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A Newly Proposed Quantitative Codification of the Principles of Classification Partial Edentulism

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Abstract

There are many classification systems for partial edentulism, each with its merits and demerits. Consequently, none of these classification systems contain all pieces of information required for enhancement of communication, treatment plan and design of partial dentures. The objective of this study was to harness all principles of the well-known classification systems into a broad-based quantitative codification system. A systematic review of literature on principles for classification of partial edentulism was carried out based on specific inclusion and exclusion criteria using search engines and data bases such as Google scholar and PubMed. The obtained pieces of information were analyzed, synthesized and quantitatively codified to produce a new classification model.

Six fundamental criteria for classification of partial edentulism were identified as follows: the number of missing teeth, the location of the missing teeth, relationship of the abutment teeth to each other and to the edentulous space/s, the periodontal health conditions of the abutment teeth, the occlusal balance and the condition of the alveolar ridge of the edentulous space. Six fundamental criteria for classification of partial edentulism were used in formulating the quantitative coding for the newly proposed classification model. The proposed classification model provides enhanced clinical and laboratory information on all the fundamental criteria for classification of partial edentulism as well as identification of all possible variations of the classes and sub-classes of the classification system.

Keywords: *Classification; Code; Criteria; Edentulism; Principles*

Abbreviations

A_1: Anterior One Side; A_2: Anterior Two Sides; P_1: Posterior One Side; P_2: Posterior Two Sides; A_1P_1: One side anteriorly and one side posteriorly; A_2P_1: Two sides anteriorly and one side posteriorly; A_1P_2: One side anteriorly and both sides posteriorly; A_2P_2: Both sides anteriorly and posteriorly; X denotes alignment of the abutment teeth; and the range of subscript of X = 1-4. Each subscript of X represents a type of alignment as follows: Diagonal = X_1; Sagittal = X_2; Transverse = X_3; and Any combination of two or three above = X_4; Y denotes periodontal health status of the abutment teeth; and the range of subscript of Y = 1-5. Each subscript of Y represents the degree of bone loss as follows: Y_1-The tooth concerned has a normal bone support; it can be used as an abutment bearing in mind other important factors in the design of a partial denture. Y_2- Loss of ¼ of bone support. The tooth concerned is characterised by presence of minimal reserve capacity; and it can be used as an abutment. Y_3- Loss of ½ of bone support. The tooth concerned has no periodontal reserve capacity; and it cannot be used as an abutment. Y_4- Loss of ¾ of bone support. The tooth concerned has negative periodontal reserve capacity; and it cannot be used as an abutment. Y_5- > 3/4 bone support has been lost. The tooth concerned cannot be used as an abutment; and it should be extracted;

Z denotes the degree of occlusal balance or harmony; and the range of subscript of Z = 1-4. Each subscript of Z represents the degree of balance of occlusal forces between the upper and lower jaws namely: No or minimal occlusal balance decompensation (NOBD) = Z_1; Moderate occlusal balance decompensation (MOBD) = Z_2; Substantial occlusal balance decompensation (SOBD) = Z_3; and Gross occlusal balance decompensation (GOBD) = Z_4; R denotes the sum total of the periodontal resistance of the remaining teeth in both jaws; and the range of subscript of R = 1-4. Each subscript of R represents the degree of occlusal decompensation within a dental arch; and between the upper and lower jaws as follows: Normal bone or no bone resorption = R_1; Horizontal bone resorption = R_2; Vertical bone resorption = R_3; Combined horizontal and vertical bone resorption = R_4

Introduction

Partial edentulism, arising from tooth loss, is one of the commonest dental conditions in the world. Millions of dental patients, suffering from partial edentulism, are being supplied with various prostheses for proper restoration of their maxilla-mandibulo-dental system for improved functions and aesthetics. Partial edentulism is defined as the loss of 1 - 15 teeth in a dental arch [1]. Discontinuity in the dental rows of the maxillary and mandibular arches can occur at different locations of the dental arches; and many possible combinations of missing teeth or edentulous spaces can be created [2,3]. Therefore, there is need to classify edentulous spaces for the following reasons: to enable a dentist to communicate effectively with a professional about a case; to formulate a good treatment plan; to anticipate the difficulties commonly encountered with a particular design; to design the denture according to the occlusal load usually expected of a particular group of abutment teeth; to aid in learning of the basics of design and to help in creating order from the many number of possible combinations of missing teeth and edentulous spaces [4].

The requirements for a god classification system include: mental and visual appreciation of the type of partially dentate arch that is being considered; differentiation between tooth supported and tooth-tissue supported partial dentures; giving a guide to the type of design to be used; and universal acceptability [4]. The need to provide more information in a classification system led to the development of ACP classification in 2002 [5]. There are many available classification systems for partially dentate arches based on different principles or rules [4]. The most common ones are: Cummer's [1,4], Kennedy's [4,6], Applegate-Kennedy [4,7], Bailyn's [4,8], Neurohur's [4,9], Mauk's [4,10], Friedman's [4,11], Godfrey's [4,12], Skinner's [4,13], Austin and Lidge's [4,14], Cradock's [4], Wild's [4,15], Costa's [4,16], Osborne and Lammine's [4,17], Beckett and Wilson's [4,18], Terkla and Laney's [4,19] Swenson's [4], Watt's [4], Avant's [4,20], Craddock's [4], Miller's [21], ACP Classification [5] and ICK Classifications [22]. However, there are some overlaps in the principles that are employed in these classification systems [4].

Most of the aforementioned classification systems, if not all, have shortcomings such as inadequate information concerning the periodontal conditions of the remaining teeth in both jaws, including the abutment teeth, as well as the conditions of the residual alveolar ridge/s of the edentulous space/s. These pieces of information are very important in drawing-up a treatment plan; and in the design of fixed or removable partial denture for a given patient [4]. The purpose of this article is to harness all the ideal principles of the notable classification systems with a view to producing a classification system that can incorporate all the identified important criteria with enhanced details and address the shortcomings of the common classification systems.

Materials and Methods

A systematic search of literature on classification systems for partially edentulous dental arches using search engines such as google search, Medline, PubMed, was conducted. Phrases such as classification of partial edentulism, requirements for classification of partial edentulism, need for classification of partial edentulism, common classification of partial edentulism, purpose of classifying partial edentulism, principles of classification of partial edentulism, types of partial edentulism and criteria for classifying partial edentulous spaces in dental arches were used during the search. The following inclusion criteria were utilised in the selection of scientific articles to be reviewed in this study:

1. Published articles on classification of partially dentate arches from 1920 to 2016;
2. Articles must be published in English Language or translated into English Language;
3. Articles must specify criteria or principles for the classification system;
4. Articles must state the objectives of classification of partially dentate arch; and
5. Articles of notable authors on the subject of classification of partial edentulism will be given prominent attention.

The exclusion criteria are listed as follows:

1. Articles that were published in other Languages other than English Language;
2. Articles that did not explicitly specify criteria or principles of classification system;
3. Articles that failed to state the objectives of the classification system;
4. Articles that failed to explain the ideal characteristics of a good classification system; and
5. Articles that failed to recognize the contributions of well-known authors on the subject of classification of partial edentulism.

The results of these searches were analysed and synthesized for similarities, dissimilarities and overlapping of principles or rules for classification with a view of coming up with a classification system that can combine the basic elements of all good classification systems in a comprehensible and logical manner.

Results and Discussion

Description of the proposed classification model

The main findings, with respect to the principles or criteria for classification of partial edentulism, are summarised in table 1 [3,4,22] while table 2 [23] shows the historical development of classification of partial edentulism.

Name of classification system	Main underlying principles for classification	Number of classes and sub-classes	Designation or code of classes or sub-classes
Cummer's	Number and position of retainer	Four classes: Class I-Diagonal Class II-Diametric Class III-Unilateral Class IV-Multilateral	Roman numeral I-IV
Kennedy's	Relationship of the edentulous spaces to the abutment teeth (location of the edentulous space in relation to the abutment teeth)	Four classes: I-IV I-III with modifications. IV-without modification	Roman numeral I-IV
Applegate-Kennedy's	It is a modification of Kennedy with more emphasis on the capabilities of the abutment teeth as well as addition of two classes are: V&VI	Six classes: I-VI	Roman numeral I-VI
Bailyn's	Base on the support derived from the abutment teeth	Two main classes: Class A-Anterior saddle Class P-Posterior saddle with sub-classes: P.I, P.II, P.III, A.III, A.I, P.II, P.I.P.II	Letter A and P with Roman numeral I-III

Neurohr's	Based on support derived from the abutment teeth	Class I-Tooth bearing Class II- Tooth and tissue bearing Class III-Tissue bearing Class I and II have many division and variations	Roman numeral I-III variations and divisions are code in Arabic numeral
Mauk's	Based on number, length and position of the spaces and position of the remaining teeth	Class I-VI	Roman numeral I-VI
Wild's	Based on the relationship between the spaces and the abutment teeth	Class I-Bounded space Class II-Free end space Class III-Combination of I &II	Roman numeral I-III
Godfrey's	Based on location and the extent of the edentulous spaces	Classes A-D	Letters A-D corded
Friedman's	Based on location of spaces and relationship of the abutment teeth	Class A: Anterior Class B: Bounded Class C: Cantilever	Letters A, B & C
Beckett and Wilson's	Based on the proportionate amount of support provided by the teeth and soft tissues	Class I: Bounded saddle Class II: Free-end Class III: Bounded saddle with poor abutments	Roman numeral I-III
Craddock's	Based on proportionate amount of soft tissues and tooth support	Class I-Supported on both sides by substantial abutment teeth Class II-Vertical pressure and Dentine resisted entirely by soft tissues Class III-Tooth supported at only one end of saddle	
Austin and Lidge's	Describes the position of the missing teeth	Classes A, P and AP. Class A is divided into 3 subdivisions-A_1, A_2 & AB_1. Class P is also subdivided into P_1, P_2 & PB_1 while AP is subdivided into AP_1 & AP_2. A=>Anterior missing teeth P=>Posterior missing teeth	

Skinner's system	Based on the relationship of abutment teeth to the edentulous spaces	Five main classes are recognised. Classes I-IV	Roman numeral I-IV
Swenson's classification	Based on the position of the edentulous space and the relationship of the abutment teeth to the space	Four primary classes with slight modification of the Kennedy's system. The four primary classes are sub-divided into Anterior Posterior and Anterior Posterior	Roman numeral
Tekla and Laney's classification	Based on the positions of the edentulous spaces and the relationship of the abutment teeth to the spaces	Combined Kennedy's and Swenson's classifications. Kennedy's class II=Swenson's class I. Kennedy's class I=Swenson's class II	Roman numeral
Watt et al classification	Based on the type of support derived from the abutment teeth and/or tissue of the edentulous space	Entirely tooth borne, Entirely tissue borne, partially tooth borne and partially tissue borne	
Osborne and Lammie's classification	Based on the type of support derived from the abutment teeth and/or tissue of the edentulous spaces. It is similar to Wait., *et al*' s classification	Three primary classes: Class I-Mucosa borne Class II-Tooth borne Class III-Combination of mucosa borne and tooth borne	Roman Numeral
Costa's classification	Describes partially edentulous based on the location of the edentulous space	Anterior lateral terminal	No coding
ACP classification	Based on diagnostic criteria: 1. Location and extent of the edentulous area/s 2. Condition of the abutment teeth 3. Occlusal scheme 4. Residual ridge	Each of these criteria is classified as: (i) Ideal or minimally compromised (ii) Moderately compromised (iii) Substantially compromised (iv) Severely compromised	
ICK classification system	Based on Kennedy's classification. The implant classification will begin with "Implant corrected Kennedy (class) followed by the description of the classification: ICK I, for Kennedy class I situations ICK II, for Kennedy class II situations ICK III, for Kennedy class III situation and ICK IV, for Kennedy class IV situation	Four classes are distinguished as indicated in Kennedy's classification	

Table 1: *Showing name, criteria, classes/subclasses and designation of classification systems [3,4,22].*

The simple nature of topographical classification systems is undermined by the low amount of information that such a classification gives to the dental practitioner [4]. It is impossible to know the health situation of the periodontium of the abutment teeth and other remaining teeth in both dental arches as well as the morphology of the residual ridge on the basis of the casts from the impressions of the jaws. Therefore, there is a need to develop a quantitative classification model that can give information on the health conditions of the abutment teeth and other remaining teeth in the dental arches. This was the basis of Siebert's [24] classification which attempts to render the types of residual ridges. Class I Siebert means residual rigde with tissue loss in width, but intact in height; class II Siebert represents residual ridges with loss in height but intact in width; class III Siebert includes residual ridges with loss of bone, both in height and width. This classification is completed with a IVth class for edentulous ridges with no bone loss.

Depending on the degree of bone resorption in the edentulous space, the anatomy of the edentulous ridge will also change with respect to frenum and muscular insertions. This represents a problem because it is very important, in removable prosthodontics, to know how easy or difficult the treatement will be. That is why it is necessary to render the clinical situation of the prosthetic field because the same topographical location in different patients represents a different clinical condition with different treatment. Therefore, a classification needs to contain as many pieces of information as possible.

The current practices require that a good classification system should give the practitioner the therapeutic solution [5]. Consequently, the desire to ensure that a classification system contains as many pieces of information as possible led the American College of Prosthodontist (ACP) to develop a classification system based on clinical criteria for partially edentulous patients in 2002 [5].

Six main criteria were identified after a thorough review of all selected scientific papers on the common classification systems. These criteria include:

1. Number (extent) of missing teeth;
2. Location of missing teeth;
3. Relationship of abutment teeth to the edentulous space/s and to each other in the same dental arch;
4. The periodontal conditions of the abutment teeth;
5. Occlusal balance (conditions and relationship of the remaining teeth in both jaws); and
6. Pattern and degree of resorption of alveolar ridge of the edentulous space.

One may ask that is it possible to have a classification system that can incorporate all the identified fundamental criteria? The author would like to answer in the affirmative that all the basic criteria identified in all the considered classification systems can be incorporated into one classification system. Therefore, the new classification system which is being proposed for partial edentulism would be formulated based on the identified criteria which will be discussed under the following major headings.

Number of missing teeth

The number and mesiodistal crown widths of missing teeth in a dental row will determine the extent of the edentulous space. It will also influence the degree of occlusal balance when the two dental arches are brought together. The number of missing teeth will be designated as 'N'. The number of missing teeth will be attached to its location by means of an underscore e.g. N_A where 'N' is the number missing teeth and 'A' is the location of the missing teeth. The word "missing" will be abbreviated as "Mi" while the phrase "missing teeth" is equivalent to an edentulous space.

Location of missing teeth (the edentulous space)

In this newly proposed classification of partial edentulism, if the mandible is involved it will be abbreviated as "Mand"; and if the maxilla is involved it will be abbreviated as "Max". The location of the edentulous space in a given dental arch will be designated as 'A' or 'P' where 'A' means anterior segment of the dental arch/row while 'P' means posterior segment of the dental arch/row. If one side of the anterior segment is involved it will be designated as A_1 but if the two sides of the anterior segment of the dental row are involved they

will be designated as A_2. If one side of the posterior segment is involved it will be designated as P_1 but if the two sides of the posterior segment are involved they will be designated as P_2. If both anterior and posterior segments are involved, they will be designated as A_iP_i where 'i' may be 1 or 2.

Relationship of the abutment teeth to each other and to the edentulous space/s: The relationship of the abutment teeth to each other and to the edentulous space/s can be described as sagittal (mesial, distal or mesial-distal), diagonal and transverse (diametric) based on axis of alignment. These relationships will be designated as 'X' in general while each particular relationship will be denoted as 'X' with an integer subscript within the range of (1-4), based on alphabetical order, as follows:

Diagonal = X_1;

Sagittal = X_2;

Transverse = X_3; and

Any combination of two or three above = X_4

The periodontal health conditions of the abutment teeth: The periodontal conditions of the abutment teeth are based on the degree of alveolar bone loss. The level of alveolar bone support of the abutment teeth determines the periodontal resistance as well as the periodontal reserve capacity of the abutment teeth. The degree of alveolar bone support of the abutment teeth as well as other remaining teeth in the dental arches is classified as follows:

No bone loss = 1;

¼ bone loss = 2;

½ bone loss = 3;

¾ bone loss = 4; and

> 3/4 bone loss = 5

The assessment of the health status of the abutment teeth, as stated above, will be coded as 'Y'; and the degree of bone loss will be attached to 'Y' as an integer within the range of (1-5). These are summarised as follows:

- Y_1- The tooth concerned has a normal bone support; it can be used as an abutment bearing in mind other important factors in the design of a partial denture.
- Y_2- Loss of ¼ of bone support. The tooth concerned is characterised by presence of minimal reserve capacity; and it can be used as an abutment.
- Y_3- Loss of ½ of bone support. The tooth concerned has no periodontal reserve capacity; and it cannot be used as an abutment.
- Y_4- Loss of ¾ of bone support. The tooth concerned has negative periodontal reserve capacity; and it cannot be used as an abutment.
- Y_5- >3/4 bone support has been lost. The tooth concerned cannot be used as an abutment; and it should be extracted.

Occlusal balance: This is the degree of balance or equilibrium of occlusal forces between the upper and lower jaws based on the number and conditions of the remaining teeth in each jaw. It represents the degree of harmony between the dentitions of both jaws. This is an important consideration in the production of direct and indirect restorations for patients. Occlusal balance is a necessity for all classifications of partially dentate arches. This criterion is based on the need to ensure that both maxillary and mandibular dental rows are considered together in every form of classification of partial edentulism because the deformities or defects in one dental row will influence the occlusal balance when the two dental rows (maxillary and mandibular dental rows) are brought together.

Consequently, the degree of occlusal disharmony will vary from minimal to moderate to substantial to severe or gross depending on the degree of defects in the dental rows and the sum total periodontal resistance reserve capacity of the remaining teeth in each dental arch (based on the degree of alveolar bone support). In substantial and gross or severe deformities or defects, the lower facial height,

at centric occlusion, is reduced; and the maxillary and mandibular arches as well as bones relations will be changed. Therefore, in these cases, there is need to re-establish the facial height and the relationship of the dental arches and dental rows. The occlusal balance is designated as 'Z' while each categorization of the occlusal balance that must be captured in every form of classification of partial edentulism is assessed using the information in table 3.

Periodontal Resistance	2.0	3.0	3.0	1.75	1.75	1.5	1.0	1.25	1.25	1.0	1.5	1.75	1.75	3.0	3.0	2.0
Upper Teeth	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
Lower Teeth	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
Periodontal Resistance	2.0	3.0	3.0	1.75	1.75	1.5	1.0	1.0	1.0	1.0	1.5	1.75	1.75	3.0	3.0	2.0

Table 3: *Shows the distribution of coefficient of periodontal resistance among the different teeth in normal dental arches [24].*

The total coefficient of periodontal resistance to occlusal forces in a normal dental arch is (30.5 units for the maxilla and 30.0 units for the mandible); and it is distributed among the teeth as shown in table 3. The loss of one or more teeth in a dental arch as well as pathological affection of the supporting periodontium of the remaining teeth in a dental arch will reduce the periodontal resistance of the concerned dental arch. Therefore, the periodontal reserve capacity of a dental arch, following loss of some teeth and pathological affection of some or all of the remaining teeth, can be determined by subtracting the sum of the periodontal resistance of the missing teeth and the lost periodontal resistance capacity of the remaining teeth from the total periodontal resistance of the concerned dental arch under normal condition. It should also be noted that the degree of occlusal decompensation can be determined by summation of the periodontal resistance of the missing teeth and the lost periodontal resistance capacity of the remaining teeth in the concerned dental arch.

Lower anterior teeth contribute 7 units out of 30 units of periodontal resistance for the lower jaw while upper anterior teeth contribute 7.5 units out of 30.5 units of periodontal resistance for the upper jaw. The remaining 23 units and 23.5 units of periodontal resistance for the lower and upper jaws respectively are contributed by premolars and molars. The degree of occlusal disharmony or decompensation will be classified, based on the sum total of loss of periodontal resistance capacity with respect to the missing teeth and the remaining teeth in both jaws according to the level of alveolar bone support, as follows:

1. Loss of Less than ¼ (25%) of the total resistance capacity is described as no decompensation or minimal decompensation.
2. Loss of ¼ (25%) of the total resistance capacity is described as moderate decompensation.
3. Loss of ½ of the total resistance capacity is described as substantial decompensation.
4. Loss of ¾ or greater than ¾ of the total resistance capacity is described as gross decompensation.

These categorizations of occlusal balance, as mentioned above, will be denoted or coded as follows:

1. No or minimal occlusal balance decompensation (NOBD) = Z_1;
2. Moderate occlusal balance decompensation (MOBD) = Z_2;
3. Substantial occlusal balance decompensation (SOBD) = Z_3; and
4. Gross occlusal balance decompensation (GOBD) = Z_4.

Each of these categories of occlusal decompensation or disharmony will be used in the classification system as appropriate.

The condition of alveolar ridge of the edentulous space: This will be assessed based on the degree and pattern of bone resorption according to Siebert [24]. Radiographic investigation will be of paramount importance in this regard. Alveolar ridge resorption will be designated as 'R' while the categorisation of the degree and pattern of resorption will be denoted as follows:

- Normal bone or no bone resorption = R_1
- Horizontal bone resorption = R_2
- Vertical bone resorption = R_3
- Combined horizontal and vertical bone resorption = R_4

Therefore, in considering the proposed classification system, the position of the abutment teeth in relation to the edentulous space/s; the relationship between the abutment teeth; the periodontal conditions of the abutment teeth and other remaining teeth; the relationship between the edentulous spaces within a dental row; and the relationship between the two dental rows (at centric occlusion) are very crucial in the design of fixed and removable partial dentures. Consequently, these relationships must be captured in the descriptions of the various classes and sub-classes of a good classification system. To this end, the proposed classification model (system) will be coded using letters, symbols and abbreviations from English Alphabets; and the coding will reflect the complexity of the defects in the concerned dental row. There are three main classes in the proposed classification system. Each class consists of sub-classes. The main classes are designated in Roman numerals as follows:

- **Class I**: Missing anterior teeth only; and the sub-classes include:
  - A_1 = Anterior one side; and
  - A_2 = Anterior two sides
- **Class II:** Missing posterior teeth only; and the sub-classes include:
  - P_1 = Posterior one side; and
  - P_2 = posterior two sides
- **Class III:** Missing anterior and posterior teeth; and the sub-classes include:
  - A_1P_1 = One side anteriorly and one side posteriorly;
  - A_2P_2 = Both sides anteriorly and posteriorly;
  - A_1P_2 = One side anteriorly and both sides posteriorly; and
  - A_2P_1 = Two sides anteriorly and one side posteriorly.

It should be noted that thousands of combinations or variations can be produced when one or more specific teeth are lost in both dental arches. Consequently, in this classification model, the total number of possible variations or combinations (with respect to all sub-classes of the three main classes for each dental row) based only on the number of missing teeth and the sides of the concerned dental arch, is 89. However, if the name of specific missing tooth or teeth, the number of missing teeth and other descriptive components of the proposed classification model are considered, hundreds of thousands of variations can be produced. The different variations of all the sub-classes that are shown in table 4 are based on the number of missing teeth and side/s of the involved dental arch.

Variations of missing teeth in locations P_1 and $_P2$	Variations of missing teeth in locations A_1 and A_2 in combination with other parameters							
	1_A_1–X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_1_ X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	4_A_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	5_A_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	6_A_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}
1_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	1_A_1–1_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_2–1_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_2–1_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_2–1_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_2–1_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	4_A_2–1_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	5_A_2–1_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	6_A_2–1_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}
2_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	1_A_1–2_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_1–2_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_1–2_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_2–2_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_2–2_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	4_A_2–2_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	5_A_2–2_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	6_A_2–2_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}
3_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	1_A_1–3_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_2–3_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_1–3_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_2–3_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_2–3_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	4_A_2–3_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	5_A_2–3_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	6_A_2–3_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}
4_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	1_A_1–4_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_1–4_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_1–4_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_2–4_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_2–4_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	4_A_2–4_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	5_A_2–4_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	6_A_2–4_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}
5_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	1_A_1–5_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_1–5_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_1–5_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_2–5_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_2–5_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	4_A_2–5_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	5_A_2–5_P_1_ X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	6_A_2–5_P_1_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}
6_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	1_A_1–6_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_1–6_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_1–6_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_2–6_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_2–6_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	4_A_2–6_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	5_A_2–6_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	6_A_2–6_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}
7_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	1_A_1–7_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_1–7_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_1–7_P_2_ X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_2–7_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_2–7_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	4_A_2–7_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	5_A_2–7_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	6_A_2–7_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}
8_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	1_A_1–8_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_1–8_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_1–8_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_2–8_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_2–8_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	4_A_2–8_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	5_A_2–8_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	6_A_2–8_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}
9_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	1_A_1–9_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_1–9_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_1–9_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_2–9_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_2–9_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	4_A_2–9_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	5_A_2–9_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	6_A_2–9_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}
10_P_2_X_{14}–Y_{1-5}–Z_{1-4}–R_{1-4}	1_A_1–10_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_1–10_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_1–10_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	2_A_2–10_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	3_A_2–10_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	4_A_2–10_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	5_A_2–10_P_2_X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}	**6_A_2–10_P_2_ X_{1-4}–Y_{1-5}–Z_{1-4}–R_{1-4}

Table 4: *Showing the different variations of the sub-classes of the proposed classification system.*

- *The first row of the table represents variations of missing teeth in locations A_1 and A_2 in combination with other parameters*
- *The first column of the table represents variations of missing teeth in locations P_1 and P_2 in combination with other parameters*
- *The 2nd column to 8th column and 2nd row to the 10th row of the table represent combined variations of missing teeth in locations A_1, A_2, P_1 and P_2 in combination with other parameters*

*** Complete edentulism*

Coding of classes, sub-classes and their variations

The coding of each sub-class will follow a definite order (as shown in table 4) as follows:

1. The jaw concerned: 'Max' for maxilla, 'Mand' for mandible;
2. The word "missing" is abbreviated as "Mi" and this will come before number of missing teeth;
3. Number of missing teeth is designated as 'N'; and this is attached to the position of the missing teeth as a prefix using the underscore symbol e.g. N_A_1.
4. Positions of missing teeth (edentulous spaces) are denoted as follows:
    - A =Anterior (Class I)
    - A_1 = Anterior one side
    - A_2 = Anterior two sides
    - P = Posterior (Class II)
    - P_1 = Posterior one side
    - P_2 = posterior two sides
    - AP = Anterior and Posterior (Class III)
    - A_1P_1 = One side anteriorly and one side posteriorly
    - A_2P_2 = Both sides anteriorly and posteriorly
    - A_1P_2 = One side anteriorly and both sides posteriorly
    - A_2P_1 = Two sides anteriorly and one side posteriorly
5. The relationship between the abutment teeth and the edentulous spaces will be coded as follows:
    - D = diagonal = X_1
    - S = sagittal = X_2
    - T= transverse = X_3
    - A combination of any two or three above =X_4.
6. The periodontal conditions of the abutment teeth: The periodontal conditions of the abutment teeth will be coded as follows:
    - No bone loss = Y_1
    - ¼ bone loss = Y_2
    - ½ bone loss = Y_3
    - ¾ bone loss = Y_4
    - > 3/4 bone loss = Y_5
7. The occlusal balance will be represented as Y_{1-4} where Y denotes occlusal balance and '1-4' denotes the degree of occlusal balance decompensation. The coding of each occlusal balance decompensation is as follows:
    - No/Minimal occlusal balance decompensation = NOBDC= Z_1
    - Moderate occlusal balance decompensation = MOBDC = Z_2
    - Substantial occlusal balance decompensation = SOBDC = Z_3
    - Gross occlusal balance decompensation of = GOBDC = Z_4
8. The condition of alveolar ridge of the edentulous space will be assessed based on the degree and pattern of bone resorption. Alveolar ridge resorption will be designated as 'R' while the categorisation of the degree and pattern of resorption will be coded as follows:
    - Normal bone or no bone resorption = R_1
    - Horizontal bone resorption = R_2
    - Vertical bone resorption = R_3
    - Combined horizontal and vertical bone resorption = R_4

Based on the aforementioned sequential arrangement of the descriptive components of the proposed classification system, the following general formulae are hereby presented for the classes and sub-classes.

Class I: Missing anterior teeth only: The general formula for Class I is given as $Mi\_N\_A\_X_{1-4}\_Y_{1-5}\_Z_{1-4}\_R_{1-4}$ where the range of N = 1-6 for A; and only one subscript value, within the range of X, Y, Z and R can be taken for any given Class I. This formula will be preceded by the prefix 'Max' or 'Mand' to indicate the concerned jaw. The general formulae for the two sub-classes of Class I are:

1. $Mi\_N\_A_1\_X_{1-4}\_Y_{1-5}\_Z_{1-4}\_R_{1-4}$ where N = 1-3
2. $Mi\_N\_A_2\_X_{1-4}\_Y_{1-5}\_Z_{1-4}\_R_{1-4}$ where N = 2-6

The variations in each of the above mentioned sub-classes of Class I depend on the number of missing teeth. These variations can be found in table 4.

Class II: Missing posterior teeth only: The general formula for Class II is given as $Mi\_N\_P\_X_{1-4}\_Y_{1-5}\_Z_{1-4}\_R_{1-4}$ where the range of N = 1-10 for P; and only one subscript value, within the range of X, Y, Z and R, can be taken for any given Class II. This formula will be preceded by the prefix 'Max' or 'Mand' to indicate the concerned jaw. The general formulae for the two sub-classes of Class II are:

1. $Mi\_N\_P_1\_X_{1-4}\_Y_{1-5}\_Z_{1-4}\_R_{1-4}$ where N = 1-5
2. $Mi\_N\_P_2\_X_{1-4}\_Y_{1-5}\_Z_{1-4}\_R_{1-4}$ where N = 2-10

The different variations, in each of the above mentioned sub-classes of Class II depend on the number of missing teeth and side/s of the concerned jaw. These variations can be found in table 4.

Class III: Missing anterior and posterior teeth: The general formula for Class III is given as $Mi\_N\_Ai\_N\_P_i\_X_{1-4}\_Y_{1-5}\_Z_{1-4}\_R_{1-4}$ where the range of N = 1 - 6 for Ai and N = 2 - 9 for Pi or N = 1 - 5 for Ai and N = 2 - 10 for Pi; i = 1 or 2 and only one subscript value, within the range of A_{1-2}, P_{1-2}, X_{1-4}, Y_{1-5}, Z_{1-4} and R_{1-4} can be taken for any given subclass or variation of Class III. 'Mi' = 'Missing'. It should also be noted that this formula will be preceded by the prefix 'Max' or 'Mand' to indicate the concerned jaw in this classification system. Examples of the sub-classes in Class III and their general formulae are as follows:

1. $Mi\_N\_A_1\_N\_P_1\_X_{1-4}\_Y_{1-5}\_Z_{1-4}\_R_{1-4}$
2. $Mi\_N\_A_1\_N\_P_2\_X_{1-4}\_Y_{1-5}\_Z_{1-4}\_R_{1-4}$
3. $Mi\_N\_A_2\_N\_P_1\_X_{1-4}\_Y_{1-5}\_Z_{1-4}\_R_{1-4}$
4. $Mi\_N\_A_2\_N\_P_2\_X_{1-4}\_Y_{1-5}\_Z_{1-4}\_R_{1-4}$

The different variations, in each of the above mentioned sub-classes of Class III depend on the number of missing teeth and side/s of the concerned jaw. These variations can be found in table 4.

Conclusion

This newly proposed classification system, for a partially dentate arch, is very descriptive of the topographic nature, occlusal balance, abutments and extent of the defects in any dental rows. Therefore, it will enhance treatment plan, design of partial dentures and communication among the dentists, dental technologists and other third parties. Mental visualization of the classified defects in the dental rows can easily be comprehended. This classification system also fulfils most of the requirements for a good classification system for partial edentulism.

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- The conception and design of the work;
- The acquisition, analysis, and interpretation of data for the work;
- Drafting the work; and
- Critical revision of the work for important intellectual content.

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Competing Interests

The author declares no conflict of interests.

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