

**ASSESSMENT OF KNOWLEDGE, ATTITUDE AND PRACTICE
AMONG DENTAL IMPLANT PRACTITIONERS, REGARDING
TECHNIQUES FOR THE ASSESSMENT OF IMPLANT STABILITY
AND ITS IMPORTANCE FOR THE SUCCESS OF AN IMPLANT- A
SURVEY**

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ABSTRACT

Aim: The aim of this study was to assess knowledge, attitude and practice among dental implant practitioners, regarding techniques for the assessment of implant stability and its importance for the success of an implant among dental implant practitioner across Bangalore.

Materials & Method: A total of hundred and eighty-one dental implant practitioners participated in the study. The knowledge and the techniques used to check implant stability and its importance was assessed with the help of an online questionnaire composed of sixteen questions. A consent form and participant information sheet were provided via e-mails and social media platforms. All the participants

received the questionnaire as google forms via online social platforms. The collected data were tabulated and analyzed statistically. **Result:** All the questions were acknowledged and the response obtained for the majority of questions was not statistically significant. According to the designation category, the response obtained for the question on importance of checking primary implant stability before loading procedure, showed that the results found to be statistically significant ($P < 0.0001$), but there was no statistical significance obtained for the

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rest of the questions. Thus, it can be assumed that the responses obtained had a mixed opinion in terms of choosing the appropriate technique in today's practice. Some preferred conventional technique for evaluation of implant stability despite certain limitations existing in terms of precision and accuracy, whereas, very few were aware about recent digitalized technique which has better precision and accuracy in evaluation. **Conclusion:** Implant therapy has gained its importance in today's dentistry field. It is also important to upgrade the knowledge about implant stability and its influence on success of implant and also the techniques used to check the implant stability. Thus, from this study it can be concluded that though the participants were aware about the knowledge on implant stability, yet more emphasize must be given about the knowledge and implementation of recent techniques used to check for implant stability in clinical practices.

KEYWORDS: Implant; Implant Stability; Implant techniques; questionnaire.

INTRODUCTION

Dental implants are the most preferred treatment option nowadays for the management of partially and completely edentulous arches. Modern dentistry has witnessed, over the last decades, a rapid and continuing evolution of techniques in different fields. Concerning the implant-rehabilitation protocols, they have been redefined over the years, as a result of new knowledges in implant surgery and in order to satisfy patient's increasing expectations in terms of comfort, aesthetic and shorter treatment period. Since Branemark introduced the osseointegration system in 1977 (Brånemark et al., 1977), classic protocols propose that implants should receive no loading during the osseointegration period, usually 3 to 4 months in the mandible and 6 to 8 months in the maxilla (Brånemark, 1983), but as the research progressed, new protocols have been proposed regarding the prosthetic-load timing, up to the immediate implant loading. Immediate loading is possible in patients with high bone density and adequate primary stability and restore the implant in occlusal contact within 48 hours of implant placement. Early loading falls temporally between conventional loading and immediate loading. Early loading is defined as the prosthetic loading or utilization of an implant at any time between immediate and conventional loading may be around Six to eight weeks.^[1]

Under defined circumstances, early and immediate loading protocols have now been recognized to be viable alternatives to the classical 1- or 2-stage delayed loading approaches. Immediate and Early loading protocol has few advantages over delayed such as, placement of

provisional prosthesis after implant insertion and a second surgical procedure is not required. Additionally, the use of this protocol under immediate placement condition may contribute to the maintenance of adjacent papillae and the height of peri-implant soft tissues.² However, the long-term prognosis of the early and immediate implant loading protocols is mainly dependent on the implant stability.

It is a proven fact that extreme micromotion during the initial reparative period following surgical insertion of implants will result in loss of osseointegration. Thus, excessive micromotion due to lack of primary stability can result in fibrous integration between implant and adjoining bone. Therefore, success of immediate loading to a larger extent depends on primary stability and the clinicians worldwide acknowledge the significance of stability for osseointegration.^[4]

Implant stability can be measured at two different stages: Primary and Secondary.³ Primary stability includes the mechanical attachment of an implant in the surrounding bone at the insertion, whereas secondary implant stability is the tissue response to the implant and subsequent bone remodelling processes. Secondary stability is determined and influenced by Primary stability. Hence, primary implant stability is known to be a crucial factor for successful osseointegration of dental implants.^[5]

The evaluation of implant stability remains a challenge for clinicians since there was no definitive predictable method with adequate scientific evidence for a long time. There are different methods explained by different authors with conflicting results. The various methods to assess implant stability can be grouped as Invasive/Destructive Methods and Non-Invasive/Non-Destructive Methods.^[6]

Invasive/destructive methods include

- Histologic/histomorphologic analysis
- Tensional test
- Push-out/pull-out test
- Removal torque analysis.

Noninvasive/nondestructive methods for assessing implant stability

- Radiographical analysis/imaging techniques
- Cutting torque resistance

- Insertion torque
- Percussion test
- Periotest
- Resonance frequency analysis (RFA): Electronic technology

In case of invasive/ destructive methods, none of these techniques are false proof, and the clinical usage of destructive tests is limited due to ethical concerns associated with invasive nature of these methodologies. Following which non-invasive techniques were introduced, there are limitations existing for few non- invasive techniques as well but are more reliable than invasive techniques. Techniques such as radiograph, assess both quantity and quality of the jawbone but not the stability, similarly, percussion test, relies on the clinician's experience level and subjective belief, even reverse torque test may cause risk of irreparable plastic deformation within implant bone integration. Thus a more reliable measure of implant stability was required, and this was resolved by an innovative technique called RFA. The Implant Stability Quotient (ISQ) is a scale of measurement developed with the Resonance Frequency Analysis (RFA) method of measuring implant stability. These devices provide a much better indicator of the level of osseointegration than all the other methods available.^[7]

Therefore, it is important to be updated in terms of knowledge and its implementation regarding the recent advancements in the field of implant dentistry. There are studies available in literature regarding usage of different techniques to assess the implant stability and also studies available on recent advanced methods to assess the implant stability.^[8] But there is a paucity of studies available in literatures, wherein questionnaire is used to assess the knowledge and attitude and practice among implant practitioners, regarding techniques used for the assessment of implant stability, and awareness about advanced techniques and its importance in the implant treatment. Thus this study aims to assess knowledge, attitude and practice among dental implant practitioners, regarding techniques for the assessment of implant stability and awareness about advanced techniques its importance for the success of an implant.

MATERIALS AND METHOD

A questionnaire based survey was carried out This study was conducted in an online setting. The study population included dental implant practitioners across Bangalore. The sample comprised of 181 participants. Simple random sampling methodology was employed. The questionnaire was framed with the help of experts in the field. The questionnaire kept the

study group in mind and questions were linked to curriculum content of dental implants and implant stability and techniques to measure the stability. The questionnaire was distributed as google forms on various online social platforms. A self – administrated questionnaire consisting of 15 close ended questions. An informed consent was taken from all the participants, following which the collected data was tabulated and analyzed statistically.

QUESTIONNAIRE

1] Are You A? (multiple choices can be selected)

- a) Post graduate student
- b) Private practitioner
- c) Academician

2] Qualification? (Multiple choices can be selected)

- a) BDS
- b) MDS
- c) Certified courses

3] Do you carry out both Prosthetic and Surgical procedures of implant?

- a) YES
- b) Only prosthetic procedures
- c) Only Surgical procedure of implant placement

4] Do you Agree; Implant stability is important for the success of an implant?

- a) Agree
- b) Disagree

5] Are you aware of, Immediate Implant Loading and Early Implant Loading procedures?

- a) Yes
- b) No

6] Do you think Primary Implant Stability is important to check prior to the above mentioned procedure? (Question 6)

- a) Yes
- b) No

7] If yes, are you aware of any techniques to check for Primary Implant Stability?

- a) Yes
- b) No

8] Which among the following do you use, to check for Primary Implant Stability?

- a) Insertion Torque
- b) Resonance Frequency Analysis (RFA)
- c) Periotest
- d) Unaware

9] Average minimum period to achieve adequate secondary stability for maxilla ?

- a) 3 months
- b) 4months
- c) 6months
- d) 8months

a) Average minimum period to achieve adequate secondary stability for mandible ?3 months

- b) 4months
- c) 6months
- d) 8months

10] Do you agree; a good primary stability dictates the success of secondary stability?

- a) Agree
- b) Disagree

11] Do you agree that checking for secondary implant stability before planning for prostheticrestoration is important?

- a) Yes
- b) No
- c) Sometimes

12] If yes/sometime, how do you measure?

- a) Percussion
- b) Resonance Frequency Analysis (RFA)
- c) Reverse torque test

d) Radiograph

13] Do you think, RFA can be considered as a reliable implant stability predictor compared to other techniques?

- a) Yes
- b) No
- c) May be
- d) Unaware

RESULTS

With respect to designation **Graph 1**, 45.3% of participants were Private Practitioners, 28.2% were Academician, and 39.2% were Post Graduates students.

Regarding the type of qualification **Graph 2**, the majority of the participants, i.e., around 81.2% were MDS qualified, 20.4% were pertaining to BDS qualification and remaining participants i.e., 20.4%, were qualified with Certified courses.

The distribution responses in **Table 1**, showed that majority of the participants performed both surgical and prosthetic procedures with maximum response obtained by private practitioner. The difference in the responses among the participants was found to be statistically non-significant.

In **Table 2**, showed 99% of participants agreed that Implant stability is important for the success of an implant with maximum response obtained by post graduate students, least was obtained by academician. The difference in responses was not statistically significant.

In **Table 3**, showed that, among all the respondents, private practitioners were more aware of Immediate and Early Implant Loading procedures. The difference in the response was found to be statistically non-significant.

The response received in **Table 4, 5 & 6**, depicts majority of respondents agreed primary implant stability is important prior to loading procedure with highest positive result obtained from private practitioner. In terms of knowledge about the technique to check the primary stability, both post graduates and private practitioner were aware than academician and in terms of practicing, the choice of technique to check for primary stability, had more preference to insertion torque with majority of response by the private practitioner, followed by RFA, and

Periotest. Post graduates were least known regarding the choice of techniques. The difference in response was non-significant.

According to the results obtained from **Table 7&8**, depicted that, postgraduates were unaware in maximum number, about time period required to achieve secondary stability in maxilla and mandible. The difference in response was statistically significant.

The respondents attitude to the question in **Table 9**, suggests majority of the respondents agree that primary stability dictates the success of implant, with highest response obtained by postgraduate, followed by private practitioner and academician, with no statistical difference in response.

According to the response observed in **Table 10&11**, suggests that both private practitioner and post graduate agreed in majority that secondary stability is important before planning prosthetic procedure with least response by academician. In terms of practice the technique implemented to check for secondary stability, suggests that RFA had maximum response by private practitioner, and least opted was reverse torque test.

The response in **Table 12**, showed that the results obtained had mixed results where few of the respondents agreed RFA can be reliable technique to measure stability, and few chose may be reliable and few disagreed.

DISCUSSION

Many research and advancements happening in the field of implantology which aims in improving better predictability and precision, in terms of methodology to assess the implant stability in today's practice by the implant practitioner, tend to have mixed opinion in opting for either conventional technique or the new technique. Till today few practitioners prefer conventional technique to assess the stability though it is objective and is not much precise method to evaluate, whereas, few opt for upgraded techniques owing to its digitalization and believing it has better accuracy in evaluating. Thus which technique is the most preferable in assessing implant stability for today's trend always remain debatable among the implant practitioner. Hence, the current study was carried out to assess the knowledge, attitude and practice of implant practitioners on upgrading their awareness about implant stability and also to assess various techniques available to check for implant stability which dictates the success of an implant.

According to the present survey results **Table 1**, the maximum number of respondents carried out both prosthetic and surgical procedure. In our opinion the reason could be that, the advantage for a clinician who carry out both surgical and prosthetic procedure, is that they might have better knowledge about biologic mechanism of healing after implant placement and consideration of implant stability check, before going ahead with loading the prosthesis, which allows the clinician to be in a better position to make a decision. A review by Muhamed A et al., (2017), determined that implant stability is, an indirect indication of Osseointegration, as well as it is a measurement of implant's resistance to movement.^[9]

Measurement of implant stability is a valuable tool for achieving consistently good results first and foremost because it plays an important role in achieving a successful outcome. The present survey depicted **Table 2**, 99% of respondents, agreed implant stability is important for implant success. With the understanding of the basics in the field of implantology, early guidelines recommended an undisturbed healing requires 3–6 months prior to prosthesis loading (Brånemark et al., 1977), protocols have been developed to shorten the overall treatment duration for the patient which includes immediate implant loading (IL) and early implant loading. Many studies have shown, there seem to be no difference in implant survival rate and marginal bone level between immediate and conventional loading, from anaesthetic perspective and both of the procedure have good success rates (Chiapasco M et al., (1997)).^[10] In our survey **Table 3**, almost all the participants were aware of both the loading procedures, with maximum response obtained from private practitioner.

Getting to know the recent developments in implant loading procedures, it is also important to focus on the factors on which these loading procedures results in a successful outcome. One such major factor is primary implant stability. Primary stability has been established to affect the process of osseointegration, the pattern of implant loading, and, finally, the success of an implant.^[11] The survey **Table 4**, showed that majority of the respondents provided the maximum response, by agreeing primary implant stability is important before loading procedures. The survey also revealed **Table 5**, that the post graduates and private practitioner agreed that primary implant stability is important before loading procedure, and were aware of the techniques to check for primary implant stability whereas, academician were least agreed to it.

The methods for studying implant stability can be categorized as invasive, which interfere with the osseointegration process of the implant, and non-invasive, which do not. Some of the

most famous methods in analyzing dental implant stability are percussion test, radiographs, reverse torque, cutting resistance, and resonance frequency analysis (RFA).^[9] The survey showed **Table 6**, the maximum respondents chose insertion torque, followed by RFA, Periotest technique. The probable reason for having maximum response for choosing insertion torque could be because of its non-invasiveness, being less expensive, easy to use. Insertion torque also helps to correlate with type of bone density and consequently implant stability achieved during time of implant placement can also be determined.^[9]

The original work of Branemark and colleagues defined protocols for predictable implant placement. These protocols involved the average time period required before loading the implant prosthesis. Accordingly, implants must be submerged during implant placement for 3 to 4 months in the mandible and 5 to 6 months for maxilla.^[12] In our study, results **Table 7&8** showed that, postgraduates were unaware in maximum number, about optimum time period required to achieve secondary stability in maxilla and mandible.

The survey depicted **Table 9**, majority of implant practitioners across all the categories of designation agreed that good primary stability dictates the success of secondary stability. According to Leonidas Podaropoulos et al, primary stability of the implant is, however, of utmost importance, because its maintenance is depended on the loading conditions, and the healing capacity of the host. Primary stability is reported to be a prerequisite for the establishment of osseointegration, that is, the secondary stability of the implant.^[13]

Osseointegration (secondary stability), is defined as a direct structural and functional connection between ordered, living bone and the surface of a load-carrying implant, is critical for implant stability, and is considered a prerequisite for implant loading and long-term clinical success of endosseous dental implants. As a result of osseointegration, initial mechanical stability (primary stability) is supplemented and/or replaced by biological stability, and the final stability level for an implant is the sum of the two.^[14] The respondents' attitude to the question in **Table 10**, suggests that both private practitioner and post graduate agreed in majority that secondary stability is important before planning prosthetic procedure with least response by academicians. In terms of practice **Table 11**, the technique implemented to check for secondary stability, suggests that RFA had maximum response by private practitioner, and least opted was reverse torque test. The probable reason for having to choose RFA commonly among the respondents, is due to its digitally advanced method providing accurate readings, it is a non-invasive and objective method for short and long-term monitoring of changes in

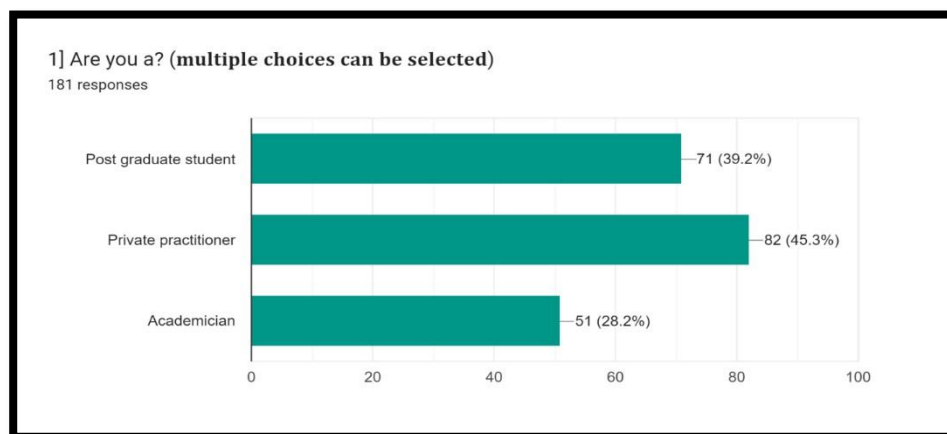
implant stability, easy to use, less time consuming, provides better case documentation.^[9] The survey also revealed **Table 12** that, the results obtained had mixed opinion, where maximum number of post graduate lacked the knowledge about RFA and its importance in terms of evaluating the stability.

In this present study, we can infer that, the knowledge of implant practitioner across different designation on implant stability is acceptable, whereas the attitudes and practices in terms of choice of techniques need improvements. Post graduates are needed to be trained in improving the knowledge on recent techniques such as RFA, owing to its efficiency in better prediction of implant stability compared to conventional techniques, which are booming in today's implant dentistry practices.

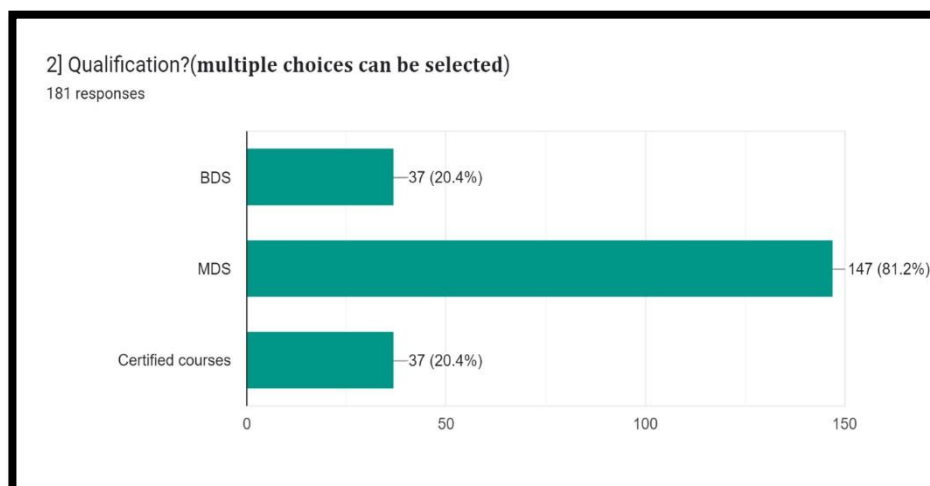
Limitation of the Study

1. Small sample size
2. The current study population was limited to Bangalore city. Further the study population can include larger geographical area for better evaluation.

Graphs and Tables



Graph 1.



Graph 2.

Table 1: Distribution responses of question” Do you carry out both Prosthetic and Surgical procedures of implant?”

Designation	Do you carry out both Prosthetic and Surgical procedures of implants			
	Only Prosthetic procedure	Only Surgical procedure	Both	Total
Academician	05(3%)	11(6%)	28(15%)	44(24%)
Post graduate student	03(2%)	21(12%)	45(25%)	69(39%)
Private practitioner	06(3%)	11(6%)	51(28%)	68(37%)
Total	14(8%)	43(24%)	124(68%)	181(100%)
P value	0.2375 (NS)			

NS*-Statistically Non-Significant, P-value* (<0.05).

Table 2: Distribution responses of question” Do you Agree; Implant stability is important for the success of an implant?”

Designation	Do you Agree, Implant stability is important for the success of an implant?		
	Agree	Disagree	Total
Academician	44(24%)	00(0%)	44(24%)
Post graduate student	69(38%)	00(0%)	69(38%)
Private practitioner	67(37%)	01(1%)	68(38%)
Total	180(99%)	01(1%)	181(100%)
P value	0.4337(NS)		

Table 3: Distribution responses of question” Are you aware of, Immediate Implant Loading and Early Implant Loading procedures?”

Designation	Are you aware of, Immediate Implant Loading and Early Implant Loading procedures?		
	No	Yes	Total
Academician	00(0%)	44(24%)	44(24%)
Post graduate student	04(3%)	65(36%)	69(39%)
Private practitioner	02(1%)	66(36%)	68(37%)
Total	06(4%)	175(96%)	181(100%)
P value	0.2388(NS)		

Table 4: Distribution responses of question” Do you think Primary Implant Stability is important to check prior to the above mentioned procedure?”

Designation	Do you think Primary Implant Stability is important to check prior to the above mentioned procedure?		
	No	Yes	Total
Academician	00(0%)	44(24%)	44(24%)
Post graduate student	04(2%)	65(36%)	69(38%)
Private practitioner	00(0%)	68(38%)	68(38%)
Total	04(2%)	177(98%)	181(100%)
P value	0.03616(S)		

S*-Statistically-Significant, P-value* (<0.05).

Table 5: Distribution responses of question “If yes, are you aware of any techniques to check for Primary Implant Stability?” according to designation.

Designation	If yes, are you aware of any techniques to check for Primary Implant Stability?		
	No	Yes	Total
Academician	02(1%)	42(23%)	44(24%)
Post graduate student	05(3%)	60(34%)	65(39%)
Private practitioner	05(3%)	63(34%)	68(37%)
Total	12(8%)	165(91%)	177(100%)
P value	0.7911(NS)		

Table 6: Distribution responses of question “Which among the following do you use, to check for Primary Implant Stability?”

Designation	Which among the following do you use, to check for Primary Implant Stability?				
	Insertion Tor`que	Resonance Frequency Analysis(RFA)	Periotest	Unaware	Total
Academician	25(14%)	14(8%)	03(2%)	02(1%)	44(24%)
Post graduate student	32(18%)	22(12%)	06(3%)	09((5%)	69(38%)
Private practitioner	49(27%)	13(7%)	01(1%)	05(3%)	68(38%)

Total	106(59%)	49(27%)	10(6%)	16(9%)	181(100%)
P value	0.0554(NS)				

Table 7: Distribution responses of question “Average minimum period to achieve adequate secondary stabilityfor maxilla?”

Designation	Average minimum period to achieve adequate secondary stability for maxilla ?				
	3 Months	4 Months	6 Months	8 Months	Total
Academician	09(5%)	15(8%)	20(11%)	00(0%)	44(24%)
Post graduate student	23(13%)	26(14%)	19(10%)	01((1%)	69(38%)
Private practitioner	18(10%)	23(13%)	26(14%)	01(1%)	68(38%)
Total	50(28%)	64(35%)	65(35%)	02(9%)	181(100%)
P value	0.5381(NS)				

Table 8: Distribution responses of question “Average minimum period to achieve adequate secondary stabilityfor mandible?”

Designation	Average minimum period to achieve adequate secondary stability for mandible ?				
	3 Months	4 Months	6 Months	8 Months	Total
Academician	37(20%)	04(2%)	01(1%)	02(1%)	44(24%)
Post graduate student	38(21%)	16(9%)	15(8%)	00((0%)	69(38%)
Private practitioner	47(26%)	13(7%)	08(4%)	00(0%)	68(38%)
Total	122(67%)	33(18%)	24(13%)	02(1%)	181(100%)
P value	0.0022(S)				

Table 9: Distribution responses of question “Do you agree, a good primary stability dictates the success ofsecondary stability?”

Designation	Do you agree, a good primary stability dictates the success ofsecondary stability?		
	Agree	Disagree	Total
Academician	42(23%)	02(1%)	44(24%)
Post graduate student	68(38%)	01(1%)	69(38%)
Private practitioner	65(36%)	03(2%)	68(38%)
Total	175(97%)	06(4%)	181(100%)
P value	0.5454(NS)		

Table 10: Distribution responses of question “Do you agree that checking for secondary implant stabilitybefore planning for prosthetic restoration is important?”

Designation	Do you agree that checking for secondary implant stability before planningfor prosthetic restoration is important?			
	No	Sometimes	Yes	Total
Academician	01(1%)	03(1%)	40(22%)	44(24%)
Post graduate student	01(1%)	04(2%)	64(35%)	69(38%)
Private practitioner	01(1%)	05(3%)	62(34%)	68(38%)
Total	03(3%)	12(6%)	166(91%)	181(100%)
P value	0.9914(NS)			

Table 11: Distribution responses of question “If yes/sometime, how do you measure?”

Designation	If yes/sometime, how do you measure?				
	Percussion	Resonance Frequency Analysis (RFA)	Reverse torque test	Radiograph	Total
Academician	07(4%)	22(12%)	03(2%)	11(6%)	43(24%)
Post graduate student	08(4%)	26(15%)	08(4%)	26((15%)	68(38%)
Private practitioner	12(7%)	30(17%)	04(2%)	21(12%)	67(38%)
Total	27(15%)	78(44%)	15(8%)	58(33%)	178(100%)
P value	0.5769(NS)				

Table 12: Distribution responses of question “Do you think, RFA can be considered as a reliable implant stability predictor compared to other tec.

Designation	Do you think, RFA can be considered as a reliable implant stability predictor compared to other techniques?				
	May be	No	Unaware	Yes	Total
Academician	08(4%)	01(1%)	06(3%)	28(16%)	43(24%)
Post graduate student	18(10%)	00(0%)	09(6%)	40(22%)	68(38%)
Private practitioner	16(9%)	02(1%)	08(4%)	42(24%)	67(38%)
Total	42(23%)	03(2%)	23(13%)	110(62%)	178(100%)
P value	0.8248(NS)				

CONCLUSION

From the study, it is observed that majority of the respondents across all the categories, were aware about the knowledge of implant stability, yet there is limited knowledge and awareness about loading protocols and techniques to check the primary and secondary implant stability among the post graduate students and academicians. This facilitates the need for strengthening education in post graduate students to reinforce their knowledge and awareness about loading protocols of various types of implants in their curriculum implants and also the newer digitalized technique which have better prediction of implant stability. Continuing education programs and refreshing courses regarding appropriate techniques and newer advanced techniques are necessary to update the knowledge of postgraduate students and academicians. However, the knowledge acquired must be implemented in their daily practice and provide the better treatment required for the patients.

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