

The International Journal of Periodontics & Restorative Dentistry

# The Lip-Tooth-Ridge Classification: A Guidepost for Edentulous Maxillary Arches. Diagnosis, Risk Assessment, and Implant Treatment Indications



Adrien Pollini, DDS<sup>1</sup> Jack Goldberg, DDS, MS<sup>2</sup> Ricardo Mitrani, DDS, MSD<sup>2,3</sup> Dean Morton, DDS, MSD<sup>4</sup>

Prosthetic rehabilitation of the edentulous maxilla is known to be challenging and requires meticulous planning. The purpose of this article is to describe a novel classification system, the Lip-Tooth-Ridge (LTR), that offers a guidepost for treatment planning the edentulous maxilla for fixed or removable prostheses. This tool will help clinicians identify the final prosthetic design and will provide a case-specific risk assessment guide regarding two different areas. A high (HER) or low (LER) esthetic risk will be determined based on lip dynamics, as well as a high or low structural risk according to the prosthetic space availability. Int J Periodontics Restorative Dent 2017;37:835–841. doi: 10.11607/prd.3209

<sup>1</sup>Resident and Graduate Student, Advanced Education in Prosthodontics,

Department of Oral Health and Rehabilitation, School of Dentistry, University of Louisville, Louisville, Kentucky, USA; Assistant Professor, Laval University, Quebec City, Canada. <sup>2</sup>Private Practice, Mexico City, Mexico.

 <sup>3</sup>Affiliate Associate Professor, Department of Restorative Dentistry, University of Washington.
Seattle, Washington, USA; Resident Faculty, Spear Education, Scottsdale, Arizona, USA.
<sup>4</sup>Professor and Chair, Department of Prosthodontics, Indiana University School of Dentistry, Indianapolis, Indiana, USA.

Correspondence to: Dr Adrien Pollini, 2420 rue de la Terrasse, Pavillon de médecine dentaire, local 1615, Ville de Québec, QC G1V 0A6, Canada. Email: adrien.pollini@gmail.com

©2017 by Quintessence Publishing Co Inc.

Prosthetic rehabilitation of the edentulous maxilla is known to be challenging and requires meticulous planning.<sup>1</sup> This is mainly due to anatomical characteristics, bone resorption pattern, quality of bone, development of prosthetic emergence profile,<sup>2</sup> oral hygiene limitations, influence of the teeth and hard tissue during speech, and the importance of the prosthesis for facial and dental esthetics.<sup>3,4</sup> Zitzmann and Marinello<sup>3</sup> reviewed the literature and provided implant restorative guidelines for the edentulous maxilla. Simon and Raigrodski<sup>5</sup> provided a classification of the types of residual ridge deficiencies and addressed the need for gingival prostheses. Bidra and Agar<sup>6</sup> classified the patients into four categories based on the amount of tissue loss, the position of the anterior teeth in relation to the residual ridge, lip support, smile line, and need for gingiva-colored prosthetic material. This classification is intended exclusively for fixed prostheses; consequently, the anterior teeth are positioned relative to the patient's ridge configuration.

It is the purpose of this article to describe a novel classification system, the Lip-Tooth-Ridge (LTR), that offers a guidepost for treatment planning the edentulous maxilla for fixed or removable prostheses. This tool will help clinicians identify the

Volume 37, Number 6, 2017



**Fig 1** Anterior tooth set-up featuring adequate midline position and harmonious relationship between the smile line, the lower lip, and the labial commissures.

final prosthetic design and will provide a case-specific risk assessment guide.

# **Classification Factors**

The LTR classification is based on the relationship between the optimal dimensions and position of the maxillary central incisor, the dimensions and dynamics of the maxillary lip, and the architecture of the edentulous ridge.

# Tooth Position

The maxillary incisal edge position is considered the starting point of any maxillary reconstruction.<sup>7,8</sup> It is determined by analyzing dentofacial esthetics, tooth proportion, phonetics, and the kinetics of the lower lip.<sup>9–14</sup> This landmark is the keystone for developing the occlusal plane and the vertical dimension of occlusion.<sup>12</sup> After proper positioning of the maxillary central incisor's incisal edge, its inclination should not be set according to any opposing tooth position nor to contact the residual ridge (unpleasant and artificial-looking esthetic outcomes associated with denture teeth placed too apical and palatal have been described in the literature<sup>13</sup>). The buccolingual position and the inclination of the six maxillary anterior teeth are conducted following a facially generated smile assessment<sup>8</sup> (Fig 1).

For the purpose of this article, the esthetic zone is described as the visible area shown on exaggerated smile, and it varies dramatically from patient to patient.

During the smile design process, the curvature of the lower lip should be used as an anatomical reference to determine the position of the maxillary teeth. The literature provides extensive clinical guidelines regarding the midline position and the relationship between the upper lip and the zeniths of the maxillary teeth.<sup>15–17</sup> Since the resorptive process of the maxillary ridge is also affected posteriorly, care should be taken to assess posterior tooth position and ensure an adequate fill of the buccal corridors.17,18

# Lip

The upper lip position is one of the most important elements in anterior esthetics; its static and dynamic assessment will play a crucial role in deciding the type of prosthetic design for the patient. Based on the upper lip position, Tjan et al<sup>19</sup> classified the smile for dentate patients as high, medium, or low, with medium and high corresponding to 80% of the population. With a medium smile, the maxillary lip moves apically (at full smile) to the maxillary central incisors' and canines' gingival levels. The use of video in addition to photography has been shown to be more effective in capturing the most apical position of the upper lip on maximum smile.20 This diagnostic tool proves that a vast number of individuals are potentially at risk, which is not evident using still photography.

Another important subjective element related to facial esthetics is the determination of adequate maxillary lip support or lip projection. Lip projection at its apex is related to lip thickness and to support provided by the maxillary alveolar process and anterior teeth. Ideal lip support is a (subjective) range, and its assessment and perception are affected by multiple factors. Furthermore, the inclination of the maxillary incisors with respect to the frontal plane affects lip support.<sup>21,22</sup> The assessment of this parameter will influence the selection of a prosthetic design including or excluding a labial extension, also called a flange. This should be evaluated at rest and during function on profile

The International Journal of Periodontics & Restorative Dentistry

© 2017 BY QUINTESSENCE PUBLISHING CO, INC. PRINTING OF THIS DOCUMENT IS RESTRICTED TO PERSONAL USE ONLY. NO PART MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM WITHOUT WRITTEN PERMISSION FROM THE PUBLISHER.



**Fig 2** The LTR classification. Visual representation of the four major indications related to the maxillary complete edentulous situation. Note that the classification is based on the defect present between the ridge and the lip horizontally and the prosthetic tooth and the ridge vertically. The bone availability for implant placement does not influence the type of indication.

and frontal views<sup>23,24</sup> and compared with a flangeless design. A thick lip phenotype will overcome many deficiencies in the prosthetic design selected by the clinician.<sup>25</sup> Therefore, any patient presenting a thin upper lip should be considered a high esthetic risk irrespective of the type of definitive restoration selected. The patient should be educated about existing anatomical limitations and allowed to make the final decision on what is considered an acceptable lip support through a trial period.

## Ridge

Vertical and horizontal bone resorption of the residual alveolar ridge has been described to occur after complete extraction of the maxillary teeth.<sup>26–28</sup> However, this resorption pattern has been described in complete denture patients after 5 to 25 years. The residual ridge undergoes a primary resorption that occurs mostly during the first 6 months after extraction and a continuous, steady resorption over the years.<sup>29,30</sup>

If surgical procedures are performed to preserve or augment the dimension of the ridge crest at the time of extraction<sup>31</sup> and no removable complete denture is worn, the amount of alveolar ridge resorption can be expected to be significantly less.<sup>29,30</sup> The alveolar bone level and status of the buccal plate around the teeth to be extracted will also influence the amount of postextraction resorption.<sup>29,30</sup> In other words, the fact that a patient presents with a maxillary removable complete denture does not necessarily imply that a labial prosthesis extension is mandatory. At the same time, adequate prosthetic space may not be available to allow all types of prosthetic designs. The lip support will be affected by the alveolar ridge resorption irrespective of its magnitude and loss of tooth structure. However, this lack of support is not necessarily related to bone availability for implant placement.

Milinkovic and Cordaro<sup>32</sup> demonstrated in a recent systematic review that horizontal bone grafts and Lefort surgery on edentulous patients (regardless of the surgical procedure performed) present unpredictable outcomes when providing lip support in cases of transition from an overdenture to a fixed restoration. Depending on the amount of bone resorption and the desired prosthetic design, the residual ridge geometry may need to be modified to ensure a convex emergence profile that will prevent food entrapment and promote appropriate oral hygiene procedures compatible with sustainable oral health.<sup>33</sup>

The main objective behind this classification is to provide the interdisciplinary treatment team with a graphic and comprehensive vision of the patient's condition. Based on this, the available prosthetic solutions and materials can be scrutinized, as opposed to having one prosthetic solution for all patients.

The LTR classification integrates two fundamental processes. The first intends to categorize the patient into one of four possible clinical scenarios based on the deficiency of hard and soft tissue between the ridge and the teeth in a

© 2017 BY QUINTESSENCE PUBLISHING CO, INC. PRINTING OF THIS DOCUMENT IS RESTRICTED TO PERSONAL USE ONLY. NO PART MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM WITHOUT WRITTEN PERMISSION FROM THE PUBLISHER.



Fig 3 Conventional crown and bridge designs. (a) Metal-ceramic. (b) Zirconia-ceramic.



Fig 4 Class I-LER and -HER. Note that on exaggerated smile, the lip line is above the prosthesis/ridge transition in the HER category.

vertical aspect and between the ridge and lip in a horizontal aspect (Fig 2). The second process consists of carrying out a risk assessment in two different areas. The first area relates to the esthetic risk and consists of incorporating the relevance of lip dynamics into the decision process. For this assessment, two scenarios should be considered: (1) lip mobility that poses a high esthetic risk (HER) such that the transition line between the prosthesis and the ridge is exposed, and (2) lip mobility that does not expose such a transition line (low esthetic risk [LER]). The second area relates to the structural risk. For any given prosthetic design, space availability plays an important role. Having inadequate space may lead to biomechanical failure. Here, two scenarios should be considered: (1) high structural risk (HSR),

which is present when inadequate space for components and materials is available, and (2) low structural risk (LSR), where patients present appropriate space.

# LTR Classifications

# Class I

This clinical condition poses the ideal scenario for a conventional implantsupported "crown and bridge" prosthesis. It is characterized by minimal tissue deficiency (the cervical margin of the proposed maxillary central incisor emerges straight from the soft tissue, mimicking a toothsupported restoration; no gingival prosthetic material is needed (Fig 3). This implant-supported prosthesis is commonly fabricated using metalceramics, although zirconia can be used as well (Fig 3b). Adequate connector sizes are critical (at least 7 to 10 mm of vertical prosthetic space, based on the type of retention selected). The vertical prosthetic space extends from the platform of a bone-level implant to the occlusal surface of the restoration. In maxillary edentulous situations, the healing pattern occurring after multiple tooth extractions leads to a flat ridge configuration. The development of a scalloped soft tissue contour is not predictable, and the use of bone and soft tissue augmentation techniques will provide suboptimal outcomes in the interproximal areas. Therefore, achieving a harmonious relationship between the tooth structure and the underlying soft tissue will require creating an illusion through a prosthetic compen-

The International Journal of Periodontics & Restorative Dentistry

 $^{\odot}$  2017 by quintessence publishing CO, Inc. Printing of this document is restricted to personal use only. No part may be reproduced or transmitted in any form without written permission from the publisher.



Fig 5 Fixed dental prostheses with pink-colored prosthetic material. (a) Metal-ceramic. (b) Zirconia-ceramic. (c) Metal-acrylic.







Fig 6 Class II-LER and -HER. Note that on exaggerated smile, the lip line is above the prosthesis/ridge transition in the HER category.

sation, such as long contact areas and/or the ceramic characterization of the gingival embrasures.

For Class I-LER, the management of interdental papillae still poses a challenge as 87% of dentate patients presenting low lip line still show interdental papillae on exaggerated smile<sup>34</sup> (Fig 4).

Conversely, Class I-HER presents an increased esthetic risk due to greater soft tissue display. Adequate soft-tissue grooming should be executed, and in certain cases, interdental gingival prosthetic material may be used (Fig 4).

#### Class II

This clinical condition consists of a larger vertical deficiency between the cervical margin of the proposed maxillary central incisor and the alveolar ridge, and it requires pinkcolored prosthetic material (ceramic, composite, or acrylic) This type of prosthesis can be fabricated using metal-ceramics (Fig 5a), zirconiaceramics (Fig 5b), or metal-acrylic (Fig 5c). The metal-ceramic and zirconia-ceramic designs will require an average of 8 to 12 mm and the metal-acrylic 13 to 15 mm in the posterior area. The Class II-HER (Fig 6) represents an esthetic risk because the junction between the prosthesis and the residual ridge will need to be hidden under the upper lip position on exaggerated smile. This requires precise presurgical planning and a surgical template to ensure that adequate bone reduction is performed.

If anatomical structures limit the removal of bone for prosthetic/ esthetic needs, an alternative design needs to be considered, such as distally tilted implants, alternative implant distribution, or the use of



**Fig 7** Overdentures retained by (a) telescope attachments, (b) Locator attachments, and (c) a bar.

zygomatic implants, to bypass the anatomical limitation and/or lack of sufficient bone for implant placement.

## Class III

This clinical situation represents a tissue deficiency primarily with a horizontal component, causing inadequate lip support (Fig 2). Hence, it warrants treatment with a removable prosthesis including a labial extension (flange). Such prostheses (overdentures) can be retained by telescope (Fig 7a) or Locator attachments (Fig 7b) (Zest). The minimal vertical space required for these prosthetic design is larger compared to that for a Class I, ranging from 11 to 12 mm depending on the system selected. A bar-type overdenture may not be recommended for this clinical scenario due to vertical space constraints.

While Class III can be converted to Class IV by means of an ostectomy, anatomical limitations such as a floor of the nose and/or sinus should be taken into account in cases where such bone reduction is not a viable option. The limited vertical space precludes the use of a fixed detachable prosthesis. If such a prosthetic design is used, a structurally weak prosthesis will result and will eventually lead to biomechanical complications.

This clinical situation involves a substantial residual defect (with vertical and horizontal components) with inadequate lip support (Fig 2), warranting a removable prosthesis with a labial extension (flange) with the option of using either the aforementioned prosthetic design for Class III or a bar type overdenture (Fig 7c). If a fixed detachable prosthesis is used for this clinical condition, oral hygiene access will be compromised due to a buccal shelf and long-term maintenance of the implants will be at risk, possibly leading to biologic complications.

# Discussion

Space constraints have long been a problem in restorative dentistry. This predicament can be addressed by increasing vertical dimension or by means of surgical bone reduction. It should be noted that both alternatives have limitations: esthetic, biologic, and/or structural.

Bone removal to create optimal space is done routinely but should be cautiously examined. The high biologic cost of removing sound hard tissue in the name of space optimization for a certain prosthetic design has to be well understood and explained to the patient.

The International Journal of Periodontics & Restorative Dentistry

© 2017 BY QUINTESSENCE PUBLISHING CO, INC. PRINTING OF THIS DOCUMENT IS RESTRICTED TO PERSONAL USE ONLY. NO PART MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM WITHOUT WRITTEN PERMISSION FROM THE PUBLISHER.

Preoperative evaluation of the patient's existing condition should be a comprehensive exercise. By doing this, the interdisciplinary treatment team can objectively choose the best and most conservative option based on the patient's specific anatomical characteristics. While modifying these characteristics to fit a certain restorative design may provide financial benefits, it may incur high biologic costs along the way.

# Conclusions

This classification system is intended to offer the interdisciplinary team a comprehensive and graphic tool to identify the patient condition and the potential solutions available. No hierarchical distinction is made between esthetic and functional risks, as both can lead to irreversible failure.

# Acknowledgments

The authors reported no conflicts of interest related to this study.

# References

- Desjardins RP. Prosthesis design for osseointegrated implants in the edentulous maxilla. Int J Oral Maxillofac Implants 1992;7:311–320.
- Schnitman PA. The profile prosthesis: An aesthetic fixed implant-supported restoration for the resorbed maxilla. Pract Periodontics Aesthet Dent 1999;11:143–151.
- Zitzmann NU, Marinello CP. Fixed or removable implant-supported restorations in the edentulous maxilla: Literature review. Pract Periodontics Aesthet Dent 2000;12:599–608.

- Taylor TD. Fixed implant rehabilitation for the edentulous maxilla. Int J Oral Maxillofac Implants 1991;6:329–337.
- Simon H, Raigrodski AJ. Gingiva-colored ceramics for enhanced esthetics. Quintessence Dent Technol 2002;25:155–172.
- Bidra AS, Agar JR. A classification system of patients for esthetic fixed implant-supported prostheses in the edentulous maxilla. Compend Contin Educ Dent 2010;31:366–370.
- Spear FM, Kokich VG, Mathews DP. Interdisciplinary management of anterior dental esthetics. J Am Dent Assoc 2006;137:160–169.
- Lombardi RE. The principles of visual perception and their clinical application to denture esthetics. J Prosthet Dent 1973; 29:358–382.
- Vig RG, Brundo GC. The kinetics of anterior tooth display. J Prosthet Dent 1978; 39:502–504.
- Pound E. Utilizing speech to simplify a personalized denture service. J Prosthet Dent 1970;24:586–600.
- 11. Robinson SC. Physiological placement of artificial anterior teeth. J Can Dent Assoc (Tor) 1969;35:260–266.
- Silverman MM. The speaking method in measuring vertical dimension. 1952. J Prosthet Dent 2001;85:427–431.
- Frush JP, Fisher RD. The dynesthetic interpretation of the dentogenic concept. J Prosthet Dent 1958;8:558–581.
- Ash MM Jr, Nelson SJ. Wheeler's Dental Anatomy, Physiology, and Occlusion, ed 8. Philadelphia: Saunders, 2003:13.
- 15. Rufenacht CR. Fundamentals of Esthetics. Berlin: Quintessence, 1990.
- 16. Goldstein RE. Esthetics in Dentistry. Philadelphia: Lippincott, 1976.
- Dong JK, Jin TH, Cho HW, Oh SC. The esthetics of a smile: A review of some recent studies. Int J Prosthodont 1999; 12:9–19.
- Choi TR, Jin TH, Dong K. A study on the exposure of maxillary and mandibular central incisor in smiling and physiologic rest position. J Wonkwang Dent Res Inst 1995;5:371–379.
- Tjan AH, Miller GD, The JG. Some esthetic factors in a smile. J Prosthet Dent 1984;51:24–28.
- 20. Van Der Geld P, Oosterveld P, Berge SJ, Kuijpers-Jagtman AM. Tooth display and lip position during spontaneous and posed smiling in adults. Acta Odontol Scand 2008;66:207–213.
- Sarver DM. Esthetic Orthodontics and Orthognathic Surgery. St. Louis: Mosby, 1998.

- Arnett GW, Bergman RT. Facial keys to orthodontic diagnosis and treatment planning. Part I. Am J Orthod Dentofacial Orthop 1993;103:299–312.
- Proffit WR, Phillips C, Douvartzidis N. A comparison of outcomes of orthodontic and surgical-orthodontic treatment of Class II malocclusion in adults. Am J Orthod Dentofacial Orthop 1992;101: 556–565.
- McNamara L, McNamara JA Jr, Ackerman MB, Baccetti T. Hard- and soft-tissue contributions to the esthetics of the posed smile in growing patients seeking orthodontic treatment. Am J Orthod Dentofacial Orthop 2008;133:491–499.
- Scott CR, Goonewardene MS, Murray K. Influence of lips on the perception of malocclusion. Am J Orthod Dentofacial Orthop 2006;130:152–162.
- Carlsson GE, Bergman B, Hedegård B. Changes in contour of the maxillary alveolar process under immediate dentures. A longitudinal clinical and x-ray cephalometric study covering 5 years. Acta Odontol Scand 1967;25:45–75.
- Tallgren A. The reduction in face height of edentulous and partially edentulous subjects during long-term denture wear. A longitudinal roentgenographic cephalometric study. Acta Odontol Scand 1966;24:195–239.
- Tallgren A. The effect of denture wearing on facial morphology. A 7-year longitudinal study. Acta Odontol Scand 1967; 25:563–592.
- 29. Tan WL, Wong TL, Wong MC, Lang NP. A systematic review of post-extractional alveolar hard and soft tissue dimensional changes in humans. Clin Oral Implants Res 2012;23(suppl):s1–s21.
- Van der Weijden F, Dell'Acqua F, Slot DE. Alveolar bone dimensional changes of post-extraction sockets in humans: A systematic review. J Clin Periodontol 2009;36:1048–1058.
- Avila-Ortiz G, Elangovan S, Kramer KW, Blanchette D, Dawson DV. Effect of alveolar ridge preservation after tooth extraction: A systematic review and meta-analysis. J Dent Res 2014;93:950–958.
- Milinkovic I, Cordaro L. Are there specific indications for the different alveolar bone augmentation procedures for implant placement? A systematic review. Int J Oral Maxillofac Surg 2014;43:606–625.
- Stein RS. Pontic-residual ridge relationship: A research report. J Prosthet Dent 1966;16:251–285.
- Hochman MN, Chu SJ, Tarnow DP. Maxillary anterior papilla display during smiling: A clinical study of the interdental smile line. Int J Periodontics Restorative Dent 2012;32:375–383.

## Author Index for The International Journal of Periodontics & Restorative Dentistry, Volume 37, 2017

Issue 1: pp 1–156; 2: pp 157–308; 3: pp 309–460; 4: pp 461–620; 5: pp 621–772; 6: pp 773–924

Abhilash A, 209 (e135) Abou-Arraj RV, 571, 843 Abundo R, 541 Açil Y, 491 Aquirre-Urizar JM, 89 Aguirre-Zorzano LA, 89 Aimetti M, 551, 655 (e245) Akhlaghi F, 49 AlBader B, 431 (e180) Albiero AM, 591 AlHelal A, 431 (e180) Alibrandi A, 87 (e120) Alkaya B, 742 (e270) Alkhraisat MH, 713 Alqahtani MS, 219 Anitua E, 713 Araújo CF, 601 Aslan S, 227 Assis G, 667 Ayna M, 491 Baghele ON, 818 (e302) Baksa G, 347 Baldini N, 413 Bannuru RR, 691 (e253) Barallat L, 533 Barausse C, 469, 819 Barbieri C, 647 Barcellos DC, 137 Barczak K, 249 Barkana I, 203 Barone A, 469 Barth CT, 531 (e210) Bartołomiej I, 789 (e297) Batalla P, 721 Beekmans BR, 511 Beekmans DG, 511 Begoña L, 713 Belser UC, 809 Benato A, 591 Benato R, 591 Bender P, 481 Bensaïd X, 117 Bernardello F, 195 Bingham CM, 273 Biroon SH, 211 Blanco J, 721 Blasi A, 758 (e290) Bornstein MM, 481 Boos FB, 861 (e321) Bosco S, 283 Boyacioglu H, 345 (e163) Breschi L, 317, 862 Bresciani E, 137, 601 Bressan E, 39 (e111), 61, 657 Briguglio F, 87 (e120) Britton E, 273 Buczkowska-Radlińska J, 249 Buduneli N, 227 Bui M, 339 Buser D, 481, 749 (e279)

Caballe-Serrano J, 749 (e279) Cagidiaco EF, 413 Cal E, 345 (e163) Calamita MA, 183 Calvo-Guirado JL, 387 Camargo PM, 363 Campos F, 241 Caneiro L, 541, 683, 721 Cardoso M, 241 Carnio J, 363 Carrasco A, 355 Casañas E, 443 Casati MZ, 235 Castano A, 99 Chackartchi T, 203 Chamberlain JA III, 531 (e210) Chang NJ, 281 (e149) Checchi V, 862 Chen CK, 281 (e149) Chen R, 423 Cherkaoui S, 117 Chevalier G, 117 Chiche GJ, 273 Cho SC, 629 Chou MY, 423 Chung CP, 825 Cicero G, 99 Coachman C, 183 Cochran DL, 125 Cordasco G, 87 (e120) Cornejo H, 355 Cortellini P, 227 Cricenti L, 551, 655 (e245) Crupi A, 87 (e120) Cruz SE, 843 Cudziło D, 908 (e344) Cune MS, 511 D'Elia C, 413 Da Silva Ávila DM, 137 da Silva Neves FL, 601 Danan M, 117 de Arriba L, 443 De Biase A, 283 De Lorenzi M, 19 de Melo RM, 241 de Oliveira Correia AM, 519 (e204) de Sanctis M, 413 De Simone G, 61 De Stavola L, 39 (e111) De-la-Fuente AM, 89 Degidi M, 591 DeGroot BS, 883 Del Fabbro M, 791 Delgado-Ruiz RA, 387 Dellificorelli G, 19 Deluiz D, 499 Derafshi R, 881 (e337) Dinoi C, 99 Dionysopoulos D, 509 (e197) do Nascimento YA, 519 (e204) Dogan N, 491 dos Santos NC, 601 Du Toit J, 377

Eccellente T, 69 Edelhoff D, 561 El Chaar E, 99 El-Haddad SA, 901 El-Shall MA, 901 Estefanía-Fresco R, 89 Fabbri G, 19 Faramarzi M, 211 Felice P, 469, 673, 819, 862 Feraz Caneppele TM, 137 Ferrari M, 263 (e142) Ferreira Camacho MP, 737 Fickl S, 403 Fincato A, 39 (e111) Fiorellini J. 683 Fiorellini JP, 219, 541 Fischer K, 403 Fisselier F, 629 Fletcher P, 499 Fradeani M, 19 Frei S, 561 Freiha C, 743 Froum SJ, 327, 629 Fu E, 281 (e149) Fu H, 79 Fujita T, 393 Galletti P, 175 Ganeles J, 291 (e154) Garacoia-Pazmiño C, 871 (e328) Garbacea A, 431 (e180) Garcia IR Jr, 861 (e321) Gariffo A, 647 Gaud-Quintana S, 136 (e130) Genova T, 541 Gerasimou P, 509 (e197) Gerber G, 347 Geurs NC, 571 Gholamin P, 49 Gianno F, 283 Gluckman H, 377 Gobatto L, 39 (e111), 61 Goldberg J, 835 Goncalves Motta SH, 737 González-Serrano J, 443 Goracci C, 413 Gorla LF, 861 Gorrente G, 683 Górska R, 908 (e344) Górski M, 249 Goto H, 393 Gotti S, 551, 655 (e245) Griffin TJ, 339 Griza S, 519 (e204) Gulses A, 491 Guneri P, 345 (e163) Gupta A, 209 (e135) Güth JF, 833 (e310) Hanratty J, 33 Happe A, 403 Haytac MC, 109, 742 (e270)

Hinrichs JE, 751 Hochuli-Vieira E, 861 (e321) Hong H, 599 (e234) Hu B, 559 (e224) Hu Z, 79 Hur Y, 339 Huynh-Ba G, 801, 883 Insua A, 871 (e328) Intini G, 423 Iorio-Siciliano A, 758 (e290) Iorio-Siciliano V, 758 (e290) Ippolito DR, 469 Irokawa D, 393 Ishii Y, 393 Isola G, 87 (e120) Janke U, 33 Jardini MA, 601 Javed F, 387 Jurczyk K, 809 Kacprzak M, 789 (e297) Kalra N, 209 (e135) Kan JY, 371 Kattadiyil MT, 431 (e180) Kauling AE, 833 (e310) Kaur M, 571 Kawai T, 521 Ke JH, 281 (e149) Kebschull M, 403 Keceli S, 742 (e270) Kerr E, 33 Khojasteh A, 49 Khouly I, 327 Kim DM, 33, 175, 355, 423, 599 (e234), 667 Kim HM, 825 Kim YJ, 371 Klinger A, 203 Klokkevold PR, 9, 363 Kohal RJ, 853 Kois JC, 371 Kolte AP, 255 Kolte RA, 255 Konobu H, 393 Kotsakis GA, 751 Kruger LG, 871 (e328) Kruk H, 117 Kubota A, 219 Kudyar N, 209 (e135) Kühnisch J, 833 (e310) Lamazza L, 283 Lan WH, 281 (e149) Lareau DE, 751 Lasho DJ, 801 Laurito D, 283 Lee EA, 165 Lee JY, 825 Lee SC, 825 Lee YN, 99 Leepong N, 693 Lenzi C, 69 Leone R, 263 (e142)

Herzberg R, 893

Levi P Jr, 533 Leziy S, 33 Li W, 559 (e224) Liang Y, 79 Liebermann A, 561 Lima DM, 519 (e204) Lin JCY, 599 (e234) Lin X, 411 (e170) Lin YL, 363 Liñares A, 721 Linkevicius T, 41 Liu Q, 559 (e224) Liu T, 411 (e170) Liu Y, 79, 411 (e170), 559 (e224) Llobell A, 219 Lo Giudice G, 87 (e120) Lollobrigida M, 283 López-Pintor RM, 443 Lops D, 657 Lozada J, 347, 431 (e180), 639 Luongo G, 69 Magaz VR, 657 Majzoub ZA, 843 Malgaonkar N, 209 (e135) Mandracci P, 541 Mangano C, 69 Mangano F, 69 Mariotti G, 317 Marzadori M, 673 Masoud M, 423 Matarese G, 87 (e120) Mathias IF, 235, 601 Matsui T, 393 Maziero Volpato CA, 561 Mazzocco F, 61 Mazzoni A, 317, 862 Mazzoni S, 317 Mazzotti C, 673 Mealey BL, 801, 883 Medina K, 533 Megarbane JM, 743 Melo de Mendonça, 519 (e204) Meloni SM, 125 Memarpour M, 881 (e337) Mendoza-Azpur G, 355 Merli M, 317 Miller RJ, 387 Mills MP, 883 Miron RJ, 749 (e279) Mitrani R. 835 Mokbel N, 743 Monje A, 347, 639, 749 (e279), 871 (e328) Montanaro NJ, 387 Morton D, 835 Moscatelli M, 317 Motamedian SR, 49 Motroni A, 317 Mounssif I, 673 Movila A, 521 Mussano F, 541 N P, 209 (e135) Na HJ, 825 Nart J, 61, 533 Natto ZS, 691 (e253)

Nayak A, 873 Nayak R, 873 Nevins M, 33, 175, 355, 599 (e234), 667, 691 (e253), 779, 789 (e297) Nicolò M, 758 (e290) Nieri M, 317 Nikaido M, 393 Nofri G, 413 Norkin FJ, 291 (e154) Norton M, 781 Noujeim ME, 801 Nóvoa L, 721 Ogata Y, 339 Okamoto R, 861 Okubo N, 393 Öncü E, 265 Ortolani M, 69 Oshman S, 99 Ouhara K, 521 Ozcan M, 109, 742 (e270) Ozen J, 491 Pagni G, 705 Pajnigara NG, 255 Pando J, 355 Paniz G, 61, 657 Paredes VM, 443 Park YJ, 825 Parma-Benfenati S, 175 Parpaiola A, 657 Pascual A, 533 Pasquinelli K, 33 Pastagia J, 433 Pelekanos S, 729 Penarrocha D, 683 Penarrocha M, 683 Pereira RS, 861 (e321) Perotto S, 551, 655 (e245) Peter B, 441 (e189) Petsch M, 853 Piattelli M, 469 Pico A, 721 Piñas L, 713 Pirih FQ, 363 Pisano M, 125 Pistilli R, 469, 819 Plakwicz P, 908 (e344) Pollini A, 835 Pour RS, 561 Pozidi G, 729 Pradeep AR, 209 (e135) Prandtner O, 561 Prihoda TJ, 883 Pripatnanont P, 693 Proussaefs P, 431 (e180) PS R, 818 (e302) Pucci CR, 137 Qin B, 79 Quintela DC, 737 Quinti F, 175 Raes F, 69 Rafael CF, 561 Rajpoot N, 873

Ramaglia L, 87 (e120), 758 (e290) Rasperini G, 33 Rebaudi A, 705 Ricci JL, 499 Riccitiello F, 758 (e290) Rikhtegaran S, 211 Roig-Ódena L, 89 Romano F, 551, 655 (e245) Romanos AH, 843 Romanos GE, 387, 533 Roncati M, 647 Rowe T, 423 Rungcharassaeng K, 371 Sacks D, 387 Saito A, 393 Saito MT, 235 Salama M, 377 Sallum EA, 235 Salvi GE, 481 Sánchez IM, 136 (e130) Santamaria MP, 235, 601 Santana RB, 737 Santos A, 533 Sanz-Sánchez I, 443 Saquib S, 209 (e135) Sarmiento H, 219 Sassatelli P, 195 Sava C, 175 Sbricoli L. 657 Schlagenhauf U, 403 Schlee M, 403 Schoolfield J, 801 Schweiger J, 833 (e310) Sculean A, 481, 809 Scutellà F, 791 Sencimen M, 491 Seol YJ, 825 Sesma N, 183 Seydaoglu G, 109, 742 (e270) Sfeikos T, 509 (e197) Shafiei F, 881 (e337) Shapoff CA, 33 Shi Y, 629 Shimizu H, 393 Silveira CA, 235, 601 Simion M, 469 Soltani L, 99 Song J, 559 (e224) Sorrentino R, 19, 263 (e142) Souza RO, 241 Spies B, 853 Spinato S, 195 Stefanini M, 673, 819 Stellini E, 61, 657 Stern JK, 136 (e130), 273 Stimmelmayr M, 833 (e310) Sugai JV, 871 (e328) Szmidt M, 249 Szubińska-Lelokiewicz D, 789 (e297) Tabatabaei FS, 49 Takai Y, 521 Takei HH, 9 Takeshita WM, 519 (e204)

Takeuchi T, 393 Tallarico M, 125, 683 Tang Q, 79 Tarnow DP, 499 Tarquini G, 549 (e217) Temple KE, 801 Testori T, 33, 791 Thanakone P, 693 Thorat M, 818 (e302) Tinoco EM, 499 Tinoco JM, 499 Tolidis K, 509 (e197) Tomkiewicz W, 789 (e297) Torshabi M, 49 Trisi P, 705 Tsai HC, 581 Türk AG, 345 (e163) Ucak O, 109, 742 (e270) Ulusoy M, 345 (e163) Unal S, 345 (e163) Urban IA, 9, 347, 639, 749 (e279), 871 (e328) Valdivia E, 355 Vallejo GH, 443 Varol A, 491 Vassilopoulos PJ, 571 Venezze AC, 657 Verardi S. 433 Vescovi P. 647 Viana Casarin RC, 235 Vicario M, 533 Villar CC, 883 Wang CW, 423 Wang HL, 347, 639, 705, 749 (e279), 871 (e328) Weinstein T, 791 Wessel JR, 531 (e210) Wismeijer D, 411 (e170) Wojtowicz A,789 (e297) Woliński J, 789 (e297) Wong MY, 581 Wu G, 411 (e170) Wu YT, 281 (e149) Wychowański P, 789 (e297) Wyrębek B, 908 (e344) Yaghmoor W, 691 (e253) Yang Z, 79 Yao CC, 581 Yuh DY, 281 (e149) Zaffe D, 195 Zarone F, 19, 263 (e142) Zfaz S, 291 (e154) Zheng Y, 411 (e170) Zhong R, 79 Zhou J, 559 (e224) Zhou L, 79 Zucchelli G, 469, 673, 791, 819, 862

The International Journal of Periodontics & Restorative Dentistry

Copyright of International Journal of Periodontics & Restorative Dentistry is the property of Quintessence Publishing Company Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.