



# Ibero-Panamerican Federation of Periodontics Delphi study on the trends in diagnosis and treatment of peri-implant diseases and conditions: A Latin American consensus

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### Abstract

**Background:** The social diversity, heterogeneous culture, and inherent economic inequality factors in Latin America (LA) justify conducting a comprehensive analysis on the current status and future trends of peri-implant diseases and conditions. Thus, the aim of this Delphi study was to predict the future trends in the diagnosis and treatment of peri-implant diseases and conditions in LA countries for the year 2030.

**Methods:** A Latin American steering committee and group of experts in implant dentistry validated a questionnaire including 64 questions divided into eight sections. The questionnaire was run twice with an interval of 45 days, with the results from the first round made available to all the participants in the second round. The results were expressed in percentages and data was analyzed describing the consensus level reached in each question.

**Results:** A total of 221 experts were invited to participate in the study and a total 214 (96.8%) completed the two rounds. Moderate (65%-85%) to high consensus ( $\geq 85\%$ ) was reached in 51 questions (79.69%), except in the questions dealing with “prevalence”, where no consensus was reached. High and moderate consensus was attained for all the questions in three fields (risk factors and indicators, diagnosis and treatment of peri-implant conditions and deficiencies, and prevention and maintenance).

**Conclusions:** The present study has provided relevant and useful information on the predictions in the diagnosis and treatment of peri-implant diseases with a high level of consensus among experts. Nevertheless, there is still a lack of agreement in certain domains.

### KEYWORDS

consensus, Delphi technique, dental implants, diagnosis, peri-implantitis

## 1 | INTRODUCTION

The use of dental implants to replace missing teeth has demonstrated long-term predictable outcomes to restore lost masticatory function and aesthetics.<sup>1,2</sup> The prevalence of biological and biomechanical complications, however, has gradually increased during the last decades and its awareness has risen in the dental community.<sup>3-5</sup> The most common biological complications are the peri-implant diseases<sup>6</sup> that were recently classified in the last World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions as peri-implant health, peri-implant mucositis, peri-implantitis, and soft and hard tissue deficiencies.<sup>7,8</sup>

Peri-implant diseases were defined as inflammatory conditions of the surrounding soft and hard tissues in response to the accumulation of bacterial biofilm and their diagnosis and associated risk factors were established based on the available scientific evidence<sup>7,9</sup>. Nev-

ertheless, the application of these clinical categories with their respective preventive and treatment recommendations have not yet being thoroughly applied in the Latin American (LA) population, who may have a specific disease expression and different exposure to risk factors. This population diversity, heterogeneous culture and inherent economic and social inequality factors may justify conducting a comprehensive analysis on the status and future trends of peri-implant diseases and conditions in this region of the world.<sup>10,11</sup>

There are different methodologies and social sciences to establish predictions and to study trends, and the most used in medical sciences is the Delphi methodology.<sup>12</sup> This approach belongs to the subjective-intuitive methods of foresight, especially useful for long-range forecasting, as expert opinions are the only source of information available.<sup>13</sup> Its main objective is to evaluate the degree of consensus among experts in a specific topic. In this approach, a structured group of individuals deals with



complex problems through structured communication, individual feedback, group judgment, and discussion.<sup>14</sup> First, by evaluating the previously available information and looking at suitable tendencies or evolution patterns and then allowing the most probable future environments, which are arrived by consensus.<sup>15</sup> The answers of the experts are obtained in consecutive rounds of anonymous questionnaires, which try to keep the maximum independency of criteria of the individual expert but aim for a consensus among the experts. Once the collected data from the surveys are analyzed, the final prediction is developed depending on the degree of consensus achieved by the selected group of experts.<sup>13</sup> Recently, this methodology has been successfully introduced in Dentistry to predict the development of different specialties in Europe, with the support of relevant scientific societies such as the Spanish Society of Periodontology (*Sociedad Española de Periodoncia y Oseointegración*, SEPA),<sup>16</sup> European Federation of Periodontology (EFP),<sup>17</sup> and the European Association for Osseointegration (EAO).<sup>18</sup> In LA, the Ibero-Panamerican Periodontology Federation (*Federación Ibero-Panamericana de Periodoncia*, FIPP) is a transnational umbrella organization gathering national societies from 15 countries. One of the main goals of this organization is to provide guidelines on education and practice and to develop future trends based on scientifically proven methods, such as the Delphi methodology.

It was therefore the primary objective of this FIPP endorsed project to use the Delphi methodology to generate by consensus the future trends in the diagnosis and treatment of peri-implant diseases and conditions in LA countries for the year 2030.

## 2 | MATERIAL AND METHODS

### 2.1 | Study design

This investigation was designed as a qualitative, observational, 2-round Delphi study.<sup>13</sup> Ethical approval and patient consent were not required, as we did not involve patients. Therefore, it had not to be conducted in accordance with the Helsinki Declaration of 1975, as revised in 2013.

### 2.2 | Advisory committee

An Advisory Committee (M.A.A, I.S.S, A.L.P, L.T, M.E.G.V, L.M.F, M.S.A.) was built in advance to: (1) define the context and the timeframe of the forecast, (2) design and validate the questionnaire, (3) select a Steering Committee comprising experts in periodontology and oral implantol-

ogy, representing all countries from the region. The role of this Steering Committee was to approve and finalize the questionnaire and to select the expert panel with members from each country with proved expertise either in the surgical or the restorative aspects of oral implants.

### 2.3 | Questionnaire

The first version of the questionnaire was discussed by the Steering Committee in September 2020. Each member scored each question for relevance, clarity, wording, and order, besides evaluating the possible answers. Also, they were asked to make free comments. Finally, the questionnaire was modified, and the final version was approved.

The structured questionnaire was designed to be completed in ~20 minutes. The final version was constructed using an online software\*. It contained 64 close-ended questions and was divided in the following eight sections:

- A. Diagnosis (8 questions)
- B. Risk factors and risk indicators (7 questions)
- C. Surgical and prosthetic considerations (11 questions)
- D. Prevalence (3 questions)
- E. Treatment of peri-implant mucositis (6 questions)
- F. Treatment of peri-implantitis (14 questions)
- G. Diagnosis and treatment of peri-implant conditions (6 questions)
- H. Prevention and maintenance (9 questions)

Well-defined answers were provided to all questions. Further, an open-end space was provided for each question to allow for open comments by the expert, answer differently or make any clarification. These comments were analyzed in the consensus meeting to discuss and to clarify the responses.

### 2.4 | Selection of experts

Experts from 16 countries were selected by the Steering Committee representing three possible professional profiles: academic (i.e., teaching institutions, universities), clinical setting (i.e., private dental practice), and the public health sector. To be considered as an expert, one of the following inclusion criteria should be met: (1) specialist with a degree or certificate obtained in a university or (2) general dentist with more than 10 years of experience in dental implantology. Using these criteria, 221 experts received an invitation letter to participate in the study, as

\* (SurveyMonkey Inc, San Mateo, CA, U.S.A)



well as the online address where the questionnaire should be answered. Each country was represented in the model by a number of experts proportional to the number of active dentists. A minimum of six experts was set for each country.

## 2.5 | Data collection

The online questionnaire was sent to the selected experts (October 2020) and a timeframe of 2 weeks was given to get the answers. These responses were collected by the Steering Committee and then after 45 days, the second round of questionnaires was sent to the experts, including a summary of the results of the first round (November 2020). In this manner the experts could “align” with the thoughts of other participants, allowing them to change their answer or remain with their previous response.

The filled second questionnaires were collected again, and a systematized data analysis was carried out to describe the consensus reached. By agreement, the following levels of consensus were established: (1) no consensus when <65% of concordant answers were attained in the second round; (2) moderate consensus when achieving between 65%–85%; and (3) high consensus when reaching >85%.

## 2.6 | Consensus conference

An online meeting conference convened by M.A.A was held on November 2020. During this meeting, the results from each question to the second questionnaire were presented. Discussion during the meeting specifically dealt with those answers not reaching consensus after the second round and those answers requiring further discussion. These specific questions requiring further discussion were clarified, and consensus was reached among those present at the conference.

## 2.7 | Data analysis

After the first and second round, the answers to each question were individually analyzed by descriptive statistics with data presented as absolute values and percentages, as well as means using a specific software.<sup>†</sup> In addition to statistical descriptors, in those questions where consensus was not achieved, the expert’s comments were taken into consideration, as well as any personal observation opposed to the consensus achieved by the experts.

## 3 | RESULTS

A total of 221 experts from LA were invited to participate in this study. In the first round, 100% of the participants answered the questionnaire and 214 (96.83%) participated in the second round. The distribution of experts for each country is depicted in Table 1.

In the first round, the established threshold for consensus (>65%) was achieved in 42 questions (65.63%) and in the second round this level reached 51 questions (79.69%). Moderate to high consensus was reached for all the questions in three fields: “risk factors and risk indicators,” “diagnosis and treatment of peri-implant conditions and deficiencies,” and “prevention and maintenance.” The field of “prevalence” did not reach consensus on any of the questions. The consensus achieved for each field is depicted in Figure 1 and Table 2.

The field of “Diagnosis” reached high consensus in four out of the eight questions. Most of the experts agreed that an initial radiograph following implant loading will be necessary to determine baseline bone levels (98.13%) and that an additional one after a loading period between 6 and 12 months should be taken to establish a bone level reference following physiological remodeling (96.73%). They also agreed that bleeding on gentle probing should be the main parameter for early diagnosis of peri-implant mucositis (85.51%) and that early diagnosis of this condition will decrease the incidence of peri-implantitis (97.20%). However, no consensus was reached regarding the role of probing (63.08%), the probe material (56.54%), or the ideal radiographic analysis to determine peri-implant marginal bone loss (58.88%) (Table 2A).

The field of “risk factors and risk indicators” reached high consensus in 6 out of 7 questions. Most of the experts considered that plaque/biofilm (87.38%), lack of professional supportive therapy (92.52%) and history of periodontal diseases (90.19%) as a risk factor for peri-implantitis. Likewise, most of the respondents estimated that smoking (97.66%), uncontrolled diabetes (96.26%), and peri-implant keratinized mucosa deficiency (89.25%) should also be considered risk factors for peri-implant diseases (Table 2B).

Most of the questions in the field of “surgical and prosthetic considerations” reached a moderate consensus. Most of the experts agree that the quality of the implant placement surgical procedure will influence the risk of peri-implantitis (90.19%). However, experts agreed that immediate implants (81.31%) and placement of implants in previously regenerated bone (80.84%) was not a risk factor leading to peri-implant diseases. Although there was consensus that similar roughness implants (70.56%) and bone level implants will be more common (76.64%), there was no consensus for the location of the implant

<sup>†</sup> Microsoft Office Excel, Los Angeles, CA, USA

TABLE 1 Experts distribution by country

COUNTRY	N	%	EXPERTS
Argentina	16	7.48	Roberto Lenarduzzi; Alejandro Maddalena; Gerardo Francisco Saiz; Adrian Carlos Bencini; Martin Fernando Zalduendo; Carlos Lemme; Ruben Alfredo Forte; Enrique Fernandez Bodereau; Ricardo Bachur; Jorge Galante; Jorge Ernesto Aguilar; Guillermo Schimini; Diego Bechelli; Raquel Miodowky; Hugo Romanelli; Mariano Axel Ramón Amer.
Bolivia	11	5.14	Primo Herrera Subelza; Paola Andrea Jiménez Daleney; Darwin Sergio Justiniano Pereyra; Roly Montero; Angela Fabiana Hurtado Saucedo; Oscar Arauco Urzagaste; Claudio Murillo Sasamoto; Pablo Enrique Guzmán Trujillo; David Muñoz; Amilkar Rocha; Luis Guillermo Peredo Paz.
Brazil	44	20.56	Maria Luiza Cabral Maia; Alessandro Lourenço Januário; Nataly Rabelo Mina Zambrana; Daniel Eduardo Saldanha de Miranda; Katia Fernanda Nery Américo; Bill Okuma Oliveira; Roger Nishiyama; Ligia Drovandi Braga Rotundo; Nayara De Lucena; Gabriel Leonardo Magrin; Marcelo Isidoro; Claudia Cristina Riquelme; Francisco De Assis Nunes Martins Araujo; Victor Matsubara; Marcelo Munhoz Romano; Rodrigo Carlos Nahás de Castro Pinto; Henrique Fukushima; Lillian Smeke; Marcelo Augusto Fonseca; Marcelo Cavalli; Piero Rocha Zanardi; Caroline Bosque Keedi; Isabella Neme Ribeiro Dos Reis; Alliny De Souza Bastos; Newton Sesma; Marcos Venturini Ferreira; Natacha Kalline De Oliveira; Karina Pintaudi Amorim; Bruno Nunes De França; Lauren Oliveira Lima Bohner; Vitório Antonio Filomeno; Carlos Eduardo Secco Mafra; Giuseppe Alexandre Romito; Juliana Assef Ganhito; Alexandre Hugo Llanos; Herbert Horiuti; Maria Luisa Silveira Souto; Gustavo Vargas Da Silva Salomão; Thiago Ramos Reis Reina; Vitor Sapata; Guilherme Castro Lima Silva Do Amaral; Caio Cesar Cremonini; Daniel Isaac Sendyk; Claudio Mendes Pannuti.
Chile	16	7.48	Sergio Olate; Rodrigo Andres Kaiser Cifuentes; Roberto Irribarra; Patricio Alejandro Herane Comandari; Roque Jose Cona Trujillo; Rodrigo Fariña; Sergio Hernan Marchant Molina; Carlos Rodrigo Parra Atala; Sergio Acosta Christian; Alfredo Hernán Von Marttens Castro; Carlos Godoy Cruzat; José Manuel Abarca; Patricio Fuentes Zuleta; Edgar Berg; Javier Enrique Basualdo Allende; Miguel Oscar De La Fuente Avila.
Colombia	12	5.61	Sergio Iván Losada Amaya; Alejandro Bermudez Munar; Yamil Augusto Lesmes Otavo; Wilhelm Bellaiza Cantillo; Janeth Pedroza; Miguel Fernando Vargas Del Campo; Fernando Galindo G; Andrea Gómez Pinzón; Lina Suárez; Rodrigo Alberto Pelaez Gallego; Maria Alejandra Sabogal Bassil; Gabriel Campuzano Barriga.
Costa Rica	10	4.67	Carolina Vargas Loría; Marisol Palma Fernández; Natalia Araya Fonseca; Mariana Gil; Gisella Rojas González; Natalia Arguedas Vega; Gerardo Mora; Pablo Guzmán; Francisco José Jiménez Bolaños; Juliana Castro.

(Continues)





TABLE 1 (Continued)

COUNTRY	N	%	EXPERTS
Ecuador	10	4.67	Edwin Andrés Ruales Carrera; Iván Mauricio Bedoya Chacon; Mauricio Andres Tinajero Aroni; Esteban José Paz Y Miño Borja; Mario Eduardo Escobar Ramos; Nicolas Aguilera; Andrés Sancho; Marco Vinicio Medina Vega; Mario Esteban Calderón Calle; Lenin Proaño.
Guatemala	11	5.14	Patricia Estrada; Luis Fernando De Leon C; Alex Villela; Maria Del Pilar Urizar Urrutia; Mynor Paolo Paiz Pazos; María Celeste Silva Bol; Diana Hernandez Chavarria; Diana Pellecer; Roberto Galindo; Otto Wug Molina; Luis Grisolia.
Honduras	10	4.67	Jose Leon Padilla; Mayra Elizabeth Pineda Salgado; Karla Rapalo; Doris Melissa Ramos Morales; Ines Johana Awad Ulloa; Jimmy Salatiel Salinas Macias; Hervey Stacy Hunter Romero; David Antón Hernández Rosales; Gabriela Caballero; Vilma Alejandra Umazor Bonilla.
Mexico	13	6.07	Alejandro Treviño; Brenda Ximena Papadopoulos Diez Barroso; Rodrigo Neria Maguey; Ana Gabriela Sifuentes Carrillo; Maria Reina Guillemin; Alex Mendivil; Marisol Pérez Gasque Builla; Mauricio Cemaj; Alain Ayrton Arteaga Ruiz; Marisol Noriega Ebel; Bárbara Patricia Busto Rojas; Elizabeth Belmonte Hernández; Brenda Ruth Garza Salinas.
Panama	10	4.67	Luis Enrique Barrera Emiliani; Mario Macrini; Mariulys Amarilis Ramos Higuero; Rosana Medela; Gianni Calvosa; Arlette Miller; Marcial Carles; Alejandra De La Rosa; Zorina Kuy; Mónica Shedden.
Paraguay	6	2.80	Carlos Barrios Cáceres; Melody Chase; Fábio Shimiti Mizutani; Rogerio Scipioni Junior; Gabriel Otazu Aquino; Patricia Fretes Wood.
Peru	14	6.54	Miguel Angel Coz; José Antonio Balarezo Razzeto; Plinio Gómez Rodríguez; Arturo Jesús Gárate Arias; Carlos O. Matta Morales; Carolina Chang Suarez; Lucio Gamboa; Miguel Delgado Bravo; María Isabel Otayza Lanatta; Claudia Delgado Nava; Andrés Chale Yaringaño; Otto Loechle Verde; Fernando José Lores Seijas; Víctor Manuel Arrascue Dulanto.
Dominican Republic	10	4.67	Ismelda Zaida Filpo Beltre; José Mena; Iris Jasmín Santos Germán; Olga Comprés; José Sebastián Benoit; Saulo Rosario; Michael Brache; Luis Alberto Portes Bueno; Domingo Santos Pantaleón; Aimée Cuesta.
Uruguay	6	2.80	Sebastián Pérez; Alicia Batlle Castillo; Conrado Saizar; Marcos Di Pascua D'angelo; Adriana Drescher; Gerardo Sagastume.
Venezuela	15	7.01	Rafael Laplana; Ricardo Almon Montaner; Alberto Enrique Blanco Yallonnardo; Antonio Gordils; Aulio Caires Carballo; Juan Carlos Martínez; Alberto Miselli; Elizabeth Albornoz; Jorge Rafael Vieira Navarro; Ilusion Romero; Roberto Luis Fermin Mago; Claudia Simoza; Tabatha L. Rojas Marin; Gredy Lugo; Ana Luisa Bernotti.



TABLE 2 Questionnaire and level of consensus achieved

Section	N	Question	Agree ✓	In disagreement	I'm not sure	Possible answers	Consensus achieved
A. Diagnosis	1	Baseline radiographic measurements following implant loading will be necessary to determine the initial position of the peri-implant bone crest	Agree ✓	In disagreement	I'm not sure		High Consensus 98.13%
	2	An additional radiograph after a loading period between 6 and 12 months should be taken to establish a bone level reference following physiological remodeling	Agree ✓	In disagreement	I'm not sure		High Consensus 96.73%
	3	Clinician must obtain baseline probing measurements at four points (M, D, MV, MP, or ML), following the completion of the implant-supported or implant-retained prosthesis	Agree ✓	In disagreement	I'm not sure		Moderate Consensus 73.36%
	4	Peri-implant tissue health and disease will be measured by means of probing	Agree ✓	In disagreement	I'm not sure		No Consensus 63.08%

(Continues)



TABLE 2 (Continued)

Section	N	Question	Agree ✓	In disagreement	I'm not sure	Possible answers	Consensus achieved
	5	Bleeding on gentle probing will be a parameter for early diagnosis of peri-implant mucositis	Agree ✓	In disagreement	I'm not sure		High Consensus 85.51%
	6	The ideal periodontal probe material will be	Metal	Plastic	Any ✓		No Consensus 56.54%
	7	The ideal radiographic analysis to determine peri-implant marginal bone loss will be	Periapical radiography ✓	Panoramic radiography	Cone beam computed tomography	Combination of systems	No Consensus 58.88%
	8	An early diagnosis of peri-implant mucositis will decrease the incidence of peri-implantitis	Agree ✓	In disagreement	I'm not sure		High Consensus 97.20%
B. Risk factors and risk indicators	1	Plaque/biofilm as a risk factor for peri-implant diseases will	Increase ✓	Be similar	Decrease		High Consensus 87.38%
	2	The lack of professional supportive therapy as a risk factor for peri-implant diseases will	Increase ✓	Be similar	Decrease		High Consensus 92.52%
	3	Periodontal diseases as a risk factor for peri-implant diseases will	Increase ✓	Be similar	Decrease		High Consensus 90.19%

(Continues)





TABLE 2 (Continued)

Section	N	Question	Agree ✓	In disagreement	I'm not sure	Possible answers	Consensus achieved
	4	Smoking will be considered a risk factor for peri-implant diseases	Agree ✓	In disagreement	I'm not sure		High Consensus 97.66%
	5	Uncontrolled diabetes will be considered a risk factor for peri-implant diseases	Agree ✓	In disagreement	I'm not sure		High Consensus 96.26%
	6	Peri-implant keratinized mucosa deficiency (< 2 mm) will be considered a risk factor for peri-implant diseases	Agree ✓	In disagreement	I'm not sure		High Consensus 89.25%
	7	Inflammatory systemic conditions and / or diseases will be considered a risk factor for peri-implant diseases	Agree ✓	In disagreement	I'm not sure		Moderate Consensus 72.90%
C. Surgical and prosthetic considerations	1	The quality of the surgical procedure performed will influence the risk of peri-implantitis	Agree ✓	In disagreement	I'm not sure		High Consensus 90.19%
	2	Immediate implants will be more prone to peri-implant diseases	Agree ✓	In disagreement ✓	I'm not sure		Moderate Consensus 81.31%

(Continues)



TABLE 2 (Continued)

Section	N	Question	Agree	In disagreement ✓	I'm not sure	Possible answers	Consensus achieved
	3	The placement of implants in regenerated bone will be more prone to peri-implant diseases	Agree	In disagreement ✓	I'm not sure		Moderate Consensus 80.84%
	4	Regarding the location of the implant platform and its relation to bone crest, the implants will be mostly	Tissue level	Bone level ✓	Both of them		Moderate Consensus 76.64%
	5	In bone level implants, implant depth positioning will be mostly	Crestal	Subcrestal ✓	Both of them		No Consensus 63.08%
	6	Regarding the implant surface roughness, the trend will be to use	Less rough implants	Similar rough implants ✓	Higher rough implants		Moderate Consensus 70.56%
	7	Regarding the abutment surface roughness, the trend will be to use	Polished abutments ✓	Textured abutments	Both of them		High Consensus 88.32%
	8	Over-contoured restorations have the potential to retain plaque and will be associated with the development of peri-implant diseases	Agree ✓	In disagreement	I'm not sure		High Consensus 98.12%
	9	Regarding the type of prosthesis, the trend will be to use	Screw retained ✓	Cement retained	Screw-cement retained	Any	Moderate Consensus 70.56%

(Continues)



TABLE 2 (Continued)

Section	N	Question	Possible answers	Consensus achieved
	10	For screw-retained crowns, the type of prosthesis will be	Direct to the implant fixture Screwed to an intermediate abutment ✓	No Consensus 46.73%
	11	For intermediate abutments, the height of the transmucosal component will be	Closer to the crestal bone ✓ Far from the crestal bone ✓	Moderate Consensus 84.11%
D. Prevalence	1	The prevalence of peri-implant mucositis will be	Higher ✓ Less	No Consensus 64.02%
	2	The prevalence of peri-implantitis will be	Higher ✓ Less	No Consensus 64.02%
	3	The prevalence of peri-implant soft tissue deficiencies will be	Higher ✓ Less	No Consensus 47.20%
E. Treatment of peri-implant mucositis	1	The treatment of mucositis will be carried out mainly by	General Dentist Specialist ✓	Moderate Consensus 78.04%
	2	The treatment of mucositis will be mainly focused on	Mechanical debridement Antimicrobials	Moderate Consensus 72.90%
	3	Mechanical debridement will be carried out mainly with	Curettes Ultrasounds	High Consensus 93.93%
	4	Pharmacological treatment will be carried out mainly with	Antiseptics Antibiotics	Moderate Consensus 70.09%
			Air polishing systems Both of them ✓	High Consensus 93.93%
			Combinatio of systems ✓	High Consensus 93.93%
			Both of them ✓	Moderate Consensus 70.09%

(Continues)



TABLE 2 (Continued)

Section	N	Question	Possible answers				Consensus achieved
	5	The ideal curesttes material will be	Surgical steel	Titanium	Plastic	Any ✓	No Consensus 37.38%
	6	Laser decontamination will be needed to treat mucositis	Agree	In disagreement ✓	I'm not sure		No Consensus 43.46%
F. Treatment of peri-implantitis	1	The treatment of peri-implantitis will be carried out mainly by	General Dentist	Specialist ✓	Both of them		High Consensus 98.13%
	2	The treatment of peri-implantitis will be mainly	Surgical	Non-surgical	Both of them ✓		Moderate Consensus 74.30%
	3	Surgical treatment of peri-implantitis will be mainly	Resective	Regenerative	Both of them ✓		Moderate Consensus 84.11%
	4	A non-surgical phase before surgery will be necessary	Agree ✓	In disagreement	I'm not sure		High Consensus 93.46%
	5	The choice of the treatment approach will depend on the peri-implant defect morphology	Agree ✓	In disagreement	I'm not sure		High Consensus 99.07%
	6	Decontamination of the exposed implant surface will be mainly	Mechanical	Chemical	Both of them ✓		High Consensus 95.33%
	7	Mechanical decontamination of the exposed implant surface will be mainly done with	Curettes	Ultrasounds	Air polishing systems	Laser Rotary systems	High Consensus 97.20% Combination of systems ✓

(Continues)



TABLE 2 (Continued)

Section	N	Question	Chlorhexidine ✓	Hydrogen peroxide	Possible answers	Consensus achieved
	8	Chemical decontamination of the exposed implant surface will be mainly done with			Local antibiotic	No Consensus 62.15%
	9	In reconstructive approaches a bone substitute will be necessary to fill the defect	Agree ✓	In disagreement	I'm not sure	High Consensus 95.33%
	10	The standard bone replacement graft will be	Allogenic	Autologous	Xenograft ✓	Moderate Consensus 74.77%
	11	In reconstructive approaches the use of a membrane will be necessary	Agree ✓	In disagreement	I'm not sure	High Consensus 92.99%
	12	The implantoplasty will be part of the resective therapy	Agree ✓	In disagreement	I'm not sure	High Consensus 85.98%
	13	Surgical approaches applying growth factors will favor re-osseointegration in the future	Agree ✓	In disagreement	I'm not sure	No Consensus 59.35%
	14	Anti-inflammatory agents will be helpful in counteracting peri-implantitis	Agree	In disagreement ✓	I'm not sure	No Consensus 50.00%

(Continues)



TABLE 2 (Continued)

Section	N	Question	Possible answers	Consensus achieved
G. Diagnosis and treatment of peri-implant conditions and deficiencies	1	Mucosal thickness will be an important factor for the esthetics outcome and for the prevention of mucosal recession	Agree ✓ In disagreement I'm not sure	High Consensus 99.07%
	2	Mucosal thickness will be an important factor for peri-implant health	Agree ✓ In disagreement I'm not sure	High Consensus 96.73%
	3	The correct diagnosis of peri-implant soft tissue dehiscence/deficiencies at single implant site will require the assessment of	The bucco-lingual position of the implant crown/platform only The height of the peri-implant papilla only Both the bucco-lingual position of the implant and the papillae height ✓ Xenografts	Moderate Consensus 76.64%
	4	The trend for treating peri-implant soft tissue dehiscence/deficiencies will involve the use of	Allografts Autologous grafts ✓ Xenografts	Moderate Consensus 84.58%
	5	The implant-supported crown should be always removed at least one month before the treatment of peri-implant soft tissue dehiscence/deficiencies, with a new definitive crown fabricated 6-9 months after the surgery	Agree In disagreement It depends on the length of the crown, adjacent and homologous teeth and patient's expectation ✓	Moderate Consensus 72.90%

(Continues)





TABLE 2 (Continued)

Section	N	Question	Agree	In disagreement ✓	Possible answers	Consensus achieved
	6	The reconstruction of the interproximal papilla between an implant with soft tissue dehiscence and the adjacent teeth will be predictable	Agree	In disagreement ✓	I'm not sure	Moderate Consensus 73.36%
H. Prevention and maintenance	1	Maintenance will be carried out mainly by	General Dentist	Specialist ✓	Hygienist	Moderate Consensus 74.77%
	2	Individualized oral hygiene instructions should be given based on the ability of each patient	Agree ✓	In disagreement	I'm not sure	High Consensus 99.53%
	3	In patients with local risk factors, the frequency of maintenance appointments will be every	3 months ✓	4 months	6 months	Moderate Consensus 84.11%
	4	In patients with systemic risk factors, the frequency of maintenance appointments should be every	3 months ✓	4 months	6 months	Moderate Consensus 78.97%
	5	In patients with periodontitis, it will be contraindicated to place dental implants before a successful periodontal treatment	Agree ✓	In disagreement	I'm not sure	High Consensus 94.86%

(Continues)



TABLE 2 (Continued)

Section	N	Question	Agree ✓	In disagreement	I'm not sure	Possible answers	Consensus achieved
	6	Improving the height of attached keratinized mucosa will be an alternative to prevent peri-implant diseases	Agree ✓	In disagreement	I'm not sure		High Consensus 92.99%
	7	When fixed implant-supported restorations impede proper diagnosis or oral hygiene access, the restoration must be removed or recontoured	Agree ✓	In disagreement	I'm not sure		High Consensus 98.60%
	8	Prevention of peri-implant diseases will be reached by means of	Anti-inflammatory agents	Hygiene and patient behavior ✓	Antimicrobial therapies		High Consensus 100%
	9	Preventive strategies will be efficient to control peri-implant diseases	Agree ✓	In disagreement	I'm not sure		High Consensus 97.20%

✓: Answer selected by experts.

No consensus: <65%; Moderate consensus: 65%–85%; High consensus: >85%.

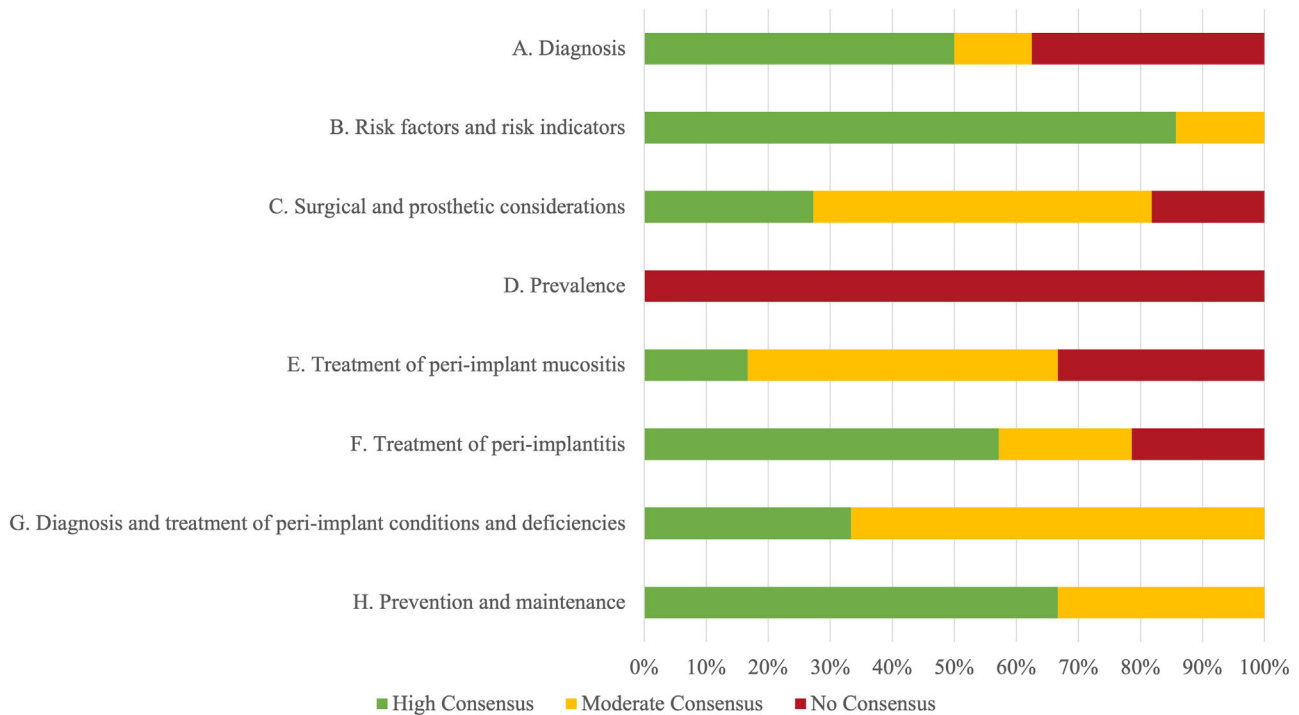


FIGURE 1 Level of consensus reached on each field (% distribution)

shoulder in regard to the bone in relation to the type of prosthesis. Experts believed that the tendency will be to use screw-retained prosthesis (70.56%). In cases where there is a need for an intermediate abutment, most experts selected polished abutments (88.32%) and with the highest possible transmucosal component (84.11%) (Table 2C).

No consensus was reached whether the prevalence of peri-implant mucositis (64.02%), peri-implantitis (64.02%), and peri-implant soft tissue deficiencies (47.20%) will be higher, similar, or less in the future (Table 2D).

In the field of “treatment of peri-implant mucositis,” most of the expert agree that a combination of approaches for mechanical debridement will be used (93.93%). However, no consensus was reached for the ideal curette material (37.38%) or for the role of lasers in the treatment of peri-implant mucositis (43.46%). Moderate consensus was reached for the rest of the items (Table 2E).

In the field of “treatment of peri-implantitis” most experts have a clear perception that the treatment of peri-implantitis will be mainly performed by a specialist (98.13%). Further, they agree that a non-surgical phase will be necessary before surgery (93.46%) and that the choice of treatment approach will depend on the peri-implant defect morphology (99.07%). There was high consensus for the combination of mechanical and chemical approaches to decontaminate the implant surface (95.33%) and also for the combination of different tools to mechanically debride the exposed implant surface (97.20%). Although a high consensus was obtained regarding the use of a bone substi-

tute (95.33%) and a membrane (92.99%) in reconstructive treatments, a moderate consensus was reached regarding the standard bone replacement graft (74.77%). Moreover, no consensus was attained regarding the use of growth factors (59.35%) or anti-inflammatory agents (50%) as adjunctive agents (Table 2F).

The questions related to the field “diagnosis and treatment of peri-implant conditions and deficiencies” provided moderate to high consensus in every item. There was a clear high consensus for the role of mucosal thickness in the aesthetic outcome (99.07%) and its relation with peri-implant health (96.73%). When it relates to the treatment of peri-implant soft tissue dehiscence/deficiencies, moderate consensus was reached for the type of graft to be used, for the need of removing or changing the prosthesis, and for the predictability of reconstructing the interproximal papilla (Table 2G).

All items achieved moderate to high consensus in the field of “prevention and maintenance.” All the experts agree that prevention of peri-implant diseases will be reached by means of hygiene and patient behavior. There was high consensus that individualized oral hygiene instructions should be given based on the ability of each patient (99.53%). The treatment of periodontitis, the improvement of keratinized mucosa, and the accessibility of the implant restoration to hygiene will be important factors in the prevention of peri-implant diseases and maintenance of peri-implant health (Table 2H).



## 4 | DISCUSSION

The results from the present Delphi study provide important useful and updated information on the trends in diagnosis and treatment of the peri-implant diseases and conditions in LA. Different institutions and organizations have recently used this methodology to generate consensus on various topics in dentistry.<sup>16,18</sup> The importance of these results is magnified by the fact that the study was carried in LA, which presents a unique cultural and economic environment. Moreover, the relevance of these results lies in the fact that opinions were consulted from a wide range of experts in implant dentistry (certificate/degree from university and/or more than 10 years of experience in the field of dental implantology) from across LA and from a diversity of settings, from the academic field to those working primarily in private practice or in the public health sector.

### 4.1 | Diagnosis

The diagnosis of peri-implant health or disease is based on a combination of clinical (presence or absence of bleeding on probing along with the magnitude or stability of probing depth) and radiographic outcomes.<sup>7</sup> In the present study there was a very high consensus that bleeding on gentle probing should be the parameter for the early diagnosis of peri-implant mucositis, because early diagnosis and treatment of this condition will decrease the incidence of peri-implantitis. However, no consensus was achieved in regard to the ideal probe material, because its preference may be more subjective than evidence based. Experts also agreed that baseline radiographs after implant loading should be necessary to determine the initial bone levels. However, because it is important to consider the physiological bone remodeling phase, the experts agreed that a radiograph 6 to 12 months after loading should be considered as the initial reference, which is in line with the recommendation made in the World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions<sup>19</sup>. It is remarkable that the experts did not agree with respect to the ideal radiographic analysis to determine peri-implant marginal bone loss, with some recommending the use of periapical radiography, others cone beam computer tomography (CBCT) and others, both. Although the use of CBCT in the diagnosis of peri-implantitis may be questioned from the ethical point of view, a recent study has shown that the accuracy of diagnosing specific defects was higher when using CBCT as compared to periapical radiographs, concluding that clinicians should be aware of the limitations of conventional radiographs.<sup>20</sup>

### 4.2 | Risk factors and risk indicators

It's worthy to note that the experts agreed that plaque/biofilm, lack of professional supportive therapy, and history of periodontal diseases were true risk factors for periimplantitis, what is in agreement with the current scientific evidence.<sup>21,22</sup> In this sense it would be interesting to confirm whether there is a dose-dependent effect of these factors with the risk of peri-implantitis.

Likewise, experts agreed that smoking, diabetes, factors related to prostheses, and peri-implant keratinized mucosa deficiency (< 2 mm) would be considered as risk factors for peri-implant diseases.<sup>19</sup> Today, the role of these factors in the development of peri-implantitis is still inconclusive. The recently developed Implant Disease Risk Assessment (IDRA) might be useful as a checklist to identify modifiable risks before implant therapy and as a tool to communicate the level of risk to the patient.<sup>9</sup>

### 4.3 | Surgical and prosthetic considerations

Is important to note that in this item, low to moderate consensus was achieved, what may be explained by the high variety of implant and prosthetic systems and components that may lead to diverse surgical and prosthetic protocols.

Different aspects of the surgical procedures, which could influence the incidence of peri-implant diseases, were agreed among the experts. Among the most important opinions we can highlight that there was no consensus in the "implant depth positioning" (subcrestal, crestal, or both). This could be supported by evidence showing that although subcrestal implants have resulted in slightly less crestal bone loss when compared with epicrestally placed implants, no statistically significant differences have been reported.<sup>23,24</sup> There was a high consensus that over-contoured restorations have the potential to retain plaque and will risk the development of peri-implant diseases, which is in line with a study reporting that emergence angles of >30 degrees were a significant risk indicator for peri-implantitis.<sup>25</sup> Although it seems that screw-retained prosthesis was the consensus trend for the future, when using cemented prosthesis special care should be taken to avoid excess cement.<sup>26</sup>

### 4.4 | Prevalence

Two out of three experts answered that the prevalence of peri-implant diseases was going to increase, which can be justified by the increasing number of patients with



implant-supported restorations together with an increase in life expectancy,<sup>18</sup> however, there was no consensus on specific prevalence levels, which can be explained by the scarcity of prevalence studies in LA and the lack of agreement in disease definition among published studies makes it difficult to pool estimates of disease prevalence.<sup>27</sup>

#### 4.5 | Treatment of peri-implant mucositis

During the Consensus meeting it was clearly stated that the early treatment of peri-implant mucositis is the key strategy to prevent peri-implantitis. There was consensus, that both, mechanical and chemical approaches will be used for biofilm removal. However, no consensus was achieved to confirm which should be the ideal protocol. Also, it was discussed that ideally, the instruments used to effectively clean smooth surfaces should be innocuous to avoid surface damage and to not affect the implant-soft tissue interface.<sup>28</sup> It is important also to remark that other factors apart from debridement and decontaminating should be taken into consideration, such as ease in the accessibility to clean, with the implant position and angulation, suprastructure design and the anatomy of peri-implant hard and soft tissues important determinants.<sup>29</sup>

#### 4.6 | Treatment of peri-implantitis

Experts agreed that the treatment of peri-implantitis should mainly be carried out by a specialist. There was a clear consensus that initial treatment should include a non-surgical phase. However, non-surgical therapy may not be enough to arrest disease and surgery may be indicated.<sup>30</sup>

Mechanical implant surface decontamination will remain the main approach for biofilm removal by combining different tools, although the adjunctive use of chemical agents will be more frequent. However, there was no consensus on which should be the ideal chemical agent, what is in agreement with the current scientific evidence.<sup>31</sup> When focusing on resective surgery there was high consensus for the use of implantoplasty to smoothen and flatten the implant surface, which is in agreement with some authors reporting the effective use of this this aggressive approach when the exposed implant surface cannot be otherwise reconstructed.<sup>32,33</sup>

When using bone reconstructive surgeries there was high consensus on the use of a bone substitute as a replacement graft to fill the defect and the use of a barrier membrane to cover the graft. Nevertheless, these predictions do

not fully agree with the current available evidence, reporting that the use of a bone substitute has only shown an added positive value on radiographic outcomes,<sup>34</sup> and the advantage of using a membrane remains unclear.<sup>35</sup> For this reason, well-designed controlled clinical trials will be needed to confirm this prediction. There was moderate consensus towards the use of xenograft rather than autologous or allogenic grafts. This agrees with evidence that shows that lateral bone augmentation procedures either simultaneous or staged to implant placement have used xenografts as the standard of therapy.<sup>36,37</sup>

Interestingly, no consensus was reached regarding the use of anti-inflammatory agents as adjunct to the treatment of peri-implantitis, in spite of the agreed inflammatory bases of this disease.<sup>19</sup> Recently, some studies have shown that macrophage phenotype and specific interleukins may play an important role in disease pathogenesis and progression of peri-implantitis<sup>38–40</sup> and, therefore, future trends to treat peri-implantitis may involve anti-inflammatory agents to modulate inflammation and counteract peri-implant tissue destruction.<sup>41–43</sup>

#### 4.7 | Diagnosis and treatment of peri-implant conditions

Soft tissue deficiencies at implant sites are not a rare finding.<sup>44</sup> These conditions may be related to implant malposition, thin soft tissue phenotype (including keratinized mucosa and mucosal thickness), marginal bone loss or soft tissue inflammation, among others. When focusing on soft tissue thickness there was high consensus on its impact on aesthetic outcomes and the prevention of marginal recession, which is in line with a recent clinical trial showing that adding a connective tissue graft to immediate implants significantly prevent the apical displacement of the gingival margin.<sup>45</sup> It has also been demonstrated that peri-implant sites with >2 mm soft tissue thickness were associated to less bone remodeling, which may impact the future risk for further bone loss.<sup>46</sup> Similarly, the experts agreed that soft tissue thickness would impact peri-implant health.

Peri-implant soft tissue deficiencies can occur as the apical shift of the mucosal margin, as a discrepancy between the length of the implant-supported crown and the homologous natural tooth or a combination of both. The experts agreed that the diagnosis of these deficiencies should be based on the bucco-lingual position of the implant and the height of the interproximal soft tissue, similarly to what has been proposed by Zucchelli and coworkers.<sup>47</sup> This classification also considers these factors to evaluate the predictability of the treatment of buccal soft tissue deficiencies



when using autologous grafts together or not with prosthesis removal and/or prosthesis change. Interestingly, the experts agreed with most of the steps described in this new classification.

#### 4.8 | Prevention and maintenance

Most of the experts agreed that preventive strategies will be efficient to control peri-implant diseases. It is well known that patient compliance and professional supportive therapy can minimize the incidence of peri-implant diseases.<sup>48</sup> Despite the fact that 100% of the experts believe that prevention of peri-implant diseases will be achieved through personal oral hygiene and patient behavior, the experts strongly believed that clinicians also play a fundamental role in the prevention of these diseases. In this scenario, there was a high consensus for the fact that oral hygiene instructions should be given individualized according to the characteristics of each patient. It has been shown that under good clinical conditions, full compliance by the patient could be even more important than recurrent professional intervention and, therefore, it is important that during maintenance appointments oral hygiene by the patient is checked and modified if necessary.<sup>49</sup>

Although a reasonable maintenance interval between 5 and 6 months has been suggested to reduce the risk of peri-implant diseases,<sup>50</sup> experts believed that in the presence of systemic risk factors, this frequency should be every 3 months. Moreover, factors such as the presence of active periodontitis, the absence of keratinized mucosa or the accessibility to oral hygiene may play an important role during preventive strategies.<sup>9</sup>

#### 5 | CONCLUSION

The use of Delphi methodology has resulted in the development of trends for the diagnosis and treatment of peri-implant diseases and conditions in LA. The consensus and discrepancies reached among the experts will be used by the Ibero-Panamerican Federation of Periodontology as a tool for reinforcing those aspects in the diagnosis, prevention and treatment of peri-implant diseases where consensus among experts was not fully achieved, also identifying areas of future research.

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#### CONFLICT OF INTEREST

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

#### AUTHOR CONTRIBUTIONS

Alarcón and Sanz-Sánchez conceived the ideas drafted in the manuscript; López, Tavelli, Galarraga, Schwarz, Málaga and Sanz designed the questionnaire; Romanelli, Peredo, Pannuti, Javer, Vieira, Montealegre, Galindo, Umazor, Treviño, Fretes, Cisneros, Collins, Bueno, Giménez validated the questionnaire and supervised the application of the questionnaire in each country; Alarcón, Sanz-Sánchez, López drafted the manuscript; López, Galarraga, Collins analyzed the data; Sanz-Sánchez, Sanz, Tavelli, Pannuti and Schwarz critically reviewed the manuscript. All the authors participated in the consensus meeting and gave their final approval for all aspects of the research.

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