EVALUATION OF RESIDUAL RIDGE AND RESTORATIVE SPACE FOR DIAGNOSING AND DETERMINING IMPLANT PLACEMENT OPTIONS FOR OVERDENTURES IN COMPLETELY EDENTULOUS PATIENTS

A Dissertation submitted to the

THE TAMILNADU DR. MGR MEDICAL UNIVERSITY

In partial fulfillment of the requirements for the degree of

MASTER OF DENTAL SURGERY

(BRANCH – I)

(PROSTHODONTICS AND CROWN & BRIDGE)

2017-2020

DECLARATION BY HEAD OF THE DEPARTMENT/HEAD OF THE INSTITUTION

This is to certify that **Dr. M. SARAVANA PRIYA,** Post Graduate student in the Department of Prosthodontics and Crown and Bridge(2017 - 2020), has done this dissertation titled "***Evaluation of residual ridge and restorative space for diagnosing and determining implant placement options for overdentures in completely edentulous patients***" under the guidance of **Dr. C. Sabarigirinathan MDS, PhD,** Professor, Department of Prosthodontics, Vice Principal, Tamil Nadu Government Dental College and Hospital, Chennai – 600 003 in partial fulfillment of the requirements for the degree of Master of Dental Surgery(2017-2020).

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I hereby declare that this dissertation titled **"*Evaluation of residual ridge and restorative space for diagnosing and determining implant placement options for overdentures in completely edentulous patients*"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. C. SABARIGIRINATHAN MDS, PhD,** Professor and Guide, Department of Prosthodontics, Tamil Nadu Government Dental College and Hospital, Chennai -600003.

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Signature of the candidate

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Dr. M. SARAVANA PRIYA, aged 34 years having residence at T-F, Dwaraka enclave, kavimani salai, West Mogappair, Chennai-37, currently studying as **Post Graduate student** in Department of Prosthodontics, Tamil Nadu Government Dental College and Hospital, Chennai – 600 003, (hereafter referred to as ‘the PG student and co- investigator’)

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https://pocketdentistry.com/14-the-edentulous-mandible-an-organized-approach-to-implant-supported-overdentures/
https://www.researchgate.net/publication/12126848_Mandibular_Implant-Supported_Overdentures_A_Prospective_Evaluation_of_the_Burden_of_Prosthodontic_Maintenance_with_3_Different_Attachment_Systems
https://www.science.gov/topicpages/m/mandibular+implant+overdentures
https://www.science.gov/topicpages/i/implant-retained+mandibular+overdenture
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This is to certify that this dissertation work titled: "***Evaluation of residual ridge and restorative space for diagnosing and determining implant placement options for overdentures in completely edentulous patients***" of the candidate ***Dr. M. Saravana Priya*** with registration Number ***241711005*** for the award of MDS degree in Prosthodontics.

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Abstract

Introduction:Rehabilitation of completely edentulous patients has taken a major improvisation with the introduction of implants in complete denture treatment. Overdentures have stood the test of time and overdentures supported by implants have sustained over the years as a viable cost efficient treatment option. Host factors like the available bone and restorative space have been the major influencers when planningand designing an implant overdenture. This study emphasises considering the ridge formalso when planning attributing to the varying stress bearing and distribution characteristics of the various ridge forms.***Aim:*** The aim of this study is to evaluate the effect of the size and arch form of the residual ridge and restorative space on the design of final prosthesis and choice of attachment systems for overdentures in completely edentulous patients.***Methodology:*** Sixty patients of the age group 35 to 65 years, with completely edentulous maxillary and mandibular arches with arch forms falling into either square/tapering/ovoid forms are to be selected for the study. Ethical clearance has to be obtained from the Institutional Ethical Committee. The subjects who fulfill the above mentioned criteria will be selected for the study with no discrimination based on sex, caste, religion or socioeconomic status. The complete treatment procedure will be explained to the patients and a written informed consent will be obtained from all the patients selected for the study. The arch forms and available restorative space are assessed and recorded for each patient. The sixty subjects are divided into 3 groups based on their mandibular arch forms.

Group I : (n=20) square arch form

Group II: (n=20) V-shaped or tapering arch form

Group III: (n=20) ovoid arch form.

The intra-oral examination is done. Using the patient's casts the ridge form is determined. The routine steps in fabrication of complete dentures are carried out. After trial dentures are fabricated, gutta-percha markers are used to mark the incisal edges of the teeth. An Orthopantamogram of the patient with dentures in mouth is taken. The inter-foraminal distance and the vertical restorative space available for restoration are measured. The magnification errors are rectified for each patient.. The ridge dimensions are measured clinically; data are categorized as residual ridge dimensions, restorative space dimensions, proposed implant number and subjected to statistical analysis.***Results:*** The One-way ANOVA shows that **Ridge width and Interforaminal distance is significantly different** according to residual ridge forms. In the post hoc test (Tukey's test), significant difference in **Ridge width** is found between Ovoid and Square type groups (Square type ridge width is higher significantly. In the post hoc test (Tukey's test), significant difference in **Interforaminal distance** is found between Ovoid and Tapering group with Square type groups (Square type interforaminal distance is higher significantly)***Conclusion:*** Within the limitations of the study done the following conclusions were drawn:

- Ridge width and Interforaminal distance is significantly different according to residual ridge forms.
- Significant difference in Ridge width is found between Ovoid and Square type groups (Square type ridge width is higher significantly).

- Hence, according to the arch forms, the dimensions considered for treatment planning differ significantly. Further in vivo finite element analysis studies based on the arch forms in implant overdenture will help clinicians in better designing of prosthesis and choice of attachment systems.

Keywords:

Implant overdenture, residual ridge form, available restorative space, treatment planning of completely edentulous patients, attachment systems for implants, stress bearing of attachments.

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INTRODUCTION

Complete dentures are the artificial substitute for the teeth and surrounding tissues that have been lost which must function in harmony with the remaining tissues. The basic challenge in the treatment of edentulous patients lies in the nature of the difference between the ways natural teeth and their artificial replacements are supported.

The dental clinicians and patients are aware of the problems associated with a complete mandibular denture when compared to other dental prostheses. In many situations, even under ideal conditions, the conventional mandibular denture fails to perform its function. Needless to mention, retention or relative lack of sufficient retention of complete mandibular dentures is common, especially when compared with excellent retention obtained with the maxillary counterpart. In such cases, implant acts as a measure to overcome the difficulties.

It has been observed that the mandibular implant overdenture is the best treatment option and most accepted by potential implant candidates who are completely edentulous[1]. The concept of implant-supported overdentures has been in use for quite many years. Because of an increased awareness, the variety of clinical situations, bone density, biomechanics, and patients' desires, an ever-growing number of patients benefit from additional retention and support through the help of implant-supported overdentures.

The concept of osseointegrated implants in edentulous patients was first brought in use by **Dr. Per-Ingvar Branemark**. The term used by Branemark and others is "**Tissue-integrated Prosthesis**".

For an implant, after fixture placement, healing, and subsequent prosthesis insertion, the bone level reaches a "steady state”. This is a balance between forces transmitted through the corrective and fixtures, and bone remodeling capabilities.

The resorptive process can be controlled with proper fixture placement which in turn prevents rampant resorption while also offering the patient a high quality, functional prosthesis[2]. The continued bone loss after tooth loss and associated compromises in esthetics, function, and health make all edentulous patients implant candidates.

The main sequelae of wearing complete dentures is residual ridge resorption. The most common site of resorption is the mandibular anterior region followed by other areas of the edentulous ridge. The reason for residual ridge resorption is multifactorial, such as anatomic, systemic or local factors. Though residual ridge resorption cannot be prevented, it can be controlled to a great extend with the help of implant supported overdentures[2].

It is a well-established fact that the more a patient wears a denture, the greater the bone loss. Yet, 80% of denture patients wear their dentures day and night, thereby accelerating bone loss. Because of the long hiatus between visits, the amount of resorption from initial denture delivery to the next professional interaction causes a high degree of destruction of the original alveolar process. Significantly, the bone loss that occurs during the first year after tooth loss is 10 times greater than in following years. Thus, rather than letting the patient loose majority of the residual bone, the dentist should inform the patients and emphasize the benefits of implants and why they should be inserted before the bone is lost. The dental professional should educate the patient about the process of bone loss caused by lack of stimulation and its consequences and explain how implants are available to treat the condition. Hence, completely edentulous patients should be informed of the necessity of dental implants to maintain bone volume, function, masticatory muscle activity, esthetics, and psychological health[3].

Ideally, patients who have unsalvageable teeth ought to lean the choice to incorporate implants to support the longer term corrective. The traditional complete denture is presented as a temporary measure to provide cosmetic and oral function during implant treatment. A drawback to be considered, in such cases, is the cost to the patient which often limits the extent of treatment, which may consist of two or three implants to support the overdenture.

Advances in implantology have greatly improved the oral rehabilitation of the edentulous patients with mild to severe residual ridge resorption. With the introduction of osseointegration principles in dentistry, new alternatives were provided for the edentulous patient's rehabilitation[4]. As several clinical studies have reported a high success rate of implant rehabilitation, this kind of treatment has become an acceptable alternative.

Implant supported over dentures demonstrates several advantages over complete dentures such as preservation of residual alveolar ridge, retention, increased stability, comfort, chewing efficiency, greater satisfaction and an improved quality of life of the patients[5]

Implant supported prosthetic treatment: The need for fewer implants makes the surgical procedures less invasive and cost effective. Studies have shown that high success rates with mandibular overdentures retained by two implants. For this reason, this treatment has been suggested as the first option for edentulous patients.

Implant supported over dentures not only require implants, but also needs some retention devices. This is achieved with the help of various types of attachment systems that are available. A variety of attachments are available that range from the traditional mechanical units to those in which retention is provided by magnetic forces. Stud attachments are particularly useful providing both retention and stability. Bar attachments are most effective retainers that offer good stability but occupy space[6].

Although good base adaptation, border extension, surface tension and other physical phenomena contribute to maintain an overdenture in place, the attachment systems plays a primary role as mechanism for retention. The use of prefabricated retention system with lower cost makes the treatment more accessible to higher number of edentulous patients.

Currently, overdentures connected by few mandibular implants have become reliable and well documented alternatives to fixed prosthesis. A geriatric treatment concept was developed that proposed overdentures supported by 2 to 4 interforaminal implants[7]. A high success rate of implants is reported with the use of different implant systems. Implant overdenture therapy has now been widely demonstrated to improve function and patient satisfaction.

Nowadays increasing age and the loss of teeth do not necessarily go hand-in-hand, but in the past, alveolar ridge resorption and a decrease in neuromuscular skills in manipulating complete dentures combined to detract from the quality of life of many patients. Edentulousness, so long considered to be a normal part of ageing, can now be thought of as a disease entity.

The success of prosthesis usually depends on careful treatment planning and selction of proper attachment which may be a bar type or stud type and it may be extaradicular or intra radicular. This is mainly done in relation to the site of placement and the amount of available space.

Available space for attachment:

The importance of correct vertical space assessment is hard to over-emphasize, and it is for this reason that mounted diagnostic casts are so useful. The precise space requirements must be checked after the trial insertion stage and an occasional change of attachment may be required. There is, however, little excuse for finding inadequate space for any attachment at this late stage. It is this type of casual treatment planning that leads to a frantic search for the smallest attachment that can be surrounded with a minute thickness of acrylic resin. A fractured denture is the inevitable result.

In selecting an attachment, it should be appreciated that space must exist for these units to be surrounded by a reasonable thickness of acrylic resin. Otherwise the denture will be weakened. Where buccolingual space is restricted, a metal lingual connector may be employed, although the design will require providing an adequate thickness of acrylic resin to surround the attachments. Vertical space is precious, and this valuable commodity is often wasted by inadequate or poorly executed root preparations.

Additional space can be provided by osseous recontouring and mucogingival surgery, allowing the level of the attachment to be reduced. The lower the level of the attachment, the more buccolingual space there is available for the artificial teeth. Where vertical space is restricted for implant supported prostheses - and this frequently occurs in the anterior maxilla -serious consideration should be given to selecting an alternative and less space consuming retaining system such as a bar.

Yunus N et al(2016)[4] evaluated the oral health related quality of life on patients with implant supported overdenture and in an implant fixed dental prosthesis.Twenty patients received implant fixed dental prosthesis and twenty eight patients had an implant supported overdenture and concluded that both mandibular implant supported overdenture and implant fixed dental prosthesis shows enhanced oral health related quality of life.

Banu R F, Veeravalli P T, Kumar V A(2016)[42] evaluated the effect of conventional denture and implant supported overdenture on the brain activity and cognitive function of completely edentulous patients. Masticatory efficiency was also evaluated. Ten completely edentulous non denture wearers were included in this study. Electroencephalogram and mini-mental state examination (MMSE) questionnaire were used to record the brain activity and cognitive function respectively and concluded that implant supported overdenture provided significant efficacy than the conventional denture.

AIM

The aim of this study is to evaluate the effect of the size and arch form of the residual ridge and restorative space on the design of final prosthesis and choice of attachment systems for overdentures in completely edentulous patients.

OBJECTIVES

i. To evaluate the size and form of the residual ridge.
ii. To assess the available restorative space
iii. To assess the influence of the same in planning of implant number and attachment designs.

REVIEW OF LITERATURE

1. **Den Dunnen ACL, Slagter AP, de Baat C, Kalk W (1997)** had presented retrospective analysis of post insertion care needed by 104 edentulous patients who had advanced mandibular bone loss managed with new dentures and overdentures supported by 2 implants with one bar – clip attachment. Almost a third of the patients needed professional hygiene care and complications were faced in tentatively one third of patients. The majority of these complications were related to the superstructure and the dentures rather than the implants and concluded that most of the edentulous patients provided with mandibular implant – retained overdentures need professional hygiene care, adjustments and management of complications.

2. **Cordioli G, Majzoub Z, Castagna S (1997)** evaluated a treatment modality using mandibular overdentures anchored to single implants in a geriatric patient population. Twenty – one patients were treated with single implants inserted at the mandibular midline. O – Ring or ball attachments were used. Implant success rate, improvement of oral comfort and function, condition of the peri – implant soft tissues, Periotest values and the interproximal marginal bone loss were evaluated up to 5 years post insertion. None of the implants failed and a mean marginal bone loss of upto 1.42± 0.56 was noted at 60 months. Remarkable improvement of oral comfort and performance was proved and finished that rehabilitation with jaw overdentures anchored to one implant will be a therapeutic different for patients.

3. **Khamis MM, Zaki HS, Rudy TE (1998)** compared the masticatory efficiency of three occlusal forms in patients with mandibular implant overdentures and determined

their effects on the implant supporting tissues. The occlusal forms evaluated are 0 degrees, 30 degrees and lingual contact and concluded that 30 degree teeth and lingualized occlusion provided better chewing efficiency than 0 degree teeth and the different occlusal forms did not have a detrimental effect on the supporting tissues.

4. **Mericske – Stern R (1998)** had discussed clinical considerations along with treatment strategies concerning three specific indications for overdentures which are, the edentulous maxilla, the edentulous mandible, and the compromised situation and came to the decision that the mandibular implant overdenture demonstrated a high success rate, usefulness and reliability as a treatment modality.

5. **Sadowsky SJ, Caputo AA (2000)** evaluated the load transfer characteristics of different mandibular – retained overdenture designs namely the cantilevered bar, spark erosion framework, noncantilevered bar, and solitary anchors, with and without edentulous ridge contact and concluded that in the absence of intimate ridge contact, the cantilevered system created the maximum stress while the solitary anchor design the minimum. With intimate contact, all designs transferred least stress to the distal and the contra lateral side of the arch.

6. **Sadowsky SJ (2001)** strictly evaluated the existing mandibular implant overdenture literature with regards to bone preservation, effect on antagonist jaw, number of implants required, anchorage systems, maintenance and patient satisfaction. The results of the study are as under:

a. Mandibular anterior region bone beneath an implant overdenture may resorb as low as 0.5 mm over a five year period, whereas resilient overdenture design may cause 2 to 3 times the resorption in the posterior mandible as compared to the complete denture.

b. A combination syndrome effect was reported by several authors with several designs of mandibular implant overdentures. This could result in maxillary alveolar bone resorption, soft tissue inflammation, midline fractures and need for reline.

c. No significant difference was found in stress reduction and peri implant health by using 2 implants or 4 implants. Retention, stability, and occlusal equilibration improved only slightly by increasing the number of implants. Masticatory forces did not differ between the implant borne and the mucosa – implant – borne treatments.

d. Greater stresses were exerted on the peri – implant bone with bar – clip attachments as compared to ball attachments. Difference in stress concentration between splinted and unsplinted implants was small, and the direction of occlusal forces played a major role. Bars were more retentive than ball attachments.

e. Immediate loading of implants with a mandibular overdenture was not established, but is giving indications of being a promising treatment concept.

f. Maintenance requirements were greatest during the first year of service and related mainly to alteration of contour and repair of the matrix or patrix. Controversy exists as to which attachment system required more maintenance. Few studies have reported any difference in the frequency of relines between splinted and unsplinted attachments.

g. Patients having mandibular overdentures supported by two implants had better satisfaction scores compared to complete denture patients.

7. **Chaffee NR, Felton DA, Cooper LF, Palmquist U, Smith R (2002)** analysed how much maintenance is needed to give acceptable and satisfactory implant – retained mandibular overdentures. Fifty eight edentulous patients were treated with mandibular implant – retained overdentures employing ball attachments. Evaluations were made at 3, 6, 12, 24, and 36 months. The authors concluded that:

a. Implant – supported overdentures required routine maintenance.

b. Prosthetic components were less reliable than implant components.

c. The most common prosthodontic complications were denture base adjustments and tightening of ball attachment mechanism.

8. **Kreisler M, Behneke N, Behneke A, d'Hoedt B (2003)** conducted this retrospective study to radiologically investigate amount of bone loss in the residual ridge of edentulous maxilla in implant retained mandibular overdenture patients during a 8 year period. Thirty five completely edentulous patients were rehabilitated with two IMZ implants placed interforaminally to support a bar retained overdenture. Standard panoramic radiographs were take preoperatively and annually at recall visits. The authors concluded that:

a. Continuous bone loss in edentulous maxilla in patients wearing implant – supported mandibular overdentures was obvious and had high variability among each person.

b. Resorption was significantly more pronounced in the anterior than in the posterior maxilla.

9. **Heydecke G, Klemetti E, Awad MA, Lund JP, Feine JS (2003)** evaluated a clinical trial comparing clinicians' ratings of the state of oral tissues and their satisfaction with treatment to edentulous patients' ratings of treatment success after provision of mandibular implant overdentures or conventional dentures and concluded that while both clinicians' and patients' rated mandibular implant overdentures significantly superior than conventional dentures, a discrepancy existed in the evaluation of individual prostheses.

10. **Attard NJ, Wei X, Laporte A, Zarb GA, Ungar WJ (2003)** compared fixed and overdenture implant supported restorations in edentulous mandibles to determine which was the most cost – effective treatment from the patients' perspective. The overdenture patients received two implants and the prosthesis was retained by means of a bar – clip assembly. The total cost included the initial clinical cost, maintenance cost, and the total time cost. The results showed that the summed up average, clinical, and time expense were noticeably larger for the fixed restoration group and concluded that providing edentulous patients with overdenture is a more cost effective treatment when compared to conventional dentures..

11. **Walton JN (2003)** compared the maintenance requirements of two attachment systems for mandibular overdentures. One hundred edentulous patients were given mandibular implant – supported overdentures retained by bar and metal clip type retention or attachments containing 2 balls. The author came to the decision that,

a. More than three times as many ball attachment implant overdentures required retreatment.

b. Twice as many ball attachment designs required replacement.

c. Ball attachment implant overdentures were significantly more likely to require patrix tightening or matrix replacement.

d. Bar – clip design was more likely to require activation of the matrix.

e. The author concluded that the bar – clip attachment implant overdenture proved to be remarkably a prosthesis with higher success demanding lesser maintenance compared to the ball attachment implant overdenture.

12. **Chu FCS, Deng FL, Siu ASC, Chow (2004)** described the treatment planning involved for the use of a magnetic attachment for a mandibular implant – supported overdenture, for a patient with Parkinsonism. The patient's chief complaint was that of an unstable mandibular denture. After implant placement, standard abutments of suitable height were selected to allow placement of magnetic keepers, 1 mm above the mucosa. New dentures were fabricated and two magnets were attached to the mandibular denture using autopolymerizing resin and concluded that the patient had no difficulty in inserting and removing the denture and was satisfied with the retention and functioning.

13. **Ohkubo C, Sato J, Hosoi T, Kurtz KS (2004)** described a technique by means of which an existing complete denture was converted into a transitional implant supported overdenture by means of an O – ring attachment, thereby increasing the retention. An existing mandibular denture was prepared by removing resin from the

intaglio surface to accommodate O – rings fitted on the abutment portion of transitional implants. Undercuts on the abutments of the transitional implants were blocked out using utility wax. Following this, the denture was attached by means of the O – ring and autopolymerizing resin to the abutment portion of the transitional implants and concluded that adequate retention for an existing denture was provided by this technique.

14. **Naert I, Alsaadi G, Quirynen M (2004)**conducted a randomized clinical trial to evaluate differences in the clinical effectiveness of prosthetic care, including patient satisfaction between splinted and unsplinted implants retaining a mandibular overdenture over a decade. Thirty six patients were divided equally into three groups, each receiving a different attachment system namely, ball, bar, or magnets. At the end of 10 years. The authors concluded that:

a. Ball group presented the highest vertical retention capacity which showed an increase over time, whereas a decrease occurred in the magnet and bar groups.

b. Most common complication of the unsplinted implants was renewal of O – ring housing and for splinted implants was activation of the clip.

c. Ball group showed fewest soft tissue complications whereas the magnet group showed the most.

d. The magnet group scored least for chewing comfort and stability.

15. **Naert I, Alsaadi G, van Steenberghe D, Quirynen M (2004)** analysed splinted and unsplinted implants impact on retaining a mandibular overdenture, over a ten year period. Thirty six completely edentulous patients were rehabilitated with two implants

placed in the canine regions. The overdentures were retained with either a ball, magnet or bar attachment system. None of the implants had failed at the end of ten years, and no significant difference was found in Mean Plaque Index, Bleeding Index, attachment level modification, Periotest values, and loss of marginal bone, amongst the three groups and concluded that two implant mandibular overdenture concept posed an unmatched prognosis, whatever may be the attachment system used.

16. **de Jong MH, Wright PS, Meijer HJ, Tymstra N(2010)** analysed the endosseous implant retained overdenture on mandibular posterior residual ridge resorption for 10-year period. sixty edentulous patients were included in the study. Thirty patients were treated with two implant supported overdenture and other thirty with four implant supported overdenture and concluded that significant difference in mandibular posterior residual ridge resorption between patients treated with either 2 or four implants to stabilize associate overdenture.

17. **Kuoppala R, Näpänkangas R, Raustia A(2012)** scaled the prognosis of implant-supported or implant-retained mandibular overdenture treatment in the long run. Fifty eight patients are subjected to clinical examination from 1984 to 2004 and arrived at the decision that the patients were happy with the treatment, no matter what the attachment system was used. Area under Removable overdentures were more comfortable to scrub and shall be cleansedextra-orally, whereas fixed-implant full-arch dentures placed in the edentulous mandible needed much more tedious maintenance measures. This sort of overdenture treatment is appropriate within the senior, even though their capacity to utilise acceptable oral hygiene can be small.

18. **Geckili O, Mumcu E, Bilhan H(2013)** compared the effects of attachment type, number of implants, gender, age, and maximum bite force (MBF) on marginal bone loss (MBL) around implants supporting mandibular overdentures. sixty-two patients are included in this study and concluded that marginal bone loss around implants supporting mandibular overdentures seems not to be affected by number of implants, attachment type, age, or gender, however it is affected by maximum bite force.

19. **Tabatabaian F, Saboury A, Sobhani ZS, Petropoulos VC(2014)** calculated the impact of inter-implant distance on retention and resistance offered by two ball attachments to mandibular implant-tissue-supported overdentures. Three pairs of implants were placed, inter-implant distance was 10,25,35 mm and concluded that inter-implant distance has no impact on the vertical retention and oblique resistance of mandibular implant-tissue-supported overdentures, whereas the anterior-posterior resistance is affected.

20. **Leventi E, Malden NJ, Lopes VR(2014)** evaluated the long-term success of a simpler implant treatment method available and to see the impact of many other factors, including sex, age, health issues, and tobacco habits. The experiment also evaluated the specific implant employed, Calcitek hydroxyapatite coated cylinder. Fourty one patients are taken in the study and observed that the implant system in this study worked to an agreeable level in a mixed group of older individuals, including those having a serious co-morbidity or tobacco habit.

21. **Saulacic N, Abboud M, Pohl Y, Wahl G(2014)** analysed the hard and soft tissue parameters of overdentures supported by implants and the impact of increased

periimplant bone density (IPBD) on implant survival. Twelve patients were taken into this study. Fourty four dental implants were implanted in mandible and was found that Implants supporting overdentures had clinically successful over the time of follow-up. IPBD shall be connected to the retainment of the periimplant bone level.

22. **Pan YH, Lin TM, Liang CH (2014)** compared patients' personal experiences compared to long-term satisfaction with mandibular implant-retained overdentures instead of conventional complete dentures. Eighty five patients were taken into the study and was found that the usage of implants to retain and support the overdenture provided comfort and offered the experimental patients greater self-confidence in social interactions, in addition to more effective oral rehabilitation.

23. **Ashmawy TM, El Talawy DB, Shaheen NH(2014)** assessed the impact of mini-implant-supported mandibular overdentures on electromyographic activity (EMG) of the masseter muscle when hard and soft foods are masticated. Twelve completely edentulous patients are taken into the study and observed that Mini-implant-supported mandibular overdentures are connected with more activity of masseter muscle and reduced duration of chewing cycle for both hard and soft foods when considering conventional dentures.

24. **Korfage A et al(2014)** assessed oral functioning, patients' satisfaction, condition of peri-implant tissues, and survival of implants up to fourteen years after their insertion in patients with oral cancer who had had mandibular overdentures placed over primary implants and concluded that patients who were treated by irradiation reported more problems in oral functioning and less satisfaction than those who had not. Patients with an implant-retained jaw overdenture observed fewer issues in oral functioning than

patients without overdenture. Primary insertion of an implant should be habitually incorporated for patients with carcinoma, as masticatory functioning of patients wearing mandibular overdentures improved appreciably and peri-implant health was quite reasonable.

25. **Listl S, Fischer L, Giannakopoulos NN(2014)** evaluated the cost effectiveness achieved by bar-retained implant overdentures based on six implants compared with four implants as treatment alternatives for the edentulous maxilla and decided that bar-retained maxillary overdentures based on six implants offer better patient satisfaction compared to bar-retained overdentures retained by four implants but are quite costlier. Final judgements about cost effectiveness needed more comprehensive clinical evidence including patient-centered health outcomes.

26. **Saito M, Kanazawa M, Takahashi H, Uo M, Minakuchi S(2014)** investigated the trend of change in retentive force for six different bar attachments during dislodgement and concluded that for the spherical bar attachment, the PGA clip and PGA bar showed wear. The retentive force of PGA-R slightly decreased. The retentive force of CoCr-R and Ti-R tended to increase. For the Dolder bar attachment, all three types of bar attachment showed no wear.

27. **Vere JW, Eliyas S, Wragg PF (2014)** evaluated Locator retained implant overdentures are associated with a high incidence of prosthodontic complications, author also investigated general dental practitioners (GDPs) are willing to maintain these prostheses in primary dental care and concluded that GDPs are not familiar with the

Locator attachment system and are reluctant to maintain implant retained overdentures. GDPs would like further training in this area.

28. **Scherer MD, McGlumphy EA, Seghi RR, Campagni WV(2014)** calculated the effect of implant location on retention and stability of a mocked up 2-implant-supported overdenture and the differences among entirely different attachment systems were examined, concluded that the retention and stability of a 2-implant simulated overdenture prosthetic device is noticeably plagued by implant location and abutment .

29. **Singh K, Gupta N(2014)** evaluated a technique to prevent trauma of the edentulous ridge from opposing dental implants when prosthesis kept out during night and concluded that the trauma caused by dental implants to the opposing toothless ridge was effectively managed by soft plastic mouthguard full of permanent compound soft liner.

30. **Calderon PS et al(2014)** determined the prognosis of different forms of dental prosthetic rehabilitation and the main complications involved and technical complications involving implant-supported prostheses. One fifty three patients are included in the study and concluded that to minimize the frequency of complications, protocols must be established from diagnosis to the completion of treatment and follow of implant-supported prostheses, especially in terms of adequate technical steps and careful radiographic evaluation of the components.

31. **Chai J, Chau AC, Chu FC, Chow TW(2014)** evaluated the diagnostic performance of computed tomography (CT) bone density measurements (in Hounsfield units [HU]) in assessing the osteoporotic status of edentulous subjects (21 men, forty

women) regular to receive inframaxillary implant-supported overdentures and terminated that supported the restricted sample size, best HU cutoff values of ~530, ~600, and ~640 HU for total hip, spine, or total body T-scores, severally, were planned. CT jaw web site HU measure had diagnostic worth in detection pathology once spine T-score was used however not once total hip, femoral neck, and total body T-scores were used. An optimum HU cutoff worth of ~460 HU for spine T-score was projected.

32. **Emami E et al(2015)** determined the quantity of change in ratings of oral health-related quality of life and to analyse patients' satisfaction ratings with mandibular three-implant overdentures. One thirty five edentate patients are taken into the study and was observed that the treatment of edentulism by three-implant overdentures had appreciable patient-based outcomes, with few perceptions of rotational movement. However, additional analysis is needed to match the effectivity of these to alternative treatment modalities, like the two-implant overdenture.

33. **Tokar E, Uludag B (2015)** calculated the differences in load transfer along with stress levels among four attachment designs of mandibular overdenture retained by one central implant and two inclined distal implants. Three screw type implants were placed in the parasymphyseal region of photoelastic mandibular models. Bar, bar with ball, bar/distally placed Rk-1s, and Locators were four attachment systems employed. Vertical loads were subjected to in the central fossa of right first molar of the mandibular overdenture and their related stress levels were analysed and found that the least stress were noticed in the locator attachments, that transmits minimal discernible stress surrounding implants.

34. **Schweyen R, Beuer F, Arnold C, Hey J(2015)** evaluated a new chairside attachment system based on polyvinylsiloxane (PVS) for numerous different attachments are used to retain overdentures on implants.Two fifty specimens are fabricated to measure the retention force and concluded that Polyvinylsiloxane attachments provide an alternative to locator attachments, exhibiting better stability of the retention force.

35. **Raedel M et al (2015)** observed the posterior alveolar ridge resorption after ten years for a study population treated with a titanium bar retained overdenture on two IMZ-implants and concluded that posterior bone resorption was found to be in the range previously reported for different implant restorations and therefore does not represent a particular problem of two implant bar retained overdentures. The results strengthen the two implant concept.

36. **dos Santos MB, Bacchi A, Consani RL, Correr-Sobrinho L(2015)** evaluated the axial tightening force applied by conventional and diamond like carbon (DLC)-coated screws and to verify, through three-dimensional finite element analysis (FEA), the stress distribution caused by different framework materials and prosthetic screws in overdenture frameworks with different misfit levels and concluded that titanium framework reduces the stress on bone than bar framework.

37. **Chang SH, Huang SR, Huang SF, Lin CL(2016)** evaluated the mechanical response of the bone/implant in an implant supported overdenture by ball attachments on two conventional regular dental implants and four mini dental implants using finite element analysis. Two finite analysis models of overdentures retained by regular dental implants and mini dental implants for a mandibular edentulous patient constituted by CT

images and CAD system and terminated that overdentures maintained victimisation ball attachments on mini implant in poor toothless bone structure increase the encompassing bone strain.

38. **Yunus N et al(2016)** analysed the oral health related quality of life on patients having implant supported overdenture and in an implant fixed dental prosthesis.Twenty patients received implant fixed dental prosthesis and twenty eight patients had an implant supported overdenture and concluded that both mandibular implant supported overdenture and implant fixed dental prosthesis shows enhanced oral health related quality of life.

39. **Rabbani S, Juszczyk AS, Clark RK, Radford DR(2015)** evaluated the effect of cyclic disengagement on the retentive force and wear patterns of pairs of three Locator inserts (blue, pink, and clear) in vitro and concluded that rapid decrease in retentive force was observed in all three models after 720 cycles for all three inserts. The most long combination was the clear insert within the 0/10 model, and the least retentive was the blue insert in the 0/10 model. After 2,160 cycles, there was a big reduction in long force of fifty nine to seventieth. However, the values of retention were still above those claimed by the manufacturer.

40. **Banu R F, Veeravalli P T, Kumar V A(2016)** evaluated the effect of conventional denture and implant supported overdenture on the brain activity and cognitive function of completely edentulous patients. Masticatory efficiency was also evaluated. Ten completely edentulous non denture wearers were included in this study. Electroencephalogram and mini-mental state examination (MMSE) questionnaire were

used to record the brain activity and cognitive function respectively and concluded that implant supported overdenture provided significant efficacy than the conventional dentures.

41. **Hegazy S, Elmekawy N, Emera RM(2016**) analysed the soft tissues modifications at implant site(periimplantitis) using two early loading protocols on treated surface- one modifying the collar portion (Laser-Lok implant) another changing the implant surface (nanosurface-treated implant).Thrity six completely edentulous patients were taken in the study. In these 18 patients were treated with laser and other eight with nanosurface and decided both treatment shows the same changes with early loading protocol.

42. **Hasan et al(2016)** compared the biting ability of implant supported overdenture and conventional dentures. Twenty six edentulous patients are included in this study. Implants are placed in the mandibular interforaminal region. The biting force evaluated using FPD-8010E software and concluded that implant supported overdenture improves the biting force than conventional complete dentures.

43. **Takahashi T(2016)** examined the maxillary implant overdenture in case of implant number and palatal coverage produces any impact strain. Four impact strain gauges placed in anterior, premolar and molar areas and concluded that implant with palateless produce more strain than palatal coverage and six implants are required to retain overdenture.

44. **Ahmad R, Abu-Hassan MI, Chen J, Li Q, Swain MV(2016)** evaluated the residual ridge resorption on implant supported overdenture patients. Twenty five

individual with implant supported overdenture on mandible with opposing maxillary complete denture are included in the study. Cone beam computed tomography and medical imaging system used and concluded that gonial angle undergoes residual ridge resorption with implant supported overdenture.

45. **Kremer U et al(2016)** examined the resorption direction of mandibular ridge beneath implant-supported overdentures. Six patients were taken into the study and observed that load on the distal flange of a mandibular implant overdenture elevates bone resorption as a local factor, whereas implants may facilitate to end organic process within the neighboring bone. An individual-adapted follow-up protocol should be established for every patient repaired with associate implant overdenture.

46. **Zanolla J et al(2016)** evaluated the implant supported overdenture and fixed denture in cleft lip and palate patients for a duration of 22 years. Seventy two patients participated in the study. Ninety seven prosthesis were provided to the patient and was observed that the prostheses displayed repetitions mainly due to attrition of the teeth, with reduced vertical dimension and fracture of acrylic base.

47. **Cardoso RG et al(2016)** evaluated the mandibular two implant supported overdenture in relation to masticatory efficiency and oral health related quality of life. Fifty completely edentulous patients are included the study in which twenty five patients undergoes implant supported overdenture and other conventional complete dentures and decided that mandibular overdenture supported by two implants with immediate loading combined by maxillary conventional dentures offer more masticatory efficiency and oral health-related quality of life than mandibular conventional dentures.

48. **Ebadian B, Mosharraf R, Khodaeian N(2016)** analysed stress levels in implant supported overdenture having different cantilever length. Two and Three implant-supported overdenture with bar and clip attachment system on an edentulous mandibular arch are involved in the study and is observed that increasing cantilever length in mandibular overdentures retained by 2-3 implants had no distinct increase in stress.

49. **Zanolla J et al(2016)** evaluated the implant supported overdenture and fixed denture in cleft lip and palate patients for a period of 22 years. Seventy two patients included in the study. Ninety seven prosthesis are given to the patient and was observed that the prostheses had repetitions mostly due to the attrition of the teeth, with reduced vertical dimension and fracture of acrylic base.

50. **Hegazy S, Elmekawy N, Emera RM(2016)** evaluated peri-implant in early loaded implant supported overdenture with modifying collar portion and other implant surface. Thirty six patients of completely edentulous included the study, in which eighteen patients in laser group and others in nanosurface group and concluded that both dental implants shows same peri-implant changes.

51. **Arafa KA(2016)** evaluated bony changes based on immediate placement of implant retained overdenture with cusped or cuspless teeth. Twenty patients are included in this study, in which ten patients are treated with cusped teeth and other in cuspless teeth and evaluated clinically and radiographically at 3,6,9 and 12 months and concluded that cusped teeth shows superior performance compared to cuspless teeth in implant supported overdenture.

52. **Al-Magaleh WR et al(2016)** evaluated the masticatory and bitting force in patients with three stages of treatment in mandibular arch. Ten patients are include the study, in which conventional dentures are given to the patients, after that four implants are placed. At third stage, ball attachment given and concluded that muscle activity more in conventional dentures than implant retained overdenture and biting force related to denture quality.

53. **Elsyad MA, Mahanna FF, Elshahat MA, Elshoukouki AH(2016)** evaluated peri-implant in implant retained overdenture based on magnetic and locator attachment. Thirty two patients are included in the study and concluded that locator attachment on mandibular implant supported overdenture shows less plaque accumulation than magnetic attachment.

54. **Takahashi T, Gonda T, Maeda Y (2017)** evaluated strain effects on maxillary implant overdentures supported by two or four implants. Implants are placed in anterior, premolar and molar region. Bar ,locator, magnet type of attachments are inserted into the implants. These implants are subjected to occlusal load and shear strain on denture are measured and concluded that magnet attachment has lower shear strain than the ball attachment.

55. **Karayazgan-Saracoglu B, Atay A, Korkmaz C, Gunay Y(2017)** evaluated the implant retained overdentures and fixed metal acrylic resin prosthesis in patients after undergoing marginal mandibulectomy procedure. Satisfaction was assessed using visual analog scale whereas quality of life was assessed by an oral health impact profile questionnaire designed for patients with edentulism (OHIP-Edent).Twenty two

participants were included in the study among which ten participants were treated with four implant-retained fixed metal-acrylic resin prostheses and other twelve participants with two implant retained overdenture and concluded that quality of life is higher in case of implant supported overdenture than implant retained fixed metal acrylic resin prostheses.

56. **Kim.y et al(2017)** compared the mini implant and conventional implant placement for an overdenture and concluded that mini implant improves patient satisfaction and acceptable marginal bone loss compared to conventional implants.

57. **Jin Suk Yoo(2017)** evaluated the stress passed on to the implant supported overdenture in relevance with the change in the denture base length, the vertical pressure and bar/clip or locator attachment. Model are fabricated using Epoxy resin. A universal testing machine wont to judge the vertical pressure and finished that to decrease the strain on implants in inframaxillary implant overdentures, the attachment of the implant should be severely designated and also the dental plate base should be extended the maximum amount as potential.

58. **Gibreel M, Fouad M, El-Waseef F, El-Amier N, Marzook H (2017)** evaluated theperi-implant tissue health of bar-clips versus silicone-resilient liners utilised with bilateral posterior bars for retention of four implant supported mandibular overdentures. Thirty completely edentulous patients were taken up in the study. Peri implant tissue evaluated using plaque scores, bleeding index, probing depth, implant stability and concluded that resilient liners are considered better than bar-clips in retaining implant supported overdenture.

59. **Abe M, Yang TC, Maeda Y, Ando T, Wada M(2017)** assessed the force distribution on abutments (tooth or implant) and tissues supporting overdentures supported by two or four abutments and inferred that quantity of tissue strain on the posterior residual ridge increased when the number of abutments were minimised.

60. **Tokar E, Uludag B, Karacaer O(2017)** analysed stress distribution features and to correlate stress levels of three different attachment designs of three-implant-retained mandibular overdentures with three different interimplant distances. Three photoelastic mandibular models with implants were made and tested and found that the least stress was found with the Locator and bar attachments for the 11-mm photoelastic model, which transmitted little or no discernible stress around implant.

61. **Raza FB, Vaidyanathan AK, Veeravalli PT, Ravishankar S, Ali AS(2018)** evaluated crestal bone resorption around single piece ball attachment implants which are placed bilaterally in canine region along the wear of O-ring in implant supported overdenture over a duration of three years. Twelve completely edentulous patients were taken into the study and concluded that bilateral single piece implant supported overdenture has a survival rate equivalent to two piece implant supported overdenture and is a considerable treatment option.

62. **Amaral CF, Gomes RS, Rodrigues Garcia RCM, Del Bel Cury AA(2018)** evaluated stress distribution in a single-implant-retained mandibular overdenture strengthened with a cobalt-chromium framework, to reduce the occurence of denture base fracture. Two 3-dimensional finite element models of mandibular overdentures supported by a single implant with a stud attachment designed in SolidWorks 2013 software were

utilised and was observed that a metal framework reinforcement for a single-implant-retained inframaxillary overdenture concentrates minimal stress through the anterior space of the restorative and will minimizreduce the occurence of fracture.

63. **Kutkut A, Bertoli E, Frazer R, Pinto-Sinai G, Fuentealba Hidalgo R, Studts J(2018)** compared conventionally fabricated complete dentures (CCDs) with un-splinted implant-retained overdentures (IODs) concerning efficacy, satisfaction and quality of life and concluded that the superciliciousness of implant retained overdentures retained by two unsplinted mandibular implants than conventional complete dentures when efficacy, satisfaction and quality of life are taken into account.

64. **Alsrouji MS et al(2018)** evaluated the principal stress, strain, and total deformation in the premaxilla region beneath a complete denture to the pattern of premaxilla bone resorption when opposed by a conventional complete denture (CD) or by a two-implant-retained overdenture (IOD) using finite element analysis (FEA) and concluded that the Stress, strain, and total deformation values present in the premaxilla area beneath a CD were approximately two times greater in a comparison between an opposing mandibular two-IOD and an opposing mandibular CD.

65. **Sánchez-Siles M et al(2018)** evaluated the quality of life and compliance among patients wearing implant overdentures and those with complete dentures for more than 20 years. Forty patients with overdentures and conventional complete dentures were included in this study.OHIP-14 questionnaires are given to the patients to complete and concluded that implant overdentures supporting cobalt chrome and gold bars provide a perfect long-term prognosis for edentulism than conventional denture.

66. **Wilson(1989)** proposed a simple, minimally invasive technique for bone mapping purpose for measuring the residual ridge as an early opportunity to check for implant eligibility of the candidate. The bone caliper proved to be an effective diagnostic tool for early bone assessment compared to the then gold standard open surgical measurement.

67. **Lobo et al(2018)** aimed to define the available native bone dimensions and safe limits for implant placement in the mandibular inter-foraminal region using CBCT imaging.

68. **Perez et al(2005)** conducted a study to compare the accuracy of Linear Tomography and Direct Ridge Mapping in assessing the mandibular ridge dimensions.

69. **Yoda et al(2015)** focused on finding the effect of attachment system on the load passed onto implants and residual ridge in a mandibular two-implant-supported overdenture in an invitro analysis. Their findings indicate that the three-dimensional load on implants and the denture base and the underlying residual ridge is significantly associated with the type of attachment used in implant-supported overdentures.

70. **Cicciu et al(2015)** conducted a work to analyse the mechanical features of three different prosthetic retention systems. . Three dental implant overdenture retention systems that are generally used have been investigated. The ball attachment system, the locator system, and the common dental abutment processed by Ansys Workbench 15.0. they were subjected to FEM and von Mises investigations. Elastic features of the studied materialswere obtained from literature information available recently. Results showed different response for both types of investigations, although locator system showed better

results for all situations of loading. The data of this virtual model show all features of different prosthetic retention systems under masticatory load.

MATERIALS AND METHODOLOGY

STUDY DESIGN:

The present clinical study was conducted to evaluate the residual ridge and available restorative space in completely edentulous patients and to evaluate if there is correlation between the different ridge forms and variations in the ridge width and restorative space. This study was carried out in the Department of Prosthodontics, Tamilnadu Government Dental College and Hospital, Chennai.

ETHICAL COMMITTEE APPROVAL:

The study was performed after obtaining approval from the Institutional Ethical Committee.

ARMAMENTARIUM(Materials)

For Ridge evaluation

- Mouth mirror, Explorer, Tweezer
- Sterile cotton, sterile gauze
- Disposable gloves, Face Mask, Head Cap
- Chlorhexidine 0.2% solution (Rexidine mouth rinse)
- Edentulous Stock impression trays
- Impression compound
- Die stone
- Stainless steel arch wire

For restorative space:

- In addition to the above cold cure acrylic for fabrication of custom trays
- Green stick compound
- Zinc oxide eugenol impression paste
- Modelling wax
- Radiopaque gutta-percha markers
- Digital Panaromic radiographs

STUDY DESIGN (METHODOLOGY)

STUDY SITE:

The study is to be carried out in the Department of Prosthodontics, Tamil Nadu Government Dental College and Hospital, Chennai, India.

SUBJECT SELECTION:

The study population for this study was selected from the outpatient section of Department of Prosthodontics of Tamilnadu Government Dental College and Hospital . Subjects between the age group of 35 and 65 years of both male and female gender were included in the study. All the participants were informed about the purpose and methods of the study and they were intimated about the need for taking a written consent to participate in the study. The consent form was prepared in the language that the participants could fully comprehend and give their concurrence.

CRITERIA FOR SELECTION :

Inclusion criteria

- Completely edentulous patients of age group 35 to 65 years
- Gender - either sex
- Completely edentulous patients with sufficient mouth opening.
- Patients with no relevant congenital deformities
- Patients willing for voluntary participation and have signed the informed consent

Exclusion criteria

- Patient with known congenital deformities
- Patients with compromised health conditions unwilling to participate in the study
- Patients with insufficient mouth opening.

STUDY SAMPLE:

Completely edentulous patients visiting the department of prosthodontics with arch forms falling into either square, tapering or ovoid type.

SAMPLE SIZE:

Sixty

SAMPLING TECHNIQUE:

Stratified random sampling.

GROUPING OF SAMPLES:

The samples are grouped according to their ridge shape into square type, ovoid type or tapering type. Thus in each sample group twenty subjects will be taken and they are subjected to the study.

METHODOLOGY

Sixty patients of the age group 35 to 65 years, with completely edentulous maxillary and mandibular arches with arch forms falling into either square/tapering/ovoid forms are to be selected for the study. Ethical clearance has to be obtained from the Institutional Ethical Committee. The subjects who fulfill the above mentioned criteria will be selected for the study with no discrimination based on sex, caste, religion or socioeconomic status. The complete treatment procedure will be explained to the patients and a written informed consent will be obtained from all the patients selected for the study. The arch forms and available restorative space are assessed and recorded for each patient. The sixty subjects are divided into 3 groups based on their mandibular arch forms.

Group I : (n=20) square arch form

Group II: (n=20) V-shaped or tapering arch form

Group III: (n=20) ovoid arch form.

The intra-oral examination is done. Using the patient's casts the ridge form is determined. The routine steps in fabrication of complete dentures are carried out. After trial dentures are fabricated, gutta-percha markers are used to mark the incisal edges of the teeth. An Orthopantamogram of the patient with dentures in mouth is taken. The inter-foraminal distance and the vertical restorative space available for restoration are measured. The magnification errors are rectified for each patient.. The ridge dimensions are measured clinically; data are categorized as residual ridge dimensions, restorative space dimensions, proposed implant number and subjected to statistical analysis.

STATISTICAL ANALYSIS:

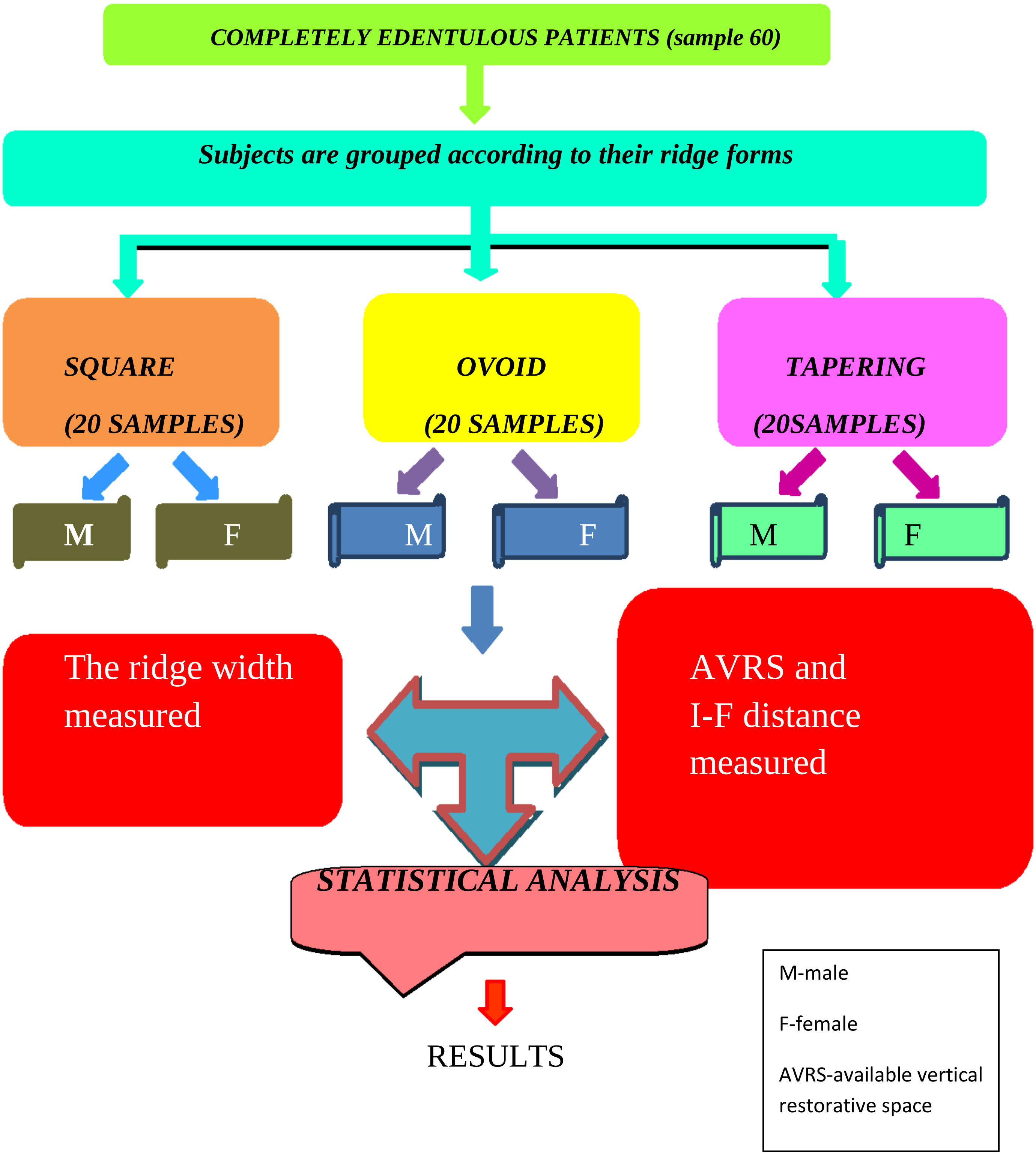
Statistical analysis was carried out using statistical software, **Statistical Package for Social Sciences (SPSS)** version 22.

The quantitative data obtained was assessed for normality using **Kolmogorov–Smirnov test** to check if the data is parametric in distribution.

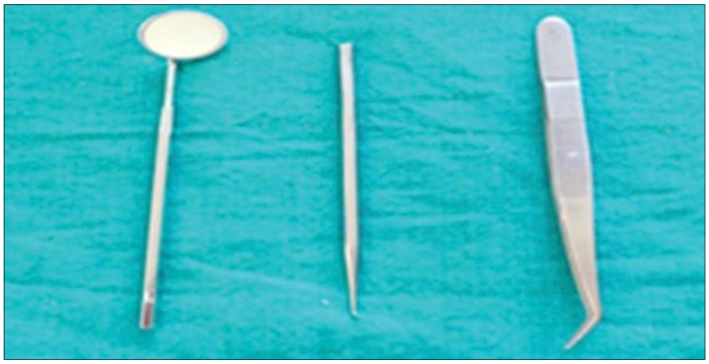
Correlation of the variation in the ridge width, interforaminal distance and restorative space was done using **Pearson's test**. Comparison of the variation in the data was carried out using **one way ANOVA**. **ANOVA** results do not identify which particular differences between pairs of means are significant.

Using **post hoc tests** to explore differences between multiple group means was done while controlling the experiment-wise error rate. **Tukey test** was also done to find out the significant difference among the groups **P Value** or the calculated probability was determined. P Value < 0.05 was considered as significant in this present study.

FLOWCHART


COMPLETELY EDENTULOUS PATIENTS (sample 60)
Subjects are grouped according to their ridge forms
SQUARE
(20 SAMPLES)
OVOID
(20 SAMPLES)
TAPERING
(20SAMPLES)
M
F
M
F
M
F
The ridge width measured
AVRS and I-F distance measured
STATISTICAL ANALYSIS
RESULTS
M-male
F-female
AVRS-available vertical restorative space

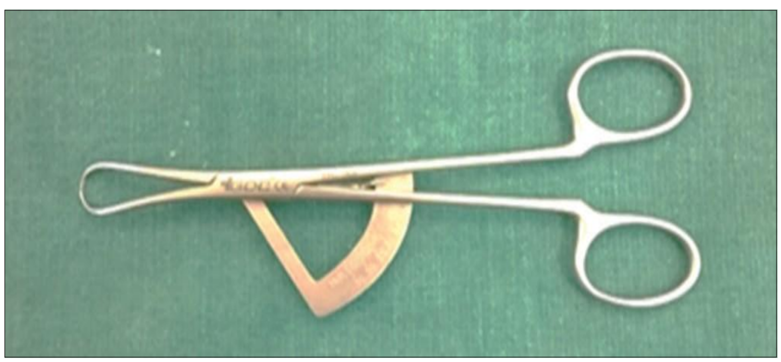
DIAGNOSTIC INSTRUMENTS



STOCK EDENTULOUS TRAYS

MEASURING SCALE

BONE CALIPER



RIDGE FORM TRACING

RIDGE MAPPING

OPG X-RAY MACHINE: ORTHOPHOS XG

RESULTS

The following results were obtained from this study that evaluated the ridge width, interforaminal distance and vertical restorative space in completely edentulous patients of the age group between 35 to 65 years to understand the influence of the above in the diagnosis and treatment planning for implant overdentures fabrication.

Completely edentulous subjects were divided into three groups based on the form of their residual ridges as square, ovoid and tapering arch forms. Each group had 20 samples.

The data obtained from the study was recorded in the Excel sheet and verified for normality. It was observed that the values obtained were normally distributed. Further data was analyzed using SPSS Version 22. Descriptive statistics were done for all the variables, their mean and standard deviation were calculated. One way ANOVA test was done to evaluate the intergroup comparisons and Pearson's correlation was done. Tukey test was also done to find out the significant difference among the groups.

Formulation of the Hypothesis:

The statistical analysis of any test actually begins with the consideration of two hypotheses. They are termed **Null** and **Alternate** hypothesis.

Null Hypothesis: Ho

It is a statement about the study population that, either is believed to be true or is used to put forth an argument unless it can be shown to be incorrect beyond a reasonable doubt. In this study, null hypothesis is formulated as : There is no correlation / difference between variation in the ridge forms and ridge or restorative space dimensions.

Alternate Hypothesis Ha

It is a claim about the study population that is contradictory to null hypothesis and what we conclude when we reject null hypothesis. In this study, the alternate hypothesis is formulated as: There is correlation/difference between variation in the ridge form and ridge or restorative space dimensions.

Probability Value:

If P value < 0.05 it is considered statistically significant.

If P value < 0.05 reject the null hypothesis and alternate hypothesis is considered.

RESULTS OF THE STUDY

The results of this study were obtained by compiling the data obtained in the study and subjecting them to descriptive statistical analysis. The results are depicted in the form of tables and bar diagrams.

Table 1: ***DESCRIPTIVE STATISTICS WERE DONE FOR ALL THE VARIABLES IN THE STUDY***

Variable	***Ridge forms***	***Mean***	***SD***	***95% CI for Mean***		***F***	***P value***
				Lower	Upper		
Ridge width	Ovoid	7.0450	1.121	6.5200	7.5700	3.38	0.041
	Square	7.9950	1.533	7.2772	8.7128		
	Tapering	7.1400	1.113	6.6190	7.6610		
Vertical Restorative Space	Ovoid	14.6600	1.359	14.0236	15.2964	0.40	0.667
	Square	14.4750	1.447	13.7977	15.1523		
	Tapering	14.8700	1.340	14.2426	15.4974		
Inter-foraminal Distance	Ovoid	38.8550	3.159	37.3763	40.3337	10.06	0.001
	Square	41.7550	2.241	40.7059	42.8041		
	Tapering	38.5350	1.936	37.6288	39.4412		

Table 2: ***PEARSON'S CORRELATION BETWEEN RIDGE WIDTH AND VERTICAL RESTORATIVE SPACE***

Correlation	***Correlation coefficient (r)***	***Strength***	***Significance (P value)***
Ridge width and Vertical Restorative space	-0.046	Very very weak	NS

NEGATIVE CORRELATION EXISTS BETWEEN THE VARIABLES *THE CORRELARION IS STATISTICALLY INSIGNIFICANT

Table 3: ***PEARSON'S CORRELATION BETWEEN RIDGE WIDTH AND INTERFORAMINAL DISTANCE***

Correlation	***Correlation coefficient (r)***	***Strength***	***Significance (P value)***

Ridge width and Interforaminal distance	0.234	Weak	NS

NEGATIVE CORRELATION EXISTS BETWEEN THE VARIABLES *THE CORRELARION IS STATISTICALLY INSIGNIFICANT

Table 4: *PEARSON'S CORRELATION BETWEEN VERTICAL RESTORATIVE SPACE AND INERFORAMINAL DISTANCE*

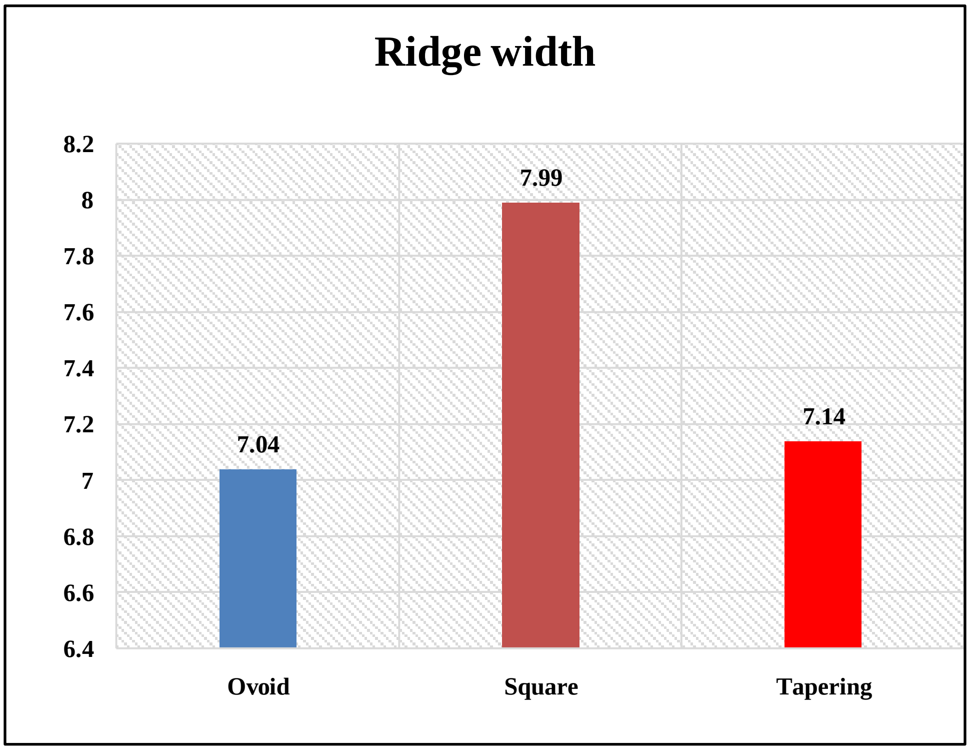
Correlation	***Correlation coefficient (r)***	***Strength***	***Significance (P value)***
Vertical Restorative space and Interforaminal distance	-0.003	Very very weak	NS

NEGATIVE CORRELATION EXISTS BETWEEN THE VARIABLES *THE CORRELARION IS STATISTICALLY INSIGNIFICANT

Table 5. ***ANOVA table***

		Sum of Squares	***Df***	***Mean Square***	***F***	***P value***
Ridge_width	***Between Groups***	10.950	2	5.475	3.387	.041
	Within Groups	92.147	57	1.617		
	Total	103.097	59			
Vertical_Rest_space	***Between Groups***	1.562	2	.781	.408	.667
	Within Groups	109.068	57	1.913		
	Total	110.630	59			
Interforaminal Distance	***Between Groups***	125.872	2	62.936	10.067	.001
	Within Groups	356.364	57	6.252		
	Total	482.237	59			

Figure1.*Graphical representation of Ridge width among the arch form groups*

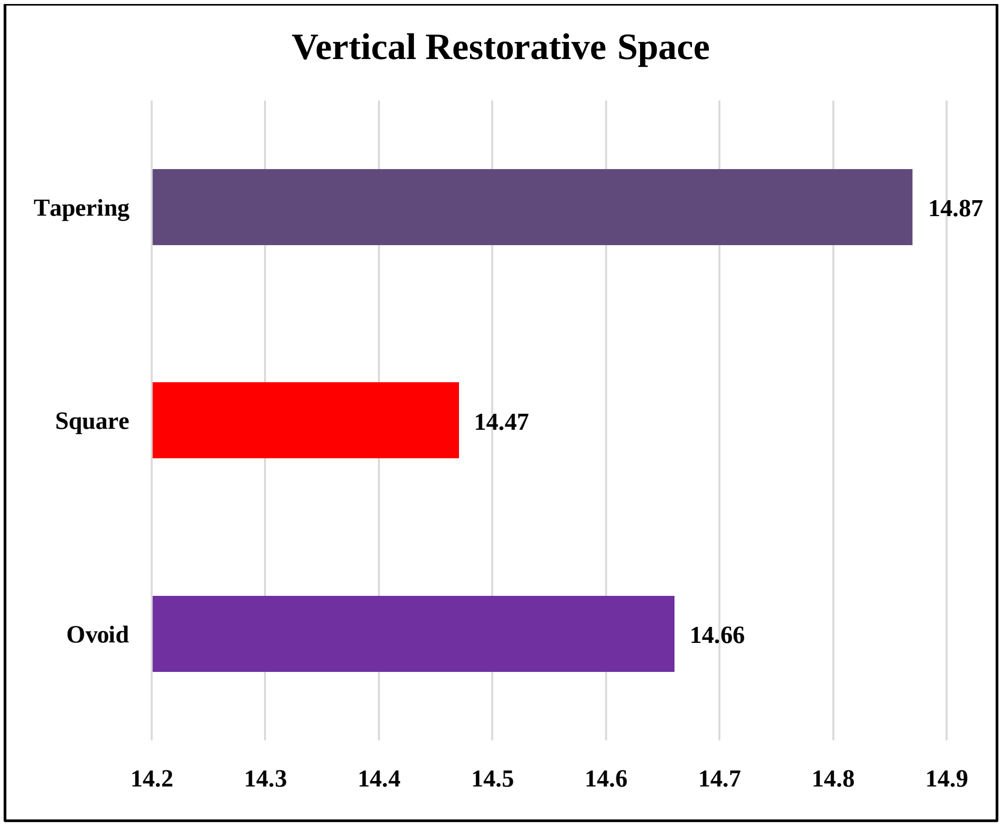


KEY

x-axis: arch form

y-axis: ridge width measurements

Figure2. Graphical representation of the vertical restorative spaces in various arch forms

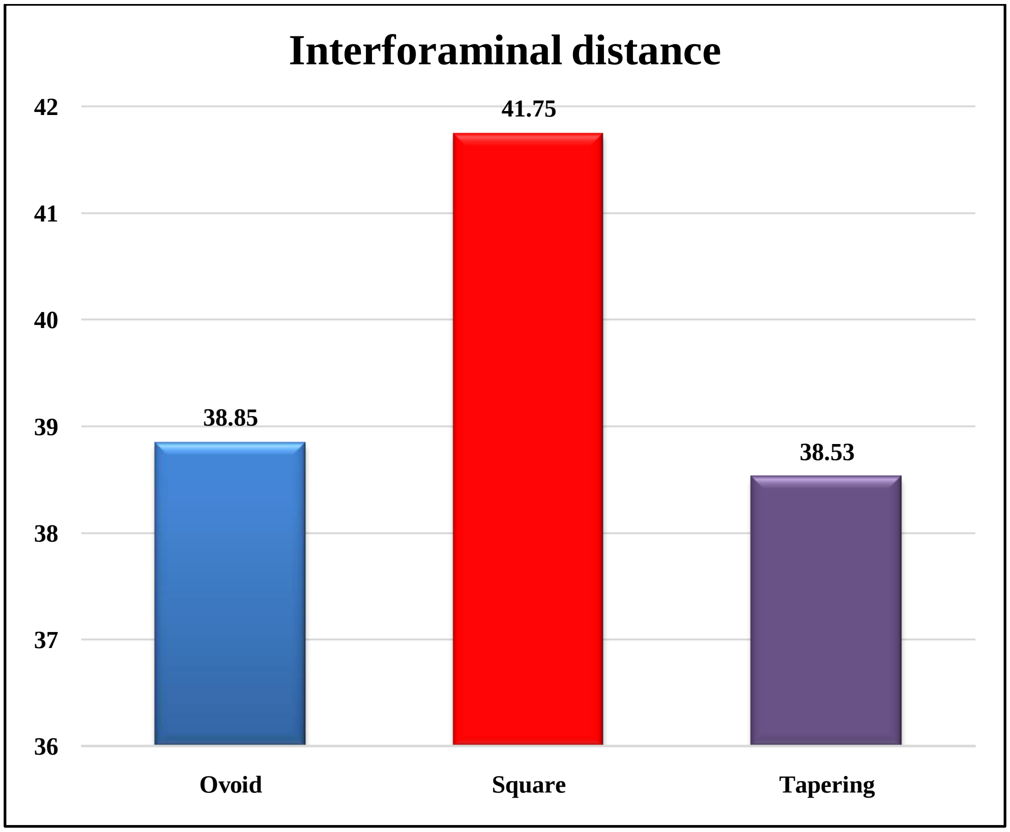


KEY

x-axis: restorative space in mm

y-axis: arch forms

Figure3. Graphical representation of interforaminal distance in various arch forms



KEY

x-axis: arch forms

y axis: interforaminal distance in mm

Interpretation of the results

Table no.1 shows the descriptive statistics for all the variable.

When the results are looked upon based on the three ridge forms, the study shows that-

For ovoid arch forms:

The average residual ridge width of ovoid arch forms was 7.0450. The minimum value recorded was 6.52 and the maximum limit of the class interval was 7.57. The ridges had a deviation of 1.121 mm measuring from around the average value.

The average vertical restorative space available in patients with ovoid arch forms was 14.6600 and they ranged between 14mm and 15.29 mm with the values falling within this range. The standard deviation was 1.359 from the mean value with the standard error of mean found to be 0.304.

The interforaminal distance calculated provided an average value of 38.8550. the confidence interval had the upper limit value as 40.33 and the lower limit value as 37.37. the values had the standard deviation of 3.159 and the standard error of mean was calculated to be 0.706.

For square arch forms:

The average residual ridge width of ovoid arch forms was 7.9950. The minimum value recorded was 7.27 and the maximum limit of the class interval was 8.71. The ridges had a deviation of 1.533 mm measuring from around the average value.

The average vertical restorative space available in patients with ovoid arch forms was 14.4750 and they ranged between 13.79mm and 15.15 mm with the values falling within this range. The standard deviation was 1.447 from the mean value with the standard error of mean found to be 0.323.

The interforaminal distance calculated provided an average value of 41.7550. The confidence interval had the upper limit value as 42.80 and the lower limit value as 40.70. The values had the standard deviation of 2.241 and the standard error of mean was calculated to be 0.501.

For tapering arch forms:

The average residual ridge width of ovoid arch forms was 7.1400. The minimum value recorded was 6.61 and the maximum limit of the class interval was 7.66. The ridges had a deviation of 1.113 mm measuring from around the average value.

The average vertical restorative space available in patients with ovoid arch forms was 14.8700 and they ranged between 14.24mm and 15.49 mm with the values falling within this range. The standard deviation was 1.340 from the mean value with the standard error of mean found to be 0.299.

The interforaminal distance calculated provided an average value of 38. 5350. The confidence interval had the upper limit value as 39.44 and the lower limit value as 37.62.

The values had the standard deviation of 1.936 and the standard error of mean was calculated to be 0.432.

From the above findings, the values seemed to fall within around the same range. Hence in order to find out whether the results of the study is of any significance, it was necessary to find out whether the arch forms differed among each other in a significant level in these parameters. If the values did not have any difference among them based on the arch forms, then null hypothesis stated for this study should be accepted, that is, the ridge dimensions and horizontal and vertical restorative space dimensions do not have a significant variation based on the arch forms.

. The F values of each parameter was calculated. The F-test is performed to find whether the study is statistically significant or not. The F values obtained shows that the study is statistically significant and analysis of variance among the parameters for each arch form was done. In order to find that the Analysis Of VAriance test or ANOVA was performed. The F-test is a precursor for ANOVA.

The P value shows the probability of insignificance. The P values obtained for ridge width and interforaminal distance were 0.041 and 0.001 respectively. Hence, **Inference:**The One-way ANOVA shows that **Ridge width and Interforaminal distance is significantly different** according to residual ridge forms

After obtaining statistically signicant group means, they were subject to further tests termed as Post hoc analysis. Post hoc tests do multiple comparisons to confirm where the significant difference has occurred in the groups.

In this study, through one way Anova, it was confirmed that the **Ridge width and Interforaminal distance is significantly different** according to residual ridge forms. Through post hoc analysis it was intended to find out because of which group of arch forms the difference became statistically signicant. A pairwise comparison, Tukey's post hoc test was done.

In the post hoc test (Tukey's test), significant difference in **Ridge width** is found between Ovoid and Square type groups (Square type ridge width is higher significantly)

In the post hoc test (Tukey's test), significant difference in **Interforaminal distance** is found between Ovoid and Tapering group with Square type groups (Square type interforaminal distance is higher significantly).

Table no. 2 shows the correlation value (Pearson's test) obtained between the ridge width and vertical restorative space.

In this study, the Pearson's correlation coefficient, the r value between ridge width and vertical restorative space was found to be a negative correlation of -0.046. also the correlation was very very weak.

Table no. 3 shows the correlation value (Pearson's test) obtained between the ridge width and interforaminal distance.

In this study, the Pearson's correlation coefficient, the r value between ridge width and interforaminal distance was found to be0.234. also the correlation was weak.

<u>Table no. 4</u> shows the correlation value (Pearson's test) obtained between the interforaminal distance and vertical restorative space.

In this study, the Pearson's correlation coefficient, the r value between interforaminal distance and vertical restorative space was found to be a negative correlation of -0.003. also the correlation was very very weak.

From the above p values,

Inference: None of the parameters are in good correlation with each other in the study.

<u>Table no. 5</u>. shows the analysis of variance among the groups.

In this study, the inference obtained is that there is no significant correlation between and within the groups according to the ridge width, interforaminal distance and vertical restorative space.

DISCUSSION

In rehabilitation dentistry, gradual and consistent change has occured, leading to use of osseointegrated dental implants which became widely accepted procedure within rehabilitation of edentulous spaces. Evaluation of the available alveolar bone dimensions is an important prerequisite for dental implant placement and successful outcome. Bone evaluation limited to usage of panoramic and/or periapical radiographs is also insufficient because it only provides two-dimensional (2D) information about implant sites.

Before the introduction of CBCT, ridge mapping was one of the alternative method for assessing the residual alveolar ridge. Direct caliper measurements following surgical exposure of the bone are the most accurate and can be considered as the ‘‘gold standard’’ to assess the bucco-lingual alveolar ridge width. However, the flap reflection and measuring the residual alveolar ridge width after surgical exposure is not feasible or advisable just for diagnosis and treatment planning of the dental implant.

In 2008, ***Lung-Chen et al*** compared different methods of assessing alveolar ridge dimensions prior to dental implant placement. Frequently , ridge mapping provides measurements of the bucco-lingual ridge width identical with those obtained by direct caliper measurement after the bone is surgically opened. As applied during current study, CBCT was less consistent compared to direct caliper measurements and didn't provide any additional, significant diagnostic information

Width of bone present is measured between facial and lingual cortical plates at crestal level of potential implant site. The crest of the edentulous ridge is composed of dense cortical bone and permits immediate fixation of the implant. It is supported by a wider base (triangular cross section) and thus an osteoplasty will provide greater width of bone, although of reduced height.). As a guideline, a minimum of 0.5 mm of bone should be available on each side of the implant at the crest to make sure the availability of necessary bone thickness and blood supply around implant. The minimum bone thickness is calculated at mid-facial and mid-lingual crestal region because round implant design resulting in more bone in all other dimensions. Thus, a 4-mm crestal diameter implant usually requires more than 5 mm of bone width. In the narrower ridge when narrow diameter implants are used, placement of two or more implants often is indicated when possible to achieve sufficient implant-bone surface area to compensate for the deficiency in the width of the implant and greater crestal concentration of stress during occlusal loads.Each 0.25 mm increase in diameter of the implant corresponds to a surface area increase of 5% to 8%. Therefore, a cylinder root form implant 1 mm greater in diameter will have a total surface area increase of 20% to 30%. Thus, less stress is transmitted to the crestal bone-implant interface improving implant prognosis. Therefore, the width of the implant is much more important compared to its height, once a minimum height has been obtained.

The available angulation of the bone denotes the root trajectory in relation with occlusal plane and, therefore, signifies the direction of force applied to the implant body. A correlation between the angulation of force between the implant body and abutment and the width of the available bone is present. In wide edentulous ridges, use of wide diameter implants may allow for a 25 degree divergence with the adjacent implant(s), natural teeth or axial forces of occlusion with moderate compromise. Though the angled load to an implant body increases the crestal stresses, the increased diameter of the implant serves to dissipate the stresses. The greater width of bone also offers some latitude in angulation at implant placement. In narrower width ridges with use of narrower diameter implants, the acceptable angulation is about 20 degrees.

Crown Height :

The crown height affects the outcome of final prosthesis along with the quantity of moment force upon the implant and crestal bone surrounding it when occlusal load is applied. It is calculated starting with the occlusal or incisal plane and finishing by ridge crest and this may be considered as a vertical cantilever. Lateral forces exerted will indirectly magnify the crestal stresses to the implant-bone interface and also to the abutment screws in the restoration. Thus, as the crown height increases, a greater number or larger diameter implants should be placed to counteract larger stress applied. The crown height/bone height ratio should be ≤ 1 for improved implant prognosis.

IMPLANT SURVIVAL RATE

The factors which affect the survival of implants are,

1. Bone quality
2. Bone quantity
3. Arch form
4. Length of implants

5. Positioning of implants

The question of whether splinting implants with bar attachments contributes to a better survival rate or not has been studied by several investigators during its past. A retrospective study of implant supported overdentures placed in eighty nine patients at eleven different Swedish centers arrived at the decision that the mode of attachment of the prosthesis to the implants did not appear to have a concrete role in the failure of the implants. However, the investigators stated that the limited number of implants and short length of the observation period did not allow for a final assessment of the success rate in relation to different attachment systems.

In a prospective study conducted in thirteen subjects, ***Naert et al*** found a cumulative survival rate of 88.6% after 4 years for bar retained overdentures with Ceka (Ceka NY, Antwerp, Belgium) attachments and hinging type in maxilla. This result contrasts with those previously published from identical group, when in a group of 5 patients who were treated with maxillary overdentures retained by 2 stud attachments (either ball or magnetic), exact success rate was only 40% after a mean loading time of 6.4 years. It should be mentioned that the authors' opinion is that the most favorable results in the most recent study were probably related to the number of implants that were rigidly splinted.

The 5-year prospective randomized study by ***Gotfredsen and Holm*** of overdentures retained from 2 implants in the mandible showed a success rate of 100%, which was independent from the attachment system used (ball or bar). These findings were in agreement with previous studies. It appears that the attachment system doesn't influence the success rate of the implants. Other factors, like bone quality and quantity, arch morphology and implant length, seem to play much more important roles in implant survival rates.

Rapid bone loss around fixtures placed within the maxillae (i.e., when O-rings were used as an attachment mode) has been documented too. Nevertheless, it was suggested that further evaluation was needed if bone reaction differed between interconnected and non interconnected fixtures, and between different attachment systems. However, other studies by Enquist and Palmqvist et al have not confirmed these findings.

In addition, Palmqvist et al couldn't find any predictive value for implant failure for a spread of superstructures that included both bars and non connected attachments. In this study, consideration has been given to a number of variables, such as cross-sectional form (round, ovoid, or parallel), straight versus curved bars, and bars with or without cantilevered sections. It appears that there's no significant difference in mean bone loss between the themes with ball or bar-retained overdentures. However, there is some evidence that mean bone loss values appear to be higher in subjects with ball attachments.It was speculated that the reason for this loss could be related to differences in loading patterns or bone conditions24.

Tokar E, Uludag B (2015) estimated the differences in load transfer and stress levels among four attachment systems used in mandibular overdenture utilising by one central implant and two inclined distal implants for retention. Three screw type implants were positioned in the parasymphyseal region of photoelastic mandibular models. Bar,

bar with ball, bar and distally placed Rk-1s, and Locators are the four attachment systems utilised. Vertical loads were applied in the central fossa of right first molar of the mandibular overdenture and their corresponding stress levels were assessed and concluded that the least stress was found in locator attachments, and this transmits minimal discernible stress surrounding the implants.

Schweyen R, Beuer F, Arnold C, Hey J(2015) evaluated a new chairside attachment system based on polyvinylsiloxane (PVS) for numerous different attachments are used to retain overdentures on implants.Two fifty specimens were made to calculate the retention force and concluded that Polyvinylsiloxane attachments provide an alternate to locator attachments, possessing better stability of retention force.

Lobo et al in 2018 aimed to define the available native bone dimensions and safe limits for implant placement in the mandibular inter-foraminal region using CBCT imaging. 100 CBCT scans were evaluated for bone dimensions, anterior loop of the inferior alveolar nerve, the lingual foramina and canals. Mean bone height was 20.34±3.3mm. Range: 13.69-26.98mm. Mean unilateral ridge length was 19.44±1.8mm. Midline lingual foramina showed a 99% prevalence-single canal in 41 cases, 2 canals in 53 cases, 3 canals in 5 cases. The bucco-lingual width traversed by the lingual canal from lingual cortex was upto the middle third in the majority of cases (77%). The anterior loop was present in 45% of the population: bilaterally in 30% and unilaterally in 15%.The mean anterior extent was 2.68±0.8 mm and range was 1.01 to 4.36mm. So keeping a standard reference level of 6 mm of crestal bone width, majority of cases showed a possibility to place implants upto 15 mm in length in the inter-foraminal region. The implant osteotomy could be positioned far enough buccally to avoid lingual vessel trauma. A safe zone of 3.5-4 mm anterior to the mesial border of the mental foramen should be maintained to account for the presence of an anterior loop. The anterior loop is an intramedullary structure and cannot be seen clinically or easily identified on 2D radiographs. Panoramic radiography revealed the prevalence to be low as 12% by Misch and Crawford (1990) [13], to as high as 40%. As reported by Ngeow et al. 2009 [14]. They also reported maximum presence of the loop bilaterally and in a few cases right side followed by left which was minimum. In a study on Indian Population the prevalence was found to be 19% (Arora 2013) [15]. Cadaveric dissections found the prevalence to be 11-28% [16, 17]. Surgical exploration in vivo revealed a 24% prevalence18Apostolakis (2012) on CBCT evaluation has revealed a prevalence of 48% which is close to the value of 45% obtained in our study [19]. The loop length was found to be 0.5-1 mm in cadaveric dissections.

In relation to these study results, in the present study it is found that-

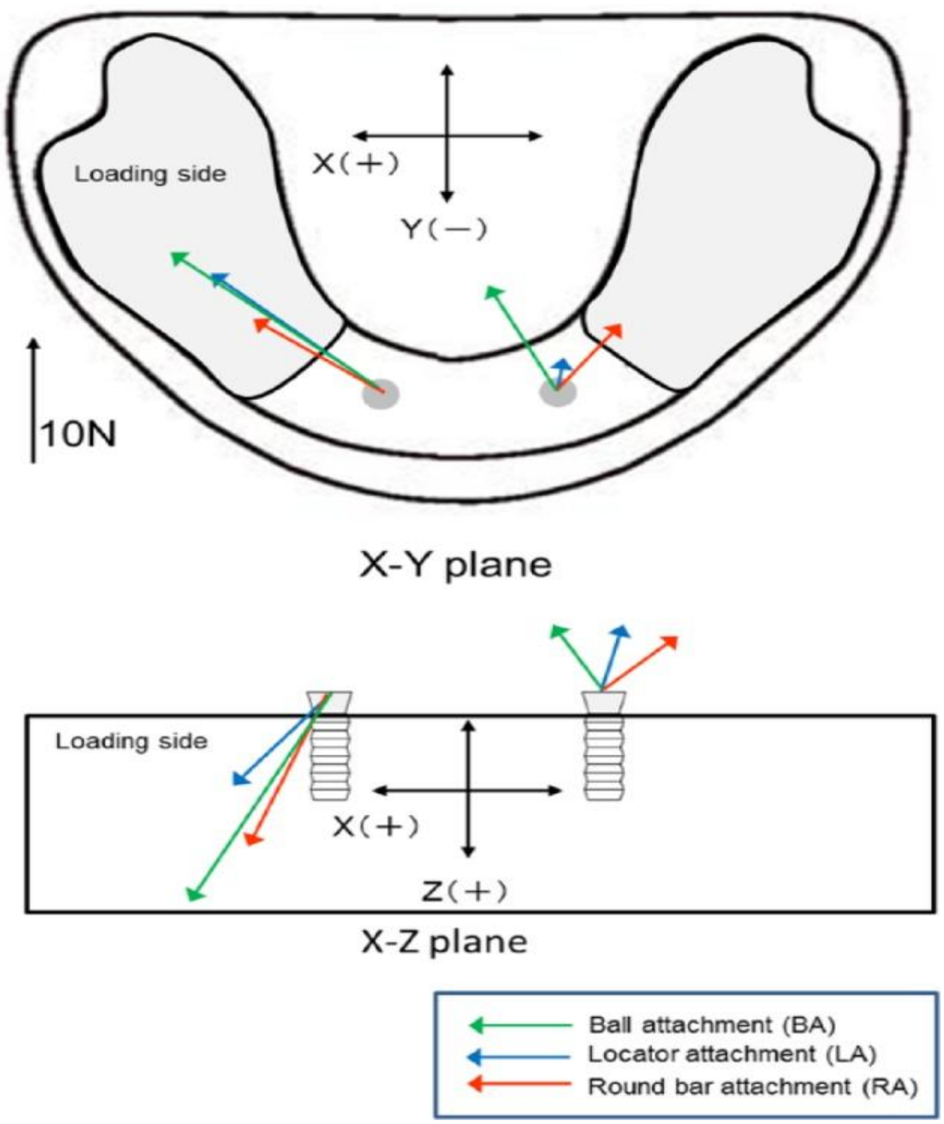
The limitations of this study are listed below:

- Sample size is limited.
- Age related changes can occur in the palatal contour.
- There can be inter observer differences in measuring ridge width, marking occlusal restorative space and in measuring interforaminal distance. Thus, in order to correctly measure these parameters, careful observation and calculation of dimensions are necessary.

In case of lower implant-based overdentures, recent conclusion is that patients' satisfaction and quality of life are significantly more important for implant supported overdentures than for conventional dentures and that a two-implant mandibular overdenture must be considered the least treatment standard for majority patients giving a social possibility of low cost therapies.

Nobuhiro yoda et al (2015) concentrated on checking influence of type of attachment on amount of load transmitted to implants and on residual alveolar ridge when mandibular two-implant-supported overdenture is concerned in a model analysis. Ball attachments, locator attachments, and round-bar attachments were chosen, then subjected to test. Static and dynamic vertical, a load of 100 N was given in the area of mandibular right first molar . Piezoelectric three-dimensional force transducers were utilized to calculate the implant load, and therefore impact upon underlying residual ridge below denture base was measured using tactile sheet sensor. Load upon implants having ball attachments was noticeably above that compared to other two attachments. Load over the residual ridge with round-bar attachments was again noticeably high compared with the other two attachments. Their findings show that the three-dimensional load on implants along with the residual ridge beneath the denture base is significantly related to the sort of attachment utilized in implant-supported overdentures.

Mericske-Stern et al. pioneered the three dimensional load measurement on implants that support overdentures.who developed an in vivo 3D load measuring device using piezoelectric transducers. ***Goto et al*** explored the influence of attachment installation situations on load transfer to implants supporting overdenture and its movements utilising load-cell transducer in model experiment. When the load was applied to the loading point on the denture, the denture base settled down. At this time, the denture was thought to rotate on the Y–Z plane as well as on the X–Z plane . The load direction on functioning side implant was consistently on the lateral (right) and posterior whatever may be the attachment type. On the other hand, the direction of the load on the nonloading side implant was upward. The lateral direction of the load on



the nonloading side implant was different among the three attachments. In addition, the recent FE analysis showed that the load on the residual ridge affected the hydrostatic stress in the mucosa which led to the bone resorption beneath the denture base.[31] Therefore, the bone resorption might be prone to occurring beneath the denture base of the IOD with RA. the shifting pattern of the load center within the sensor area on the residual ridge , it mainly changed the lateral direction in BA and RA, which were thought to be affected by the rotational movement of the denture . On the other hand, the load center of LA mainly changed in the antero-posterior direction. denture movement is affected not only by the attachment system but also by other factors, such as the form of the residual ridge, tissue displacement, and the position of the implants. the measuring device using a tactile sheet sensor enabled us to measure the load distribution on an area of approximately 100 mm^2 of the residual ridge. The limited conclusions drawn from the results of this study were as follows:

1. The model analysis using piezoelectric 3D force transducers along with a tactile sheet sensor helped us to clarify the influence of attachments used in IOD on loading to implants and alveolar ridge underneath.
2. Utilising RA in an IOD is beneficial for decreasing the load to the supporting implants.
3. Load on residual alveolar ridge below the denture in IODs can be considerably toned down when a BA is placed.

Several factors need to be considered prior implant treatment planning for a long term success, the available native bone dimensions being a key factor. The implants should be bodily centered towards the buccal aspect of the ridge to prevent trauma to the lingual canal and vasculature. An average horizontal ridge length of nineteen millimetre unilaterally will permit for placement of 3-4 interforaminal implants in majority cases. Implants must be fixed in a prosthetically favourable position with sufficient surrounding native bone while avoiding impingement on the vital neurovascular structures, say the anterior loop of inferior alveolar nerve and position of lingual vessels.

SUMMARY

The implant – retained overdenture is a treatment modality that is less time consuming, more economical and of lesser risk to the patients and tissues and is a true alternative to fixed prosthesis. Ten years ago age was considered to be an exclusion criterion for implantation. Today, there is evidence that elderly patients would benefit from implants and that the effectiveness of mandibular implant – supported overdentures is high[1].

If a choice of prostheses is offered namely, fixed or implant – supported overdentures, elderly patients more than 50 years of age would prefer the overdenture. Approximately 60% of implant restorations in completely edentulous patients are restored with the overdenture concept because of its functional, anatomic, economical, or esthetic considerations. The making of complete dentures which provides patient comfort, function and aesthetic harmony in addition stability and retention stays to be one of the most challenging procedure in dental practice. The main sequelae of wearing complete dentures is the residual ridge resorption. The most common site of resorption is mandibular anterior region followed by other areas of the edentulous ridge.

Implant supported overdentures are indicated in cases of severely resorbed ridges, in cases of mucosal intolerance to denture bases and for patients with reduced masticatory efficiency, single completed denture[45].There are a number of advantages of implant supported overdentures like proper positioning of teeth for esthetics, providing a stable occlusion, better success rates improved masticatory performance, better phonetics and proprioception, preservation of alveolar ridge and minimal mucosal coverage. There are a number of drawbacks of implant supported overdentures like plaque accumulation, inadequate space for attachments, discomfort due to improper placement, technique sensitive and expensive.

The retention of attachments may be based on mechanical, frictional or magnetic. The retention obtained by these methods vary in degree of retention and the most commonly used retention is mechanical retention. Various attachment systems are available which range from pre-fabricated to castable attachments (or) they may be classified as design as bars, stud, screw and magnets. It’s the operator’s decision on selecting the proper attachment based on the particular situation and the need for the attachment plus keeping the affordability by the patient. Bar attachment are most commonly used if there is sufficient inter arch space which provides sufficient retention. If they lack space stud attachments are preferred, magnets can also be used in situations lacking space but has the disadvantage of corrosion and cost effectiveness.

Though there are lots of advantages of an implant supported overdentures but they are also associated with a plethora of complications. These include a need for reactivation or replacement of the attachment, as well as relines after placement. The screw loosening seems to be a common problem after insertion, while the clip/attachment fracture is another complication. Corrosion, with a subsequent rapid loss of retention and extreme wear of some magnet systems is another major complication. Prosthetic complications also included loosening of abutment titanium screws of ball and bar attachments. There are other complications like marginal bone loss, implant survival rate which are not related to the type of attachment rather its related to type of bone, placement of implant and occlusal force.

Thus attachment is a vital part in implant supported overdentures which in the future must be affordable and reachable to all patients who desire the complete denture prosthodontics. Although good base adaptation, border extension, surface tension and other physical phenomenon contribute to maintaining an overdenture in place, these play an important role as a mechanism for retention, stability and support for these prosthesis.

CONCLUSION

Within the limitations of the study done the following conclusions were drawn:

- Ridge width and Interforaminal distance is significantly different according to residual ridge forms.
- Significant difference in Ridge width is found between Ovoid and Square type groups (Square type ridge width is higher significantly).
- Hence, according to the arch forms, the dimensions considered for treatment planning differ significantly. Further in vivo finite element analysis studies based on the arch forms in implant overdenture will help clinicians in better designing of prosthesis and choice of attachment systems.

Bibliography

1. Pan YH, Lin TM, Liang CH. Comparison of patient's satisfaction with implant-supported mandibular overdentures and complete dentures. Biomed J. 2014;37:156-62.
2. Kreisler M, Behneke N, Behneke A, d'Hoedt B. Residual ridge resorption in the edentulous maxilla in patients with implant-supported mandibular overdentures: an 8-year retrospective study. Int J Prosthodont. 2003;16:295-300.
3. Chai J, Chau AC, Chu FC, Chow TW. Diagnostic performance of mandibular bone density measurements in assessing osteoporotic status. Int J Oral Maxillofac Implants. 2014;29:667-74.
4. Yunus N, Masood M, Saub R, Al-Hashedi AA, Taiyeb Ali TB, Thomason JM. Impact of mandibular implant prostheses on the oral health-related quality of life in partially and completely edentulous patients. Clin Oral Implants Res. 2016;27:904-9.
5. Cardoso RG, Melo LA, Barbosa GA, Calderon PD, Germano AR, Mestriner W Junior, Carreiro AD. Impact of mandibular conventional denture and overdenture on quality of life and masticatory efficiency. Braz Oral Res. 2016;30:102.
6. Raedel M, Lazarek-Scholz K, Marré B, Boening KW, Walter MH. Posterior alveolar ridge resorption in bar-retained mandibular overdentures: 10-year results of a prospective clinical trial. Clin Oral Implants Res. 2015;26:1397-401.

7. Gonda T, Maeda Y, Walton JN, MacEntee MI. Fracture incidence in mandibular overdentures retained by one or two implants. J Prosthet Dent. 2010;103:178-81.

8. Hasan I, Madarlis C, Keilig L, Dirk C, Weber A, Bourauel C, Heinemann F. Changes in biting forces with implant-supported overdenture in the lower jaw: A comparison between conventional and mini implants in a pilot study. Ann Anat.2016;208:116-122.

9. de Jong MH, Wright PS, Meijer HJ, Tymstra N. Posterior mandibular residual ridge resorption in patients with overdentures supported by two or four endosseous implants in a 10-year prospective comparative study. Int J Oral Maxillofac Implants. 2010;25:1168-74.

10. Attard N, Wei X, Laporte A, Zarb GA, Ungar WJ. A cost minimization analysis of implant treatment in mandibular edentulous patients.Int J Prosthodont.2003;16:271-6.

11. den Dunnen AC, Slagter AP, de Baat C, Kalk W. Professional hygiene care, adjustments and complications of mandibular implant-retained overdentures: a three-year retrospective study. J Prosthet Dent. 1997;78:387-90.

12. Cordioli G, Majzoub Z, Castagna S. Mandibular overdentures anchored to single implants: a five-year prospective study. J Prosthet Dent. 1997;78:159-65.

13. Khamis MM, Zaki HS, Rudy TE. A comparison of the effect of different occlusal forms in mandibular implant overdentures.J Prosthet Dent. 1998;79:422-9.

14. Mericske-Stern R, Grütter L, Rösch R, Mericske E. Clinical evaluation and prosthetic complications of single tooth replacements by non-submerged implants. Clin Oral Implants Res. 2001;12:309-18.

15. Sadowsky SJ, Caputo AA. Effect of anchorage systems and extension base contact on load transfer with mandibular implant-retained overdentures.J Prosthet Dent. 2000;84:327-34.

16. Sadowsky SJ. Mandibular implant-retained overdentures: a literature review. J Prosthet Dent. 2001;86:468-73.

17. Chaffee NR, Felton DA, Cooper LF, Palmqvist U, Smith R. Prosthetic complications in an implant-retained mandibular overdenture population: initial analysis of a prospective study. J Prosthet Dent. 2002;87:40-4.

18. Heydecke G, Klemetti E, Awad MA, Lund JP, Feine JS. Relationship between prosthodontic evaluation and patient ratings of mandibular conventional and implant prostheses. Int J Prosthodont. 2003;16:307-12.

19. Chu FC, Deng FL, Siu AS, Chow TW. Implant-tissue supported, magnet-retained mandibular overdenture for an edentulous patient with Parkinson's disease: a clinical report. J Prosthet Dent. 2004;91:219-22.

20. Ohkubo C, Sato J, Hosoi T, Kurtz KS. O-ring attachments for transitional implant-retained overdentures.J Prosthet Dent. 2004;91:195-7.

21. Naert I, Alsaadi G, Quirynen M. Prosthetic aspects and patient satisfaction with two-implant-retained mandibular overdentures: a 10-year randomized clinical study. Int J Prosthodont. 2004;17:401-10.

22. Naert I, Alsaadi G, van Steenberghe D, Quirynen M. A 10-year randomized clinical trial on the influence of splinted and unsplinted oral implants retaining mandibular overdentures: peri-implant outcome. Int J Oral Maxillofac Implants. 2004;19:695-702.

23. Kuoppala R, Näpänkangas R, Raustia A. Outcome of implant-supported overdenture treatment--a survey of 58 patients. Gerodontology. 2012;29:577-84.

24. Mumcu E, Bilhan H, Geckili O. The influence of healing type on marginal bone levels of implants supporting mandibular overdentures: a randomized clinical study. Indian J Dent Res. 2012;23:514-8.

25. Tabatabaian F, Saboury A, Sobhani ZS, Petropoulos VC. The effect of inter-implant distance on retention and resistance to dislodging forces for mandibular implant-tissue-supported overdentures. J Dent (Tehran). 2014;11:506-15.

26. Leventi E, Malden NJ, Lopes VR. Periimplant bone-level reduction in relation to hydroxyapatite-coated dental implants that act as mandibular overdentureretainers: results at 6 to 10 years. J Prosthet Dent. 2014;112:792-7.

27. Saulacic N, Abboud M, Pohl Y, Wahl G. Implant-supported mandibular overdentures and cortical bone formation: clinical and radiographic results.Implant Dent. 2014;23:85-91.

28. Ashmawy TM, El Talawy DB, Shaheen NH. Effect of mini-implant-supported mandibular overdentures on electromyographic activity of the masseter

muscle during chewing of hard and soft food. Quintessence Int. 2014;45:663-71.

29. Korfage A, Raghoebar GM, Slater JJ, Roodenburg JL, Witjes MJ, Vissink A, Reintsema H. Overdentures on primary mandibular implants in patients with oral cancer: a follow-up study over 14 years. Br J Oral Maxillofac Surg. 2014;52:798-805.

30. Listl S, Fischer L, Giannakopoulos NN. An economic evaluation of maxillary implant overdentures based on six vs. four implants. BMC Oral Health. 2014;14:105.

31. Saito M, Kanazawa M, Takahashi H, Uo M, Minakuchi S. Trend of change in retentive force for bar attachments with different materials. J Prosthet Dent.2014;112:1545-52.

32. Vere JW, Eliyas S, Wragg PF. Attitudes of general dental practitioners to the maintenance of Locator retained implant overdentures. Br Dent J. 2014;216:E5.

33. Scherer MD, McGlumphy EA, Seghi RR, Campagni WV. Comparison of retention and stability of two implant-retained overdentures based on implant location.J Prosthet Dent. 2014;112:515-21.

34. Singh K, Gupta N, Gupta R, Abrahm D. Prosthetic rehabilitation with collapsible hybrid acrylic resin and permanent silicone soft liner complete denture of a patient with scleroderma-induced microstomia. J Prosthodont. 2014;23:412-6.

35. Calderon PS, Dantas PM, Montenegro SC, Carreiro AF, Oliveira AG, Dantas EM, Gurgel BC. Technical complications with implant-supported dental prostheses. J Oral Sci. 2014 ;56:179-84.

36. Emami E, de Souza RF, Bernier J, Rompré P, Feine JS. Patient perceptions of the mandibular three-implant overdenture: a practice-based study. Clin Oral Implants Res. 2015;26:639-43.

37. Tokar E, Uludag B. Load Transfer Characteristics of Various Designs of Three-Implant-Retained Mandibular Overdentures. Int J Oral Maxillofac Implants.2015;30:1061-7.

38. Schweyen R, Beuer F, Arnold C, Hey J. Retentive characteristics of a vinylpolysiloxane overdenture attachment system. Clin Oral Investig. 2015;19:947-53.

39. dos Santos MB, Bacchi A, Consani RL, Correr-Sobrinho L. Influence of Diamondlike Carbon Coating of Screws on Axial Tightening Force and Stress Distribution on Overdenture Bar Frameworks with Different Fit Levels and Materials. Int J Oral Maxillofac Implants. 2015;30:1019-27.

40. Chang SH, Huang SR, Huang SF, Lin CL. Mechanical response comparison in an implant overdenture retained by ball attachments on conventional regular and mini dental implants: a finite element analysis. Comput Methods Biomech Biomed Engin. 2016;19:911-21.

41. Rabbani S, Juszczyk AS, Clark RK, Radford DR. Investigation of retentive force reduction and wear of the locator attachment system with different implant angulations. Int J Oral Maxillofac Implants. 2015;30:556-63.

42. Banu R F, Veeravalli PT, Kumar V A. Comparative Evaluation of Changes in Brain Activity and Cognitive Function of Edentulous Patients, with Dentures and Two-Implant Supported Mandibular Overdenture-Pilot Study. Clin Implant Dent Relat Res. 2016;18:580-7.

43. Hegazy S, Elmekawy N, Emera RM. Peri-implant Outcomes with Laser vs Nanosurface Treatment of Early Loaded Implant-Retaining Mandibular Overdentures. Int J Oral Maxillofac Implants. 2016;31:424-30.

44. Takahashi T, Gonda T, Mizuno Y, Fujinami Y, Maeda Y. Influence of Palatal Coverage and Implant Distribution on Implant Strain in Maxillary Implant Overdentures. Int J Oral Maxillofac Implants. 2016;31:136-42.

45. Ahmad R, Abu-Hassan MI, Chen J, Li Q, Swain MV. The Relationship of Mandibular Morphology with Residual Ridge Resorption Associated with Implant-Retained Overdentures. Int J Prosthodont. 2016;29:573-580.

46. Kremer U, Schindler S, Enkling N, Worni A, Katsoulis J, Mericske-Stern R. Bone resorption in different parts of the mandible in patients restored with an implant overdenture. A retrospective radiographic analysis. Clin Oral Implants Res. 2016;27:267-72.

47. Zanolla J, Amado FM, da Silva WS, Ayub B, de Almeida AL, Soares S. Success rate in implant-supported overdenture and implant-supported fixed denture in cleft lip and palate patients. Ann Maxillofac Surg. 2016;6:223-227.

48. Ebadian B, Mosharraf R, Khodaeian N. Effect of cantilever length on stress distribution around implants in mandibular overdentures supported by two and three implants. Eur J Dent. 2016;10:333-40.

49. Zanolla J, Amado FM, da Silva WS, Ayub B, de Almeida AL, Soares S. Success rate in implant-supported overdenture and implant-supported fixed denture in cleft lip and palate patients. Ann Maxillofac Surg. 2016;6:223-227.

50. Hegazy S, Elmekawy N, Emera RM. Peri-implant Outcomes with Laser vs Nanosurface Treatment of Early Loaded Implant-Retaining Mandibular Overdentures. Int J Oral Maxillofac Implants. 2016;31:424-30.

51. Arafa KA. The impact on bone tissues of immediate implant-supported mandibular overdentures with cusped and cuspless teeth. Saudi Med J. 2016;37:79-83.

52. Al-Magaleh WR, Abbas NA, Amer AA, Abdelkader AA, Bahgat B. Biting Force and Muscle Activity in Implant-Supported Single Mandibular Overdentures Opposing Fixed Maxillary Dentition. Implant Dent. 2016;25:199-203.

53. Elsyad MA, Mahanna FF, Elshahat MA, Elshoukouki AH. Locators versus magnetic attachment effect on peri-implant tissue health of immediate loaded two implants retaining a mandibular overdenture: a 1-year randomised trial. J Oral Rehabil.2016;43:297-305.

54. Takahashi T, Gonda T, Maeda Y. Effect of Attachment Type on Implant Strain in Maxillary Implant Overdentures: Comparison of Ball, Locator, and Magnet Attachments. Part 1.Overdenture with Palate. Int J Oral Maxillofac Implants.2017;32:1308–14.

55. Karayazgan-Saracoglu B, Atay A, Korkmaz C, Gunay Y. Quality of life assessment of implant-retained overdentures and fixed metal-acrylic resin

prostheses in patients with marginal mandibulectomy. J Prosthet Dent. 2017;118:551-560.

56. Kim Y. Mini Implant-Retained Complete Overdenture Can be an Alternative Treatment Option for Selected Patients. J Evid Based Dent Pract. 2017;17:116-118.

57. Yoo JS, Kwon KR, Noh K, Lee H, Paek J. Stress analysis of mandibular implant overdenture with locator and bar/clip attachment: Comparative study with differences in the denture base length. J Adv Prosthodont. 2017;9:143-151.

58. Gibreel M, Fouad M, El-Waseef F, El-Amier N, Marzook H. Clips vs Resilient Liners Used With Bilateral Posterior Prefabricated Bars for Retaining Four Implant-Supported Mandibular Overdentures. J Oral Implantol. 2017;43:273-281.

59. Abe M, Yang TC, Maeda Y, Ando T, Wada M. Support Ratio Between Abutment and Soft Tissue Under Overdentures: A Comparison Between Use of Two and Four Abutments. Int J Prosthodont. 2017;30(3):242–244.

60. Tokar E, Uludag B, Karacaer O. Load Transfer Characteristics of Three-Implant-Retained Overdentures with Different Interimplant Distances. Int J Oral Maxillofac Implants. 2017;32(2):363-371.

61. Raza FB, Vaidyanathan AK, Veeravalli PT, Ravishankar S, Ali AS. Analysis of crestal bone loss around single piece ball attachment implant placed bilaterally in canine region and wear of O-ring in implant supported

overdenture: Three year follow-up. Clin Implant Dent Relat Res. 2018;20:403-409.

62. Amaral CF, Gomes RS, Rodrigues Garcia RCM, Del Bel Cury AA. Stress distribution of single-implant-retained overdenture reinforced with a framework: A finite element analysis study. J Prosthet Dent. 2018;119:791-796.

63. Kutkut A, Bertoli E, Frazer R, Pinto-Sinai G, Fuentealba Hidalgo R, Studts J. A systematic review of studies comparing conventional complete denture and implant retained overdenture. J Prosthodont Res. 2018;62(1):1-9.

64. Alsrouji MS, Ahmad R, Abdul Razak NH, Shuib S, Kuntjoro W, Baba NZ. Premaxilla Stress Distribution and Bone Resorption Induced by Implant Overdenture and Conventional Denture.J Prosthodont. 2018.

65. Sánchez-Siles M, Ballester-Ferrandis JF, Salazar-Sánchez N, Gómez-García FJ, Moraleja-Ruiz R, Camacho-Alonso F. Long-term evaluation of quality of life and satisfaction between implant bar overdentures and conventional complete dentures: A 23 years retrospective study. Clin Implant Dent Relat Res. 2018;20:208-214.

DEPARTMENT OF PROSTHODONTICS

TAMIL NADU GOVERNMENT DENTAL COLLEGE AND HOSPITAL

CHENNAI-600003

Evaluation of residual ridge and restorative space for diagnosing and determining implant placement options for over dentures in completely edentulous patients

CASE PROFORMA

Date:	O.P No:	Group No:
Name:	Age/Sex:	Case No:
Address:	Tel No :	Mobile No :

Occupation:

Patient's Complaint :

Any relevant medical/surgical/allergy/trauma history:

Period of edentulousness:

History of previous dentures(if any):

Patient satisfaction regarding the retention, stability, masticatory functions and phonetics with the previous denture:

History of residual ridge modifications done if any:

Patient Evaluation:

Clinical:-

General appearance:

Build:

Shape of head:

Shape of face:

Symmetry of the face:

TMJ :

movements,pain-

Mouth opening:

Tongue size, shape:

Soft tissue-

Alveolar mucosa:

Labial mucosa:

Palatal mucosa:

Floor of mouth:

Retromolar trigone:

Lateral throat form:

any findings significant to the study:

Arch forms-

Upper:

Lower:

Occlusal vertical dimension of restorative space:

Radiographic:

Residual ridge height-

Vertical restorative space from crest of ridge to occlusal plane-

Inferences:

Final diagnosis:

PATIENT INFORMATION SHEET

Name of the Investigator
Dr.M.Saravana Priya **Name of the Institution:**
Tamil nadu government dental college and hospital.

Name of the guide
Dr.C.Sabarigirinathan MDSD
Tamilnadu Government Dental College & Hospital, Chennai-3

We are conducting a study on titled **Evaluation of residual ridge and restorative space for diagnosing and determining implant placement options for over dentures in completely edentulous patients** on patients attending TNGDCH.

PROCEDURE

- An intraoral and extraoral examination will be carriedout before the treatment procedure.
- Clinical and radiographic evaluation of the residual ridge and restorative space of the patients is done and the data obtained are subjected to analysis.

RISKS OF PARTICIPATING IN THE STUDY

Pain or allergy as a result of any of the materials used for the treatment, may occur.

The treatment for such complications, if any, will be given appropriately.

BENEFITS OF PARTICIPATING IN THE STUDY

The participation in the study will result in the formation of a more relevant and acceptable treatment plan for the patient condition.

CONFIDENTIALITY

The identity of the patients participating in the research will be kept confidential throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

ஆராய்ச்சிப் பற்றிய தகவல் படிவம்

1. இம்ப்ளாண்ட் பல் செட்டுகள் வடிவமைப்பில் தாடை மற்றும் பல் கட்டமைப்பு இடத்தின் முக்கியத்துவத்தை சீர்தூக்கி அறிதல்.
2. நோயாளி பற்றிய குறிப்புகள் பிறர் அறியா வண்ணம் ஆராய்ச்சி முடியும் வரை இரகசியமாக பாதுகாக்கப்படும். அதை வெளியிடும் நேரத்தில் எந்த நோயாளியின் தனி அடையாளங்களும் வெளியிட வாய்ப்பு கிடையாது.
3. இந்த ஆராய்ச்சியில் பங்கு பெறுவது நோயாளியின் தனிப்பட்ட முடிவு மற்றும் நோயாளிகள் இந்த ஆராய்ச்சியில் இருந்து எப்போது வேண்டுமானாலும் விலகிக் கொள்ளலாம். நோயாளியின் இந்த முடிவிற்கு அவருக்கு அல்லது ஆராய்ச்சியாளருக்கு எந்த பாதிப்பும் ஏற்படுத்தாது என்பதை தெரியப்படுத்துகிறோம்.
4. இந்த ஆராய்ச்சி முடிவுகள் நோயாளிகளுக்கு ஆராய்ச்சி முடியும் தருவாயிலோ அல்லது இடையிலோ தெரிவிக்கப்படும். ஆராய்ச்சியின் பொழுது ஏதும் பின் விளைவுகள் ஏற்பட்டால் அதை சரி செய்ய தகுந்த உதவிகள் அல்லது தேவையான சிகிச்சைகள் உடனடியாக மேற்கொள்ளப்படும்.

நோயாளியின் பெயர்　　　　　　　　　　கையொப்பம்/கைரேகை

முதன்மை ஆய்வாளர்
தமிழ்நாடு அரசு பல் மருத்துக் கல்லூரி,
சென்னை–600 003.

INFORMED CONSENT FORM

STUDY TITLE:

"Evaluation of residual ridge and restorative space for diagnosing and determining implant placement options for over dentures in completely edentulous patients"

Name : O.P No:

S. No:

Address : Age/Sex:

Tel. No :

I,_______________________________________age ________

years exercising my free power of choice, hereby give my consent to be included as a participant in the study titled **Evaluation of residual ridge and restorative space for diagnosing and determining implant placement options for over dentures in completely edentulous patients.**

I agree to the following:

- I have been informed to my satisfaction about the purpose of the study and study procedures including investigations to monitor and safeguard my body function.
- I understand that this study will require the obtaining of digital radiographs for evaluation purposes.
- I agree to undergo the procedure involved in the study process.
- I have informed the doctor about all medications I have taken in the recent past and those I am currently taking
- I agree to cooperate fully throughout the study period
- I hereby give permission to use my medical records for research purpose. I am told that the investigating doctor and institution will keep my identity confidential.

Name of the patient Signature/ Thumb impression

Name of the investigator Signature

ஆராய்ச்சி ஒப்புதல் படிவம்

இம்ப்ளாண்ட் பல் செட்டுகள் வடிவமைப்பில் தாடை மற்றும் பல் கட்டமைப்பு இடத்தின் முக்கியத்துவத்தை சீர்தூக்கி அறிதல்.

பெயர் வயது/பால்

ஆராய்ச்சி சேர்க்கை எண். புறநோயாளி எண்.

நான் என் சுய நினைவுடன் மற்றும் முழு சுதந்திரத்துடனும் இந்த மருத்துவ ஆராய்ச்சியில் சேர்ந்து கொள்ள ஒப்புதல் அளிக்கிறேன். கீழ் காணப்படும் நிபந்தனைகளுக்கு ஒப்புதல் அளிக்கிறேன். இந்த ஆராய்ச்சியின் நோக்கமும் அதன் சிகிச்சை முறைகளும் எனக்கு திருப்தி அளிக்கும் வகையில் அறிவுறுத்தப்பட்டது. இந்த ஆராய்ச்சியின் போது நோயாளிக்கு பயன்படுத்தும் மூலப் பொருட்களையும், பயன்படுத்தும் முறைகளையும் தீங்கு தராமல் இருக்கும் பொருட்களை உபயோகப்படுத்துவதை நன்கு அறிவேன். மற்றும் எனக்கு அனைத்து செயல்களும் மருத்துவர் அவர்களால் விளக்கிக் கூறப்பட்டது.

நான் மருத்துவ சிகிச்சை முறைக்கு முழுமையாக ஒத்துழைத்து ஏதேனும் அசாதாரண நோய் அறிகுறிகள் ஏற்பட்டால் உடனடியாக என் மருத்துவருக்கு தெரிவிக்க ஒப்புக் கொள்கிறேன். என் மருத்துவக் குறிப்பு ஏடுகளை மருத்துவ ஆராய்ச்சியில் பயன்படுத்த சம்மதிக்கிறேன். இந்த ஆராய்ச்சி மையமும், ஆராய்ச்சியாளரும் என் அடையாளத்தை இரகசியமாக வைத்திருப்பதாக அறிகிறேன்.

நோயாளியின் பெயர் கையொப்பம்/கைரேகை தேதி

ஆராய்ச்சியாளர் பெயர் கையொப்பம் தேதி

Raw Data

gender	ridge form	ridge width	vertical restorative space	interforaminal distance	no of implants	attachment type
m	ovoid	8.2	13.8	34.1	4	BAR-LA/BALL
m	ovoid	7.3	14.2	36.3	4	BAR-LA/BAR-CLIP
m	square	11	15	42	5	BAR-LA/BAR-CLIP
f	tapering	9	16.3	41	5	BAR-LA/BAR-CLIP
m	tapering	6.8	13.9	39	4	BALL/LA
m	tapering	9.7	14.7	38	4	BAR-LA/BAR-CLIP
f	tapering	7.7	17.2	38.3	4	BAR-LA/BAR-CLIP
m	tapering	7.4	13.8	38.3	4	BALL/LA
f	tapering	8.2	16.4	36.7	4	BAR-LA/BAR-CLIP
f	ovoid	8.5	15.7	37.8	4	BAR-LA/BAR-CLIP
m	square	9	15.2	43.6	5	BAR-LA/BAR-CLIP
m	ovoid	9.1	16.2	44.2	5	BAR-LA/BAR-CLIP
f	square	12	11.8	44.1	5	BALL/LA
m	ovoid	7.5	12.3	35.7	4	BALL/LA
m	ovoid	8.3	12.8	37.5	4	BALL/LA
m	square	7.4	15.7	39.4	4	BAR-LA/BAR-CLIP
m	ovoid	7.9	14.9	40.3	4	BAR-LA/BAR-CLIP
f	tapering	6.8	15.2	39.4	4	BAR-LA/BAR-CLIP
m	square	8.1	12.1	39	4	BALL/LA
f	tapering	8	18.2	37.3	4	BAR-LA/BAR-CLIP
f	ovoid	6.3	15.3	37.3	4	BAR-LA/BAR-CLIP
m	square	9.2	14.8	41	4	BAR-LA/BAR-CLIP
m	square	8.6	13.9	42.7	5	BALL/LA
f	tapering	7.9	15.2	38.9	4	BAR-LA/BAR-CLIP
m	tapering	6.7	15.3	41.4	4	BAR-LA/BAR-CLIP
f	ovoid	7.3	16.8	36.9	4	BAR-LA/BAR-CLIP
m	ovoid	6.8	16.4	43.3	5	BAR-LA/BAR-CLIP
f	square	7.8	17.5	43.1	5	BAR-LA/BAR-CLIP
f	ovoid	6.9	14.8	42.6	5	BAR-LA/BAR-CLIP
f	square	7.7	15.7	39.2	4	BAR-LA/BAR-CLIP
f	ovoid	5.6	14.9	44.7	5	BAR-LA/BAR-CLIP
f	ovoid	4.9	13.8	40.8	4	BALL/LA
f	ovoid	6	12.7	38.5	4	BALL/LA
f	tapering	6.3	13.5	36.5	4	BALL/LA
m	tapering	5.8	14.1	38.4	4	BAR-LA/BAR-CLIP
m	tapering	4.7	12.9	36.9	4	BALL/LA
m	square	6.8	15.3	37.5	4	BAR-LA/BAR-CLIP
f	square	6.4	15.6	37.2	4	BAR-LA/BAR-CLIP
m	tapering	7.3	14.7	37.5	4	BAR-LA/BAR-CLIP
m	square	7.8	14.8	43.2	4	BAR-LA/BAR-CLIP

f	tapering	6.9	13.2	36.8	4	BALL/LA
f	square	6.8	15.9	44.1	4	BAR-LA/BAR-CLIP
m	ovoid	5.4	16.4	35.1	4	BAR-LA/BAR-CLIP
m	ovoid	5.9	15.1	36.2	4	BAR-LA/BAR-CLIP
m	tapering	6.1	14.7	41.5	4	BAR-LA/BAR-CLIP
f	square	5.8	14.6	42.4	5	BAR-LA/BAR-CLIP
m	square	8	14.2	43.6	5	BAR-LA/BAR-CLIP
m	square	6.9	13.9	41.6	4	BALL/LA
m	ovoid	7.1	14.6	37.8	4	BAR-LA/BAR-CLIP
f	tapering	6.6	13.8	42.8	5	BALL/LA
f	ovoid	8.1	13.8	36.1	4	BALL/LA
m	square	7.8	13.5	43.6	5	BALL/LA
f	square	8.5	12.3	44.7	5	BALL/LA
m	ovoid	6.9	12.8	40.6	4	BALL/LA
m	tapering	7.4	14.9	39.1	4	BAR-LA/BAR-CLIP
f	tapering	6.7	15.1	37.8	4	BAR-LA/BAR-CLIP
m	tapering	6.8	14.3	35.1	5/4	BAR-LA/BAR-CLIP
f	ovoid	6.9	15.9	41.3	5	BAR-LA/BAR-CLIP
f	square	5.9	15	42.3	5	BAR-LA/BAR-CLIP
m	square	8.4	12.7	40.8	5	BALL/LA