GRADUATION PROJECT

Degree in Dentistry

TITLE:

81: SUCCESS CRITERIA IN PERI-IMPLANT HEALTH: THE IMPORTANCE OF KERATINIZED TISSUE

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RESUMEN

La salud peri-implantaría es un determinante crítico del éxito de los implantes dentales. Más allá de la osteointegración y la estabilidad radiográfica, la función del tejido queratinizado (TQ) ha adquirido una relevancia clínica como componente protector del tejido blando que rodea los implantes dentales. Una anchura insuficiente de TQ se ha asociado con mucositis peri-implantaría, peri-implantitis, recesión mucosa y acumulación de placa. Los objetivos de este estudio incluyen: evaluar la función del tejido queratinizado en el mantenimiento de la salud peri-implantaría y determinar su importancia como criterio de éxito del implante, evaluar si una mucosa queratinizada insuficiente se asocia con complicaciones en la salud peri-implantaría. Se llevó a cabo un estudio empírico transversal mediante un cuestionario de 17 preguntas respondido por 102 profesionales, incluyendo odontólogos e implantólogos, con distintos años de experiencia. Los datos se recogieron a través de Google Forms y se analizaron mediante estadística descriptiva, gráficos y tablas. Los resultados demostraron que el 97% de los profesionales evaluaba rutinariamente la anchura del TQ durante la planificación del tratamiento. El 98% coincidió en que el TQ mejora la estabilidad del implante a largo plazo. El 67% asoció la ausencia de TQ con mucositis peri-implantaría o peri-implantitis. Zirconio fue el material de elección para las coronas (77%). Por lo tanto, el TQ es un criterio fundamental y reconocido para el éxito del implante entre los profesionales dentales. Una anchura adecuada de TQ, junto con un seguimiento peri-implantario rutinario, es esencial para prevenir enfermedades y garantizar la estabilidad del implante.

PALABRAS CLAVE

Odontología, Tejido queratinizado, salud periimplantaria, periimplantitis, implantes dentales.

ABSTRACT

Peri-implant health is a critical determinant of long-term dental implant success. Beyond osseointegration and radiographic stability, the role of keratinised tissue (KT) has gained increasing clinical relevance as a protective soft tissue component surrounding dental implants. Insufficient KT width has been associated with peri-implant mucositis, peri-implantitis, mucosal recession, and increased plaque accumulation. The objectives of this study include evaluate the role of keratinised tissue in maintaining peri-implant health and determine its significance as a criterion for implant success, whilst assessing whether insufficient keratinised mucosa is associated with peri-implant health complications. An empirical cross-sectional study was conducted using a 17 questions questionnaire answered by 102 dental professionals, including general dentists and implantologists, with varying years of experience. Data were collected via Google forms and analysed using descriptive statistics, graphs, and charts. The results demonstrated 97% of practitioners routinely evaluated KT width during treatment planning. 98% agreed KT improves long-term implant stability. 67% associated absent KT with peri-implant mucositis or peri-implantitis. Zirconium was the dominant crown material choice (77%). Thus, KT is a fundamental and widely recognised criterion for implant success among dental professionals. Adequate KT width, alongside routine peri-implant monitoring, is essential for preventing disease and ensuring long-term implant stability.

KEYWORDS

Dentistry, keratinised tissue, peri-implant health, peri-implantitis, dental implants.

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1. INTRODUCTION

1.1 Peri-implant health

Dental implants are widely used and recognised as a treatment option for the replacement of missing teeth for edentulous or partially edentulous patients (1). When evoking the long-term survival of implants; the mobility, the level and quality of bone, or the absence of infection are often recognised as important criterion. Although these are pivotal, the stability and longevity of dental implant depend widely on the maintenance of soft tissue around the dental implant, known as peri-implant tissue health (2) (3).

Peri implant health refers to the ideal, non-diseased condition of the tissue surrounding an osseointegrated dental implant. Firstly, it is characterised by the lack of inflammation: no presence of erythema or swelling. The visual appearance should resemble healthy gingiva. Secondly, upon probing, there should be no bleeding nor suppuration (4), although recent searches have permitted to have a single bleeding spot around the implant (5). Thirdly, the probing depth should not increase overtime compared to the baseline measurements. Additionally, the implant must be stable in situ without mobility (6). The surrounding bone should be stable, with no signs of bone loss or resorption. Thus, the changes occurring during physiological bone remodelling after surgery don't jeopardising peri-implant health (5).

1.1.1 Anatomy of the peri-implant tissue

Anatomically, peri-implant tissue can be divided into two parts, soft and hard tissues. The soft tissue includes the peri-implant mucosa, which results after the healing of the dental implant. Whereas, the hard tissue, constituted by the bone, is in close contact with the implant abutment and is responsible for its stability through osseointegration. Therefore, they are interrelated in ensuring implant success as the mucosa provides protection and seal to the underlying bone and the bone itself protects the implant (4). The peri-implant tissue anatomy differs from natural teeth as they lack periodontal ligament and root cementum, but its components aim to present similar roles. The soft tissues included in the peri-implant area are the junctional epithelium, the connective tissue (CT), and the keratinised mucosa (KM).

The outermost epithelium is the masticatory epithelium which is orthokeratinised and ends in the gingival margin crest, in its continuation we find the junctional epithelium. The junctional

epithelium (JE) is directly in contact with the implant and achieve adhesion via hemidesmosomes, thus, the JE forms a transmucosal seal around the implant to protect the bone underneath from bacterial or mechanical invasion. The JE height is usually 1.5 to 2mm (4). Inferior to the JE lies the CT, its layer is 1-2mm thick and is composed of collagen fibres in direct contact with the implant surface, unlike in natural teeth, the fibres are oriented in parallel or circumferential manner since there is a lack of cementum and Sharpey's fibres. This explains the reduced vascularity in peri-implant tissue. Additionally, the JE and the CT form apically the supracrestal tissue height of 3-4mm including attachment fibres, previously called the biological width (figure 1) (7). This component of the peri-implant tissue cannot be disrupted, as an invasion of the biological width results in breaking the hermetic seal around the implant putting at risk the longevity of the dental implant (8).

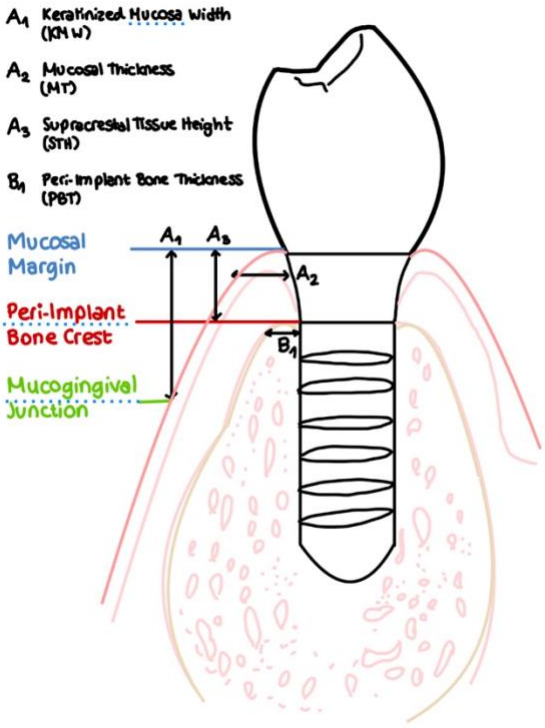


Figure 1: Illustration of KT and peri-implant anatomy

1.1.2 What is keratinised tissue

The keratinised mucosa (KM) is an important component of the peri-implant soft tissue. It runs from the mucosal margin to the mucogingival junction and form the height of the keratinised tissue (KT) (Figure 1) (7). It is lined by keratinised epithelium enabling a protection against harmful friction from the external environment. The phenotype of the peri-implant mucosa includes keratinised mucosa width, mucosal thickness, supracrestal tissue height, and the peri-implant bone (8). The KM possess a lamina propria constituted of fibrous connective tissue and collagen fibres. The role of the KM is to provide optimal sealing and constitute a barrier to potential intrusion from bacteria or external components, despite being weaker than natural teeth. A healthy KM is ideally >2mm, to prevent gingival recession, bone loss, and facilitate patient oral hygiene. Hence, KM has a crucial role in preventing mucosal inflammation and further complication.

1.1.3 How to measure the width of keratinised mucosa

KM width is measured with a periodontal probe before, during, and in the post-operative follow-up of implant surgery. The sufficient amount of the KM width predicts whether the peri-implant tissue will provide stability to the implant (3,8).

1. **Limits of the KM width:** The first step is to identify the limits of the keratinised mucosa: the distance from the mucosal margin or free gingival margin to the mucogingival junction (8).
2. **Measurement location:** It is measured in the buccal (vestibular) side of the implant crown (6,9).
3. **Mucogingival line location**: using the periodontal probe, distinguish between the free mobile mucosa and the fixed keratinised tissue. Position the probe in a horizontal manner on the free mobile mucosa. Then, we move the probe coronally until we see ischemia of the surrounding tissue. The line where the ischemia is observed constitutes the mucogingival line (9).
4. **Measurement recording**: the measured in recorded in absolute numbers to avoid observer bias. The recommended width is $\geq$ 2mm, it is the threshold value to distinguish between sufficient and insufficient width of KM (2).

1.1.4 Clinical relevance of measuring KM width

Quantifying the width of KM is relevant as sufficient amount can avoid soft tissue complications, facilitate the patient's oral hygiene, and allow prediction on soft tissue stability and underlying bone around the implant (3,8) .

Insufficient amount of KM width is related with increased accumulation of plaque and more mucosal tissue inflammation. Therefore, adequate KM width participates in better mucosal tissue maintenance as it provides a barrier against microorganism invasion. Hence, measuring the width of KM is crucial in the process of patient rehabilitation with dental implants as it can prevent the development of peri-implant complications (3,5,8,10).

In case of insufficient KM, there is preventative measures to increase its width to avoid these complications. These include free gingival grafts (5), apically positioned flap along with an autologous graft (8), subepithelial CT graft, leukocyte and platelet rich fibrin membrane placement and PRF membrane (1).

1.2 Importance of peri-implant health

As the use of dental implants is growing, it also means the rise of implant related diseases such as peri-implant mucositis or peri-implantitis. The understanding about peri-implant health is vital as it allows to recognise the first signs of disease, therefore, allowing dentists to prevent their appearance through close monitoring of peri-implant health parameters. Furthermore, demonstrating the clinical relevance this subject has gained over the years (10).

1.3 Understanding peri-implant mucositis and peri-implantitis

Peri-implant diseases result from complications occurring due to a disbalance between bacterial invasion and the host response to the aggression, occurring around a dental implant previously osseointegrated. Peri-implant mucositis and peri-implantitis are most frequent. The prevalence of peri-implant mucositis is 2/3 of adults with implants and peri-implantitis is 1/4 of adults (11). These numbers show these are frequently occurring diseases, therefore, acquiring knowledge to best recognise them, allows to achieve better prevention and avoid more severe manifestations (3,5).

1.3.1 Peri-implant mucositis

Peri-implant mucositis is a localised inflammation affecting solely the peri-implant mucosa without affecting the underlying bone. It is a reversible process known to be the predecessor of peri-implantitis if not diagnosed in time (3,12).

The aetiology of the disease mainly is the aggregation of bacterial biofilm in the form of bacterial plaque around the implant. Studies have shown that the biofilm must be present for 3 weeks to trigger an inflammatory response. From a histologic point of view, it resembles gingivitis as we can appreciate a clear inflamed lesion adjacent to the junctional epithelium along with infiltrates such as plasma cells or B- and T-lymphocytes (3,5).

There are multiple diagnostic criteria of peri-implant mucositis established by the “2017 World Workshop on the classification of Periodontal and Peri-Implant Diseases and Conditions”. Firstly, the existence of inflammation in the peri-implant soft tissues such as swelling and redness. Secondly, bleeding and/ or suppuration upon probing. Bleeding can be at a single spot around

the implant or as a line of bleeding upon probing anywhere around the implant. The probing depth can be increased or not compared to previous visits. To add, there is no evidence of bone loss in radiographic tests (5,8,12).

Peri-implant mucositis is a reversible disease, since upon the removal of the biofilm, the mucosal tissue heals, and inflammatory biomarkers decrease in the sulcular fluid of the peri-implant. However, if not diagnosed in time, the biofilm can sit deep into the submarginal space, where it is more difficult to achieve a total removal (3).
It is advised to treat the condition promptly and establish preventive measures before reaching the next, more aggressive phase of the disease (3).

1.3.2 Peri-implantitis

Peri-implantitis is characterised as a pathological disorder closely related with biofilm, inflammation of the mucosa around the implant, and gradual bone loss around the implant unlike in peri-implant mucositis. Therefore, the inflammation is more extensive and reaches the bone, progressively absorbing it (3,5,11).
The diagnosis criteria of peri-implantitis include inflammation in the peri-implant tissues, bleeding and/ or suppuration upon probing at a single point or in a line at any point around the implant, increase in the probing depth in comparison to previous visits.
Importantly, circumferential bone loss which exceeds the initial bone remodelling loss after implant surgery. Periapical radiographs are required to confirm the level of bone reabsorption (3,12,13).

The aetiology is related to biofilm infiltration in the peri-implant space and is polymicrobial. Peri-implantitis tend to develop rapidly and progress in an apical direction. The inflammatory infiltrate is bigger in size and in density containing more plasma cells, B-lymphocytes, macrophages, and neutrophils. The presence of a cascade of cytokines (IL1-alpha, TNF-alpha, IL-6) stimulating osteoclasts, further explains bone destruction. Therefore, this condition is more aggressive. Hence, the importance of early diagnosis and preventive measures to improve the treatment outcome (3,5,8).

2. OBJECTIVE

General objective:

- Evaluate the role of keratinised tissue in maintaining peri-implant health and determine its significance as a criterion for implant success.

Specific objectives:

- Assess whether a lack of keratinised mucosa is related to peri-implantitis/ other implant-related complications
- Determine what constitutes peri-implant health

Hypotheses:
The null hypothesis (H_0) is that the presence or absence of keratinised tissue has no effect on the peri-implant health and doesn't contribute to the clinical success.

The alternative hypothesis (H_1) is that keratinised tissue is indispensable for a sustained healthy peri-implant health, and it contributes to the successful clinical outcome of an implant. Therefore, avoids the development of complications such as peri-implant mucositis and peri-implantitis.

3. MATERIAL AND METHODS

3.1 Study design

The design of the study is empirical research; information must be gathered to obtain results. A questionnaire composed of 17 questions was created, aimed at dentists or specialist in implant, or surgery (Annex 1).
The objective of the questionnaire is to: identify whether monitoring peri implant tissue health before, during, and after implant surgery has an impact on the success of the procedure, identify what parameters are measured to ensure a healthy peri-implant tissue, what techniques are used to maintain keratinized tissue width, if the chosen material for the implant crown has an impact on the success, and assess the awareness of dentists on the importance of peri-implant health and keratinized tissue for the long term stability of the implant. Furthermore, the focus is on the upper maxilla from teeth 15 to 25.

3.2 Sampling size

The sampling choice is purposive sampling, as the participants in the sample are selected based on their knowledge on the subject.

The sample size is aimed at 100, to get relevance in the results obtained and distinguish if there is a form of consensus on the subject throughout dentists and specialists.

The recruitment process to invite participants is done through sharing the online form to dentists, ask the professor at the policlinic of the university, and going to the master's clinic to gather more answers from teachers and students.

3.3 Inclusion and exclusion criteria

The target population are dentists or specialists in implants or in surgery. The inclusion criteria include dental professionals that have experience in implant surgery and placement, or dentists specialized in implantology.
Thus, dentists specialized in other fields of dentistry, who are not familiar with implant surgery cannot answer my questionnaire. Dentistry students are also excluded from my sample since they don't have the knowledge to answer and help in the research. The public is also excluded since they won't be able to answer the questionnaire.

3.4 Interventions

The questionnaire was designed; it is composed of 16 multiple choice questions and 1 open question accessible through Google Forms. The format chosen aims to keep it simple and quick for participants to answer, requiring a maximum of 3-4 minutes.

The first two questions aim to discover the level of specialization and the years of experience of the participant. Then, the questions are divided into before, during, and after implant surgery, to assess whether peri implant health and width of keratinized tissue is a real parameter considered throughout the whole process or if it is considered only when complications appear. To add, it also focuses on the post-operative protocol focusing on peri-implant tissue health among professionals.

A pilot testing was conducted to ensure the content of the questionnaire is understandable and clear. Therefore, it was sent to a small group of dentists for them to answer and to get their feedback on the time it took to answer and their impression on the reliability of my questions before sending it to the ethics committee.

3.5 Data collection and analysis

In the data analysis phase, the objective is to establish a correlation between healthy peri-implant tissue, enough keratinized tissue and the success of implants. Therefore, graphs, tables, and charts will be used to demonstrate my results.

3.6 Limitations and Ethical issues

This research project presents several limitations. Firstly, the relevance of my research is based on the numbers of answers collected. Therefore, less than 100 responses to the questionnaire, will incapacitate me to draw relevant conclusion. Secondly, the results will be focused on dentists that are in my network, therefore, it's unlikely to get the opinion of dentists from the United States, Asia, ... This means the opinions can be limited as the sample include dentists from similar environment that can be unaware of some technologies/ protocols used in other countries. This might jeopardise the general validity of my research.
To add, the answers gathered may contain bias as dentists/ professionals won't answer honestly if it means showing they are wrong or that they don't do their job properly by not monitoring certain parameters in implant surgery.

In terms of ethics, before starting the phase of data collection, the questionnaire was approved by the ethics committee of Universidad Europea with CI code: 2026-101 and department code: OD.031/2526.
Additionally, the dentists who participated were required to provide their informed consent adapted to the research. The data collected is anonymous and remains confidential. The responders have the right to retract from participating in the research at any time which is indicated in the Google form.

4. RESULTS

QUESTIONNAIRE RESULTS SUMMARY

Total Respondents: 102

Questions	n	%
Professional Role		
A dentist	43	42%
A specialist in implantology/ surgery	59	58%
Years of Experience		
1-5 years	29	28%
6-10 years	20	20%
11-15 years	53	52%
Do you routinely evaluate KT width before implant placement?		
Yes	99	97%
No	3	3%
Minimum width of KT before implant placement?		
1-2mm	30	48%
>2mm	30	50%
If KT absent/insufficient, what do you recommend?		
Free gingival graft	57	56%
Subepithelial connective tissue graft	30	29%
Collagen matrix/ Soft tissue substitute	11	11%
No specific intervention	4	4%
Do you place implants using?		
The conventional technique	68	67%
Guided surgery technique	34	33%
Do you consider KT level/thickness during surgery?		
Yes, always	89	87%
Only in certain cases	13	13%
Specific techniques to preserve/increase KT?		
Coronally advanced flap	43	42%
Simultaneous grafting	24	24%
Flapless technique	16	16%
No specific technique	18	18%
Not evaluated	1	1%
Does KT facilitate soft tissue handling during surgery?		
Yes	97	95%
No influence	2	2%
No	3	3%
Do you monitor BOP post-surgery?		
Yes	66	65%
No	25	25%
Not evaluated	11	10%
Do you measure probing depth post-surgery?		
Not evaluated	24	24%

No	50	49%
Yes	28	27%
What is absence of KT associated with?		
Peri implant mucositis/ Peri implantitis	68	67%
Increased mucosal recession	30	29%
More bleeding on probing	3	3%
No Clinical difference	1	1%
Does KT improve long-term peri-implant stability?		
Yes	98	98%
Uncertain	3	2%
Do you measure parameters at 2-year follow-up?		
Yes: BOP, Probing depth	72	71%
Only if the patient present complications	27	26%
No	3	3%
Crown material prefered for long-term stability of implants?		
Zirconium	79	77%
Zirconia crown with T base	15	15%
Metal porcelain	3	3%
Lithium disilicate Empress	5	5%

Table 1: Questionnaire results summary

4.1 Sample population and demographics

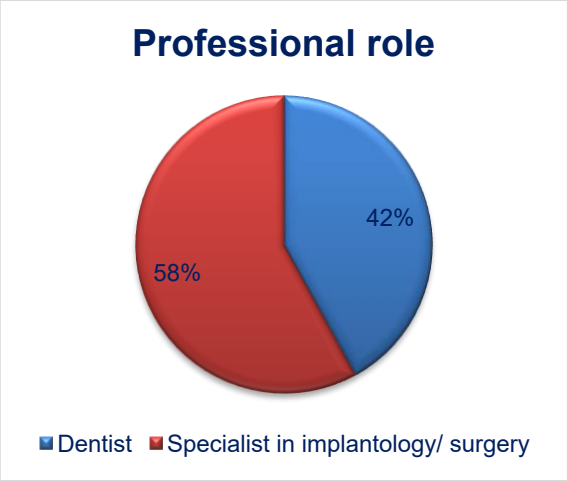


Figure 2: Repartition of the dental professionals in sample

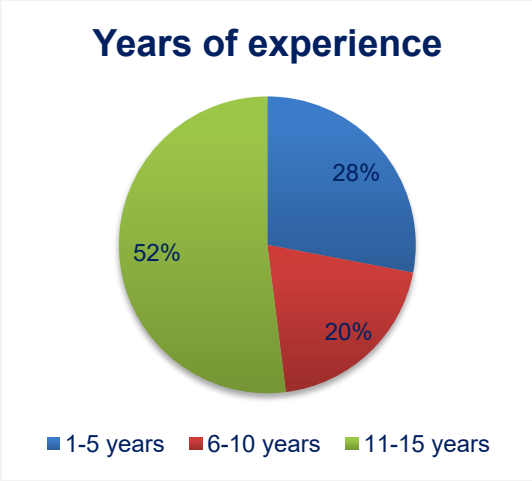


Figure 3: Experience (years) of sample

4.2 Keratinized tissue evaluation and management in practices

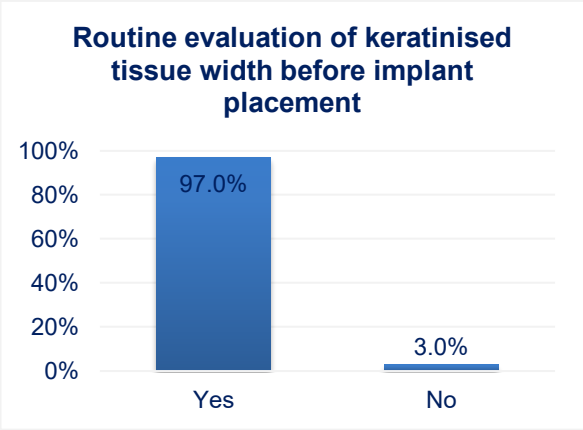


Figure 4: % of dentists in sample evaluating KT in planning process

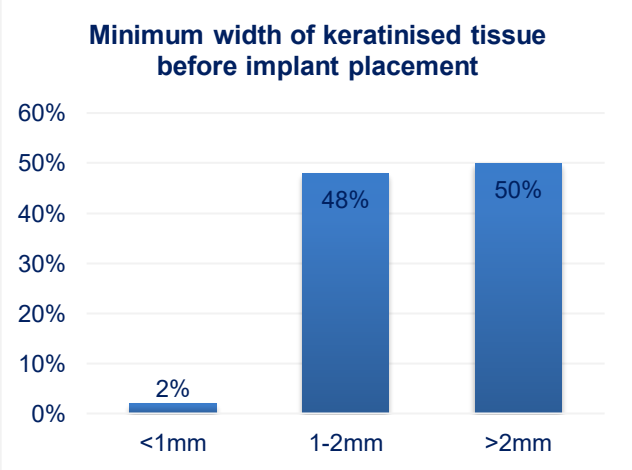


Figure 5: Opinion of dentists regarding the minimum width of KT

4.3 Management of Deficient KT

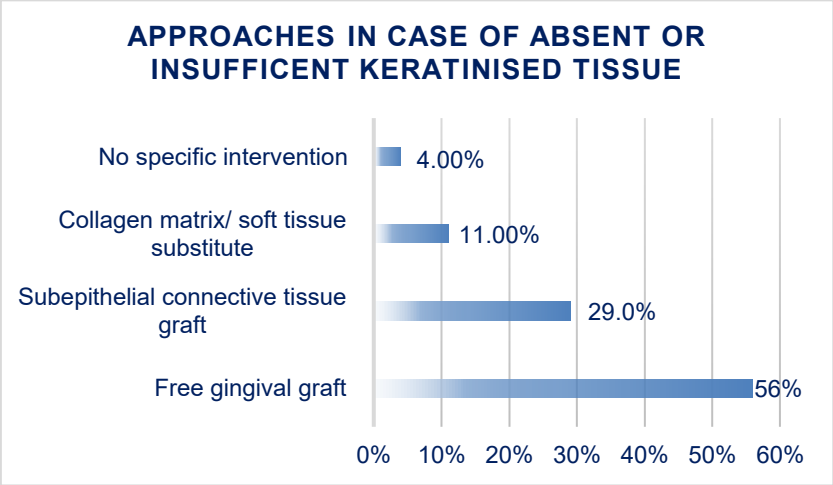


Figure 6: Techniques used in case of insufficient KT

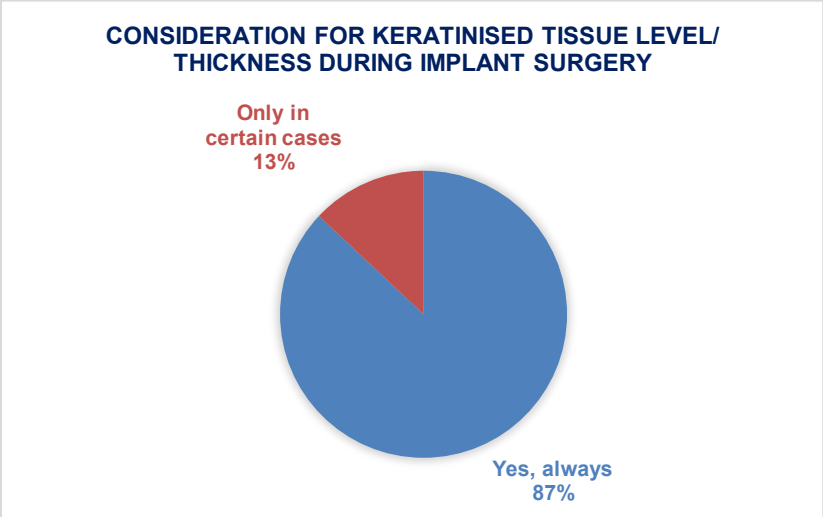


Figure 7: % of dentists KT level during implant surgery

4.4 Surgical methods and follow up considerations

The dental professionals in the sample revealed a preference to place implants for the conventional technique with 67% (n=68), while the guided surgery technique was preferred by 33% (n=34).

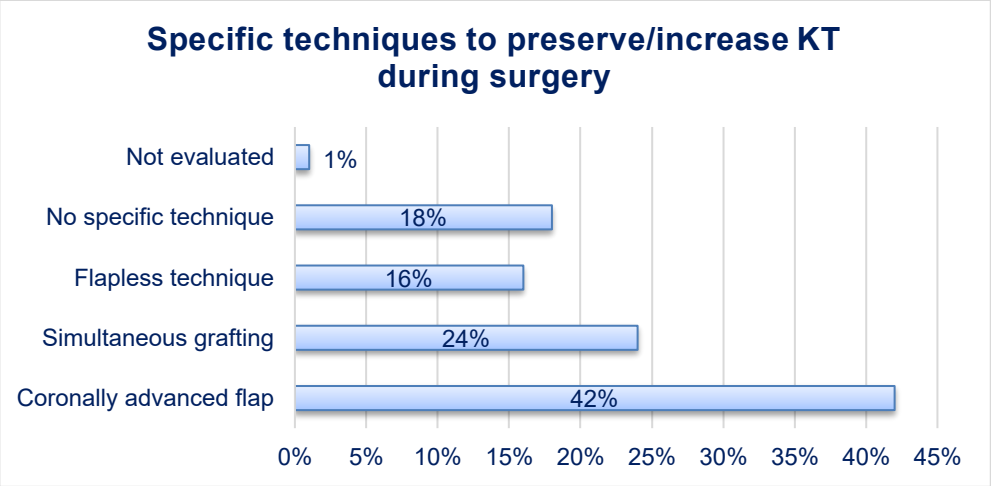


Figure 8: Techniques used by sample to increase KT during surgery

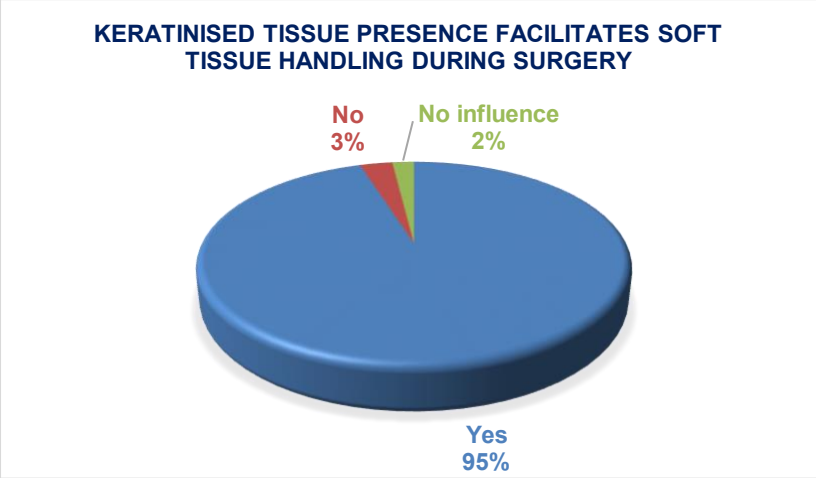


Figure 9: % of dentists in sample for who KT presence helps in tissue handling during surgery

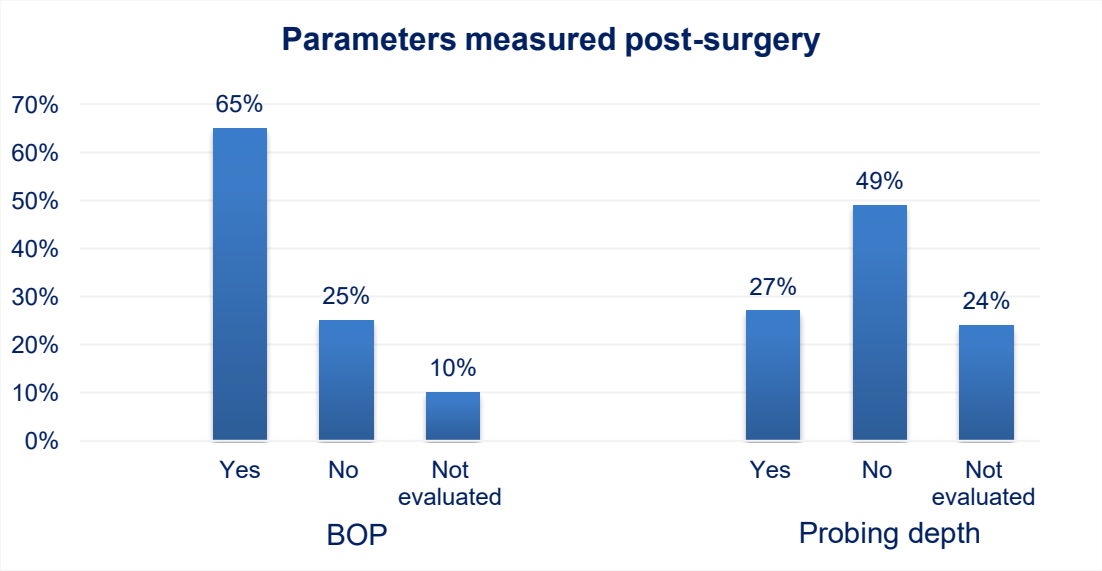


Figure 10: Parameters used in follow-up

4.5 Significance of keratinized tissue

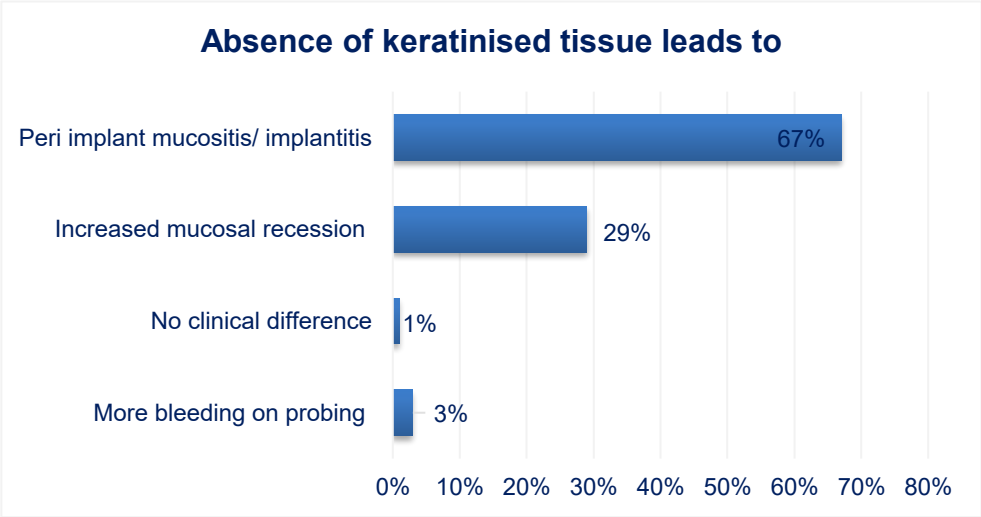


Figure 11: Complications following a lack of KT

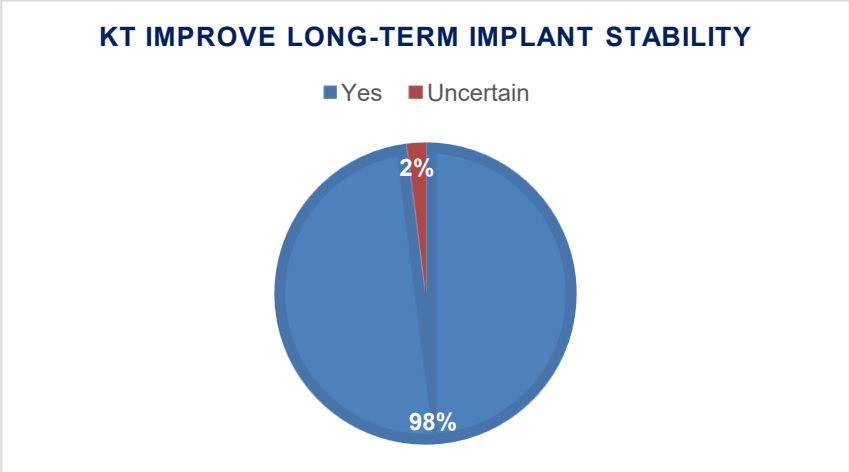


Figure 12: Positive effects of KT on implant outcome

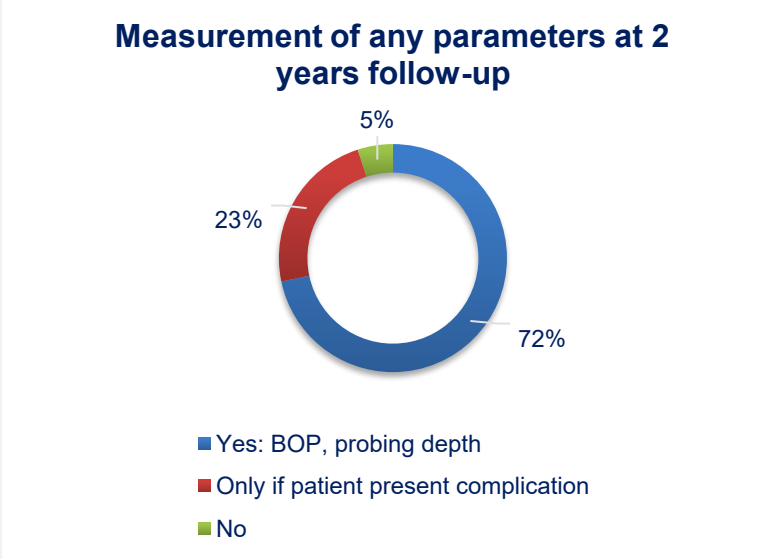


Figure 13: Parameters used in the follow up to monitor peri-implant health

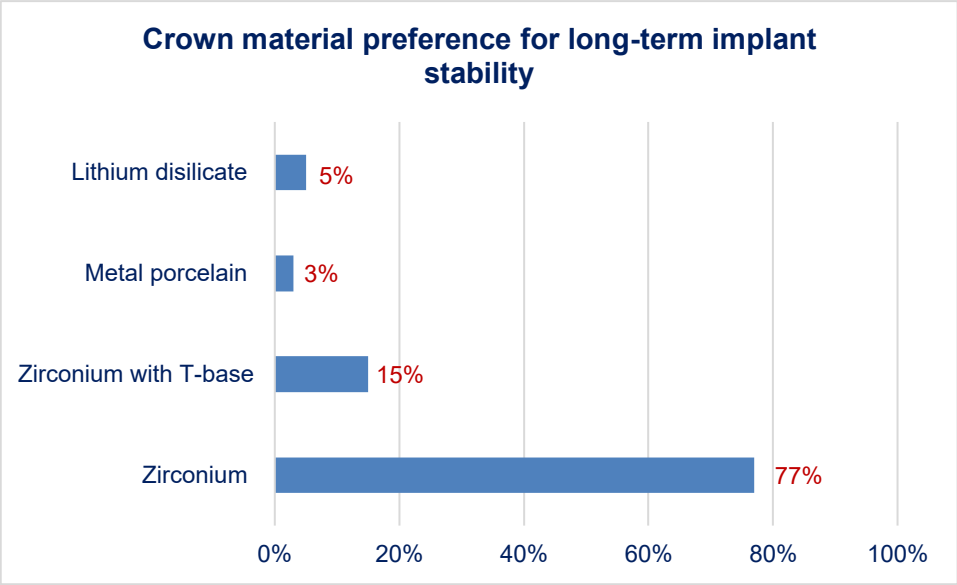


Figure 14: Preferred crown material for implant stability

5. DISCUSSION

The results gathered from the sample of 102 dental professionals with different clinical experience show that KT plays an important role in modern implant surgery.

Firstly, after analysing the results, peri implant health definition has evolved significantly. Previously, the determinants of success were focused mainly on the osseointegration and radiographic stability of the implant. Recently, peri-implant health adopts a more multi-factorial approach with the importance of keratinised tissue which has gained crucial clinical relevance.

The study sample has reached a consensus on the significance of KT to both achieve and maintain health in the peri-implant. Therefore, nowadays a necessity for an adequate surgical outcome and achieve successful long-term stability of implants, supporting H_1.

The fact that 97% (n=99) of the practitioners evaluate KT width before surgery suggest that KT is now a recognised and fundamental parameter to ensure an adequate planning and clinical outcome. Furthermore, the threshold for minimum KT width was agreed by 48% (n=49) for 1-2mm and by 49% (n=50) for >2mm, these results don't suggest that a strong disagreement was established within the sample but rather strengthen the importance of KT. Regarding the first group (1-2mm), being satisfied with a "smaller" amount of KT in this case doesn't undermine its importance but rather shows that a small amount still has the sufficient protective features and biological seal for the expected results.

It can also describe a more realistic answer, as not all patients will have >2mm and if KT augmentation procedures must be done for every implant surgery, it would increase the time, skills and resources required significantly for dentists. To add, many patient cases have reported to be successful with 1mm of KT width, which proves the point that little presence of KT, in a biological point of view is still a better than none (9). The second group (>2mm) relies more on best case scenario approach and emphasises that more KT will provide greater tissue resilience and more biological seal around the abutment. This includes greater protection against inflammation and microtraumas the implant site will suffer over the years. Additionally, more KT leads to greater aesthetic outcomes and increased resistance to recession. Hence, 1-2mm threshold represents a minimum target below which complications can emerge and >2mm is the optimal threshold, improving the clinical outcome.

The results gathered showing 87% (n=89) of the dental specialists in our sample analyse KT during implant placement suggest that KT consideration is done throughout the whole process

and not merely in the planning. It constitutes additional evidence demonstrating the significance of KT level. Furthermore, the agreement between dental professionals to increase the amount of KT in case of absence or insufficiency at 96% (n=98) supports that KT width is clearly a criterion for success (14). This means only 4% (n=4) don't use augmentation techniques. Most practitioners (n=87, 85,2%) showed preference for autogenous graft technique; free gingival graft (n= 57, 55,8%) and subepithelial connective tissue graft (n= 30, 29,4%) rather than collagen or soft tissue substitutes (n=11, 10,8%). The results obtained support the literature as free gingival graft is mostly used and provides predictable results in gaining KT width when the patient presents 0.5mm of KT or less (15). Followed by subepithelial connective tissue grafts which are widely used for the augmentation of both the width of KT and soft tissue thickness around the implant (16). Although their use requires two surgical sites and might compromise the aesthetic due to colour and texture. Their strong adoption reflects that the sole purpose is not to increase the amount of tissue but rather to recreate an environment around the implant with the biological and mechanical properties of true keratinised gingiva (15,16).

Regarding the facilitation during surgery, 95% (n=97) of dentists agreed that the presence of KT in sufficient amount helps in the handling of soft tissue during implant surgery. On the other hand, only 3% (n=3) responded it has no influence and 2% (n=2) conferred it doesn't change anything. It has been shown that enough KT provides increased precision and stability while placing implants. Along with greater ease for the surgical procedure as the techniques are more predictable and easier to perform for the dental specialist (15–17). However, the abilities and correct use of surgical procedures by the dentists remain of upmost importance for the outcome. Furthermore, 97% (n=98) of the sample have stated that the presence of KT in recommended amount improves the long-term stability of the implant. This remarkable unanimity, despite the varying background of the professionals within the sample highlights the clinical importance of KT for sustained peri-implant health. This aligns with the properties KT gives, including, less plaque accumulation (5), better soft tissue attachment in the promotion of stable epithelial and CT (9), reduction of potential inflammation as KT acts as a protective barrier, reduced risk of peri-implant mucositis and peri-implantitis (2,10).

These two sets of results confer that KT presence is primordial both during the surgery for the immediate outcome and after for the development and healing of a stable and healthy implant environment. To add, its natural properties significantly improve patient satisfaction in terms of comfort, hygiene and aesthetics.

With respect to the parameters after surgery, professionals demonstrated more importance to measure the BOP (n=66, 65%) after implant surgery, compared to the probing depth itself (n=28, 27%). The feedback gathered from most professionals on the BOP and probing measurement is not significant directly after surgery. A plausible explanation is that the implant site remains vulnerable in the immediate post-operatory period, and minimising further trauma is crucial for proper healing, prior to the assessment of any parameters. However, in the follow-up period (2 years) it was deducted to be more pertinent. 71% of dentists in the sample measure the BOP and probing depth as part of the routine examination to monitor peri-implant health and KT width, while 23% only records them in case of complications. Although, the BOP and probing depth are key indicators of inflammation, suppuration, loss of tissue resistance, decrease in marginal bone level, … (3,5,12) This demonstrates that most professionals adopt preventive approaches and others act only in situation of biological distress.

The significance of KT width is further emphasised with the results on the complications following implant placement with insufficient KT. 67% (n=68) responded it leads to peri-implant mucositis/ peri-implantitis, 29% (n=30) reported it leads to increased mucosal recession and 3% (n=3) to more BOP. Whereas only 1% (n=1) stated it has no clinical difference. The feedback gathered from this question is that all the above occur due to insufficient KT. This demonstrates that all professionals within our sample reached a consensus that absence of KT leads to post-operatory complications (18). It strongly aligns with the clinical observation from the literature on the protective role of KT in the prevention of peri-implant pathologies (2,5).

The crown material chosen by the professionals to place on the implant abutment appears to have an impact on the stability in terms of peri-implant health. 77% of professionals preferred zirconium, followed with zirconium with a T-base with 15%, lithium disilicate (n=5, 5%) and metal porcelain (n=3, 3%) were less preferred among the sample.
According to the literature, it is not solely the crown material that impacts the peri-implant health but the material's ability to resist bacterial adhesion and low biofilm affinity (18,19). Monolithic zirconia is a strong option due to its natural smooth surface, the Ra is <0.2μm, an important threshold to consider as >0.2μm the surface irregularities of materials facilitate plaque accumulation (18). Therefore, its low plaque affinity and low surface energy render it

more resistant to biofilm formation (20). Zirconia also demonstrates outstanding soft tissue integration and mucosal seal implying reduced risk of peri-implantitis (21).
Zirconia with Ti base is widely used nowadays as it combines the fit precision of Titanium and the favourable profile of zirconia. Thus, offering greater aesthetic outcomes, better soft tissue contours reproduction, and the optimal crown design in terms of biomechanics (22,23).
Lithium disilicate has great advantages as zirconia with also very low inflammatory markers but is better suited for anterior restorations of single units or posterior crown with minimal stress (24,25). Metal porcelain is the most unpredictable material with the greater probing depth, increased risk of bone resorption, higher portion of inflammatory markers and compromised aesthetics. Thus, it constitutes the least favourable option (19).

6. CONCLUSIONS

The findings of this study support the alternative hypothesis that keratinized tissue plays a fundamental role in maintaining peri-implant health and constitutes a key criterion for implant success.

Regarding the general objective, the results from 102 dental professionals demonstrate a strong clinical consensus that adequate KT width is indispensable throughout the implant process — from pre-surgical planning through long-term follow-up. A remarkable 98% of the sample confirmed that KT improves long-term implant stability, reflecting its established role in the current standards of implantology.

Concerning the first specific objective, the absence or insufficiency of keratinized mucosa was strongly associated with peri-implant complications. 67% of professionals linked insufficient KT to peri-implant mucositis and peri-implantitis, and 29% to increased mucosal recession. These findings align with the existing literature, confirming that KT width below the recommended threshold increases susceptibility to inflammatory peri-implant disease and soft tissue deterioration.

Regarding the second specific objective, peri-implant health is best understood as a multifactorial condition defined by the absence of clinical inflammation, stable probing depths, no radiographic bone loss, implant stability, and sufficient KT width of at least 1–2mm. This study reinforces that peri-implant health extends beyond osseointegration and must incorporate soft tissue quality as a measurable success parameter.

In conclusion, keratinized tissue should be systematically evaluated and maintained throughout the implant process, and augmentation procedures should be considered whenever KT is insufficient to safeguard long-term implant health and patient outcomes.

7. SUSTAINABILITY

The findings of this project carry meaningful implications across economic, environmental, and social dimensions of sustainability, aligned with the United Nations Sustainable Development Goals (SDGs).

From an economic perspective, early identification and management of insufficient KT reduces peri-implant complications. Preventing these conditions avoids costly surgical interventions, implant failures, and repeated prosthetic treatments, reducing the financial burden on both the patient and the dental professionals. This supports SDG3 (good health and well-being) by promoting cost efficient and preventive dental care.

Environmentally, a preventive approach to implant management minimises resource consumption associated with repeated surgeries, disposable materials, and laboratory work required in case of implant failure. Fewer interventions translate into reduced clinical waste footprint, contributing to more sustainable dental practises.

From a social standpoint, ensuring adequate KT width promotes equitable access to long-term implant success regardless of patient background. Educating dental professionals on this criterion strengthens clinical standards globally and supports SDG4 (quality education) through improved training and professional awareness. Ultimately, this project reinforces a patient-centred, preventive philosophy that prioritises long-term oral health and quality of life.

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9. ANNEXES

Annex 1: Questionnaire

Importance of peri-implant health and keratinized tissue in upper maxilla implant success

This survey is part of the Graduation Project in Dentistry at Universidad Europea of Madrid titled 81: SUCCESS CRITERIA IN PERI-IMPLANT HEALTH: THE IMPORTANCE OF KERATINIZED TISSUE and directed by Dr x. The purpose of this work is "Evaluate the role of keratinized tissue in maintaining peri-implant health and determine its significance as a criterion for implant success" and the information will be collected through a brief survey.
When you submit this form, it will not automatically collect your details like name and email address unless you provide it yourself.
Required

1.Your participation in this study is voluntary. You may request to be withdrawn from the study without prior justification or prejudice to you. The information collected will be kept confidential and will not be used for any other purpose outside this research and research dissemination purposes. The data collected will be completely anonymous. No personal identifying information will be requested. Information collected in the survey will be treated in accordance with the provisions of Organic Law 3/2018, of December 5, Protection of Personal Data and Guarantee of Digital Rights. Do you give your consent to participate in the survey as a volunteer for the results to be used in the Final Degree Project 81: SUCCESS CRITERIA IN PERI-IMPLANT HEALTH: THE IMPORTANCE OF KERATINIZED TISSUE?

Yes
No

2.For the purposes of the provisions of the regulation of the Organic Law 3/2018, of 5 December, on the Protection of Personal Data and Guarantee of Digital Rights, you are informed and expressly consent that the data provided in the survey may be used for the afore mentioned purposes. This consent is granted without prejudice to all the rights that you have in relation to the regulations, with the possibility of accessing the information provided, rectification, cancellation and opposition at any time you wish. For such purposes, you must write to the tutor x.

3.Are you

A dentist
A specialist in implantology/ surgery

4.How many years of experience do you have?

1-5 years
6-10 years
11-15 years

5.Do you routinely evaluate the width of keratinised tissue before implant placement?

Yes
No
Not evaluated

6.In your opinion what is the minimum width of keratinised tissue before implant placement?

< 1mm
1-2mm
>2mm
No particular importance

7.If keratinised tissue is absent or insufficient would you suggest

Free gingival graft
Subepithelial connective tissue graft
Collagen matrix/ Soft tissue substitute
No specific intervention

8.Do you place implants using

The conventional technique
Guided surgery technique

9.During implant surgery, do you take into account the level or thickness of keratinised tissue?

Yes, always
Only in certain cases
Never

10.Do you use any specific techniques to preserve or increase keratinised tissue during implant placement?

Coronally advanced flap
Simultaneous grafting
Flapless technique
No specific technique
Not evaluated

11.Do you think the presence of keratinised tissue facilitates soft tissue handling during surgery?

Yes
No
No influence

12.After implant surgery, do you monitor the bleeding on probing (BOP)?
Yes
No
Not evaluated

13.After implant surgery, do you measure the probing?

Yes
No
Not evaluated

14.In your experience, the absence of keratinised tissue is associated with

More bleeding on probing
Increased mucosal recession
Peri implant mucositis/ Peri implantitis
No significant clinical difference

15.Do you believe the presence of sufficient keratinised tissue improves the long-term stability of peri-implant tissue?

Yes
No
Uncertain
16.During the follow up (2 years) do you measure any parameters?
Yes: BOP, Probing depth
No
Only if the patient present complications

17.From your experience, the crown material used has a long-term impact on stability? If yes, specify which material is best in your opinion.