Knowledge and Awareness Regarding Clinical Management of Thin Ridges Among Dentist Practicing Dental Implants - A Questionnaire Based Online Survey

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Abstract: The study aims to assess the knowledge and awareness regarding clinical management of thin ridges among dentists practising dental implants. Deficient alveolar ridge is a common difficulty faced by dental practitioners during replacement of missing teeth by dental implants. Hence there is a need to gain adequate bone to place implants. There are various methods to manage thin ridges. Proper knowledge and skills are needed to manage this situation. This study was designed around a questionnaire assessing the knowledge and awareness among dentists on an online platform - google forms was used to prepare the survey, the link of the survey was distributed to the volunteers using convenience sampling and snowball sampling methods. The data was collected, tabulated in excel sheets, and analyzed using the SPSS software. In this study most of the Prosthodontist, Oral Surgeon and Periodontist feel that managing reduced height is challenging and most of the specialists prefer bone expansion than ridge splitting. The commonly used graft material was autograft and the specialist preferred to augment bone when encountered a thin ridge.

Keywords: Dental Implants; management, residual ridge resorption, thin ridges, bone graft

INTRODUCTION

Implants are preferred in restoring missing teeth at any situation regardless of site, atrophy, disease or injury. But Thin ridges of the maxillary and mandibular ridges are great difficulties that are faced during dental implant placement. Residual ridge resorption is the condition which is the deciding factor for the type, position and complexity of placing implants (Kaarthikeyan and Jangid, 2016). Atwood in 1962 classifies the residual ridge configuration under Order I - Pre-extraction, Order II- Post-extraction, Order III- High, well rounded, Order IV- Knife-edge, Order V- low, well-rounded, Order VI- depressed (Atwood, 1962). Residual ridge resorption is a complex biophysical process and a common occurrence following extraction of teeth. RRR is a localized pathologic loss of bone, which cannot be built back by removing the causative factors. The atrophy of the ridge is progressive during the first year and gradually the rate of resorption reduces. Ridge atrophy causes increase in the inter arch space (D., Mehra and D., 2014). Most resorption occurs in the alveolar process, whereas the basal portion remains relatively intact. Most of the bone mass in the mandible consists of cortical bone in the basal portion (*Website*, no date) depending on the region of edentulous space deficient height can be managed.

Several bone manipulation techniques are there to alter bone density to give adequate strength and make space to place implants. As a part of the repair process bone has the capacity to undergo regeneration (Basa, Varol and Turker, 2004). Bone regeneration techniques include inlay and onlay grafting, bone expansion, guided bone regeneration (GBR), bone splitting osteotomy, different fixation devices such as bone screws, pins, titanium mesh, different augmentation materials, and different barrier membranes (Simion, Baldoni and Zaffe, 1992).

For a maxillary posterior when the height is short, maxillary sinus lift procedure is done and when the mandibular posterior height is less, nerve repositioning is done. Short implants and GBR can also be used (Esposito *et al.*, 2010a). When the available bucco-lingual width is less than 3mm, the deficient ridge is gained by a two stage augmentation using block or particulate graft along with titanium mesh. When the width is 3-5mm, distraction osteogenesis is performed as a two staged technique. Ridge split technique along with simultaneous implant placement is performed when sufficient cancellous bone is available between the bucco-lingual widths of 3-5mm. This reduces second surgery. Bone expansion is done when there is an adequate 4mm width available on the most common area where bone expansion is performed is the anterior maxilla, followed by posterior maxilla followed by anterior mandible and then the posterior mandible. This technique allows to expand and to relocate the alveolar bone by taking advantage of the softer bone quality found in Types III and

IV maxillary bone instead of losing the bone by drilling (Siddiqui and Sosovicka, 2006; Esposito *et al.*, 2010b). Osteotomes are used in bone expansion procedure (Hahn, 1999).

Autogenous bone grafts are gold standard in bone grafting material which allows osteogenesis and osteoinduction. Intra orally autograft materials are obtained from edentulous areas such as maxillary tuberosity, mandibular symphysis, and mandibular ramus. Extra orally they are obtained from iliac crest, rib, tibia, and calvarium. Autografts maintain bone structures such as minerals, collagen, and viable osteoblasts and bone morphogenic proteins (BMPs).(Mittal, Jindal and Garg, 2016) An allograft is a tissue graft between individuals of the same specimen but of nonidentical genetic composition. Fresh allografts are rarely used because of immune response and the risk of disease transmission. Freeze dried bone or demineralized freeze dried bone is commonly used in the field of dentistry. Alloplasts are synthetic bone materials which have osteoconductive property. Calcium phosphates, bioactive glasses, and biocompatible composite polymers are the most common types of alloplasts. Xenografts are obtained from the inorganic portion of animal bones. The inorganic portion is an excellent source of calcium and provides a natural matrix. GBR is the use of membranes for space provision over a vertical or horizontal defect, it promotes the growth of osteogenic cells and prevents the migration of infection from the soft tissue. Membranes can be resorbable and non-resorbable.(Hartmann, 2015)

Previously our department has published extensive research on various aspects of prosthetic dentistry ('Evaluation of Corrosive Behavior of Four Nickel–chromium Alloys in Artificial Saliva by Cyclic Polarization Test:An in vitro Study', 2017; Ganapathy, Kannan and Venugopalan, 2017; Jain, 2017a, 2017b; Ranganathan, Ganapathy and Jain, 2017; Ariga *et al.*, 2018; Gupta, Ariga and Deogade, 2018; Anbu *et al.*, 2019; Ashok and Ganapathy, 2019; Duraisamy *et al.*, 2019; Varghese, Ramesh and Veeraiyan, 2019), this vast research experience has inspired us to research to evaluate the knowledge and awareness of the different procedures in handling the clinical management of thin ridges to restore by dental implants.Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade (Ezhilarasan, 2018; Ezhilarasan, Sokal and Najimi, 2018; Gupta, Ariga and Deogade, 2018; Jeevanandan and Govindaraju, 2018; J *et al.*, 2018; Menon *et al.*, 2018; Prabakar *et al.*, 2018; Rajeshkumar *et al.*, 2018, 2019; Vishnu Prasad *et al.*, 2018; Wahab *et al.*, 2018; Dua *et al.*, 2019; Duraisamy *et al.*, 2019; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Gheena and Ezhilarasan, 2019; Malli Sureshbabu *et al.*, 2019; Mehta *et al.*, 2019; Panchal, Jeevanandan and Subramanian, 2019; Rajendran *et al.*, 2019; Ramakrishnan, Dhanalakshmi and Subramanian, 2019; Sharma *et al.*, 2019; Varghese, Ramesh and Veeraiyan, 2019; Gomathi *et al.*, 2020; Samuel, Acharya and Rao, 2020)

MATERIALS AND METHODS

Thorough planning of methodology was done before conducting the study to reduce bias. A questionnaire on different procedures, different clinical situations to manage thin ridge, was prepared keeping in mind the assessment of the knowledge and awareness on management of thin ridges in clinical practise, the questions were validated and reviewed closely. Dentists of different age groups and different years of experience and different specialties were included in this study. Sampling was done using convenience sampling and snowball sampling methods whereby volunteers approached were asked to circulate the questionnaire to other dentists matching the inclusion criteria. An online platform was used to prepare the questionnaire - Google forms, the link was sent to the volunteers, the volunteers participating in the study were asked for consent prior to their participation. A total of 100 responses were collected and were analyzed and tabulated using excel sheets followed by statistical analysis using the SPSS software.

RESULTS AND DISCUSSION

The results of the study involved different distribution of the questions and the association between the speciality and the different questions asked. In this study, the gender distribution among the respondents were 51% and 49% of males and females respectively (Figure 2)and the age group was into three categories (figure 1).. The distribution of speciality among responses in the study population revealed that 32%, 23%, 20% and 25% of responses were from general dentist, prosthodontist,oral surgeon and periodontist respectively (figure 3). The distribution of years of experience in the study population revealed that 29% , 38% and 33% had < 2 years, 2-5 years and >5 years of experiences respectively (Figure 4). The distribution of treatment options for thin ridge in the study population revealed that 40%,32% and 28% of responses were FPD, dental implants and TPD/RPD respectively (Figure 5). The distribution of the Difficult type of ridge to manage in the study population revealed that 25% , 54 % and 22% of responses were Deficient width, Insufficient height and both respectively (Figure 6). The distribution of the techniques improving bone volume in the study population revealed that 28%,16%,10% and 46% of responses were Augmentation, Bone expansion, ridge splitting and all the above respectively (figure 7). The distribution of the Bone expansion region in the study population revealed that 29%,46%,20% and 5% of responses were posterior maxilla,anterior maxilla, both anterior and posterior maxilla and lower arch respectively (figure 8). The distribution of the Bone width during bone expansion in the study population revealed that 24%,71% and 5% of responses were <4mm ,4mm and >4mm respectively (figure

9). The distribution of the Bone expansion for bone type in the study population revealed that 3%,4%,56%and 37% of responses were D1,D2,D3 and D4 respectively (figure 10). The distribution of the procedure done when the 3mm available bone in the study population revealed that 28%,16%,10% and 46% of responses were augmentation,bone expansion,ridge splitting and all the options respectively (figure 11). The distribution of the bone type for ridge splitting in the study population revealed that 27%,16%,10%and 47% of responses were narrow crest and widens at apical , uniform crestally and apically,adequate cortical thickness width and both A and C respectively (figure 12). The distribution of the risk factor for ridge splitting in the study population revealed that 56%,36%and 8% of responses were fracture of the buccal cortical plate, dental implant failure and technique sensitive respectively (figure 11). The distribution of the ridge splitting technique in the study population revealed that 27%,29% and 44% of responses were single stage technique, two stage technique and both of them respectively (figure 14). The distribution of the graft material used in the study population revealed that 40%,17%,19% and 24% of responses were autograft,allograft, alloplast and xenograft respectively (figure 15). The distribution of the use of GBR in the study population revealed that 49%,21% and 30% of responses were regeneration,act as scaffold and protect bone graft respectively (figure 16).

The association between the speciality and the questions showed various significance. Mainly , there was a difference in the speciality and the choice of treatment when a thin ridge is encountered, the choice of option given, difficulty in which type of bone the techniques used to manage thin bone. (Figure 17-28)

Based on the results of the study described here, The category and design of the final prosthesis and key implant positions are first determined after a patient's interview and evaluation of existing medical and dental conditions. Available bone describes the quantity of bone within the edentulous area considered for implantation. It is measured in height, width, length angulation and crown height space. If the bone is inadequate to support an ideal abutment for the indented prosthesis or bone grafting, the ideal site is often indicated or an alternative site may be considered. According to Schropp et al, when a tooth is lost, the bucco-lingual alveolar ridge dimension decreases significantly, 3.8 and 6.1mm over a period of 3-12 months, respectively('Bone healing and soft tissue contour changes following single-tooth extraction: A clinical and radiographic 12-month prospective study', 2004). The amount of resorption can reach upto 50% of the original width. In this study 71% of the dentists stated that 4mm width is needed to do bone expansion. But none of the specialists chose >4mm for ridge split but 5 % of the general dentist chose above 4mm width Lekovic et al. 1997 Scipioni et al. stated that another important issue is the effect of the detachment of the periosteum from the bone surface. (Lekovic *et al.*, 1997)(Simion, Baldoni and Zaffe, 1992) Some authors proposed the preservation of the periosteum on the bone (i.e., mucosal flap or split-flap) to minimize bone resorption However, using the split-flap design, a horizontal augmentation with GBR is contra- indicated. Ridge splitting technique was a successful procedure in the early 90's. Original reports by Simion et al and Scipioni et al, in 1992 and 1994, respectively, demonstrated an alveolar width gain between 1 and 4 mm after the split-crest procedure and successful immediate implant placement and osseointegration (success rate of 98.9%).(Bassetti, Bassetti and Bosshardt, 2016) This study stated 47% Narrow crest and widens at apical and adequate cortical thickness width is when ridge expansion is done. In 1997, Engelke et al reported the reconstruction of narrow anterior maxillary alveolar ridges by the preparation of an ''artificial socket'' (lamellar cortical splitting) with immediate interlamellar implant placement and primary stabilization with micro- fixation. About 56% of the dentist revealed that it was the risk of the fracture of the buccal plate and 36% felt it was implant failure that has the most associated risk factor.

Success of the dental implant needs a good quality and quantity of bone. It depends on this factor. This is usually altered due to periodontal disease, trauma etc. managing this clinical situation can be made using various grafts materials and GBR(Adell *et al.*, 1981) . Augmentation, ridge splitting are widely done in order to manage this clinical situation. In treating large bone defects, it is one of the most challenging scenarios where autologous bone plays a major role in treating it. Autologous bone grafts are gold standard graft material which has got osteogenic and osteoconductive property.(Méndez-Ferrer *et al.*, 2010)(Lichte *et al.*, 2011) It avoids immune rejection as it is taken from same individual, whereas in allografts this falls a main drawback (Weingart and Bruggenkate, 2000) and it has quick resorption rate. Xenografts are widely used materials to substitute intra oral bone grafting. Deproteinized bovine bone matrix (DBBM) is used (Ehrler and Vaccaro, 2000). In this study it was found to be 40% who chose autografts as the choice of graft material followed by xenograft. About 6% of the general dentist stated the use of allografts which have got a lesser success rate than the other materials. Ridge splitting techniques either be done in single stage and two stage technique when there is adequate bone or when the buccal plate chips off. 49% of the specialists and experienced general practitioners have agreed that a GBR helps in regeneration which helps in prevention of migration of undesired cells from outside and allows space for promoting in-growth of osteogenic cells, but when we look it to the association 15% of the general dentist have suggested it that it acts as a scaffold only. Our institution is passionate about high quality evidence based research and has excelled in various fields ((Pc, Marimuthu and Devadoss, 2018; Ramesh *et al.*, 2018; Vijayashree Priyadharsini, Smiline Girija and Paramasivam, 2018; Ezhilarasan, Apoorva and Ashok Vardhan,

2019; Ramadurai *et al.*, 2019; Sridharan *et al.*, 2019; Vijayashree Priyadharsini, 2019; Chandrasekar *et al.*, 2020; Mathew *et al.*, 2020; R *et al.*, 2020; Samuel, 2021)

CONCLUSION
Within the limitations of the study, management of thin ridges is a clinical challenge faced by dental professionals. The changes in the ridge has to be assessed prior to the beginning of new prosthetic rehabilitation. In this study most of the Prosthodontist, Oral Surgeon and Periodontist feel that managing reduced height is challenging and most of the specialists prefer bone expansion than ridge splitting. The commonly used graft material was autograft and the specialist preferred to augment bone when encountered a thin ridge.

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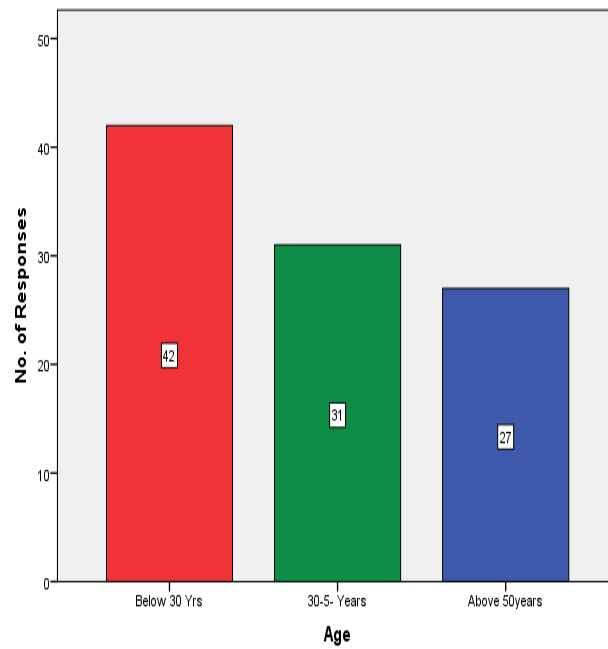
Fig.1: Shows the distribution of the age among the responses. X axis represents age and Y axis represents the number of responses. 42% were below 30 years (red), 31% were between 30-50 years (green), and 27% were above 50 years (blue).
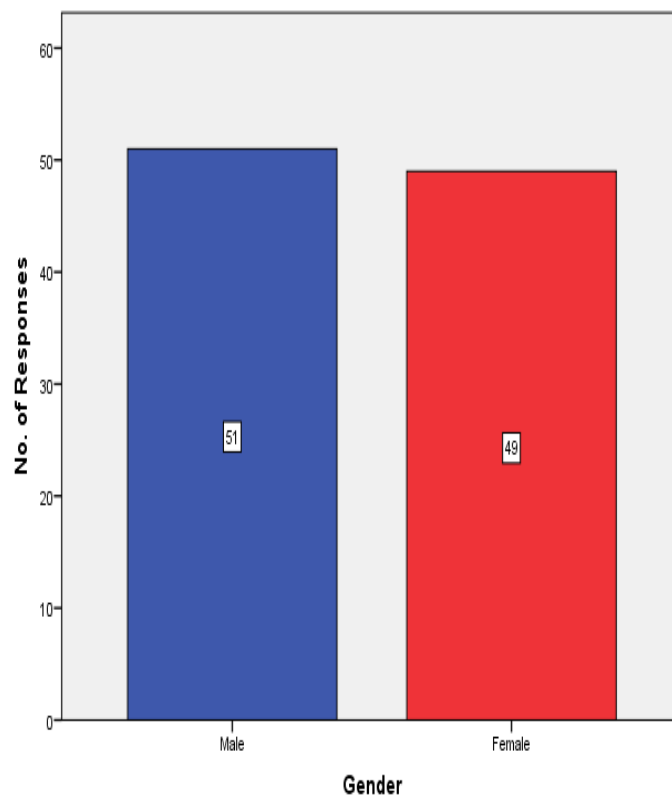

Fig.2: Shows the distribution of the gender among the responses. X axis represents gender and Y axis represents the number of responses. 51% were male (male), and 49% were female (blue).
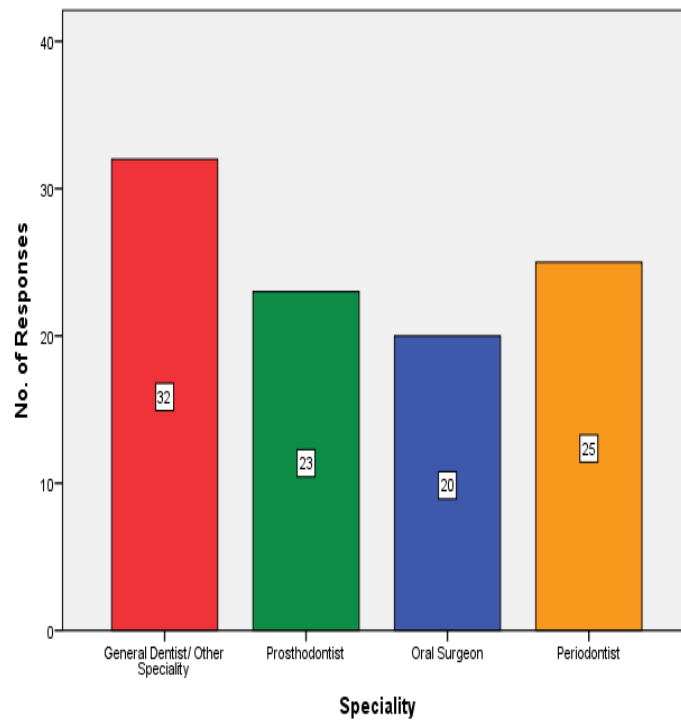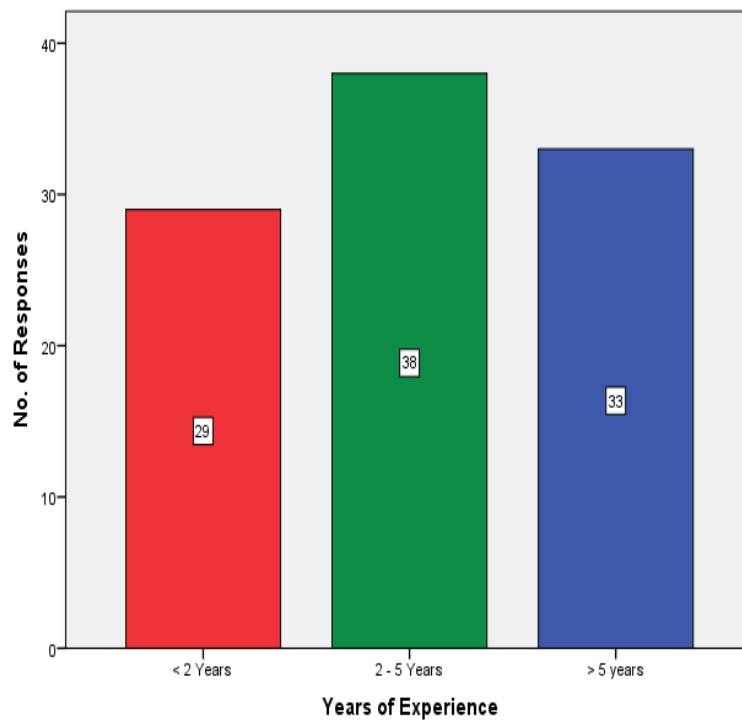
Fig.3: Shows the distribution of the speciality among the responses. X axis represents speciality and Y axis represents the number of responses. 32% were general dentist (red), 23% were prosthodontist (green), 20% were oral surgeon (blue), 25% were periodontist (orange).

Fig.4: Shows the distribution of the years of experience among the responses. X axis represents years of experience and Y axis represents the number of responses. 29% were < 2 years (red), 38% were among 2-5 years (green), and 33% were > 5 years (blue).
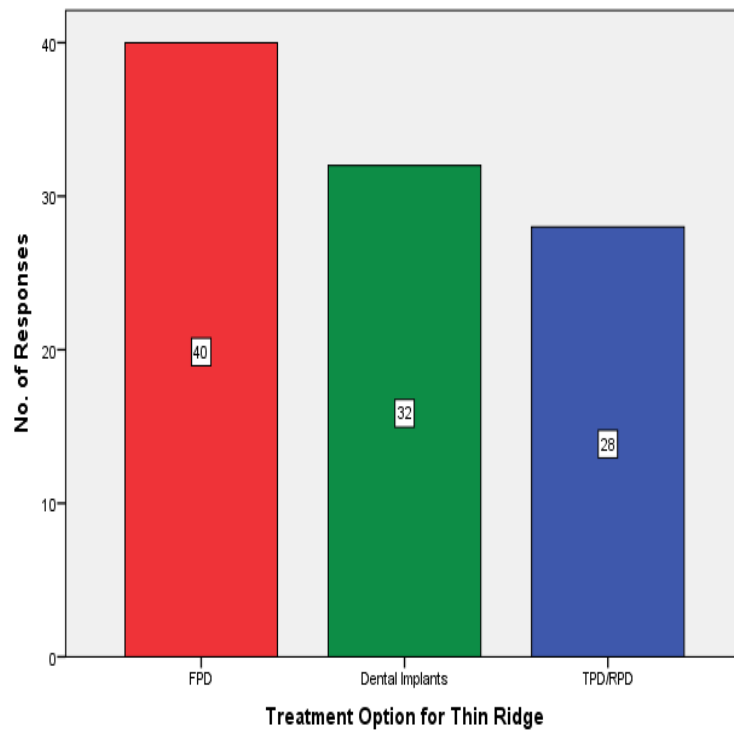
Fig.5: Shows the distribution of the treatment option for thin ridge among the responses. X axis represents the treatment option for thin ridge and Y axis represents the number of responses. 40% were FPD (red), 32% were Dental implants (green), and 28% were TPD/RPD (blue).
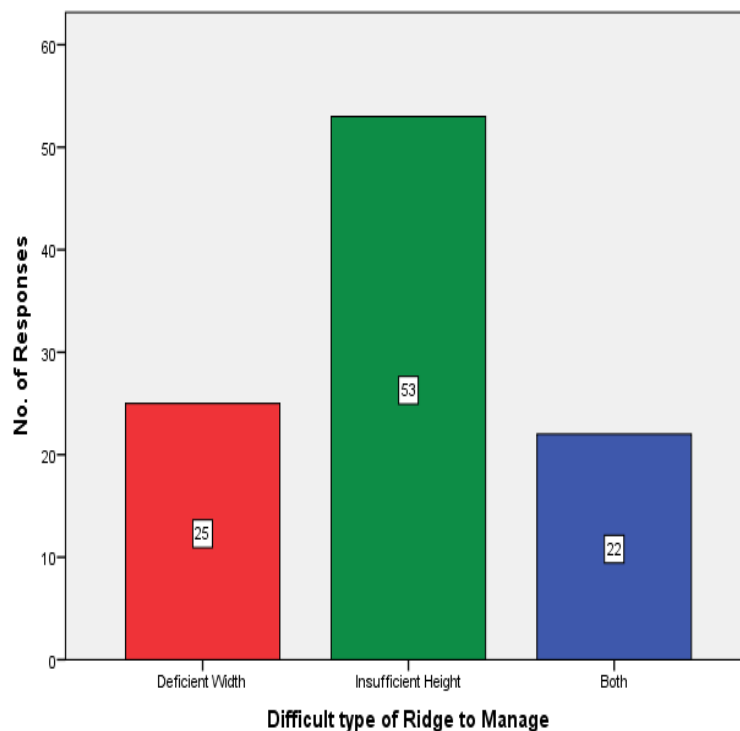
Fig.6: Shows the distribution of the difficult type of ridge to manage among the responses. X axis represents the difficult type of ridge to manage and Y axis represents the number of responses. 25% were Deficient width (red), 53% were Insufficient height (green), and 22% were both (blue).
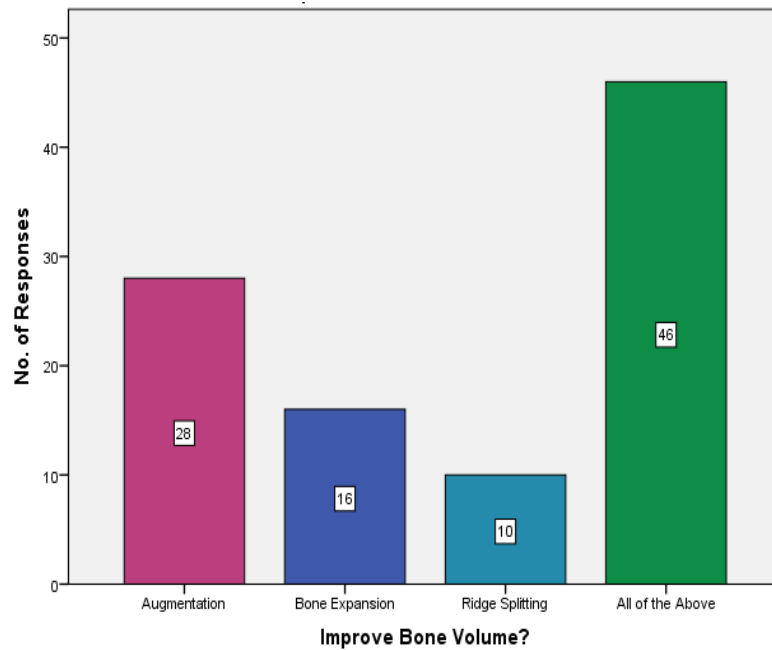
Fig.7: Shows the distribution of the techniques improving bone volume among the responses. X axis represents techniques improving bone volume and Y axis represents the number of responses. 28% were Augmentation (purple), 16% were Bone expansion (blue), 10% were ridge splitting (light blue), and 46% were all the above (green).
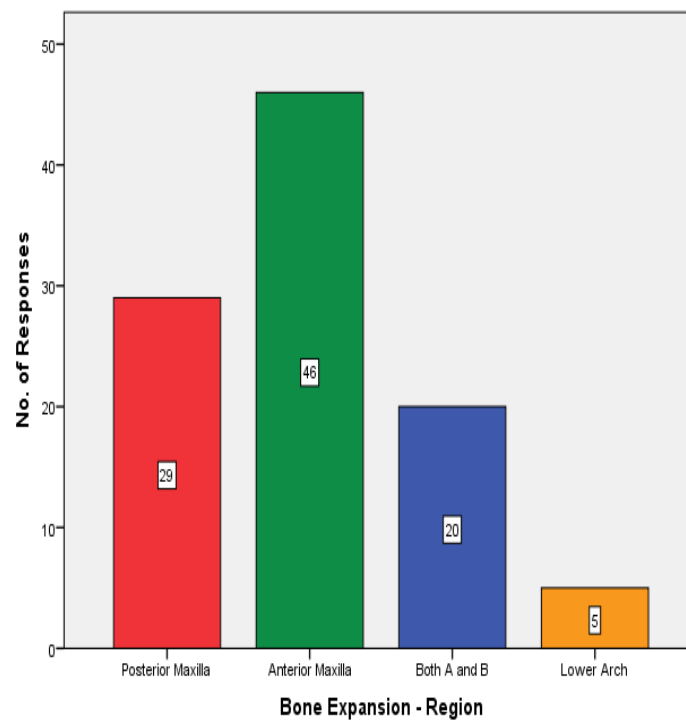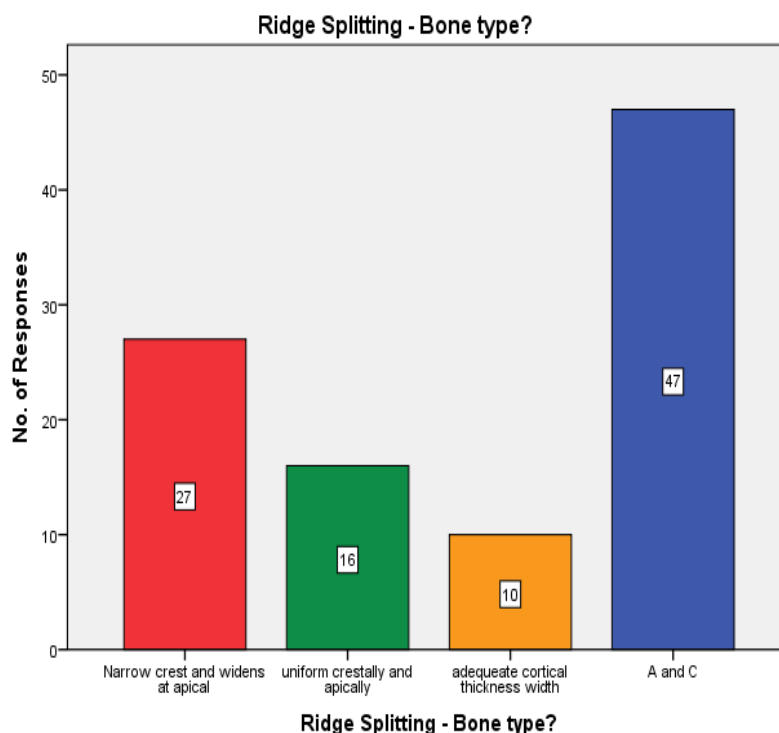

Fig.8: Shows the distribution of the Bone expansion region among the responses. X axis represents Bone expansion region and Y axis represents the number of responses. 29% were posterior maxilla (red), 46% were anterior maxilla (green), 20% were both anterior and posterior maxilla (blue), 5% were lower arch (orange).
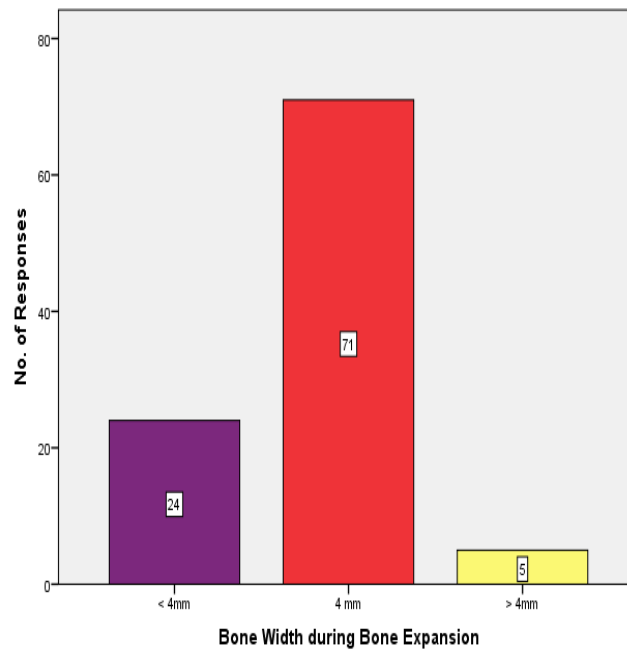
Fig.9: Shows the distribution of the Bone width during bone expansion among the responses. X axis represents bone width during bone expansion and Y axis represents the number of responses. 24% were < 4mm (purple), 71% were 4mm (red), 5% were > 4mm (yellow).
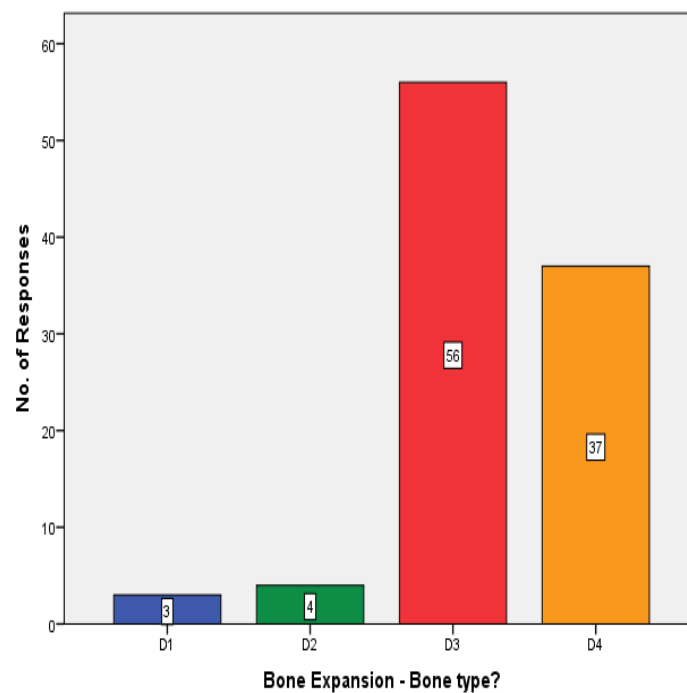
Fig.10: Shows the distribution of the Bone expansion for bone type among the responses. X axis represents bone expansion for bone type and Y axis represents the number of responses. 3% were D1 (blue), 4% were D2 (green), 56% were D3 (red), 37% were D4 (orange).
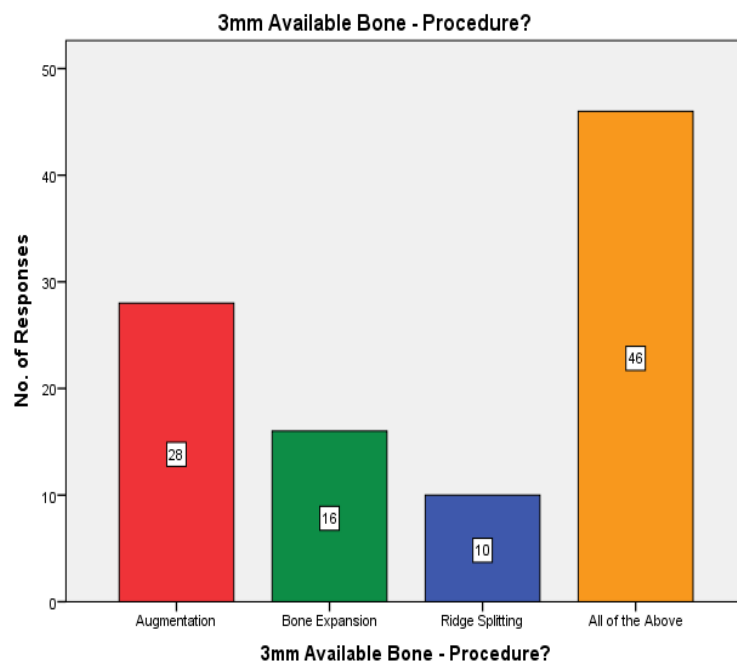
**Fig.11: Shows the distribution of the procedure done when 3mm available bone among the
responses. X axis represents procedure done when 3 mm available bone and Y axis represents the
number of responses. 28% were augmentation (red), 16% were Bone expansion (green), 10%
were ridge splitting (blue), 46% were all the option (orange).**

**Fig.12: Shows the distribution of the bone type for ridge splitting among the responses. X axis
represents bone type for ridge splitting and Y axis represents the number of responses. 27% were
Narrow crest and widens at apical(red), 16% were uniform crestally and apically(green), 10%
were adequate cortical thickness width(orange), 47% were A & C(blue)**
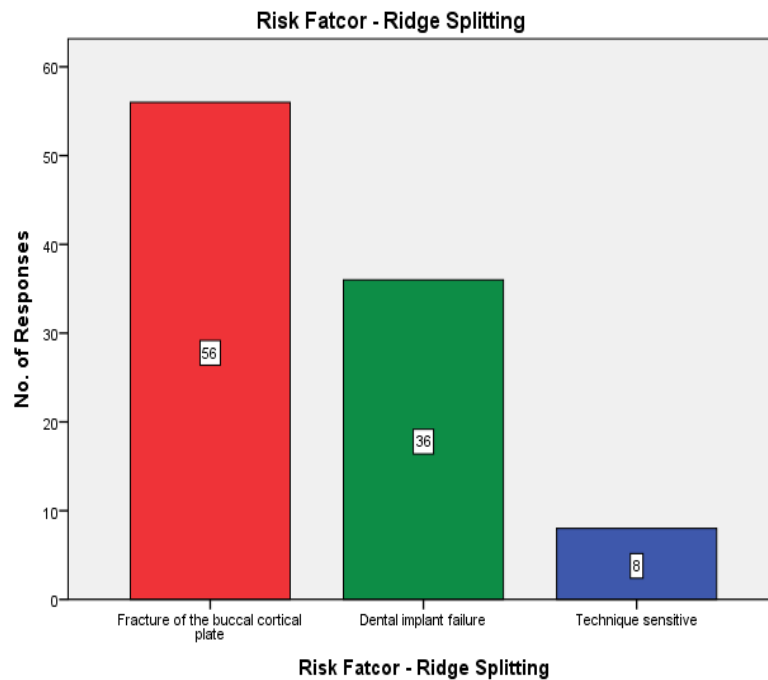
Fig.13: Shows the distribution of the risk factor for ridge splitting among the responses. X axis represents risk factor for ridge splitting and Y axis represents the number of responses. 56% were fracture of the buccal cortical plate(red), 36% were dental implant failure(green), 8% were technique sensitive(blue)
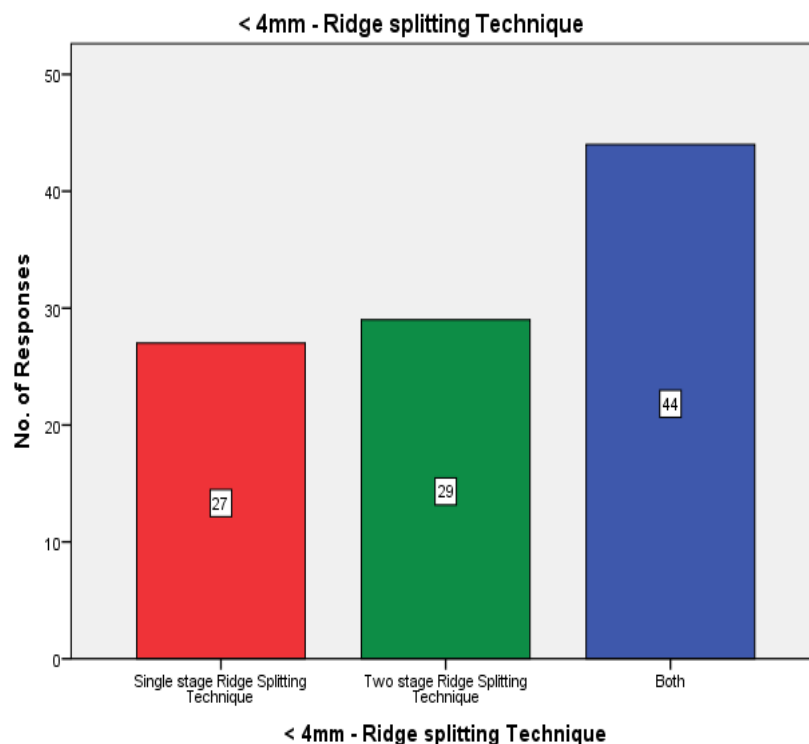
Fig.14: Shows the distribution of the ridge splitting technique among the responses. X axis represents ridge splitting technique and Y axis represents the number of responses. 27% were single stage technique(red), 29% were two stage technique and 44% were both(blue)
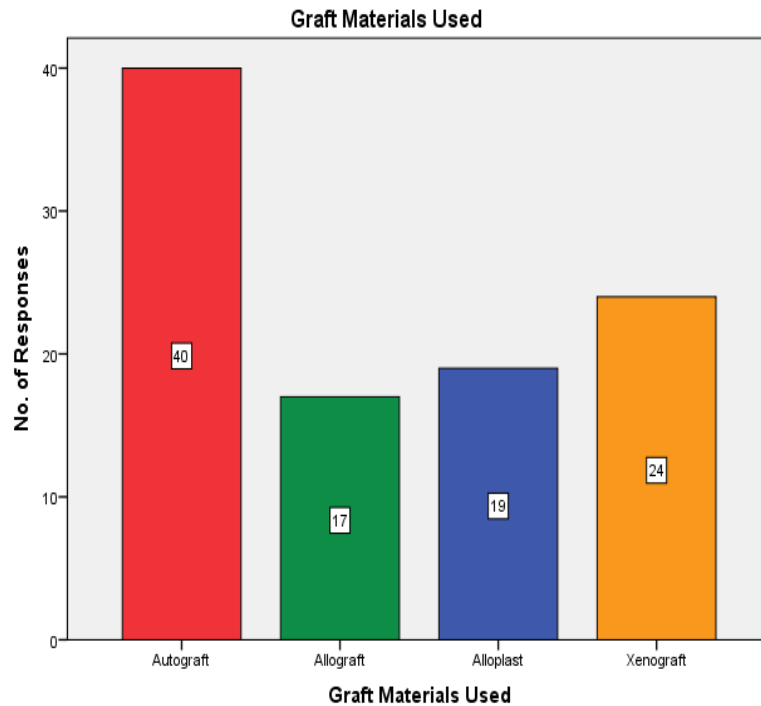
Fig.15: Shows the distribution of the graft material used among the responses. X axis represents graft material used and Y axis represents the number of responses.40% were allograft(red), 17% were allograft(green), 19% were alloplast(blue), 24% were xenograft(orange).
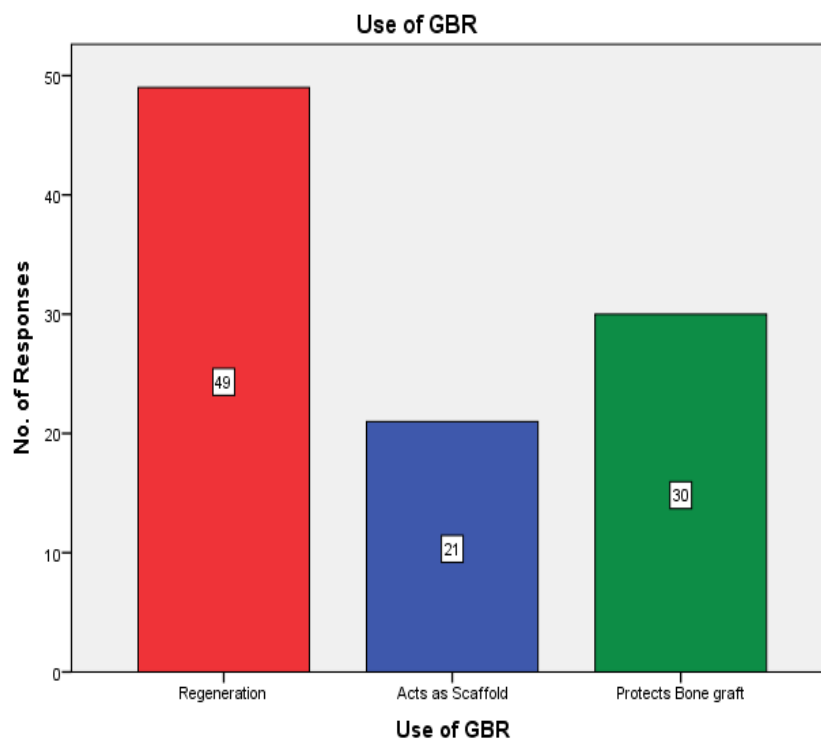
Fig.16: Shows the distribution of the use of GBR among the responses. X axis represents use of GBR and Y axis represents the number of responses. 49% were regeneration(red), 21% were act as scaffold(blue), 30% were protects bone graft(green)
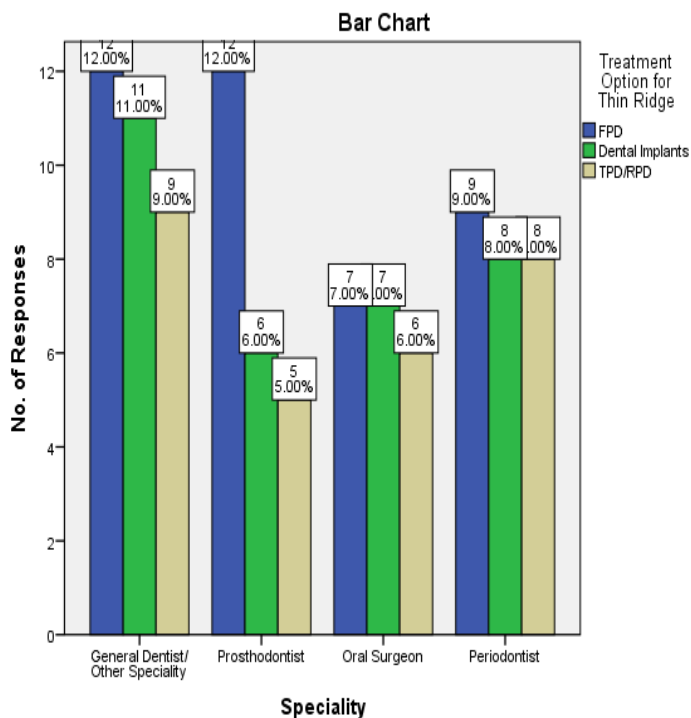
Fig.17: shows the association of speciality and responses for question, what treatment options would you choose when you encounter thin ridges? X axis represents the speciality and Y axis represents the number of responses. Chi sqaure association was done and found to be statistically not significant. Chi square value : 1.985, df : 6, p value :0.921>0.05. However, FPD was the preferred choice among the general dentist and prosthodontist when compared to other specialties.
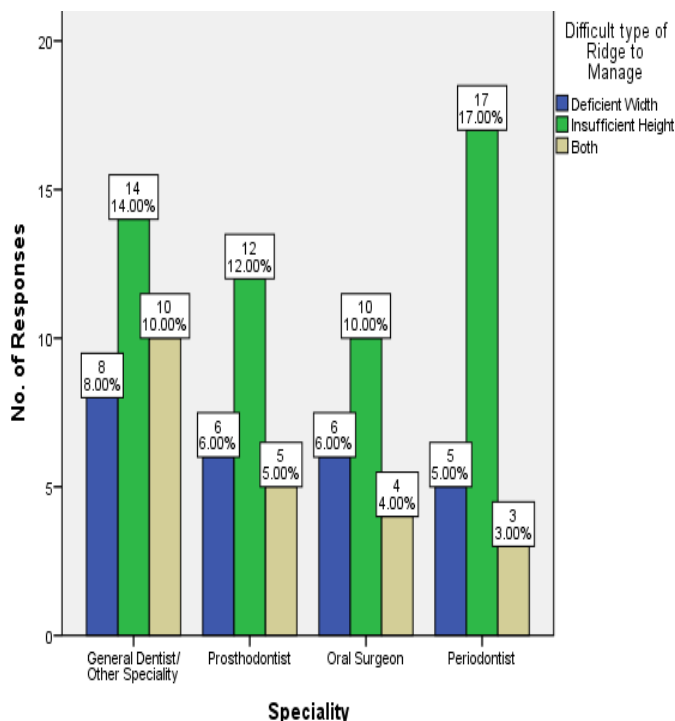
Fig.18: shows the association of speciality and responses for the question, Which type of ridge is very difficult to manage? X axis represents the speciality and Y axis represents the number of responses. Chi square association was done and found to be statistically not significant. Chi square value : 4.494, df : 6, p value :0.610>(0.05). However, insufficient height was the difficult among the periodontists to manage when compared to other specialties.
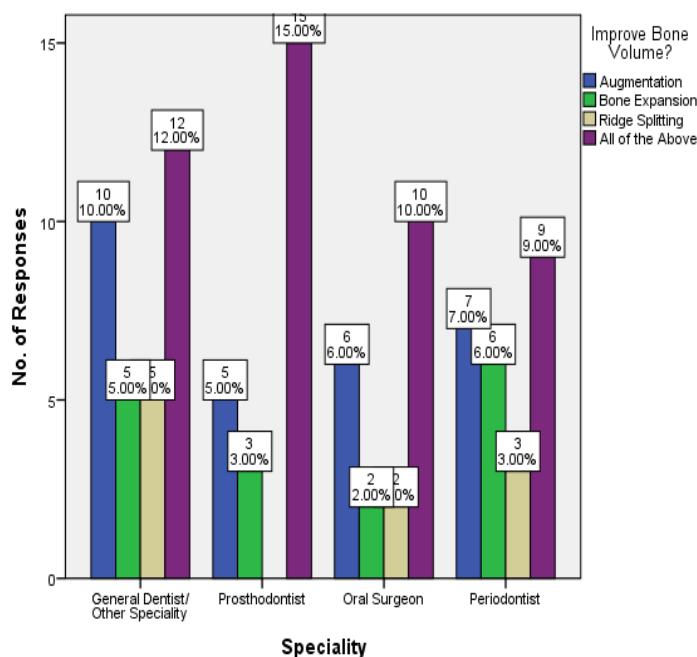
Fig.19: shows the association of speciality and responses for the question, What will you do to increase the width and height? X axis represents the speciality and Y axis represents the number of responses. Chi square association was done and found to be statistically not significant. Chi square value : 8.424, df : 9, p value :0.492> (0.05). However, augmentation, bone expansion and ridge splitting was the preferred choice among the prosthodontists than other specialties.
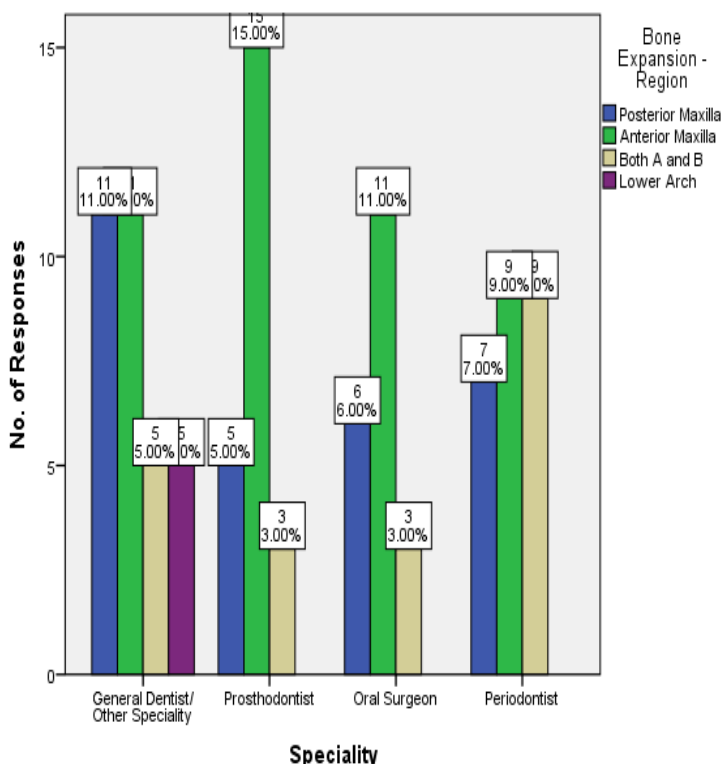

Fig.20: shows the association of speciality and responses for the question, Bone expansion surgical techniques are done in which region? X axis represents the speciality and Y axis represents the number of responses. Chi square association was done and found to be statistically not significant. Chi square value : 8.424, df : 9, p value :0.492> (0.05). However, anterior maxilla was the preferred choice among the prosthodontists than other specialties.
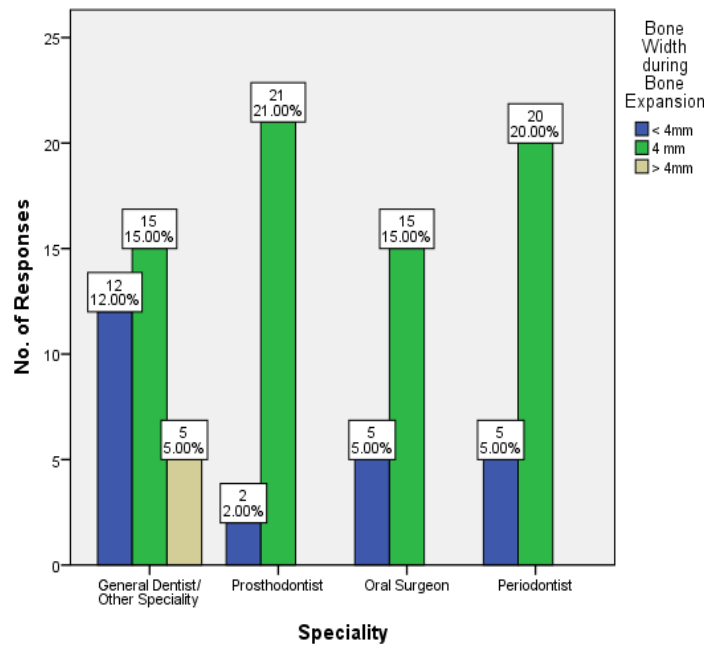
Fig.21: shows the association of speciality and responses for the question, How much mm should the width of the bone be during the bone expansion procedure? X axis represents the speciality and Y axis represents the number of responses. Chi square association was done and found to be statistically significant. Chi square value : 19.764, df : 6, p value :0.003< (0.05). However, 4mm for bone expansion was preferred among the prosthodontists than other specialties.
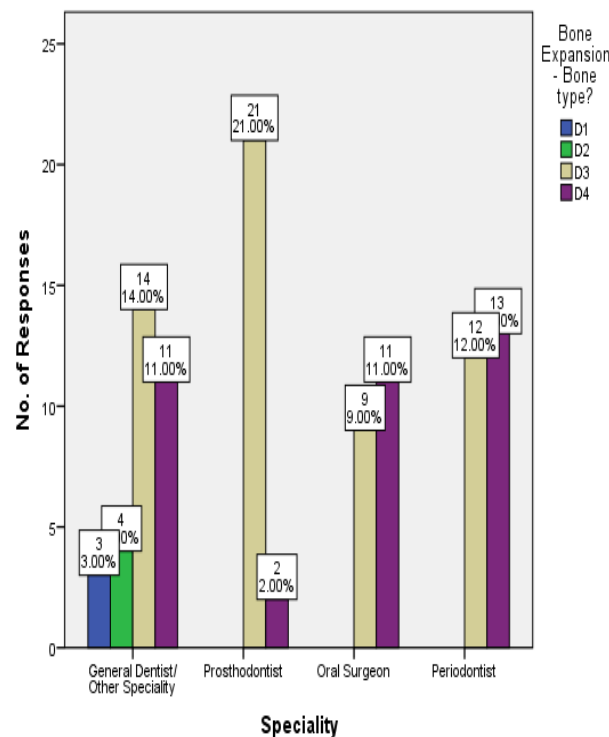

Fig.22: shows the association of speciality and responses for the question, Bone expansion is better when used in which type of bone? X axis represents the speciality and Y axis represents the number of responses. Chi square association was done and found to be statistically significant. Chi square value :29.881, df : 9, p value :0.000< (0.05). However, D3 type of bone preferred for bone expansion among the prosthodontists when compared to other specialties.
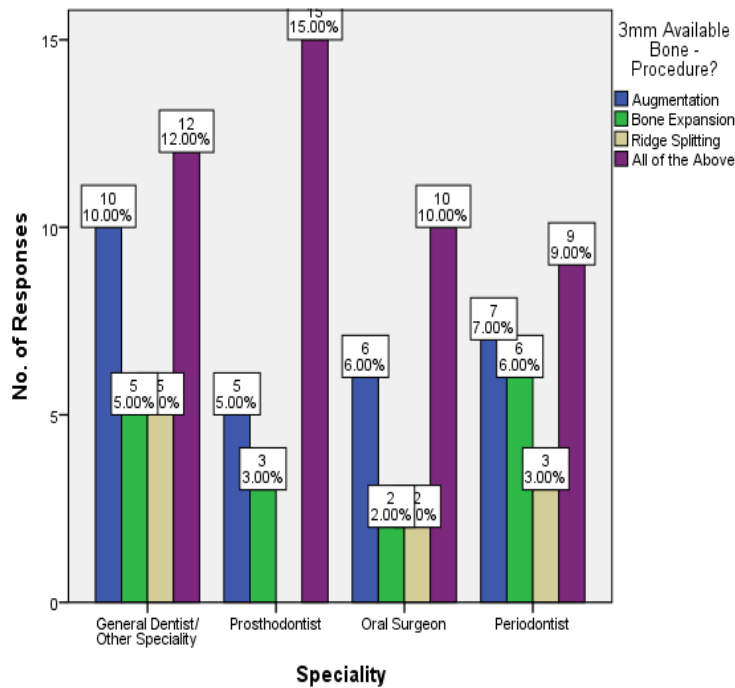
Fig.23: shows the association of speciality and responses for the question, When a 3mm of bone width is available, which procedure will you choose? X axis represents the speciality and Y axis represents the number of responses. Chi square association was done and found to be statistically not significant. Chi square value : 8.424, df : 9, p value :0.492>0.05. However,for 3mm bone availability augmentation, ridge splitting, bone expansion was preferred among prosthodontist, oral surgeon than other specialties.
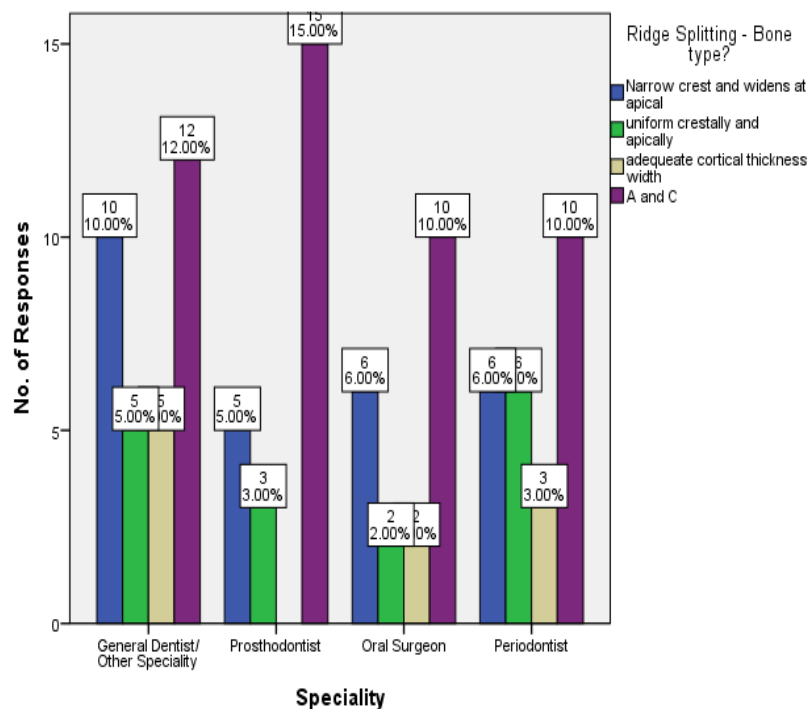

Fig.24: shows the association of speciality and responses for the question, What type of bone is best suited for ridge splitting? X axis represents the speciality and Y axis represents the number of responses. Chi square association was done and found to be statistically not significant. Chi square value : 8.128, df : 9, p value :0.521>0.05. However, narrow crest and adequate cortical thickness of bone for ridge splitting were preferred among the prosthodontists when compared to other specialties.
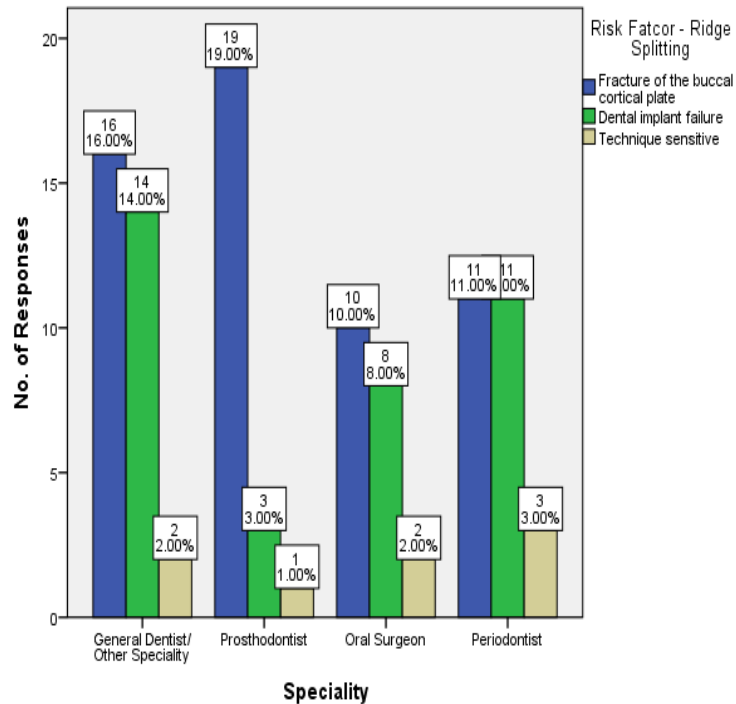
Fig.25: shows the association of speciality and responses for the question, What do you think will be the risk factor of ridge splitting? X axis represents the speciality and Y axis represents the number of responses. Chi square association was done and found to be statistically not significant. Chi square value : 9.425, df : 6, p value :0.151>0.05. However, Fracture of buccal cortical plate was the preferred choice among the prosthodontists when compared to other specialties.
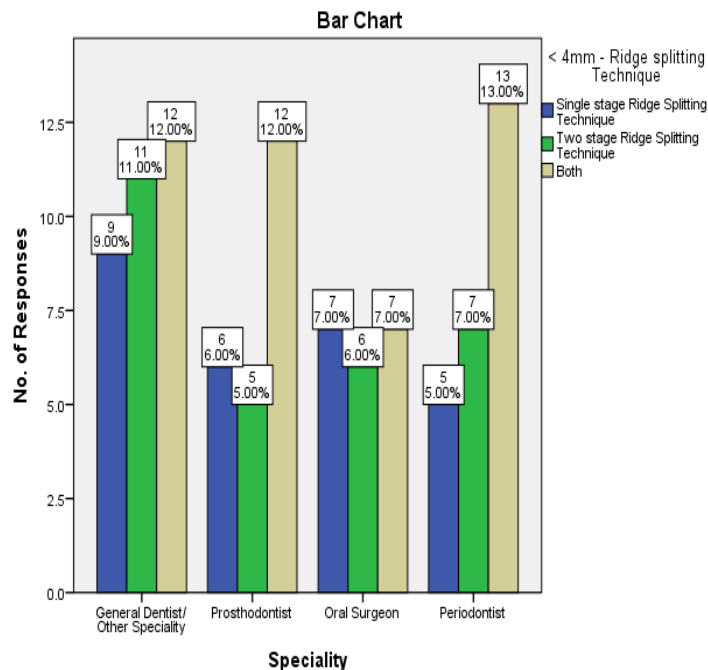

Fig.26: shows the association of speciality and responses for the question, Narrow edentulous alveolar ridges < 4 mm wide can be expanded by? X axis represents the speciality and Y axis represents the number of responses. Chi square association was done and found to be statistically not significant. Chi square value : 3.091, df : 6, p value :0.797>0.05. However, single and two stage ridge splitting were preferred among the periodontists when compared to other specialties.
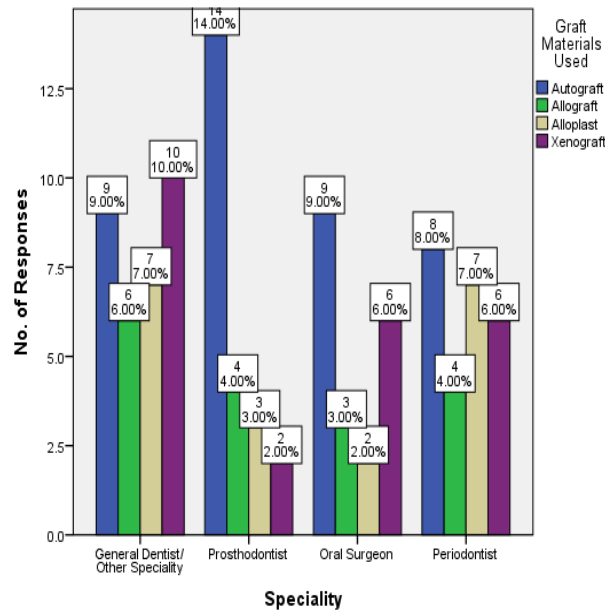
Fig.27: shows the association of speciality and responses for the question, What graft material is to be used for managing thin ridges? X axis represents the speciality and Y axis represents the number of responses. Chi square association was done and found to be statistically not significant. Chi square value : 10.012, df : 9, p value :0.350>0.05. However, autograft was the preferred choice among the and prosthodontists when compared to other specialties.
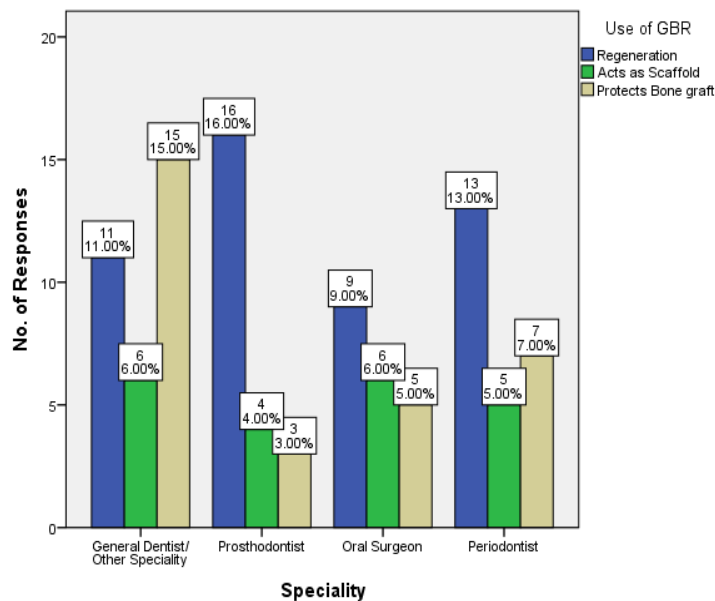

Fig.28: shows the association of speciality and responses for the question, GBR procedure results in? X axis represents the speciality and Y axis represents the number of responses. Chi square association was done and found to be statistically not significant. Chi square value : 9.938, df : 6, p value :0.127>0.05. However, regeneration was the preferred choice among the prosthodontists when compared to other specialties.