GRADUATION PROJECT

Degree in Dentistry

IDENTIFYING KEY PARAMETERS IN IMPLANT PLANNING TO PREVENT FUTURE PERI-IMPLANTITIS

Madrid, academic year 2025/2026

Identification number: 80

RESUMEN

Introducción: La identificación de los parámetros clave a la hora de planificar un implante tiene un impacto real en la prevención de la periimplantitis. **Objetivo:** En este trabajo se evalúa la eficacia de la planificación en 3D a la hora de colocar un implante con el fin de lograr la salud periimplantaria, tanto mediante la determinación de la posición óptima del implante como del perfil de emergencia del mismo. **Materiales y métodos**: Determinamos dichos parámetros mediante una encuesta realizada a través de Microsoft Forms a cirujanos dentistas especializados en implantología de la Universidad Europea de Madrid y a profesionales de clínicas dentales de Madrid. **Resultados:** Los resultados muestran que la distancia mínima entre la cortical y el implante para preservar el tejido blando y prevenir la retracción de la mucosa es de 1,6-2 mm. La distancia mínima entre un implante y un diente, y entre dos implantes, es de 1,5-2 mm y 3 mm, respectivamente, para lograr una buena salud periimplantaria. La profundidad de la posición del implante influye en la cicatrización de los tejidos blandos y en la posible pérdida ósea, por lo que el implante debe colocarse 2 mm por debajo de la cresta. Para conseguir un perfil de emergencia protésico natural en un caso de colocación inmediata y provisionalización de un implante unitario, el implante debe colocarse más de 3 mm por debajo del margen gingival. El ángulo de emergencia del implante debe ser inferior a 20° con respecto al perfil de emergencia de la futura prótesis, a fin de evitar el riesgo de periimplantitis. **Conclusión:** A partir de estos datos, se puede concluir que la planificación tridimensional es fundamental para colocar el implante en una posición óptima y con un perfil de emergencia correcto, con el fin de prevenir una futura periimplantitis.

PALABRAS CLAVE

Odontología, implantes, periimplantitis, planificación en 3D, parámetros clave.

ABSTRACT

Introduction: Identifying the key parameters when planning an implant has a real impact to prevent the peri-implantitis. **Objective:** In this work the effectiveness of the 3D planification was assessed when placing an implant in order to achieve a peri-implant health, both by determining the optimal implant position and the emergence profile of the implant. **Material and Methods:** Those parameters were determined by administering a survey thought Microsoft form to dental surgeon specializing in implantology from the European University of Madrid and to practitioners in dental clinics in Madrid. **Results:** In this survey 4 main variables were analyzed: the distance between the cortical bone and the implant, the mesiodistal distance between the implants and adjacent teeth, the depth of implant insertion and the prosthetic emergence profile. Results show that the minimum distance between the cortical and the implant to maintain the soft tissue and prevent mucosal recession is 1.6-2mm. The minimum distance in between and implant and a tooth and 2 implants is respectively 1.5-2mm and 3mm to achieve a good peri-implant health. The depth of the implant position influences the soft-tissue healing and possible bone loss, and the implant should be place 2mm subcrestally. To achieve a natural prosthetic emergence profile in a case of immediate placement and provisionalisation of a single implant, the implant should be placed more than 3mm below the gingival margin. The emergence angle of the implant should be less than 20° in relation to the emergence profile of the future prosthesis to avoid the risk of peri-implantitis. **Conclusion:** Based on these data, it can be concluded that the 3D planification is essential to place the implant in an optimal position and with a correct emergence profile in order to prevent a future peri-implantitis.

KEYWORDS

Odontología, Implant, Peri-implantitis, 3D planification, Key parameters.

ÍNDICE

1. INTRODUCTION 1

1.1 Background and context 1

1.2 The role of 3D implant planning 1
1.2.1 Definition and overview of digital / 3D implant planning 1
1.2.2 Advantages of 3D planning 2
1.2.3 The link between preoperative planning and long-term implant success 2

1.3 Understanding Peri-implantitis 2
1.3.1 Definition of peri-implant diseases 2
1.3.2 Clinical and radiographic manifestation link to planning errors 3
1.3.3 Consequences for implant survival in the context of 3D errors 3

1.4 Importance of identifying key parameters during planning 4
1.4.1 Buccal bone thickness 4
1.4.2 Emergence profile (angulation angle) / prothesis profile 4
1.4.3 Deepness of the implant 5
1.4.4 Mesiodistal distance 6
1.4.5 Justification 7

2. OBJETIVE 8

3. MATERIAL AND METHODS 9

4. RESULTS 11

5. DISCUSION 19

5.1. Regarding the deepness of the implant position influencing soft tissue healing and possible bone loss 19

5.2. Regarding the optimal depth in the maxilla (anterior region) to allow adequate restoration space and maintain healthy soft tissue around the implant. 19

5.3. Regarding the risk of peri-implant bone loss due to the placement of an implant apical to the cemento-enamel junction of adjacent teeth 19

5.4. Regarding the minimum distance between adjacent teeth and an implant in order to achieve a natural and stable gingival margin 20

5.5. Regarding the minimum distance between two adjacent implants in order to achieve a good peri-implant health. 20

5.6. Regarding the minimum buccal bone thickness, we need to maintain in order to support soft tissue and prevent mucosal recession 20

5.7. Regarding the placement of the implant below the gingival margin in case of an immediate placement and provisionalisation of a single implant in order to achieve a natural emergence profile, natural aesthetics and good gingival health 21

5.8. Regarding the emergence angle of an implant in relation to the emergence profile of the future prosthesis to avoid the risk of peri-implantitis 21

6. CONCLUSIONS 22

7. SUSTAINABILITY 23

8. REFERENCES 24

9. ANNEXES 28

9.1. Survey 28

9.2. Validation of investigation committee 30

9.3. Informed consent 31

1. INTRODUCTION

1.1 Background and context

The implants in dentistry are used since 1965 when the Dr. Branemark found out to fuse bone with titanium and discovered the concept of osseointegration. It's the beginning of the modern implantology.(1)

From this point started the commercialization of dental implant and then by 2000 the digital planification and the guided surgery appears with news techniques such as immediate placement and loading, minimally invasives techniques.

Dental implants are beginning to play an important role in dental treatment, both for minor cases as well as for major restorations.(2)

However, with the rapid expansion of dental implant some complications start to appears such as peri-implantitis(3) .Those complications are sometimes favorized by a lack of planification of the implant(4)

1.2 The role of 3D implant planning

1.2.1 Definition and overview of digital / 3D implant planning

The scanner has proven to be a key element in the modern digital dentistry in the case of braces placement, crown placement and especially in dental implant placement, allow an accurate position of the implant in the maxilla or mandible with a high reliability (5).

Despites a good reliability of Intra-oral radiography for detection of peri-implant bone loss, the use of CBCT has showed higher results(6). CBCT provides more 3D details enable more accurate ranges of diagnostics (5).

The constant increase in the complexity of cases and the emergence of new technologies have highlighted the limitations of existing techniques and the usefulness of digital approaches (7).

It also allowed the planning of the ideal implant position, thereby providing a greater margin of error when operating near vital anatomical structures (such as the inferior alveolar nerves when placing an implant in the mandible) avoiding the risk of medical complications for the patient and also for the angular deviation of the implant (8).

1.2.2 Advantages of 3D planning

In partially edentulous patients, implants placed with static guided surgery and intraoral scanning demonstrated both angular and linear deviations when compared with virtually planned implant positions (9).

The virtual intra-oral model enhances the creation of static guide surgery and dynamic guide surgery (10), reducing the placement errors and increasing efficacy.

Before the 3d planification the adjustment for implants angulations and positions during the surgery were determined according to the practitioner's experience and the bone condition (increasing the possibility of errors), nowadays 3D planning improves the accuracy of implant placement by taking into consideration bone density and ridge anatomy. Thanks to the predefined parameters, the software generates optimal virtual positions for implants, allowing practitioners to make only minor adjustments (10).

For the immediate placement of the implant, the computer assisted implant surgery is also a great help. It avoids waiting for complete healing of soft and hard tissues with better result than free-hand surgery (11).

1.2.3 The link between preoperative planning and long-term implant success

Thanks to digital recording (as CBCT) virtual plans can be superimposed on the actual post-operative situation, allowing for precise measurement of deviations and assessment of the success of the placement (12).

The computer assisted implant surgery reduce the number of surgery needed (11) and so reduce the risk of implant failing.

1.3 Understanding Peri-implantitis

1.3.1 Definition of peri-implant diseases

A peri-implant disease result in an unbalance between the bacteria and the host response. Two types of peri-implant diseases may be encountered: the peri-implant mucositis and the peri-

implantitis. Respectively affecting the soft tissue around the implant (mucosa) and affecting the bone (13).

The peri-implantitis is link with the hygiene of the patient, for the maintenance the dentist has to do a professional plaque control and a hygiene care reinforcement (14).

The peri-implantitis may be related with the positioning of the implant (13,15), it can occurs if the implant is not well embedded in a healthy bone (15). The buccal cortical is especially important because it's the part that receive the most vascular supply and if it's interrupted the necrosis of the buccal bone may appear "avascular necrosis"(15) causing mucosal recession and favoring the appearance of bacteria, this results in a greater risk to develop an unfavorable peri-implant condition (15) such as peri-implantitis. To prevent it, regular probing around the implant should be performed, because the probing is essential to assess the peri-implant health status (13).
Taking care of the problem as soon as possible, with the appropriate treatment is necessary to ensure good peri-implant health (13,15).

1.3.2 Clinical and radiographic manifestation link to planning errors

Thanks to the CBCT it's possible to know in advances the presence or absence of defect sites around the future implant position (16). Intra-oral radiography are also recommended to check the evolution of the bone during a maintenance (16), but it can creates distortion of the image and also because of the 2D results that offer this type of image it can result as superimposition (16) and so an incorrect diagnosis. Despite this risk of errors, they remain the standard to assess peri-implant bone health (13).

Therefore, early detection of peri-implantitis (changes in marginal bone level) and reduction of angulation errors require the use of a standardized film or sensor holder as well as paralleling technique (13).

1.3.3 Consequences for implant survival in the context of 3D errors

The success of an implant is considered if at 12 months follow-up there is no bleeding on probing, no more marginal bone loss (more than 0.5mm), and a pocket depth less than 5mm (17).

Many factors during the 3D planification may affect the implant placement, such as the form of the support, an error in the surgical guide construction and/or fixation, and even in the procedure itself (18).

When these errors occur, a CBCT can be used to evaluate the bone defects around the implant to see the number of sites (mesial,distal,buccal,lingual) with defect (19). Therefore, it's not possible to achieve the "implant success criteria explain above". So, the implant survival is not guaranteed. That's why it's important to identify the key parameters while planning the implant.

1.4 Importance of identifying key parameters during planning

Evidences show that 3D assessment is essential to detect the anatomic characteristics when planning an implant (8). The main characteristics to take into consideration are the buccal bone thickness, the emergence profile (angulation),the mesiodistal distance and the deepness of the implant (20).

1.4.1 Buccal bone thickness

In an esthetic zone, the implant placement is essential (20), so the planification has to be perfect in order to have a good result. To obtain good outcomes the buccal bone needs to be at least 2mm thick (20–22). With this thickness of the bone, it's possible to achieve a good peri-implant mucosa and a long-term tissue stability (20).

The thickness of the bone is also a factor to support the soft tissue and prevent the recession of the mucosa (20,22), because if the implant is placed too buccally it can lead to a gingival recession and therefore an unnatural contour (20).

1.4.2 Emergence profile (angulation angle) / prothesis profile

In relation to the emergence profile, both the implant position below the gingival margin and the emergence angle must be carefully planned to ensure a natural esthetic result and optimal gingival health (20,23,24).

An emergence angle below 30° seems to have positive effect on the marginal level change. To know that, it's possible to take intra-oral radio of different angles values during a period of time,

then the influence of the emergence angle on marginal bone loss and supracrestal soft tissue around dental implants is known (25).

1.4.3 Deepness of the implant

The depth of the implant relative to its apico-coronal position is assessed, with the best results observed for implants placed more than 1 mm subcrestally (28), reducing the risk of peri-implantitis.

The supracrestal tissue height is one of the components of the peri-implant soft tissue phenotype, and the latter contributes to peri-implant health and stability of bone (28). To ensure this primary stability it's recommended to maintain at least 3 to 5mm apical bone (22).

To ensure the soft tissue and bone healing, the neck of the implant should be positioned 3 to 4mm apical to the expected position of the gingival zenith (22).

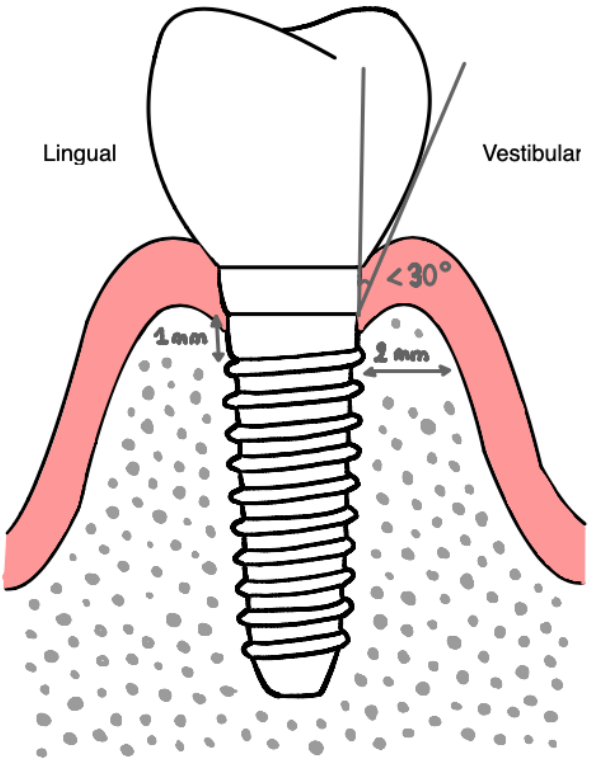


Figure 1. Position of the implant regarding the cortical bone, the crestal bone and the emergence profile of the future prothesis.

1.4.4 Mesiodistal distance

The practitioner has to be aware of the space available for the implant prior to the placement (26).

The wrong minimum distance between 2 adjacent implants or an implant and a tooth are one of the main complication in 3D planification (27). It can cost an increase of therapeutic time, discomfort for the patient and can have real consequences such as the loss of the implant because of a lack of osseointegration (27).

The diameter of the implant is also a mesio-distal factors to take into consideration when planning an implant in order to reduce the buccal bone crest resorption (21). The wider the implant diameter the more risk of resorption (21).

To avoid it, it's possible to use CBCT, it's a great help during the implant planning to obtain the right position of the implant (5,7,26,27).

The minimum distance between 2 implants is 3mm (26) and between the implants and the adjacent tooth is 1.5mm (20,26,27).

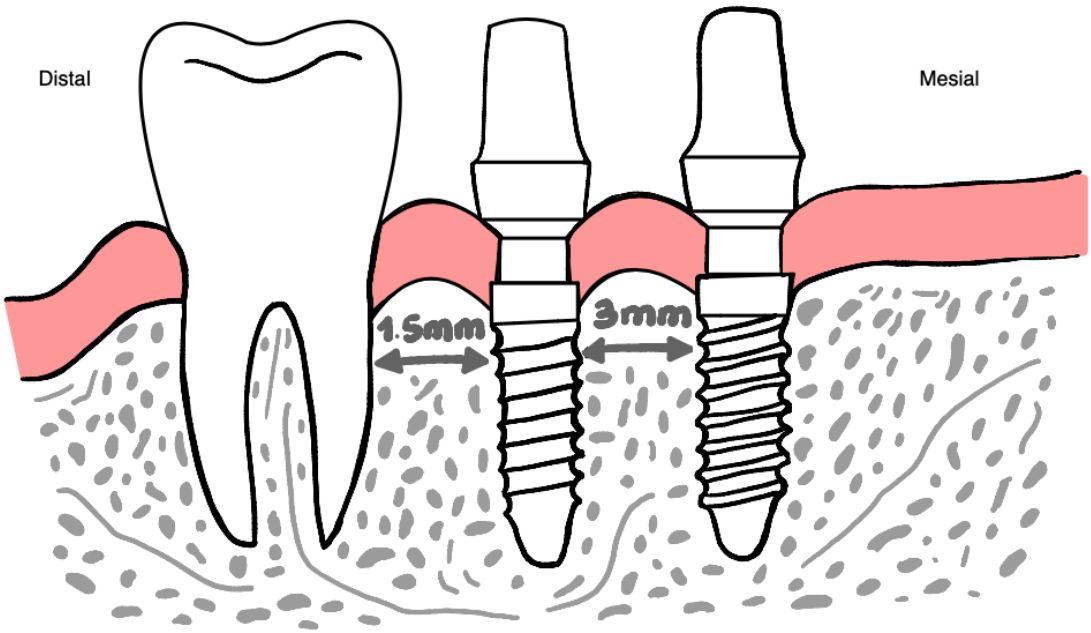


Figure 2. Mesio-distal distance between an implant and a tooth.

1.4.5 Justification

This is why it's important to assess the effectiveness of the 3D planification when planning an implant. All the studies were chosen in order to achieve a peri-implant health in this situation, and then gathering with the survey to have the more accurate results possible.

2. OBJETIVE

To assess the effectiveness of 3D planification in patient undergoing implant planning in order to achieve peri-implant health.

a) Determine how 3D planning allows for optimal implant positioning, contributing to the preservation of peri-implant bone loss.
b) Assess the impact of implant 3D planning on the emergence profile, in relation to tissue stability and the prevention of peri-implantitis.

The null hypothesis is that the 3D planification in patient undergoing implant planning isn't indispensable in order to achieve a peri-implant health.

The alternative hypothesis is that the 3D planification in patient undergoing implant planning is indispensable in order to achieve a peri-implant health.

3. MATERIAL AND METHODS

A cross-sectional descriptive study with a mixed-method design was developed to collect data on key parameters to consider during implant planning in order to achieve a good peri-implant health: describing past and present practices without manipulation of variable and no causes and effects. As quantitative components it includes MCQs and yes/no answers and as qualitative components it includes four main variables: the distance between the cortical bone and the implant, the mesiodistal distance between the implants and adjacent teeth, the depth of implant insertion, the prosthetic emergence profile.

A questionnaire survey thought Microsoft form was created. The survey was administered to two target groups: Dental surgeons specializing in implantology. The surveys will be conducted by experienced dentists from the European University of Madrid and to practitioners in dental Clinics in Madrid. The participants to the survey were invited to share it with their colleagues. The sample of participant is 75.

The questionnaires were sent via Microsoft form by email to the above-mentioned participants. The responses were anonymized and compiled for analysis. The practitioners' opinions were then compared with data from the scientific articles, consulted via the PubMed, Medline, and Bibliotheca CRAI databases.

The problem was formulated according to the PICO model as follows: For patient (P) undergoing implant planning (I), The use of 3D planification (C) achieve a better peri implant health (O)?

The study was realized in accordance with the ethical characteristics of surveys implying human participants. An informed consent was obtained from each participant after a detailed presentation of the study's objective, the methods used, the voluntary nature of participation, the anonymity of responses, the confidentiality of data, and the right to withdraw at any time without consequences. No personally identifiable data was collected. The questions were designed in a neutral and unbiased way, reviewed with the tutor who is currently working in this field. Responses were protected by security measures such as encryption, passwords and restricted access to authorized personnel. The possible conflicts of interest were taking into consideration (for example between practitioners and implants manufacturers). The data were used exclusively for the stated research objectives. The survey was approved by the Ethics

commitee from of the European University of Madrid under the following reference codes: codigo CI: 2026-102 and codigo departamento: OD.032/2526.

Inclusion criteria: Practitioners with clinical experience in implantology, informed consent to participate in the study. Exclusion criteria: Incomplete or unusable responses, participants with no training or experience in implantology.

The survey results were summarized in tables and descriptive graphs, allowing for a comparative visualization between practitioners' opinions and recommendations from the scientific literatures.

4. RESULTS

What is your profession?	Number of responses
General dentist	17
Implantologist	25
Oral surgeon	32
Prosthodontist	1
Total	75

Table 1. Data collection based on the question n°1 of the survey.



Figure 3. Graph based on the question n°1 of the survey showing the proportion of individuals.

In this survey 17 participants are general dentist, 25 are implantologist, 32 are oral surgeon and 1 is prosthodontist.

How many implants do you place per month?	Number of responses
none	4
1 to 5	11
6 to 10	10
11 to 20	18
More than 20	32
Total	75

Table 2. Data collection based on the question n°2 of the survey.



Figure 4. Graph based on the question n°2 of the survey showing the proportion of individuals.

In this survey 4 practitioners don't place any implant/month, 11 practitioners place 1 to 5 implants/month, 10 practitioners place 6 to 10 implants/month, 18 practitioners place 11 to 20 implants/month and 32 practitioners place more than 20 implants/month.

Almost the half of the participant (43%) have a strong activity in implantology and are currently placing more than 20 implants a month, followed by a quarter of participant (24%) placing from 11 to 20 implants a month.

Do you use 3D planning when placing implants?	**Number of responses**
Never	3
Sometimes	8
Often	18
Always	46
Total	75

Table 3. Data collection based on the question n°3 of the survey.



Figure 5. Graph based on the question n°3 of the survey showing the proportion of individuals.

In this survey 3 practitioners never use 3D planning, 8 practitioners use it occasionally, 18 practitioners use it frequently, and 46 practitioners use it systematically to place an implant.

More than the half of the participants (61%) are using the 3D planification for every single implant they placed followed by one quarter of the participant (24%) who use it often, proving the usefulness of this software.

Based on your personal experience: Does the depth of the implant position influence soft tissue healing and possible bone loss?	Number of responses
Yes	71
No	1
I do not take this measurement into account when placing implants.	1
I don't know	2
Total	75

Table 4. Data collection based on the question n°4 of the survey.

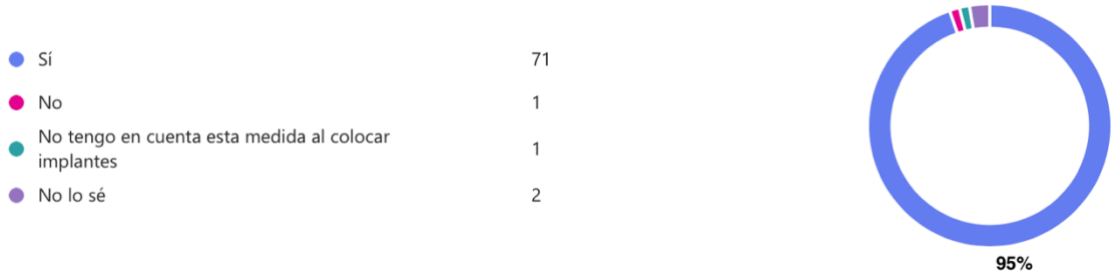


Figure 6. Graph based on the question n°4 of the survey showing the proportion of individuals.

In this survey 71 practitioners believe that implant depth influences soft tissue healing and possible bone loss, while 1 practitioner does not think it has any influence, 1 doesn't take it in consideration and 2 doesn't know. highlighting that the depth of the implant almost unanimously influences the periodontium.

Based on your personal experience: What is the optimal depth in the maxilla (anterior region) to allow adequate restoration space and maintain healthy soft tissue around the implant?	Number of responses
At the crestal level	2
1 mm subcrestal	20
2 mm subcrestal	38
Depends on tissue thickness	15
Total	75

Table 5. Data collection based on the question n°5 of the survey.



Figure 7. Graph based on the question n°5 of the survey showing the proportion of individuals.

In this survey regarding the optimal implant depth in the anterior maxilla to allow adequate restorative space and maintain healthy peri-implant soft tissue: 2 practitioners place it at the crestal level, 20 practitioners place it 1 mm subcrestally, 38 practitioners place it 2 mm subcrestally, and15 practitioners believe it depends on tissue thickness. The half of the participant (51%) would place it 2mm subcrestally followed by a quarter of participant (27%) placing it 1mm subcrestally in order to allow an adequate restoration space and maintain healthy soft tissue around the implant.

Based on your personal experience: Up to How many millimeters deep the placement of an implant apical to the cemento-enamel junction of adjacent teeth increase the risk of peri-implant bone loss ?	Number of responses
More than 1mm	6
More than 2mm	21
More than 3mm	26
It doesn't affect	22
Total	75

Table 6. Data collection based on the question n°6 of the survey.



Figure 8. Graph based on the question n°6 of the survey showing the proportion of individuals.

In this survey, 6 practitioners considered that a depth greater than 1 mm apically relative to the cementoenamel junction of adjacent teeth increases the risk of peri-implant bone loss, while 21

practitioners indicated that a depth greater than 2 mm would do so. 26 practitioners believed that the risk increases when the implant is placed more than 3 mm apically. In contrast, 22 practitioners stated that implant depth does not affect the risk of peri-implant bone loss. For this question, the responses are somewhat more diluted, with almost the same percentage of participants believing that the position of the implant 2 (28%) or 3 mm (35%) apical to the cementoenamel junction of the adjacent teeth influences the peri-implant bone loss, and the same percentage of participants (29%) believing that it has no impact.

Based on your personal experience: What is the minimum distance from adjacent teeth at which an implant should be placed in order to achieve a natural and stable gingival margin?	**Number of responses**
Less than 1mm	1
In between 1.5mm and 2mm	52
In between 2.1mm and 2.5mm	18
More than 2.6mm	4
Total	75

Table 7. Data collection based on the question n°7 of the survey.



Figure 9. Graph based on the question n°7 of the survey showing the proportion of individuals.

In this survey 1 practitioner considered that the minimum distance between a tooth and an implant in order to achieve a natural and stable gingival margin should be less than 1mm, 52 practitioners would place the implant in between 1.5 to 2mm from the tooth, 18 practitioners would place it between 2.1 and 2.5 mm, and 4 practitioners would position it at more than 2.6 mm.

Two third of the participant (69%) think by placing an implant in between 1.5 and 2mm away from the adjacent teeth is enough to achieve a natural and stable gingival margin followed by a quarter of participants (24%) thinking that placing it in between 2.1 and 2.5mm achieve good results.

Based on your personal experience: What is the minimum distance that should be maintained between two adjacent implants to achieve good peri-implant health?	Number of responses
At least 1mm	0
At least 2mm	11
At least 3mm	63
At least 4mm	1
Total	75

Table 8. Data collection based on the question n°8 of the survey.



Figure 10. Graph based on the question n°8 of the survey showing the proportion of individuals.

In this survey 0 practitioner considered that the minimum distance between 2 adjacent implants in order to achieve a good peri-implant health should be at least 1mm, 11 practitioners would place the implant at least 2mm from the adjacent one, 63 practitioners would place it between at least at 3mm, and 1 practitioner would position it at least at 4mm.

The vast majority of participant (84%) would maintain a distance of at least 3mm between 2 implants in order to achieve a good peri-implant health.

Based on your personal experience: How many millimeters of buccal bone thickness should be maintained to support soft tissue and prevent mucosal recession?	Number of responses
From 0 to 1mm	1
From 1.1 to 1.5mm	14
From 1.6 to 2mm	40
More than 2mm	20
Total	75

Table 9. Data collection based on the question n°9 of the survey.



Figure 11. Graph based on the question n°9 of the survey showing the proportion of individuals.

In this survey, regarding the thickness of the cortical plate in order to support the soft tissue and prevent the mucosal recession, 1 practitioner consider that maintaining 0 to 1mm is enough, 14 practitioners would maintain in between 1.1 to 1.5mm, 40 practitioners would maintain from 1.6 to 2mm and 20 practitioners would maintain more than 2mm of buccal bone thickness.
The half of the participant (53%) believe that maintaining between 1.6 and 2mm of cortical bone is sufficient to ensure proper implant positioning and tissue stability, followed by a quarter of participant (27%) thinking that maintaining more than 2mm is better to ensure this tissue stability.

Based on your personal experience: in cases of immediate placement and provisionalisation of single implants, how many millimeters below the gingival margin should the implant be placed in order to achieve a natural emergence profile, natural aesthetics and good gingival health?	**Number of responses**
Less than 1mm	1
In between 1 and 2mm	14
In between 2.1 and 3mm	21
More than 3mm	39
Total	75

Table 10. Data collection based on the question n°10 of the survey.



Figure 12. Graph based on the question n°10 of the survey showing the proportion of individuals.

In this survey, 1 practitioner considered that the implant should be placed less than 1 mm below the gingival margin in cases of immediate placement and provisionalisation of single implants. 14 practitioners recommended placing it between 1.1 and 2 mm, 21 practitioners between 2.1 and 3 mm, and 39 practitioners more than 3 mm below the gingival margin in order to achieve a natural emergence profile, optimal aesthetics, and healthy gingival tissues.

More than the half of the participant (52%) believe by placing the implant 3mm or more below the gingival margin would obtain a natural esthetic, followed by a quarter of participant (28%) placing it in between 2.1mm and 3mm.

Based on your personal experience: What should be the emergence angle of an implant in relation to the emergence profile of the future prosthesis to avoid the risk of peri-implantitis?	**Number of responses**
Less than 20°	42
Less than 30°	28
Less than 40°	5
Less than 50°	0
Total	75

Table 11. Data collection based on the question n°11 of the survey.



Figure 13. Graph based on the question n°11 of the survey showing the proportion of individuals.

In this survey, 42 practitioners considered that the emergence angle of an implant should be less than 20° in relation to the future prosthetic emergence profile in order to avoid the risk of peri-implantitis. 28 practitioners recommended an angle of less than 30°, while 5 practitioners indicated less than 40°. None of the practitioners selected an emergence angle of less than 50°. More than the half of the participant (56%) would keep an emergence angle of the implant less than 20° in relation with the emergence profile of the future prosthesis in order to avoid the risk of peri-implantitis, followed by the third of the participant (37%) respecting an angle of at least 30°.

5. DISCUSION

5.1. Regarding the deepness of the implant position influencing soft tissue healing and possible bone loss

For this question, almost all the participants (95%) are agreeing to say that the deepness of the implant Influences the soft tissues healing. Some articles are confirming this affirmation (20), and other are giving even more information such as how deep the implant influence it (28).

5.2. Regarding the optimal depth in the maxilla (anterior region) to allow adequate restoration space and maintain healthy soft tissue around the implant.

The main result is to place the implant 2mm subcrestal with 51% of the answer followed by 1mm subcrestal with 27% of the answer. Considering the bone level, the best situation would be to place the implant at the level of the crest but considering the tissue height as a most important criteria the best situation would be to place the implant more than 1mm subcrestally (28) so at least 2mm subcrestal. Other study are less precised and only recommend to place the implant slightly subcrestally (from 1 to 2mm) in order to maintain a healthy soft tissue around the implant(20). Regarding the answers and the articles, both emphasise the fact that placing 2mm subcrestal is the best way to maintain healthy the soft tissue around the implant.

5.3. Regarding the risk of peri-implant bone loss due to the placement of an implant apical to the cemento-enamel junction of adjacent teeth

Here there is a more discuss situation with almost the same percentage of participants believing that the position of the implant 2 (28%) or 3 mm (35%) apical to the cementoenamel junction of the adjacent teeth influences the peri-implant bone loss, and the same percentage of participants (29%) believing that it has no impact. A study stand that the position of the implant should be at more than 3mm from the cementoenamel junction of the adjacent tooth in order to reduce the risk of peri-implant bone loss (29) whereas in the survey a 1/3 of participant think it doesn't even have any impact, it could be explain by a lack of experiences of practitioners or limitations of the software that aren't able to calculate this feature.

5.4. Regarding the minimum distance between adjacent teeth and an implant in order to achieve a natural and stable gingival margin

From the survey more than 2/3rd of practitioners (69%) believes that placing an implant in between 1.5 to 2mm away from the adjacent tooth is enough in order to achieve a good gingival margin followed by a quarter of practitioners (24%) believing that placing it in between 2.1 to 2.5mm is better. There is a first study standing for the importance of maintaining a minimum distance in between the tooth and the implant of 1.5 to 2mm in order to achieve a natural and stable gingival margin (20). There is an another study considering the adequate distance in between a tooth and an implant is >1.5mm (26). Between these two articles, the margin varies from a minimum of 1.5 to 2 mm as the majority of practitioners have responded, whereas a quarter of the practitioners who responded to the survey would have left an additional safety margin. This difference can be explained by safety concerns.

5.5. Regarding the minimum distance between two adjacent implants in order to achieve a good peri-implant health.

For this question the main majority of the practitioners (84%) are agree to say that an implant should be place at least 3mm away from the adjacent tooth in order to preserve a good peri-implant health. Consulting the literatures, any distance less than 3mm is a violation of distance between 2 adjacent implants (26,27). Here both the articles and the practitioners questioned are agree to say that 3mm is the minimum distances in between 2 implants in order to keep a good peri-implant health.

5.6. Regarding the minimum buccal bone thickness, we need to maintain in order to support soft tissue and prevent mucosal recession

For this question half of the practitioners (53%) would try to maintain at least between 1,6 and 2mm of cortical bone in order to support soft tissue and prevent the mucosal recession followed by one fifth of the participants (19%) retaining at least 1.1 to 1.5 mm and a quarter (27%) retaining at least 2 mm. So here the majority would stand for keeping at least between 1.6 and 2mm of cortical bone but there is a difference of opinion with others who would keep more or less than this range. Some studies say to prevent the resorption of the buccal bone crest it's recommended to maintain 2mm of cortical when placing the implant (21), whereas other say that it's recommended to keep in between 1.5 to 2mm (20), this difference of 0.5mm might be due to the different situations (when the patient has more or

less remaining bone) and also could be due to the positioning of the abutment for the future restauration in order to be aesthetic.

5.7. Regarding the placement of the implant below the gingival margin in case of an immediate placement and provisionalisation of a single implant in order to achieve a natural emergence profile, natural aesthetics and good gingival health

More than the half of the participant (52%) believe by placing the implant 3mm or more below the gingival margin would obtain a natural esthetic followed by almost a 1/3rd of participants (28%) believing that placing it in between 2.1mm to 3mm is enough to reach this natural esthetic. A review of the literature indicates that the correct apical positioning is in between 2 to 3mm apical to obtain a natural esthetic and a good gingival margin (20). When other study would place the implant 3-4mm apical from the pre-determined facial gingival margin of the definitive crown (23). This difference between the analysis of the articles and the professional experience of practitioners could be explained by the ease of placing it slightly more apically while ensuring aesthetic results and good gingival health.

5.8. Regarding the emergence angle of an implant in relation to the emergence profile of the future prosthesis to avoid the risk of peri-implantitis

According to the survey results, more than the half of the participants (56%) believe that the emergence angle of the implant should be <20°, followed by more than a third of participants (37%) who believe that the emergence angle of the implant must be <30° in order to avoid the risk of peri-implantitis. According to articles, it suggests that there is an association between an emergence angle >30° and a higher risk of peri-implantitis compared to an emergence angle <30° (24,30). Half of the participants (56%) responded <20°, this difference can be explained by a desire to preserve the periodontium as much as possible by reducing the emergence angle from 30° to 20°.

6. CONCLUSIONS

To conclude thanks to the results, obtain, both in the survey and from the articles, I would say that the 3D planification when placing an implant is essential in order to achieve a peri-implant health. The majority of practitioners who responded to the survey use it systematically in their clinical practice.

First of all, for the optimal implant positioning such as the mesio-distal distance between and implant and a tooth or in between 2 implants, as well as for the bucco-lingual and apico-coronal positioning. Without the use of 3D planification, the implant may be positioned in a wrong way and thereby create a favorable condition for the development of a peri-implantitis.

Secondly, the 3D planification also has an impact concerning the emergence profile of the future prosthesis. Both the emergence angle and the gingival margin in case of immediate placement and provisionalisation must be taken into account when placing the implant in order to achieve a natural emergence profile. If those values are not respected, it can lead to tissues instability and a possible future peri-implantitis.

7. SUSTAINABILITY

This study contributes to sustainability in dentistry by promoting long-term peri-implant health and reducing the need for corrective treatments. By identifying key parameters in implant planning, such as optimal distances between the implant and surrounding structures, appropriate implant depth, and controlled emergence angle, the results support more predictable and durable clinical outcomes.

From an environmental perspective, preventing peri-implantitis reduces the need for additional surgical interventions, materials, and clinical resources, thereby limiting waste and resource consumption. Socially, maintaining soft tissue stability and preventing mucosal recession improves patient well-being, comfort, and quality of life over time. Economically, minimizing complications decreases long-term treatment costs for both patients and healthcare systems.

Overall, applying these evidence-based guidelines supports a more sustainable approach to implant dentistry by enhancing treatment longevity, improving patient outcomes, and reducing the burden of retreatment.

8. REFERENCES

1. Rawat P, Saxena D, Sharma A. Per-ingvar branemark: the father of modern dental implantology. Cureus. 2024. doi:10.7759/cureus.73950

2. Duong H, Roccuzzo A, Stähli A, Salvi GE, Lang NP, Sculean A. Oral health-related quality of life of patients rehabilitated with fixed and removable implant-supported dental prostheses. Periodontol 2000. 2022;88(1):201-37. doi:10.1111/prd.12419

3. Galarraga-Vinueza ME, Pagni S, Finkelman M, Schoenbaum T, Chambrone L. Prevalence, incidence, systemic, behavioral, and patient-related risk factors and indicators for peri-implant diseases: an AO/AAP systematic review and meta-analysis. J Periodontol. 2025;96(6):587-633. doi:10.1002/JPER.24-0154

4. Stefanini M, Marzadori M, Sangiorgi M, Rendon A, Testori T, Zucchelli G. Complications and treatment errors in peri-implant soft tissue management. Periodontol 2000. 2023;92(1):263-77. doi:10.1111/prd.12470

5. Wojciech F, Aleksandra J, Machoy ME. CBCT and modern intraoral scanners as tools for developing comprehensive, interdisciplinary treatment plans. Adv Clin Exp Med. 2024;33(11):1267-76. doi:10.17219/acem/175817

6. Song D, Shujaat S, De Faria Vasconcelos K, Huang Y, Politis C, Lambrichts I, et al. Diagnostic accuracy of CBCT versus intraoral imaging for assessment of peri-implant bone defects. BMC Med Imaging. 2021;21(1):23. doi:10.1186/s12880-021-00557-9

7. Kafedzhieva A, Vlahova A, Chuchulska B. Digital technologies in implantology: a narrative review. Bioengineering. 2025;12(9):927. doi:10.3390/bioengineering12090927

8. Mistry A, Ucer C, Thompson J, Khan R, Karahmet E, Sher F. 3D guided dental implant placement: impact on surgical accuracy and collateral damage to the inferior alveolar nerve. Dent J. 2021;9(9):99. doi:10.3390/dj9090099

9. Massuda CKM, De Carvalho MR, De Moraes JB, Pallos D, Kim YJ. Accuracy of guided dental implant surgery using a fully digital workflow: a case series. J Prosthet Dent. 2024;132(5):973-80. doi:10.1016/j.prosdent.2022.09.016

10. Chen C, Hsu H, Kuo Y, Kuo H, Wang C. Digital workflow and guided surgery in implant therapy: literature review and practical tips to optimize precision. Clin Implant Dent Relat Res. 2025;27(3):e70038. doi:10.1111/cid.70038

11. Schiavon L, Mancini L, Settecase E, Jung RE, Joda T. Does computer-assisted surgery improve the accuracy of immediate implant placement? A systematic review and network meta-analysis. J Periodontal Res. 2025;jre.70010. doi:10.1111/jre.70010

12. Nulty AB. A novel methodology for analysing dental implant positional changes from virtual planning to placement without CBCT. Br Dent J. 2024. doi:10.1038/s41415-024-7905-7

13. Heitz-Mayfield LJA. Peri-implant mucositis and peri-implantitis: key features and differences. Br Dent J. 2024;236(10):791-4. doi:10.1038/s41415-024-7402-z

14. Hong I, Koo KT, Oh SY, Park HW, Sanz-Martín I, Cha JK. Comprehensive treatment protocol for peri-implantitis: an up-to date narrative review of the literature. J Periodontal Implant Sci. 2024;54(5):295. doi:10.5051/jpis.2303360168

15. Monje A, Roccuzzo A, Buser D, Wang H. Influence of buccal bone wall thickness on the peri-implant hard and soft tissue dimensional changes: a systematic review. Clin Oral Implants Res. 2023;34(S26):8-27. doi:10.1111/clr.14177

16. Oshima T, Asaumi R, Ogura S, Kawai T. Evaluation of peri-implant bone defects on cone-beam computed tomography and the diagnostic accuracy of detecting these defects on panoramic images. Imaging Sci Dent. 2024;54(2):171. doi:10.5624/isd.20230258

17. Zhu Y, Lu H, Yang S, Liu Y, Zhu P, Li P, et al. Predictive factors for the treatment success of peri-implantitis: a protocol for a prospective cohort study. BMJ Open. 2024;14(1):e072443. doi:10.1136/bmjopen-2023-072443

18. Alqutaibi AY, Al-Gabri RS, Ibrahim WI, Elawady D. Trueness of fully guided versus partially guided implant placement in edentulous maxillary rehabilitation: a split-mouth randomized clinical trial. BMC Oral Health. 2025;25(1):1680. doi:10.1186/s12903-025-07073-0

19. Oshima T, Asaumi R, Ogura S, Kawai T. Evaluation of peri-implant bone defects on cone-beam computed tomography and the diagnostic accuracy of detecting these defects on panoramic images. Imaging Sci Dent. 2024;54(2):171. doi:10.5624/isd.20230258

20. Universidad Anáhuac Cancún, Cancún, Mexico, Hernández JAP, Baroi AM, "Cristofor Simionescu" Faculty of Chemical Engineering and Environmental Protection, "Gheorghe Asachi" Technical University of Iasi, 700050 Iasi, Romania, Papusa Vasiliu M, Faculty of Medicine, Apollonia University of Iasi, 700511, Romania, et al. Optimal placement of dental implants: assessing bone, soft tissue, depth, and position for long-term success. Romanian J Oral Rehabil. 2025;17(2):1053-67. doi:10.62610/RJOR.2025.2.17.95

21. Viña-Almunia J, Candel-Martí ME, Cervera-Ballester J, García-Mira B, Calvo-Guirado JL, Peñarrocha-Oltra D, et al. Buccal bone crest dynamics after immediate implant placement and ridge preservation techniques: review of morphometric studies in animals. Implant Dent. 2013;22(2):155-60. doi:10.1097/ID.0b013e318287a947

22. Sailer I, Sanz M, Cordaro L. ORF IEM 2025 Consensus report on the clinical recommendations for immediacy in implant dentistry: from single-unit restorations to full-arch implant prostheses. Int J Prosthodont. 2025;38(supplement):s1-9. doi:10.11607/ijp.suppl.1

23. Kan JYK, Yin S, Rungcharassaeng K, Zucchelli G, Urban I, Lozada J. Facial implant gingival level and thickness changes following maxillary anterior immediate tooth replacement with scarf-connective tissue graft: a 4–13-year retrospective study. J Esthet Restor Dent. 2023;35(1):138-47. doi:10.1111/jerd.12996

24. Soulami S, Slot DE, Van Der Weijden F. Implant-abutment emergence angle and profile in relation to peri-implantitis: a systematic review. Clin Exp Dent Res. 2022;8(4):795-806. doi:10.1002/cre2.594

25. Strauss FJ, Park J, Lee J, Schiavon L, Smirani R, Hitz S, et al. Wide restorative emergence angle increases marginal bone loss and impairs integrity of the junctional epithelium of the implant supracrestal complex: a preclinical study. J Clin Periodontol. 2024;51(12):1677-87. doi:10.1111/jcpe.14070

26. Ribas BR, Nascimento EHL, Freitas DQ, Pontual ADA, Pontual MLDA, Perez DEC, et al. Positioning errors of dental implants and their associations with adjacent structures and

anatomical variations: a CBCT-based study. Imaging Sci Dent. 2020;50(4):281. doi:10.5624/isd.2020.50.4.281

27. Rizzo G, Prado MC, Rigo L. Prevalence of dental implant positioning errors: a cross-sectional study. Imaging Sci Dent. 2022;52(4):343. doi:10.5624/isd.20220059

28. Quispe-López N, Gómez-Polo C, Zubizarreta-Macho Á, Montero J. How do the dimensions of peri-implant mucosa affect marginal bone loss in equicrestal and subcrestal position of implants? a 1-year clinical trial. Clin Implant Dent Relat Res. 2024;26(2):442-56. doi:10.1111/cid.13306

29. Mailoa J, Fu JH, Chan HL, Khoshkam V, Li J, Wang HL. The effect of vertical implant position in relation to adjacent teeth on marginal bone loss in posterior arches: a retrospective study. Int J Oral Maxillofac Implants. 2015;30(4):931-6. doi:10.11607/jomi.4067 PubMed PMID: 26252046.

30. Atieh MA, Shah M, Ameen M, Tawse-Smith A, Alsabeeha NHM. Influence of implant restorative emergence angle and contour on peri-implant marginal bone loss: a systematic review and meta-analysis. Clin Implant Dent Relat Res. 2023;25(5):840-52. doi:10.1111/cid.13214

9. ANNEXES

9.1. Survey

Q1 : What is your profession ?

- General Dentist
- Implantologist
- Oral surgeon
- Prosthodontist

Q2 : How many implant you're placing a month ?

-None

-1 to 5

-6 to 10

-11 to 20

- more than 20

Q3 : Do you use 3D planification when placing implant ?

-Never

-Sometimes

-Often

-Always

Q4: Based on your personal experience: Does the deepness of the implant position influence the healing of the soft tissue and a potential bone loss?

-Yes

-No

-I'm not taking this measure in consideration when placing implant

-I don't know

Q5 : Based on your personal experience: What's the optimal deepness in maxilla (anterior sector) to allow adequate restorative space and maintain healthy the soft tissue around the implant ?

-At the crestal level

-1mm subcrestal

-2mm subcrestal

-depending on the tissue thickness

Q6: Based on your personal experience: Up to How many millimeters deep the placement of an implant apical to the cemento-enamel junction of adjacent teeth increase the risk of peri-implant bone loss?

-more than 1 mm

-more than 2 mm

-more than 3 mm

-It doesn't affect it

Q7 : Based on your personal experience: At which minimum distance from adjacent teeth an implant should be placed in order to achieve a natural and stable gingival margin ?

-less than 1mm

-between 1.5 and 2mm

-between 2,1 and 2.5mm

-At least 2.6mm from each other

Q8: Based on your personal experience: Which minimum distance between 2 adjacent implants should be maintain in order to achieve a good peri implant health?

-At least 1mm

-At least 2mm

-At least 3mm

-At least 4mm

Q9 : Based on your personal experience: How many mm of buccal bone thickness do we need to maintain in order to support the soft tissue and preventing mucosal recession ?

-0 to 1mm

-1,1 to 1.5mm

- 1.6 to 2mm

-More than 2mm

Q10 : Based on your personal experience: In case of immediate placement and provisionalization of single-tooth implants. How many mm the implant should be position below the gingival margin to have a natural emergence profile, a natural esthetic and good gingival health?

-Less than 1mm

-Between 1 and 2mm

- Between 2.1 and 3mm

-More than 3mm

Q11 : Based on your personal experience: How many degree the emergence angle of an implant regarding the emergence profile of the future prosthesis should be to avoid the risk of peri-implantitis?

-Below 20°

-Below 30°

- Below 40°

-Below 50°

9.2. Validation of investigation committee

Título del proyecto:

TFG 80: IDENTIFYING KEY PARAMETERS IN IMPLANT PLANNING TO PREVENT FUTURE PERI-IMPLANTITIS

Tipo de proyecto:

TFG

Código CI:

2026-102

Código OTRI:

Sin especificar

Código Departamento:

OD.032/2526

Dictamen:

APROBADO

9.3. Informed consent

MODELO DE CONSENTIMIENTO INFORMADO PARA ENCUESTAS DE TRABAJO FIN DE GRADO

Este documento es un modelo de Consentimiento Informado para encuestas **anónimas** desarrolladas en Trabajos de Fin de Grado de Odontología. El tutor responsable deberá eliminar este encabezado y sustituir el texto en rojo por la información que corresponda. En algunos casos será necesario adaptar el Consentimiento Informado al estudio e incluir información adicional.

INFORMED CONSENT

This survey is part of the Graduation Project in Dentistry at Universidad Europea of Madrid titled Identifying Key Parameters in Implant Planning to Prevent Future Peri-implantitis and directed by [redacted] The purpose of this work is To assess the effectiveness of 3D planification in patient undergoing implant planning in order to achieve peri-implant health. To determine how 3D planning allows for optimal implant positioning, contributing to the preservation of peri-implant bone loss. To assess the impact of implant 3D planning on the emergence profile, in relation to tissue stability and the prevention of peri-implantitis and the information will be collected through a brief survey.

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 Identifying Key Parameters in Implant Planning to Prevent Future Peri-implantitis?

Yes ☐ **No** ☐

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 aforementioned purposes. This consent is granted without prejudice to all the rights that you have in relation to the aforementioned 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 [redacted]