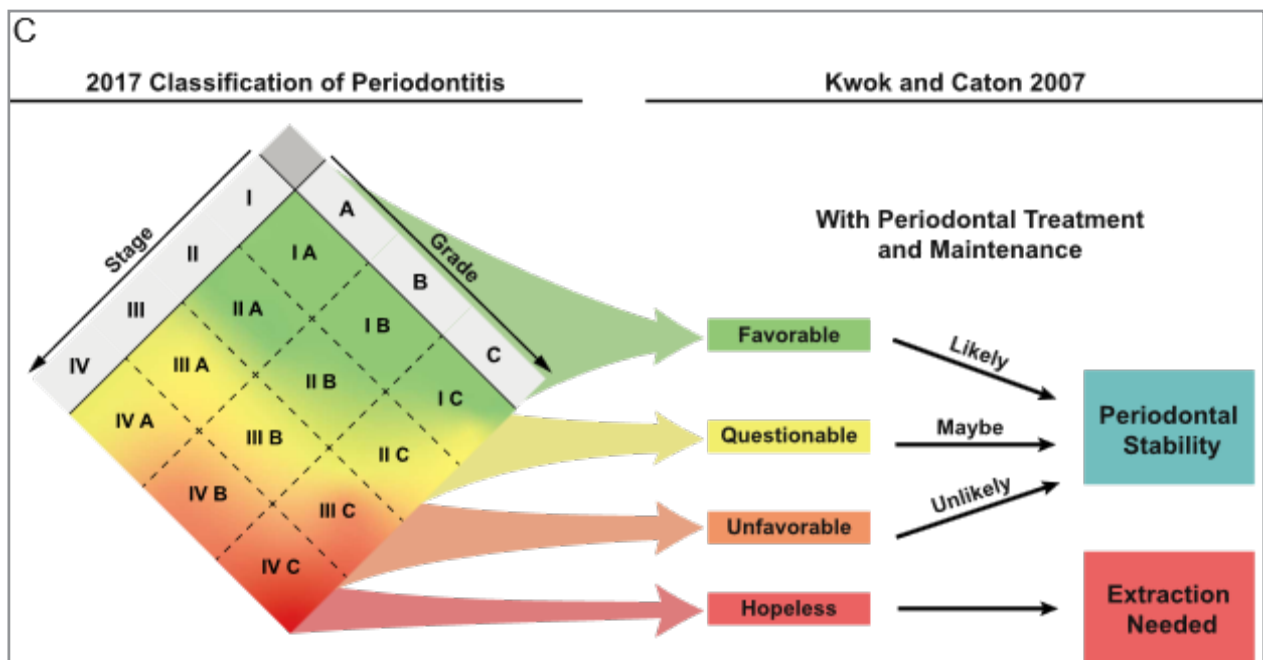
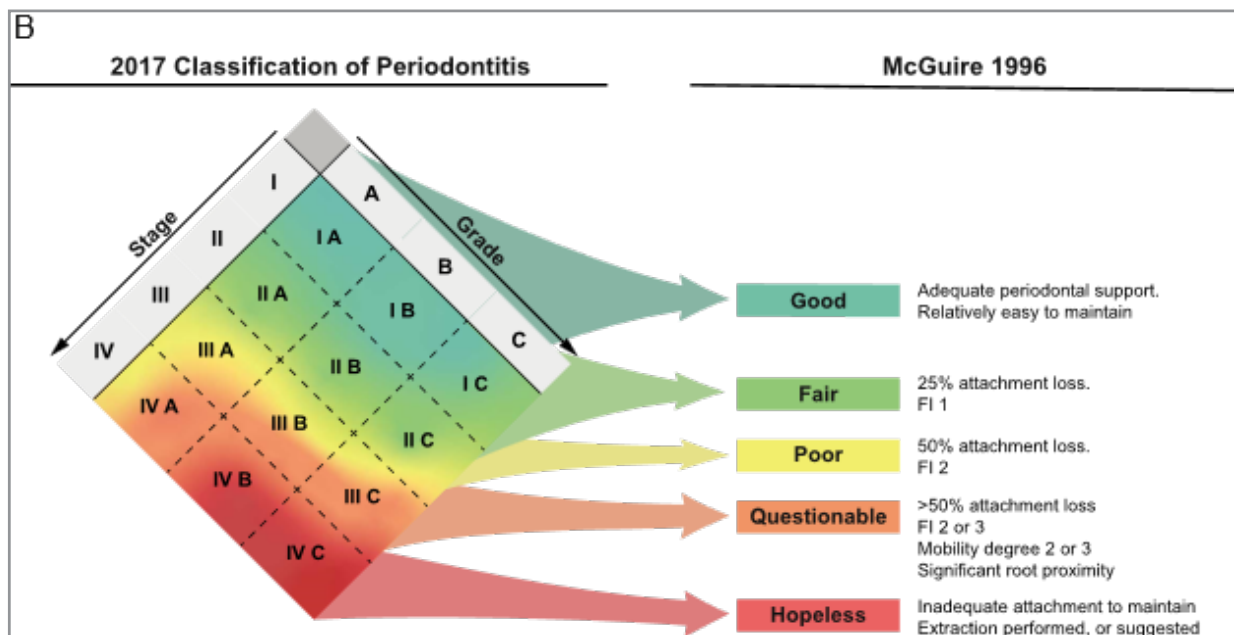
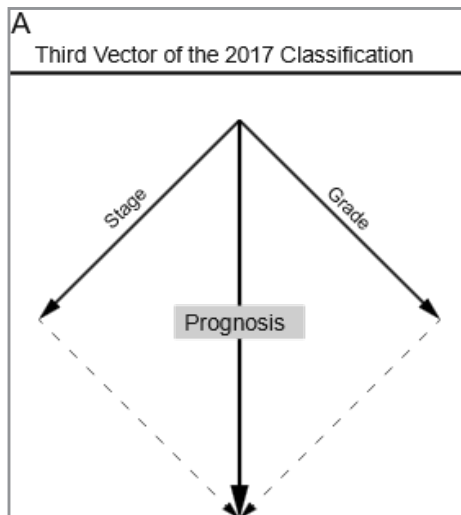
Based on these components, they proposed a new prognostic system divided into four categories: favorable, questionable, unfavorable, and hopeless.

- **Favorable prognosis:** Periodontal stability is likely to be maintained if local and systemic factors can be controlled with treatment and maintenance.
- **Questionable prognosis:** Periodontal stability may be maintained if local and systemic factors are controlled with treatment and maintenance, though breakdown may occur under other conditions.
- **Unfavorable prognosis:** Local and systemic factors cannot be controlled, making periodontal stability unlikely to be maintained.
- **Hopeless prognosis:** Extraction is recommended.

They concluded that their system requires long-term verification and adaptation, and several similar suggestions have been made since Kwok and Caton devised their prognostic system [21, 31, 32].

Table 1. Summary of previous prognostication systems.

	Hirschfeld 1978	McFall 1982	Becker 1984 (I / Periodontol)	Becker 1984 (IIPD)	Wilson 1987	McGuire 1991	McGuire 1996	Cusack 2002	Fardal 2004	Kwok 2007	Tsami 2009	Nihal 2017	McGowan 2017
What the System Evaluates	Tooth loss, FI	Tooth loss, FI	Tooth loss, PD, FI	Tooth loss, PD, FI	Tooth loss	Tooth loss	Tooth loss	Tooth loss	Tooth loss	Stability#	Tooth loss	Tooth loss	N/A
Classification of prognosis	Favorable	Favorable	Good	Good	Good	Good	Good	Good	Good	Favorable	Good	Favorable	Secure
	Questionable	Questionable	Questionable	Questionable	Fair	Fair	Fair	Questionable	Uncertain	Questionable	Moderate	Fair	Doubtful
			Hopeless	Hopeless	Poor	Poor	Poor	Hopeless	Poor	Unfavorable	Guarded	Questionable	Poor
					Questionable	Questionable	Questionable	Hopeless	Hopeless	Hopeless	Hopeless	Unfavorable	Irrational to treat
Notes on Each Classification	Response to therapy; Well-maintained (WM), Downhill (D), Extreme downhill (ED)	WM, D, ED			Individual tooth prognosis & overall prognosis	Individual tooth prognosis & overall prognosis	Individual tooth prognosis & overall prognosis						
Criteria for each category	1. Favorable: no mention, 2. Questionable: one or more of the following: FI, deep nonretractable pocket, extensive alveolar bone loss, marked mobility (degree 2-2.5) a/w PD	1. Good: no mention, 2. Questionable: 50% bone loss/tooth length, PD 6-8mm, FI II, deep vertical developmental groove, mesial FI of maxillary first bicuspid, mesial FI of maxillary first tricuspid, extensive decay (not resorbable), 3. Hopeless: 75% bone loss/tooth length, PD >8mm, FI III, mobility degree 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000	1. Good: no mention, 2. Questionable: 50% bone loss/tooth length, PD 6-8mm, FI II, deep vertical developmental groove, mesial FI of maxillary first bicuspid, mesial FI of maxillary first tricuspid, extensive decay (not resorbable), 3. Hopeless: 75% bone loss/tooth length, PD >8mm, FI III, mobility degree 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000	1. Favorable: "likely" stability/further loss does not occur; 2. Questionable: "maybe" stability if the local/systemic factors are controlled, further loss does not occur, but complex; 3. Guarded: >50% AL, poor root form, FI II or III, mobility degree 2; 4. Hopeless: inadequate attachment in health, comfort and function	1. Good: adequate support, easy to maintain; 2. Moderate: <50% AL, FI I, allow maintenance to good root form, FI II or III, mobility degree 2; 3. Guarded: >50% AL, poor root form, FI II or III, mobility degree 2; 4. Hopeless: inadequate attachment in health, comfort and function	1. Favorable: "likely" stability/further loss does not occur; 2. Questionable: "maybe" stability if the local/systemic factors are controlled, further loss does not occur, but complex; 3. Guarded: >50% AL, poor root form, FI II or III, mobility degree 2; 4. Hopeless: inadequate attachment in health, comfort and function	1. Good: PD<3mm & proximal BL<1/3; 2. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 3. Poor: PD 7mm & >2/3 BL & BOP FI<4; 4. Hopeless: PD>3mm, BOP FI<4; 5. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 6. Poor: PD 7mm & >2/3 BL & BOP FI<4; 7. Hopeless: PD>3mm, BOP FI<4; 8. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 9. Poor: PD 7mm & >2/3 BL & BOP FI<4; 10. Hopeless: PD>3mm, BOP FI<4; 11. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 12. Poor: PD 7mm & >2/3 BL & BOP FI<4; 13. Hopeless: PD>3mm, BOP FI<4; 14. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 15. Poor: PD 7mm & >2/3 BL & BOP FI<4; 16. Hopeless: PD>3mm, BOP FI<4; 17. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 18. Poor: PD 7mm & >2/3 BL & BOP FI<4; 19. Hopeless: PD>3mm, BOP FI<4; 20. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 21. Poor: PD 7mm & >2/3 BL & BOP FI<4; 22. Hopeless: PD>3mm, BOP FI<4; 23. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 24. Poor: PD 7mm & >2/3 BL & BOP FI<4; 25. Hopeless: PD>3mm, BOP FI<4; 26. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 27. Poor: PD 7mm & >2/3 BL & BOP FI<4; 28. Hopeless: PD>3mm, BOP FI<4; 29. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 30. Poor: PD 7mm & >2/3 BL & BOP FI<4; 31. Hopeless: PD>3mm, BOP FI<4; 32. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 33. Poor: PD 7mm & >2/3 BL & BOP FI<4; 34. Hopeless: PD>3mm, BOP FI<4; 35. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 36. Poor: PD 7mm & >2/3 BL & BOP FI<4; 37. Hopeless: PD>3mm, BOP FI<4; 38. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 39. Poor: PD 7mm & >2/3 BL & BOP FI<4; 40. Hopeless: PD>3mm, BOP FI<4; 41. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 42. Poor: PD 7mm & >2/3 BL & BOP FI<4; 43. Hopeless: PD>3mm, BOP FI<4; 44. Uncertain: PD 4-6mm & BL 1/3-2/3 & BOP FI<4; 45. Poor: PD 7mm & >2/3 BL & BOP FI<4; 46. Hopeless: PD>3mm, BOP FI<4; 4						



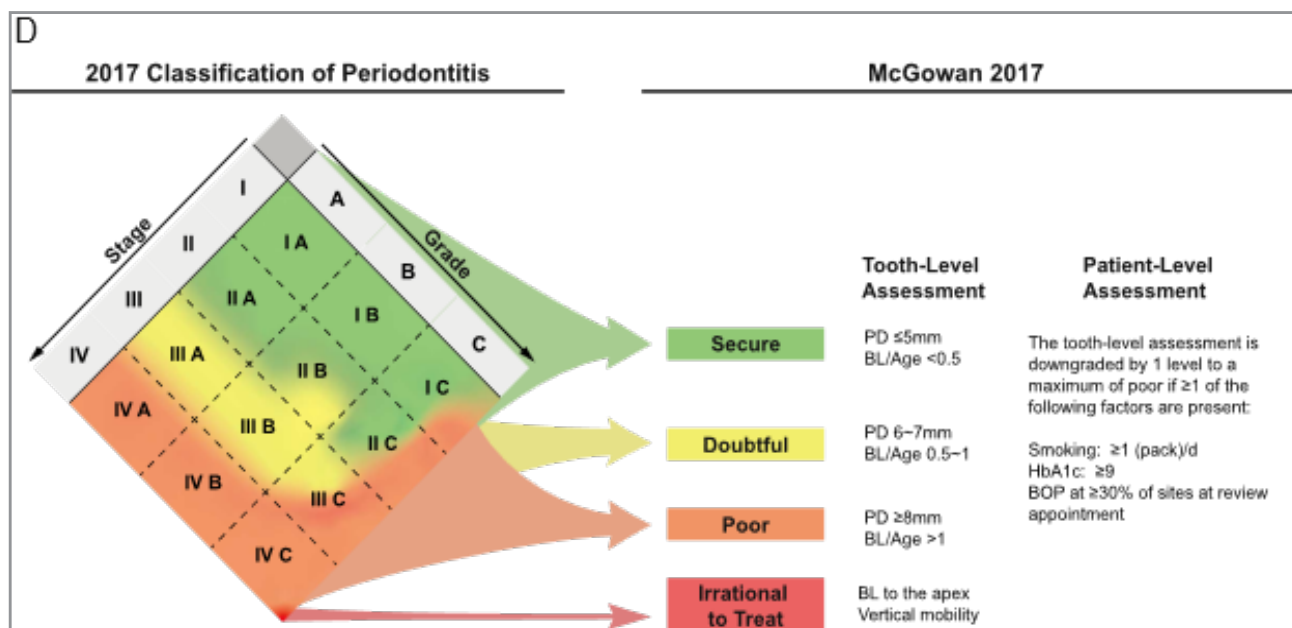


Figure 3: Comparison between the 2017 classification and prognostic classifications in the past. A) The 2017 classification is in fact a 3-vector system. B) Comparing the prognostic classification of McGuire 1996 and the 2017 classification [17]. C) Comparing the prognostic classification of Kwok 2007 and the 2017 classification [20]. D) Comparing the prognostic classification of McGowan "2017" and the 2017 classification [21]. Dotted lines and color gradient scales were used to visually represent the uncertainties regarding prognostic boundaries between each set of stage and grade. FI, furcation involvement; BL, bone loss; BOP, bleeding on probing; HbA1c = glycated hemoglobin A1c.

Comparing the 2017 Classification with Previous Prognostic Systems

The 2017 classification of periodontitis represents a paradigm shift by incorporating risk and prognostic factors, thus allowing for a certain degree of prognostication. This necessitates an evaluation of how it compares with existing prognostic systems and what its limitations might be. In this study, we compared three major prognostic systems: McGuire's system, Kwok's system, and McGowan's system (Figure 3, Table 2).

The reason we chose McGuire's system is that it serves as the foundation of most, if not all, modern prognostic systems, and most other systems are similar to his system. Kwok's system was selected for its unique incorporation of periodontal stability, and McGowan's system was included for its recent introduction and inclusion of both patient-related and tooth-related factors.

Comparison with McGuire's System: McGuire's system is well-regarded for its comprehensive approach to prognosis, classifying it into good, fair, poor, questionable, and hopeless categories. Comparing this with the 2017 classification:

- Stage I, Grade A/B corresponds to McGuire's Good prognosis.
- Stage I, Grade C and Stage II, Grade A/B align with Fair prognosis.
- Stage II, Grade C and Stage III, Grade A/B align with Poor prognosis.
- Stage III, Grade C and Stage IV, Grade A are akin to Questionable prognosis.

- Stage IV, Grade B correlates with Questionable or Hopeless prognosis.
- Stage IV, Grade C matches with Hopeless prognosis.

Although the match is not exact, clinicians can reasonably infer prognosis by translating the 2017 classification into McGuire's system.

Comparison with Kwok's System: Kwok's system focuses on periodontal stability, classifying prognosis as favorable, questionable, unfavorable, and hopeless:

- Stage I/II, Grade A/B corresponds to Favorable prognosis.
- Stage II/III, Grade B/C align with Questionable prognosis.
- Stage III/IV, Grade C align with Unfavorable prognosis.
- Stage IV, Grade C matches Hopeless prognosis.

While Kwok's system integrates the innovative concept of stability, direct comparison with the 2017 classification remains challenging due to the abstract nature of stability. Nonetheless, the gradient analysis shows a more even match with the 2017 classification than McGuire's system.

Comparison with McGowan's System: McGowan's system, which includes patient-related factors (e.g., smoking, diabetes) and tooth-related factors, aligns with the 2017 classification as follows:

- Stage I, Grade A/B or C and Stage II, Grade A/B correspond to Secure prognosis.
- Stage II, Grade C and Stage III, Grade A/B align with Doubtful prognosis.

- Stage III, Grade C and Stage IV, Grade B match with Poor prognosis.
- Stage IV, Grade C equates to Poor prognosis or Irrational to treat.

McGowan's system's emphasis on patient-related factors makes it the most conceptually aligned with the 2017 classification. When

compared, Kwok's system's Questionable prognosis matches the widest range of the 2017 classification stages and grades, whereas McGowan's system's Poor prognosis covers the most extensive area. McGuire's hopeless prognosis criteria span a broader area of the 2017 classification compared to the other systems.

Table 2: Comparison of the 2017 classification with previous prognostic systems. CAL, clinical attachment loss

2017 classification of periodontitis	Conditions	Compared with McGuire 1996	Compared with Kwok 2007	Compared with McGowan 2017
Stage I Grade A, B	1~2mm CAL + <2mm/5years additional CAL + no complexity	Good	Favorable	Secure
Stage I Grade C, Stage II Grade A, B	1-2mm CAL + ≥2mm/5years CAL (or 3-4mm CAL + <2mm/5 years CAL) + no complexity	Fair	Favorable	Secure
Stage II Grade C	3-4mm CAL + ≥2mm/5years + no complexity	Fair or Poor	Questionable	Doubtful
Stage III Grade A, B	≥5mm CAL + < 2mm/5years + simple (complexity)	Poor	Questionable	Doubtful
Stage III Grade C	≥5mm CAL + ≥ 2mm/5years + simple (complexity)	Poor or Questionable	Questionable	Poor
Stage IV Grade A	≥5mm CAL + 0mm/5years + complex (complexity)	Questionable	Questionable	Poor
Stage IV Grade B	≥5mm CAL + <2mm/5years + complex (complexity)	Hopeless (retention) or hopeless (extraction)	Unfavorable	Poor
Stage IV Grade C	≥5mm CAL + ≥2mm/5years + complex (complexity)	Hopeless (retention) or hopeless (extraction)	Unfavorable or Hopeless	Poor or Irrational to treat

Review of Risk Assessment Systems/Models

Alongside periodontal prognostic systems, periodontal risk assessment systems (PRAs) have been the focus of study and development by numerous researchers [6, 8, 10, 32-54]. Theoretically, a prognostic system for periodontitis should be based on prognostic factors, while PRA systems should be based on risk factors, which encompass multiple factors causing the disease. Periodontal risk factors can significantly impact the severity of the disease, although intervening with these factors does not always guarantee favorable outcomes [55-57]. Conversely, prognostic factors, such as patient compliance, share similarities with risk factors but are more directly linked to ensuring favorable results [56]. Some risk factors, such as smoking, are also categorized as prognostic factors. Thus, while analyzing factors related to the prognostic aspects of the 2017 classification should ideally focus on prognostic factors, reviewing previous PRA systems/models is also necessary due to the challenge of distinguishing between prognostic and risk factors.

Numerous PRA systems/models have been reported thus far (Table 3). Page et al. developed a PRA system using the periodontal risk calculator (PRC). In the early stages of their study, their team incorporated 9 to 13 risk factors [8, 39]. However, the PRC faced limited adoption by clinicians due to unclear criteria for each parameter and overly complicated software. In 2003, Lang et al. developed their own PRA system, designed to enable clinicians to determine risk at a glance using a hexagonal diagram featuring six parameters: BOP%, number of PD≥5mm, number of tooth loss (TL), BL/age, systemic & genetic conditions, and environmental factors [10, 38, 46, 49]. Since then, PRA has evolved into several modified versions. However, most PRA systems/models developed thus far remain overly complex and lack objective verification for clinical use. Consequently, further research and consensus are warranted to simplify and validate these systems. [Table 3](#)

Year of the plan	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100																			
Topic	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	Topic 7	Topic 8	Topic 9	Topic 10	Topic 11	Topic 12	Topic 13	Topic 14	Topic 15	Topic 16	Topic 17	Topic 18	Topic 19	Topic 20	Topic 21	Topic 22	Topic 23	Topic 24	Topic 25	Topic 26	Topic 27	Topic 28	Topic 29	Topic 30	Topic 31	Topic 32	Topic 33	Topic 34	Topic 35	Topic 36	Topic 37	Topic 38	Topic 39	Topic 40	Topic 41	Topic 42	Topic 43	Topic 44	Topic 45	Topic 46	Topic 47	Topic 48	Topic 49	Topic 50	Topic 51	Topic 52	Topic 53	Topic 54	Topic 55	Topic 56	Topic 57	Topic 58	Topic 59	Topic 60	Topic 61	Topic 62	Topic 63	Topic 64	Topic 65	Topic 66	Topic 67	Topic 68	Topic 69	Topic 70	Topic 71	Topic 72	Topic 73	Topic 74	Topic 75	Topic 76	Topic 77	Topic 78	Topic 79	Topic 80	Topic 81	Topic 82	Topic 83	Topic 84	Topic 85	Topic 86	Topic 87	Topic 88	Topic 89	Topic 90	Topic 91	Topic 92	Topic 93	Topic 94	Topic 95	Topic 96	Topic 97	Topic 98	Topic 99	Topic 100
Objectives	Objective 1	Objective 2	Objective 3	Objective 4	Objective 5	Objective 6	Objective 7	Objective 8	Objective 9	Objective 10	Objective 11	Objective 12	Objective 13	Objective 14	Objective 15	Objective 16	Objective 17	Objective 18	Objective 19	Objective 20	Objective 21	Objective 22	Objective 23	Objective 24	Objective 25	Objective 26	Objective 27	Objective 28	Objective 29	Objective 30	Objective 31	Objective 32	Objective 33	Objective 34	Objective 35	Objective 36	Objective 37	Objective 38	Objective 39	Objective 40	Objective 41	Objective 42	Objective 43	Objective 44	Objective 45	Objective 46	Objective 47	Objective 48	Objective 49	Objective 50	Objective 51	Objective 52	Objective 53	Objective 54	Objective 55	Objective 56	Objective 57	Objective 58	Objective 59	Objective 60	Objective 61	Objective 62	Objective 63	Objective 64	Objective 65	Objective 66	Objective 67	Objective 68	Objective 69	Objective 70	Objective 71	Objective 72	Objective 73	Objective 74	Objective 75	Objective 76	Objective 77	Objective 78	Objective 79	Objective 80	Objective 81	Objective 82	Objective 83	Objective 84	Objective 85	Objective 86	Objective 87	Objective 88	Objective 89	Objective 90	Objective 91	Objective 92	Objective 93	Objective 94	Objective 95	Objective 96	Objective 97	Objective 98	Objective 99	Objective 100
Activities	Activity 1	Activity 2	Activity 3	Activity 4	Activity 5	Activity 6	Activity 7	Activity 8	Activity 9	Activity 10	Activity 11	Activity 12	Activity 13	Activity 14	Activity 15	Activity 16	Activity 17	Activity 18	Activity 19	Activity 20	Activity 21	Activity 22	Activity 23	Activity 24	Activity 25	Activity 26	Activity 27	Activity 28	Activity 29	Activity 30	Activity 31	Activity 32	Activity 33	Activity 34	Activity 35	Activity 36	Activity 37	Activity 38	Activity 39	Activity 40	Activity 41	Activity 42	Activity 43	Activity 44	Activity 45	Activity 46	Activity 47	Activity 48	Activity 49	Activity 50	Activity 51	Activity 52	Activity 53	Activity 54	Activity 55	Activity 56	Activity 57	Activity 58	Activity 59	Activity 60	Activity 61	Activity 62	Activity 63	Activity 64	Activity 65	Activity 66	Activity 67	Activity 68	Activity 69	Activity 70	Activity 71	Activity 72	Activity 73	Activity 74	Activity 75	Activity 76	Activity 77	Activity 78	Activity 79	Activity 80	Activity 81	Activity 82	Activity 83	Activity 84	Activity 85	Activity 86	Activity 87	Activity 88	Activity 89	Activity 90	Activity 91	Activity 92	Activity 93	Activity 94	Activity 95	Activity 96	Activity 97	Activity 98	Activity 99	Activity 100
Resources	Resource 1	Resource 2	Resource 3	Resource 4	Resource 5	Resource 6	Resource 7	Resource 8	Resource 9	Resource 10	Resource 11	Resource 12	Resource 13	Resource 14	Resource 15	Resource 16	Resource 17	Resource 18	Resource 19	Resource 20	Resource 21	Resource 22	Resource 23	Resource 24	Resource 25	Resource 26	Resource 27	Resource 28	Resource 29	Resource 30	Resource 31	Resource 32	Resource 33	Resource 34	Resource 35	Resource 36	Resource 37	Resource 38	Resource 39	Resource 40	Resource 41	Resource 42	Resource 43	Resource 44	Resource 45	Resource 46	Resource 47	Resource 48	Resource 49	Resource 50	Resource 51	Resource 52	Resource 53	Resource 54	Resource 55	Resource 56	Resource 57	Resource 58	Resource 59	Resource 60	Resource 61	Resource 62	Resource 63	Resource 64	Resource 65	Resource 66	Resource 67	Resource 68	Resource 69																															

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The PPS system eliminates potential confusion by determining prognosis for each tooth rather than at the patient level. It comprises 10 to 12 parameters necessary for assessing prognosis, each scored from 0 to 3 for intuitive division (Table 4; Table 5). Clinicians can estimate prognosis by totaling parameter scores. The system categorizes prognosis into five categories—good, fair, poor, questionable, and hopeless—based on McGuire’s prognostic system. This intentional choice leverages McGuire’s

system as the foundation of current prognostic systems, aiding familiarity for clinicians. Unlike previous prognostic systems, the PPS system incorporates new variables such as alcohol consumption, compliance, combined lesion, clinician experience, and stress to enhance periodontal prognosis prediction. This broader scope aims to provide a more comprehensive assessment of prognostic factors, facilitating improved treatment planning and patient care.

Table 4. The novel periodontal prognostic scale (PPS) system.

			Parameters	Score 0	Score 1	Score 2	Score 3	Related articles	Remarks
PPS-12	PPS-11	PPS-10	PD	≤3mm	4~6mm	7~8mm	≥9mm	Fardal 2004, Matuliene 2008,	
			% B L / r o o t length	0~<=25%	25~<=50%	50~<=75%	>75%	Taylor 1998, Graetz 2017	
			FI (for multi-root)	Normal	Degree I	Degree II	Degree III	Matuliene 2008, Graetz 2015	
			C r o w n - r o o t ratio (for single-root)	<0.5 (1:2)	0.5 (1:2)~0.8 (1:1.25)	0.8 (1:1.25)~<1.0 (1:1)	>1.0 (1:1)	Martinez-Canut 2015	
			Mobility	Normal	Degree I	Degree II	Degree III	Matuliene 2008, Graetz 2017	
			Root proximity	>1.5mm	0.8~1.5mm	0.6~0.8mm	<0.6mm	Vermeylen 2005, Kim 2008	
			Combined lesion	No combined	Endo-periodontal lesion	Perio-endodontic lesion	True combined	Rotstein 2004, Shenoy 2010, Bonaccorso 2014	Further research is needed.
			S m o k i n g (self-reported)	NS, FS (over 13years)	FS (less than 13yrs), 1~19cig./d	20~30cig./d	≥31cig./d	Tomar 2000, Calsina 2002, Krall 2006	
			A l c o h o l (self-reported)	0~3units/week (light drinker both female & male)	4~7units/week (light driker for male & moderate drinker for female)	8~14 units / week (moderate drinker for male & heavy drinker for female)	>14 units/week (heavy drinker for both male & female)	Tezal 2004, Hach 2015	Classification of Hach 2015, 1 unit=12.5g of pure alcohol (=a bottle of beer(355ml, 4.5%))
			Compliance	Complete (100%)	75% of total requested SPT	50% of total requested SPT	Non complier (0%)	Pretzl 2008, Tsami 2009, Matuliene 2010, Silva 2014	
		Level of clinician	Periodontist with more than 10 years experiences	Periodontist with under 10 years experiences	GP with more than 3 years experiences	GP with under 3 years experiences	McGuire 1991, McGuire 1996	Further research is needed.	
		Diabetes	HbA1c <6%	H b A 1 c 6~<7.5%	HbA1c 7.5~<9.5%	H b A 1 c >9.5%	Christgau 1998, Lalla 2006		
		Stress	0~13	14~26	27~40	Pateints being treated for stress or depression	Genco 1999, Hilgert 2006	Total score of perceived stress scale-10 (Cohen 1988)	

	Good prognosis	Fair prognosis	Poor prognosis	Questionable prognosis	Hopeless prognosis
Expected survival period	More than 10 years	5 to 10 years	3 to 5 years	1 to 3 years	less than 1 year
PPS-10 (total 30)	0~6	6~12	13~17	18~24	25~30
PPS-11 (total 33)	0~6	6~12	13~20	21~27	28~33
PPS-12 (total 36)	0~6	6~12	13~23	24~30	31~36

PPS, periodontal prognostic scale; BL, bone loss; FI, furcation involvement; NS, nonsmoker; FS, former smoker; SPT, supportive periodontal therapy.

Table 5: Perceived stress scale-10 & scoring rule to evaluate patient’s stress [61], [62]

	Respond to each question by marking on box per row	Never	Almost never	Sometimes	Often	Very often
PSS 1	In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
PSS 2	In the last month, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4

PSS 3	In the last month, how often have you felt nervous and stressed?	0	1	2	3	4
PSS 4	In the last month, how often have you felt confident about your ability to handle your personal problems? (R)	4	3	2	1	0
PSS 5	In the last month, how often have you felt that things were going your way? (R)	4	3	2	1	0
PSS 6	In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
PSS 7	In the last month, how often have you been able to control irritations in your life? (R)	4	3	2	1	0
PSS 8	In the last month, how often have you felt that you were on top of things? (R)	4	3	2	1	0
PSS 9	In the last month, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
PSS 10	In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

PSS, perceived stress scale.

General Rules that were Used to Create the Novel PPS System

- 1. Individual Tooth Prognosis:** The PPS system evaluates the periodontal prognosis of individual teeth only, disregarding patient-level prognosis, for simplicity and consistency.
- 2. Selection of Parameters:** We chose 12 parameters that can be easily measured and recorded periodically by clinicians and hygienists (see Table 6). For instance, while clinical attachment loss (CAL) provides more accuracy than probing depth (PD), PD is included in the PPS for convenience. Similarly, %BL/root length replaces the complicated %BL/age parameter.
- 3. Scoring System:** All parameter grades are quantified on a scale of 0 to 3 and summed to determine the final prognostic grade.
- 4. Disease Progression Prediction:** The PPS system predicts not only tooth loss but also the progression of periodontal disease.
- 5. Adaptability of PPS-12:** PPS-12, incorporating all 12 parameters, is recommended as the basic system. However, if certain parameters cannot be evaluated (e.g., stress survey or HbA1c measurement), prognosis can be estimated based on PPS-11 or PPS-10, respectively. Nonetheless, the essential 10 parameters of PPS-10 should always be evaluated as they are crucial for judging periodontal prognosis.
- 6. Trackability and Research Compatibility:** The system allows for continuous tracking and comparison of prognosis changes during treatment or maintenance. Additionally, it facilitates retrospective and prospective research using standardized parameters.
- 7. Periodic Re-evaluation:** The PPS system is planned for periodic re-evaluation (every 2 to 3 years) to assess and adjust the adequacy and accuracy of selected parameters. The goal is to align prognostic categories (good, fair, poor, questionable, and hopeless) with corresponding survival rates over specified timeframes.

These general rules aim to ensure the practicality, adaptability, and reliability of the novel PPS system, enhancing its usability for clinicians and researchers alike.

Table 6: 12 Parameters of the New PPS System

1.	Probing depth
2.	% BL/root length
3.	FI for multi-root or crown-root ratio for single-root
4.	Mobility
5.	Root proximity
6.	Combined lesion
7.	Smoking
8.	Alcohol
9.	Compliance
10.	Level of clinician
11.	Diabetes
12.	Stress

Analysis of the Prognostic Function of the 2017 Classification and Significance of the Novel PPS System

The 2017 classification stands out as an innovative system due to its dual role as a diagnostic and prognostic tool. By incorporating various risk and prognostic factors, it provides clinicians with valuable information for estimating the prognosis of periodontitis. However, its prognostic capabilities are limited to some extent, prompting the need for comparison with previous prognostic systems.

In our study, we analyzed the compatibility of McGuire's, Kwok and Caton's, and McGowan's prognostic systems with the 2017 classification. While McGuire's system demonstrated balanced matches for certain categories, others proved challenging to align due to ambiguous boundaries. Kwok and Caton's system showed promising compatibility, although further clinical validation is necessary. McGowan's system, on the other hand, exhibited poorer alignment with the 2017 classification, likely due to its reliance on a limited number of parameters.

The 2017 classification's unique feature lies in its dynamic nature, where both stage and grade can change based on therapy and maintenance outcomes. This adaptability enhances its prognostic function, allowing for continuous assessment and adjustment over time. However, limitations exist, particularly in distinguishing between severity and complexity in stage IV cases and the exclusion of combined lesions from the main classification.

The 2017 classification's unique feature lies in its dynamic nature, where both stage and grade can change based on therapy and maintenance outcomes. This adaptability enhances its prognostic function, allowing for continuous assessment and adjustment over time. However, limitations exist, particularly in distinguishing between severity and complexity in stage IV cases and the exclusion of combined lesions from the main classification.

To address these shortcomings and offer a practical solution, we propose the Novel Periodontal Prognostic Scale (PPS) system. Developed based on seven guiding principles, the PPS system evaluates individual tooth prognosis using 10 to 12 easily measurable parameters. By adopting parameters such as alcohol consumption, compliance, combined lesions, clinician expertise, and stress, the PPS system enhances prognostic accuracy while maintaining simplicity.

We envision several potential roles for the PPS system in dentistry. Notably, it could minimize unnecessary extractions while facilitating prompt removal of teeth requiring immediate attention. Its simplicity and objectivity ensure consistency across clinicians and offer greater trust to patients. Moreover, its standardized approach fosters systematic research in periodontitis, enabling global comparison and assessment.

Through ongoing studies and parameter refinements, we anticipate the PPS system to evolve and remain updated with the latest research, further enhancing its prognostic capabilities and value in clinical practice and research alike.

Conclusions

The 2017 classification offers both diagnostic and limited prognostic capacities for assessing periodontitis. Through our

analysis of various risk and prognostic factors within the classification, we sought to match each combination of stage and grade with corresponding categories from previous prognostic systems. Utilizing color gradient analysis, we visually confirmed that clinicians can roughly estimate periodontal prognosis by combining stage and grade. Among the three major prognostic systems—McGuire's, Kwok and Caton's, and McGowan's—we found that Kwok and Caton's system provided the best match.

McGuire's system exhibited limited correspondence with the 2017 classification, particularly in categorizing poor prognosis, while McGowan's system showed overall poor alignment despite its similarity in incorporating patient-related factors like smoking and diabetes, akin to the 2017 classification's reliance on risk factors.

However, due to the 2017 classification's primary focus as a diagnostic tool, its accuracy in predicting disease progression is limited. Thus, we propose a novel Periodontal Prognostic Scale (PPS) system, following seven guidelines we devised. It is essential to acknowledge that the novel system aims for convenience and simplicity rather than perfection, with the intent for future studies to verify its efficacy. Regular adjustments and improvements to parameters and system content, along with periodic error corrections, are crucial to enhancing the PPS system's practicality and usability for clinicians in real-world settings.

Acknowledgements

The authors did not receive funding and have no conflict of interest to declare in relation to this systematic review.

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