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Dentists' perceptions and usability testing of the implant disease risk assessment IDRA, a tool for preventing peri-implant disease: A qualitative study

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ABSTRACT

Introduction: we aimed to explore dentists' perceptions toward the implementation of a dental informatics risk assessment tool which estimates the risk for a patient to develop peri-implantitis.
Materials and Methods: the Implant Disease Risk Assessment Tool (IDRA) was presented to a convenience sample of seven dentists working in a university clinic, whom were asked to use IDRA with the information of three clinical cases whilst thinking aloud and then fill the System Usability Scale (SUS). A semi-structured interview technique was used with audio record to allow free expression of participants' perceptions related to the IDRA. The interviews information was categorized and analyzed by the authors.
Results: to our knowledge, this is the first study conducted to develop a qualitative usability test of IDRA, evaluating the effectiveness, efficiency, and users' satisfaction. There were more variations in responses the greater the degree of complexity of the clinical case. Generally, the participants classified the tool as good, getting usability values of 77,2 (SD 19,8) and learnability 73,2 (SD 24,5).
Conclusion: four additional factors should be considered to improve IDRA tool: 1) considering the relation between contour angle and *peri*-implant tissue height; 2) automatic periodontal classification in the IDRA tool after completing the periodontogram in the clinical software; 3) presentation of a flowchart to assist therapeutic decisions alongside the final score defined by the IDRA tool; 4) integrating of precision tests such as Implantsafe® DR… (dentognostics gmbh, Jena) and Oralyzer®(dentognostics gmbh, Jena).
Clinical Significance: etiology and pathogenesis of peri-implant diseases is multifactorial. These tools must follow a natural integration to be easily applied in a clinical setting. It is important to study their usability from the clinicians' point of view, evaluating the effectiveness, efficiency, and users' satisfaction.

1. Introduction

Peri-implant inflammation is associated with the presence of certain bacteria [1], other factors and clinical confounding variables have been identified [2]. Specifically, smoking, previous periodontal disease, poor oral hygiene, and residual excess cement have all been linked with peri-implant diseases [3]. Recent studies have also focused on the prosthetic features like restoration emergence profile and angle, showing that over-contoured restorations have higher risk of developing peri-implantitis [4].

The early diagnosis of mucositis is an effective way for decreasing the risk of developing peri-implantitis [5,6]. The diagnosis of peri-implantar diseases is mainly based on an array of clinical measurements and pocket probing depths, bleeding on probing and assessment of radiographic images. However, these clinical parameters alone are not enough to identify active peri-implant disease, future crestal bone loss, or future implant failure. Additional information based on medical records is also essential, but it does not provide information to the current state of disease activity, nor does it identify the individuals who are susceptible to future disease progression [7–9]. These conventional diagnostic protocols require several manual recordings and professional examiners with trained expertise. Also, clinical data refer only to established disease states, thus not being able to predict before clinical signs set in.

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Since the etiology and pathogenesis of peri-implant diseases have received increasing attention, a risk assessment tool was develop to predict the occurrence of peri-implantitis: the Implant Disease Risk Assessment (IDRA). This tool is used with the purpose of minimizing the chance of developing peri-implant tissue breakdown [10]. By understanding the key factors associated with the development of peri-implant diseases documented in the literature the clinician may selectively address such factors to improve the outcomes for implant therapy [11]. The analyses of results from recent studies addressing risk factors/indicators for biological complications associated with dental implants have identified eight important factors that may contribute to the development of peri-implantitis: 1) history of periodontitis; 2) percentage of sites with bleeding on probing (BOP); 3) prevalence of probing depth $\geq$ 5 mm; 4) bone loss in relation to the patient's age; 5) periodontitis susceptibility [12]; 6) supportive periodontal therapy; 7) implant restorative depth; and 8) prosthesis-related factors. These eight parameters have been combined in an octagon that helps visualizing the risk for disease development. A comprehensive evaluation using this functional diagram will provide an individual total risk profile and determine the need for measures targeting risk reduction. This new diagram was designed to allow incorporation of changes in line with future developments or additional factors become evident from the literature modifications [11].

This study aims to:

- Develop a qualitative usability test, evaluating the accuracy, sensitivity, and specificity of IDRA Tool.
- Understand the opinion of dentists regarding the implementation of clinical decision aid tools, such as IDRA.

2. Materials and methods

2.1. Study design, participants, and setting

This is a qualitative cross-sectional study followed the Consolidated Criteria for Reporting Qualitative Research Checklist (COREQ) [13]. For the present study we included a convenience population of dentists dedicated to the field of Implantology. All participants were invited to participate through an internal channel (institutional e-mails). At an early stage, two clinicians were purposively invited to participate in the study as they were qualified individuals in Dental Implants teaching in the University Catholic Portuguesa, Faculty of Dental Medicine (FMDUCP). The purpose of including especially these two clinicians was the need to verify and validate the protocol to practice with the target population. Therefore, all the described methodology was used first by these two clinicians, and after its verification and protocol improvement, it was presented to seven dentists dedicated to the field of Implantology. We believe seven individuals is adequate at the current stage of the intervention, as it yielded varied enough information to proceed on the qualitative study [14].

2.2. Procedures

The study design was divided into 1) usability testing of IDRA TOOL with think-aloud approach, 2) completion of System Usability Scale (SUS), and 3) semistructured interview with audio record as shown in Fig. 1.

To answer the first research question (What are the first thoughts, feelings or impressions of clinicians while practicing IDRA?) three clinical cases were presented to the 7 clinicians and they were asked to determine the risk of each clinical case using the IDRA tool (https://www.perio-tools.com/idra/en/). The clinical cases presented were real patients from the FMDUCP university dental clinic. For the creation of each case, text information was collected from the clinical record, together with the orthopantomography and the periogram. It should be noted that the cases follow an increasing gradient of complexity and seek to include several possible scenarios according to the tool's request (Supplement 1).

In this stage, the think-aloud approach was used. Each participant was instructed on how to think-aloud during the IDRA tool protocol intervention [15]. The goal of performing a think-aloud test is to record potential users' experiences and thoughts about this tool. The role of the principal investigator in the thinking aloud approach was to interact with the participants, guide them through the tasks, and encourage them to think aloud during the tests. The main researcher, as moderator, did not intervene or disrupt the thinking process, only if the participants actively asked for help where they guided to move forward with the tool.

After the thinking aloud, the clinicians were asked to complete the System Usability Scale (SUS) (Supplement 2). The SUS is a widely established tool within the field of usability research [16]. Its 10 items (e.g., 'I think that I would like to use this system frequently') were answered on a 5-point scale from 1 ('Strongly disagree') to 5 ('Strongly agree'). Individual overall SUS scores were determined following the procedure described by Lewis et al. [17], resulting in scores ranging from 0 to 100 in 2.5 point increments, where scores >68 were considered as above average, scores >80 as high, and 100 representing best possible usability [18]. To interpret individual SUS scores, corresponding adjectives (e.g., 'good' or 'excellent') identified by Bangor et al. [19] were added. It was chosen because of its extensive use in medical research, simplicity, and suitability for small sample sizes [18,19]. This scale was individually presented to the participants right after the first contact with the IDRA TOOL, before any discussion. The main objective of this scale is to ask participants to register their immediate response to each item, and not to deliberate the response for a long time. SUS is not a diagnostic tool. It was used to provide an overall usability assessment measurement, as defined by ISO 9241–11, which was made up to answer the following characteristics: effectiveness, efficiency, and satisfaction.

Additionally, a semistructured interview was conducted between the

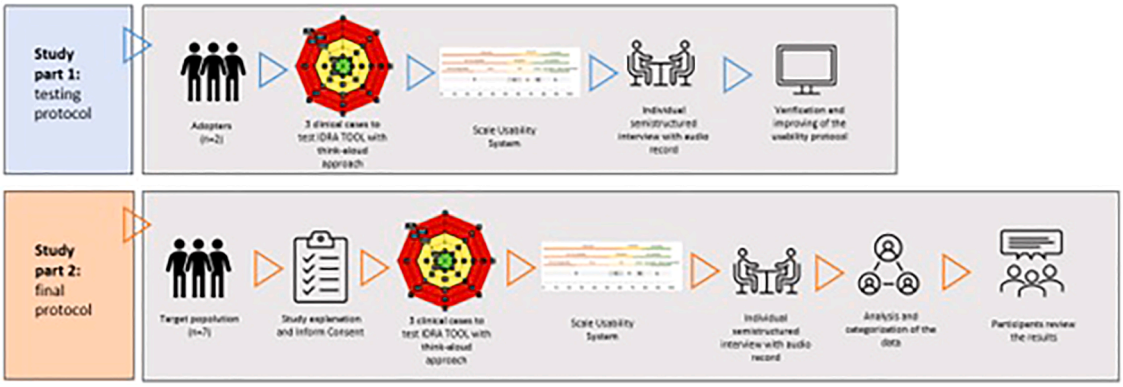

Fig. 1. Study protocol.

main researcher and participating clinicians to express their thoughts and opinions about their experience of use IDRA tool. The fact that a think-aloud method will always exclude some thought processes that are not held long enough to be expressed in working memory, a follow-up interview is commonly recommended to add in-depth information of participants thought processes and to allow interviewees to validate researchers' interpretation of their think aloud utterances [20]. Individually a discussion was conducted by the main researcher for each clinician to reflect on their perceptions toward the IDRA tool experience (Supplement 3). Those interviews were meant to answer the second research question: What are the clinicians' perceptions toward IDRA utility? The interviews were audio-recorded and then converted into English language by the principal investigator.

2.3. Data analysis

Considering the sample size, the data was processed using Microsoft Excel®(Windows). Data analysis included the listening and understanding of the audio recordings by the main researcher, and subsequently the categorization of the information into overall usability themes regarding the contents of the identified usability findings. Also, examples of each category were shown to illustrate each theme. Finally, a subsample of the participants was contacted to check and review the results. They were asked to comment if their views were totally represented and if they agreed with the authors' interpretation.

3. Results

In this section, the results from usability testing of IDRA Tool (Table 1, 2, and 3), the data collection of semistructured interview and think-aloud approach (Table 4), and completion of SUS (Fig. 2) are presented.

Table 1, 2, and 3 shows the answers given by the 7 participants when filling out the IDRA Tool. Although all the information presented to the participants was the same, the presence of variation in responses is verifiable, especially in clinical case 1 and 2. The identified themes are categorized on table 4 and to illustrate them, some examples used by the participants were summarized. To analyze the answers given by the 7 participants in the SUS, a bar graph was created (Figs. 2). The average usability rating measured via SUS was 76,4 (SD 19,2). In this study, the usability dimension had a score of 77,2 (SD 19,8) and the learnability dimension had a score of 73,2 (SD 24,5), indicating that patients perceived both usability and learnability of the IDRA Tool similarly as good [19].

4. Discussion

To our knowledge, this is the first study conducted to develop a qualitative usability test of IDRA Tool, evaluating the effectiveness, efficiency, and users' satisfaction. Overall, participants shared favorable beliefs and expectations about IDRA Tool and its ability to increase the early detection and prevention of peri-implant diseases.

Qualitative data enabled us to discover specified usability aspects as well as valuable recommendations. Accompanying interviews showed that appreciation, interest, and willingness to use were high. However, problems involving technical and clinical barriers interfered with some clinicians. Quantitative measures consisted of the usability testing protocol and the use of SUS questionnaire, wherein patients general usability rated as good (76,4), helped to identify potential issues which may eventually be improved or surpassed in a possible tool update.

4.1. Comparison of responses entered the idra tool considering think-aloud approach and the interviews

In an initial phase, it was intended to verify the first reactions and impressions of clinicians during the first contact with the IDRA Tool. The reactions obtained by the clinicians were homogeneous, reporting the tool was organized, visual and interactive (Table 4).

Regarding the first clinical case (table 1), it is verifiable that all clinicians interpreted the information presented in the same way, and therefore there was no variation in the responses inserted in the analyzed parameters of the tool. The same is not verified in the following clinical cases. Where a greater number of variations is notable especially in the third clinical case.

In the second and third clinical cases there is a variation of responses in the definition of the field "periodontitis susceptibility", which is corroborated by clinicians during the think aloud approach, where they claim that they are not familiar with the new classification of periodontitis and that only clinicians who are dedicated to the area of periodontology are able to easily identify the state and grade of periodontitis("…difficulty in classifying periodontitis"; "…requires knowledge of the new classification of periodontology…"). Some clinicians suggest the integration of IDRA tool into clinic software. After completing the periogram, the periodontal diagnosis, including state and degree of disease, could appear automatically in the tool ("Integrate this software tool so that the fields are filled in after completing the periodontogram").

Regarding the field " Number of sites with PD $\geq$ 5 mm ", there were no response variations, once necessary information was presented through a periodontal chart. Clinicians only must identify, count and register the number of sites with a probing depth equal or greater than to 5 mm. The same method was used to determine the supportive periodontal therapy.

Regarding the "% Alveolar bone loss" field, the response variations between clinicians in the second clinical case are notorious. A question that arose in this field was whether it applied to natural teeth and dental implants or only to natural teeth. Clinicians suggested that this field should be better detailed. Thus, when the tool is used, the user will have all the necessary information in the same place. In the third clinical case, as it is an edentulous patient, this field was automatically blocked, which was accepted with interest by the clinicians, once it facilitated filling out the tool, demonstrating its dynamics and interactivity between the different clinical cases ("…not having teeth, it blocks the field…"). Returning to answer variations, in the second clinical case, most clinicians answered correctly and without exposing doubts in the think aloud approach. However, 3 clinicians had doubts about how to account the bone loss of worst affected tooth site. Considering the reports of the 3 clinicians during think aloud approach, it is due to the way of identifying this bone loss, Heitz-Mayfiled et al. [11] indicate that "Bone loss is estimated from a periapical or bitewing radiograph". The

Table 1
Information referring to "clinical case 1″ entered by the 7 clinicians in the IDRA TOOL.

Participants identification Diagram parameters	A1	B1	C1	D1	E1	F1	G1
Periodontitis susceptibility	Health	Health	Health	Health	Health	Health	Health
Number of sites with PD $\geq$ 5 mm	0	0	0	0	0	0	0
% alveolar bone loss	0	0	0	0	0	0	0
Supportive periodontal therapy	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant
Restorative margin to bone	Soft	Soft	Soft	Soft	Soft	Soft	Soft
Implant prothesis	Cleanable	Cleanable	Cleanable	Cleanable	Cleanable	Cleanable	Cleanable

Table 2
Information referring to "clinical case 2″ entered by the 7 clinicians in the IDRA TOOL.

Participants identification Diagram parameters	A2	B2	C2	D2	E2	F2	G2
Periodontitis susceptibility	III	III	II	III	II	II	III
Number of sites with PD ≥ 5 mm	2	2	2	2	2	2	2
% alveolar bone loss	50	30	20	80	80	80	80
Supportive periodontal therapy	5 months or less	5 months or less	5 months or less	5 months or less	5 months or less	5 months or less	5 months or less
Restorative margin to bone	Soft	Soft	Soft	Soft	Soft	Soft	Soft
Implant prothesis	Cleanable	Cleanable	Cleanable	Cleanable	Cleanable	Cleanable	Cleanable

Table 3
Information referring to "clinical case 3″ entered by the 7 clinicians in the IDRA TOOL.

Participants identification Diagram parameters	A3	B3	C3	D3	E3	F3	G3
Periodontitis susceptibility	5 teeth loss	III	III	IV	5 teeth loss	5 teeth loss	5 teeth loss
Number of sites with PD ≥ 5 mm	19	19	19	19	19	19	19
% alveolar bone loss	–	–	–	–	–	–	–
Supportive periodontal therapy	None	None	None	None	None	None	None
Restorative margin to bone	>1,5	<1,5	>1,5	<1,5	>1,5	<1,5	>1,5
Implant prothesis	Not	Not	Not	Not	Not	Not	Not

fact that there is no rigorous method of measuring bone loss, but rather an estimate, clinicians are doubtful and reticent about their answer.

There were no variations in responses to the "Implant prothesis-related factors" field and there were no doubts or difficulties by clinicians in filling it out. Nonetheless, it is necessary to choose an assessment methodology with less subjective and more personalized. In this sense, patient *compliance* should be evaluated in this vector. Since even with the best intentions and efforts by health professionals, the expected goals will not be achieved if patients do not have a certain degree of *compliance*. The aim is to measure the plaque index at each visit by means of a plaque developer and then fill in the corresponding vector. The main goal is besides recording concrete data capable of quantitatively identifying the bacterial plaque of that individual, it also works as an awareness and form of doctor-patient communication in the improvement of oral health care [21–23].

The field "Restorative margin to bone" was the one that generated the most doubts during its completion and the one that obtained the greatest variation in responses. It's consistent in the literature that the distance of ≤1.5 mm from the restorative margin of the implant-supported prosthesis to the marginal bone crest at time of restoration as a risk indicator for periimplantitis. In this sense, Heitz-Mayfiled et al. [11] created the functional diagram according to this hypothesis: low risk for a soft tissue level implant, moderate risk as a distance of 1.5 mm, and high risk as a distance of <1.5 mm [24]. However, one of the doubts raised by the clinicians was "I can answer according to the patient's current status, but I don't know how it was when the patient was prosthetically rehabilitated." This hypothesis was already considered in the IDRA Tool presentation article. However, in the clinicians' opinion, an alternative to this field should be found. The evaluated factor would be more rigorous and invariable, such as the relation between contour angle and *peri*-implant tissue height [25].

A participant also highlighted the importance of having a flow-chart to assist therapeutic decisions alongside the final score defined by the IDRA tool. Currently, Heitz-Mayfiled et at. [26] published in the 13th volume of the ITI Treatment Guide a decision support flowchart, which supports and normalizes the therapy in cases of peri-implant diseases.

Lastly, two participants mentioned the importance of integrating

Table 4
Data collection of semistructured interview and think-aloud approach.

1. What are the first thoughts, feelings or impressions of clinicians while practicing IDRA?

Theme	Example
Confidence ($n = 5$)	"I see this tool capable of optimizing my check-ups for the patients I rehabilitate"; Would recommend 100%"; "I would use this tool a lot."
Organized ($n = 1$)	"…great to have the possibility to save the file at the end of each analysis"
Visual ($n = 3$)	"…it's not confusing at all, the diagram helps to understand which factor or factors we should try to modify"
Personalized ($n = 2$)	"…we can choose how many points to probe …"
Interactive ($n = 2$)	"…not having teeth, it blocks the field …"

2. What are the clinicians' perceptions toward IDRA utility?

Theme	Example
Consistency with guidelines ($n = 7$)	"…more prosthetic data should be incorporated… I don't know how the patient occludes, for example"; "…it was interesting to ask the height of the prosthetic abutment."
Barrier ($n = 7$)	"…difficulty in classifying periodontitis"; "… requires knowledge of the new classification of periodontology"
Limitation ($n = 2$)	"…I can answer according to the patient's current status, but I don't know how it was when the patient was prosthetically rehabilitated."
Complexity ($n = 7$)	"simple, useful tool …"
Systematized ($n = 3$)	"…tool that systematizes patient controls"; "helps improve patient controls"
Development ($n = 2$)	"…depending on the score that results from the tool, a kind of decision/therapeutic tree should be automatically generated to follow…"; "Integrate this software tool so that the fields are filled in after completing the periodontogram"
Scientific approach ($n = 2$)	"…genetic evaluation tests should be integrated, polymorphisms…but I don't know if it exists. I know for periodontitis, inflammatory response tests."
More training ($n = 7$)	"…has to be explained or studied before"
Aim of intervention ($n = 4$)	"…allows you to quickly identify patients at risk."
Link with clinical software ($n = 6$)	"…new classification is complex, it has to be well studied or else there is a way to have it done automatically here in the tool."
Didatic and educacional ($n = 1$)	"…an interesting tool from a didactic and educational point of view…"
Collaboration with recent clinicians ($n = 1$)	"…useful for clinicians to initiate contact with patients rehabilitated with dental implants, who still have not systematized the factors to be taken into account in the diagnosis of these pathologies."
Interact with patients ($n = 1$)	"…it generates valuable information, to be presented to the patient during the control appointments to have an objective examination and something tangible to be able to understand the state of health of the dental implants."

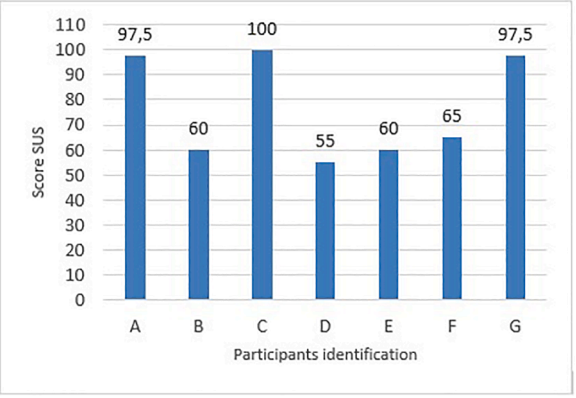

Fig. 2. Analysis of the SUS score of each participant.

precision tests into peri-implant risk tools, such as genetic tests or tests for inflammatory mediators. ImplantSafe® DR… (dentognostics GmbH, Jena) and ORALyzer® (dentognostics GmbH, Jena) tests have already been validated to function with a single biomarker, such as, aMMP-8 that is demonstrated as a biomarker of significance in the new classifications of peri-implantitis. These tests could be integrated into risk assessment tools with two main objectives. One with short-term results: identification of imbalances in the amount of aMMP-8 and consequently the early detection of peri-implant diseases, even before there are clinical signs. Another objective would be the creation of a database that gathered clinical and molecular data that in the long term would enable new lines of investigation and development of new approaches in diagnosis and therapy [27–32].

Although not mentioned by any of the clinicians surveyed, great importance has been attributed to the thickness of keratinized peri-implant mucosa to ensure long-term peri-implant health. Historically, classic studies attributed minimal importance to the peri-implant soft tissue conditions. Heitz-Mayfield, in a systematic review for the Sixth European Workshop on Periodontology found "no association between the absence of keratinized peri-implant mucosa and peri-implant disease" [33]. Later, Esposito et al. [34] stated that there is "insufficient reliable evidence to provide recommendations whether techniques to increase the width of keratinized/ attached mucosa are beneficial to patients or not". In the same period, Wennstrom and Derks [35] during the third EAO Consensus Conference found out that the evidence in support of the need for keratinized tissues around implants to maintain health and tissue stability is limited. In more recent years, the attention of the scientific community over the importance of soft tissues has dramatically increased as demonstrated by the great number of systematic reviews published in a short period of time: in particular, Gobbato et al. [36] found out that reduced keratinized mucosa width (KMW) around implants appears to be associated with clinical parameters indicative of inflammation and poor oral hygiene, suggesting the need of a certain amount of keratinized thickness to guarantee peri-implant health. In the same years, similar conclusions were drawn by Lin et al. [37] and Brito et al.60 who found that lack of adequate keratinized mucosa (KM) around endosseous dental implants is associated with more plaque accumulation, tissue inflammation, mucosa recession, and attachment loss. In 2021, the EAO organized the sixth Consensus Conference. Fickl et al. [38] investigated the influence of soft tissue augmentation procedures around dental implants on marginal bone level changes and found out that soft tissue augmentation either for augmentation of keratinized mucosa or soft tissue volume inconsistently influenced marginal bone level changes when compared to no soft tissue augmentation, but consistently improved secondary outcomes such as bleeding indices, mucosal inflammation, and peri-implant pocket depth. The combination of soft and hard tissue augmentation showed no statistically significant difference in terms of marginal bone level changes when compared to hard tissue augmentation alone but resulted in less marginal soft tissue [39]. Similar results have been published in the same period following the 2022 DGI, Osteology Foundation, and SEPA by Ramanauskaite et al. [40] who stated that, based on the observation that significantly less bone loss occurs around implants placed in thick tissue phenotypes com-pared to thin phenotypes, clinicians may be encouraged to augment thin, soft tissue before or during implant placement to enhance crestal bone stability. One of the remaining open questions is whether specific clinical thresholds in soft tissue thickness should be used to distinguish be-tween peri-implant health and disease: as reported by Ravida et al. [41] the presence of KM is not essential to achieve peri-implant health, but the quality of evidence supporting KM as a risk factor for peri- implant disease and the 2-mm cutoff point used in the literature is low at best. Very recently, Tavelli et al. [42] reported that implant sites characterized by the presence of KM were associated with a high stability of the peri-implant soft tissue margin. Two factors may have influenced the results of this literature research. First, different thresholds were used by different researchers to define an adequate width of KM to maintain peri- implant health. From a clinical perspective, the presence of a soft tissue seal around the collar of the implant, regardless of the dimensions, works as an effective barrier, capable of biologically protecting the peri-implant structures still seems of paramount im-portance. In this regard, it may be reasonable to suggest that an absence of KM and the presence of a thin (0–2 mm) band of keratinized tissue should be considered to represent two different clinical conditions, even though they were included in the same group, in several studies. The other important factor that could explain the lack of association between paucity of KM and peri-implantitis, is that the incidence of peri-implantitis increases with time. Therefore, to demonstrate a possible association, we would need several long-term studies, when instead most of the research on this topic is limited to a few years of follow-up [43–45].

Likewise, Rocuzzo et al. [46] demonstrated the presence of one or two adjacent teeth seemed to have no impact on peri-implant marginal bone level changes, rejecting scientific hypothesis that periodontal attachment of a tooth adjacent to a dental implant plays a beneficial role in maintaining the peri-implant marginal bone level [47].

4.2. *Comparison sus considering think-aloud approach and the interviews*

In Fig. 2, it is possible to verify the results of the questionnaire completed by all participants.

Generally, in Fig. 2, the SUS score of each participant can be observed, with the divergence of results in 2 groups being notorious: a group with a score between 97.5 and 100, and another group with a score between 55 and 65. This duality represents the feedback given by clinicians during the individual semi-structured interview. On the one hand, there were clinicians who mentioned positive points such as "… tool that systematizes patient controls", "helps improve patient controls" and "…allows you to quickly identify patients at risk". In the opinion of these clinicians, it is a clinical decision support tool, which helps not only to systematize the factors to be considered during the control consultations of patients rehabilitated with dental implants, but also helps to quickly identify, with only 8 factors, the risk of peri-implantitis of a given patient. On the other hand, some clinicians consider this tool interesting for young dentists who are starting to get in touch with the area of oral implantology, so with this tool they will be able to have the parameters that they should consider to evaluate the risk of a patient developing a peri-implantitis. The same participants also mention the interest of this tool for explaining to the patient their risk of developing a peri-implant disease, showing through the functional diagram which parameters can be modified to alter the risk.

4.3. *Limitations*

The conceptual and exploratory nature of this study implies less

statistics and have left most of the data up for personal interpretation by the researcher. Even though the intentions have been to avoid it, the potential bias should not be underestimated.

5. Conclusions

Based in these findings, future efforts should focus on improving and standardizing protocols and reporting of prediction modeling in peri-i-implant diseases, conducted to implementation of validated models in clinical practice, measuring their utility and considering new sources of predictors.

Ultimately, through this usability test study of the IDRA tool, it is agreed that the following 4 aspects should be considered:

- Considering the relation between contour angle and *peri*-implant tissue height;
- Automatic periodontal classification in the IDRA tool after completing the periodontogram in the clinical software;
- Presentation of a flowchart to assist therapeutic decisions alongside the final score defined by the IDRA tool;
- Integrating the results of precision tests such as Implantsafe® DR… (dentognostics gmbh, Jena) and Oralyzer®(dentognostics GmbH, Jena).

CRediT authorship contribution statement

Rita Bornes: Conceptualization, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing, Project administration. **Javier Montero:** Conceptualization, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing, Project administration, Supervision. **Ana Ferreira:** . **Nuno Rosa:** Conceptualization, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing, Project administration, Supervision, Funding acquisition. **André Correia:** Conceptualization, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing, Project administration, Supervision, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jdent.2023.104630.

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