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RESEARCH ARTICLE

IMPACT OF ANTI-OXIDANT RICH DIET IN RESIDUAL RIDGE RESORPTION: A POPULATION BASED STUDY OF THE FOOD HABITS FOR THE RESIDENTS OF MANIPUR (NORTH EAST) AND THEIR PROSTHETIC MANAGEMENT AND REHABILITATION

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ABSTRACT

Aim: The aim of this study is to evaluate the RRR in terms of Height, width and inter-arch space for men and women of Manipur on anti-oxidant rich and anti-oxidant deficient diet. This study also aimed to evaluate the relative percentage of RRR after 6 months of tooth extraction in men and women of Manipur on anti-oxidant rich and anti-oxidant deficient diet. **Materials and Methods:** A total of 60 edentulous patients (30 male and 30 female) with age range of 50-60 years were included in this clinical trial which was completed in four phases (clinical and radiographic diagnosis, surgical extraction of grade III mobile teeth, OPG on the day of extraction and bone level measurement phase, OPG in the 6th month after extraction and bone level measurement phase). The eligible patients were randomly allocated in two equivalent groups of 30 participants each per group. The allocation was in 1:1 ratio via randomized chit method. Group I included the case group, that is patients on anti-oxidant rich diet, and Group II included the control group, that is anti-oxidant deficient diet. A total of 60 conventional complete denture were fabricated and delivered one month after extraction and were divided into Group I and Group II in the ratio 1:1. Digital OPG were used for measuring the bone level in terms of height, and bone mapping to know the width and inter-arch space was measured at mandibular 1st molar area immediately after extraction and in the 6th month of follow up after tooth extraction and data was collected. **Results:** Statistical analysis revealed that in Men and women on Antioxidant Rich diet, there was not much of significant difference in the Residual alveolar ridge resorption when compared between the 1st day and 6th month of edentulism ($p > 0.05$) whereas Residual alveolar ridge resorption was significant ($p < 0.05$) for the Men and women on Antioxidant Deficient diet. Residual Alveolar Ridge Resorption in Men and Women after 40 years of age is minimal, because of their high antioxidant rich diet (beta carotene and ellagic acid) which prevents alveolar bone resorption and promotes bone remodelling after tooth extraction. Women though on menopause after 40 years of age, the Residual Ridge Resorption was minimal because of their antioxidant rich diet and Vice versa. Statistical analysis also revealed that there was not much of significant difference in the percentage of ridge resorption (in the 6th month of edentulism) when compared in Male and Female patients of Manipur ($p > 0.05$). Both sexes reacted equally to the Residual Ridge Resorption.

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INTRODUCTION

Antioxidants are compounds that our body makes naturally. We can also get them from foods. They work to protect the cells from damage caused by oxidants. Oxidants, on the other hand are free radicals that our body produces to defend itself against bacteria and viruses. These free radicals produces chain reactions that may damage the cells of organisms. Antioxidants

are compounds that inhibit oxidation. Antioxidants could be consumed through diet which is naturally occurring eg. Ascorbic acid (Vitamin C & E) or are produced internally in the human body eg. Glutathione & enzymes (catalase, superoxide dismutase). They could also be the industrial chemicals that are produced in pharmaceutical industries and are consumed through medicinal supplements. Natural antioxidants provides benefits like slowing down the signs of ageing, making our

skin look youthful, lowers the risk of heart disease, lowers cancer and mortality risk more than supplements. Naturally occurring antioxidants are kidney beans, broccoli (carotenoids, lutein, zeaxanthin and beta-carotene), raisins (Anthocyanins), tomatoes (lucopene), mangoes (vitamin A & flavanoids), oranges (resveratrol), grapes (vitamin C & resveratrol), cherries (flavonoids, isoqueritrin and queritrin), walnuts (Polyphenols), beets (Betalains), spinach (Beta-Carotene, Lutein and Zeaxanthin), brown rice (phenolics and flavonoids), Dark chocolate (Flavanols and Polyphenols) etc. After tooth extraction, cascade of inflammatory reaction is activated and the extraction socket is temporarily closed by blood clot. Within first week, epithelial tissue begins its proliferation and migration. Within 2 weeks, active bone formation is seen at the bottom of the socket. About 6 months the socket is filled with newly formed bone. Even after the healing of wounds, the residual ridge alveolar bone undergoes a life-long catabolic remodelling. The size of the residual ridge is reduced most rapidly in the first 6 months, but the bone resorption activity of residual ridge continues throughout life at a slower rate, resulting in removal of a large amount of jaw structure. This unique phenomenon has been described as residual ridge resorption (RRR). Several research has been done to see the effect of antioxidant rich diet on cancer, cardiovascular diseases, skin ageing changes etc. This study focuses to see the effect of Antioxidants rich diet on Residual Ridge Resorption in completely edentulous patients and their prosthetic management and rehabilitation.

MATERIALS AND METHODS

The present randomized controlled trial was carried out in the Department of Prosthodontics and Crown and Bridge in collaboration with Department of Oral Medicine, Diagnosis and Radiology and Department of Oral and Maxillofacial Surgery, to evaluate the amount of alveolar bone resorption in mandibular 1st molar area with conventional complete denture opposing a maxillary complete denture over a period of 6 months of follow-up.

Study design: Study was designed to be a randomized clinical trial (RCT): Two parallel groups with 1:1 random allocation via chit method were included 60 subjects (30 males and 30 females) with mean age of 55.4 years.

Case Group I: Each subject who were on antioxidant rich diet and having blood antioxidant level of 11-12mg/dl (which was determined by using spectroscopic methods), received maxillary and mandibular conventional complete denture one month after extraction of grade III mobile mandibular posterior teeth.

Control Group II: Each subject who were on antioxidant deficient diet and having blood antioxidant level of 5-6mg/dl (which was determined by using spectroscopic method), received maxillary and mandibular conventional complete denture one month after extraction of grade III mobile mandibular posterior teeth.

Patient consent

The proposed treatment modalities and alternatives were discussed with patients in this study. Explanatory consultation, treatment duration, prosthodontic restoration, and possible

complications as well as risks were all written in a consent form. The patients were fully informed about the possible consequences of the proposed clinical trial and signed a special written consent form designed for this purpose in accordance with the Declaration of Helsinki (2008). The consent forms were both in Manipuri and English for better understanding by the patients.

Inclusion and exclusion criteria

Completely edentulous patient with fresh extraction with respect to mandibular posterior teeth and in the age group of 50 to 60 years were included in the study. Patients were co-operative, healthy without any systemic disease and devoid of any bone disorders. Male and Female patients were in the ratio of 1:1 were from Manipur (North East). Half of the patients were on antioxidant rich diet and the remaining were on antioxidant deficient diet. Class I inter arch relationship were included and Anatomic, Prosthetic, Metabolic, Systemic and Functional factors were taken into consideration for the fabrication of Conventional complete denture. Exclusion criteria include patients with maxillofacial defects, patients suffering from systemic diseases, patients with any type of tumor, neurologic, or cerebrovascular diseases or hemorrhagic or severe cardiopulmonary disorders, and patients suffering from any neuromuscular disorders.

This study was conducted in 4 phases

In Phase 1, clinical and radiographic diagnosis was done. In this phase, grade III mobile mandibular posterior teeth was planned for extraction followed by OPG on the same day.. OPG was taken just after extraction and the height was measured from upper border of the mandibular canal to the crest of the residual alveolar ridge and data was collected in the Mandibular 1st Molar region of edentulism. The data was obtained for measuring the bone levels with the help of computer software (OPG) and was tabled. All data were statistically analyzed for result. Bone mapping was done to collect the data for Residual alveolar ridge width, 4mm apical to the crest in the Mandibular 1st Molar region and the patient was clinically evaluated for the inter arch space, measured and data was collected on the same day of extraction. In Phase 2, Fabrication of Conventional complete denture was planned which was scheduled one month after extraction on complete healing of the extraction socket. For this Primary impressions were made from alginate. Impressions were poured with dental plaster and diagnostic cast were made. Border molding was performed with low fusing compound, and final impressions were made with Zinc oxide impression paste. Jaw relation, teeth selection and try-in was done. Maxillary and mandibular Complete dentures were fabricated with high impact heat cured acrylic resin, and occlusion corrections were performed to remove the interferences occurring due to processing errors and the patient was instructed to store the maxillary and mandibular complete denture in 0.2% diluted solution of chlorhexidine and change the solution every alternate day. In Phase 3, Digital Orthopantomograph (OPG) was done to measure the Alveolar bone level in the mandibular 1st molar area using *measuring tool*, for which the references was taken from the alveolar crest to the upper border of the mandibular canal in the 6th month of follow up of the patient and magnification error was checked. The data was obtained for measuring the bone levels with the help of computer software (OPG) and was tabled. All data were statistically analyzed for

result. Bone mapping was done to collect the data for Residual alveolar ridge width, 4mm apical to the crest in the Mandibular 1st Molar region and the patient was clinically evaluated for the inter arch space, measured and data was collected in the 6th month of follow up of the patient.

Method used for calculating bone loss

Residual Alveolar bone changes or loss (in terms of height and width) after 6th month of edentulism = Original Residual alveolar bone level (in terms of height and width) on the day of extraction – Residual Alveolar bone level (in terms of height and width) in the 6th month of follow up.

Statistical analysis

The data collected was subjected to chi square statistical analysis.

RESULTS

This study showed that there was a mean Alveolar bone loss of 0.5 mm each in terms of height and width in Males measured at mandibular 1st molar area in Group I with antioxidant rich diet [Table 1] while 3.0 mm and 1.5 mm Alveolar bone loss in terms of height and width respectively for the case of Group II Males with antioxidant deficient diet [Table 4].

There was a mean Alveolar bone loss of 0.75 mm each in terms of height and width in Females measured at mandibular 1st molar area in Group I with antioxidant rich diet [Table 2] while 4.0 mm and 1.5 mm Alveolar bone loss in terms of height and width for the case of Group II Females with antioxidant deficient diet.[Table 5]. There was a mean available Interarch space of 1.25 mm in Males measured at mandibular 1st molar area in Group I with antioxidant rich diet [Table 1] while 6.00 mm the case of Group II Males with antioxidant deficient diet [Table 4]. There was a mean available Interarch space of 1.75 mm in Females measured at mandibular 1st molar area in Group I with antioxidant rich diet [Table 2] while 8.00 mm the case of Group II Females with antioxidant deficient diet.[Table 5]. This study showed that there was a mean % Alveolar bone loss of 3.57 and 8.33 and 10.41 each in terms of height and width and inter arch space in Males measured at mandibular 1st molar area in Group I with antioxidant rich diet [Table 3] while 21 and 15 and 50% Alveolar bone loss in terms of height and width and interarch space respectively for the case of Group II Males with antioxidant deficient diet [Table 6]. This study showed that there was a mean % Alveolar bone loss of 5.76 and 15.00 and 14.58 each in terms of height and width and inter arch space in Females measured at mandibular 1st molar area in Group I with antioxidant rich diet [Table 3] while 30 and 18.75 and 66.66% Alveolar bone loss in terms of height and width and interarch space respectively for the case of Group II Females with antioxidant deficient diet [Table 6].

Table 1. Measurement of residual alveolar ridge after tooth extraction in Men of Manipur with antioxidant rich diet

Day of data analysis	Height in mm in 1 st molar region	Width in mm 4mm apical to crest	Interarch space in mm in the 1 st molar region	Row Total
Men (1 st Day)	14	6	12	32
Men (6 th Month)	13.5	5.5	13.25	32.25
Column Total	27.5	11.5	25.25	64.25

The chi-square statistic is 0.092. The *p*-value is 0.9552. (>0 .05, insignificant)

Table 2. Residual alveolar ridge after tooth extraction in women of Manipur with antioxidant rich diet

Day of Data Analysis	Height in mm in 1 st molar region	Width in mm 4 mm apical to the crest	Interarch space in mm in the 1 st molar region	Row Total
Women (1 st Day)	13	5	12	30
Women (6th Month)	12.25	4.25	13.75	30.25
Column Total	25.25	9.25	25.75	60.25

The chi-square statistic is 0.201. The *p*-value is 0.9044 (>0 .05, insignificant)

Table 3. Percentage residual ridge resorption for the patient with different gender (sex) of the residents of Manipur

Gender	% RRR in Height (6 th month)	% RRR in Width (6 th month)	% RRR in Interarch Space (6 th month)	Row Total
Men	3.57	8.33	10.41	22.31
Women	5.76	15	14.58	35.34
Column Total	9.33	23.33	24.99	57.65 (Grand Total)

The chi-square statistic is 0.0181. The *p*-value is 0.9135 (>0 .05, insignificant)

Table 4. Measurement of residual alveolar ridge after tooth extraction in men of Manipur with antioxidant deficient diet

Day of data analysis	Height in mm in 1 st molar region	Width in mm 4mm apical to crest	Interarch space in mm in the 1 st molar region	Row Total
Men (1 st Day)	14	10	12	36
Men (6 th Month)	11.00	8.5	18.00	37.50
Column Total	25.0	18.5	30.00	73.50

The chi-square statistic is 1.652. The *p*-value is 0.4379. (<0 .05, significant)

Table 5. Residual alveolar ridge after tooth extraction in women of north India with antioxidant deficient diet

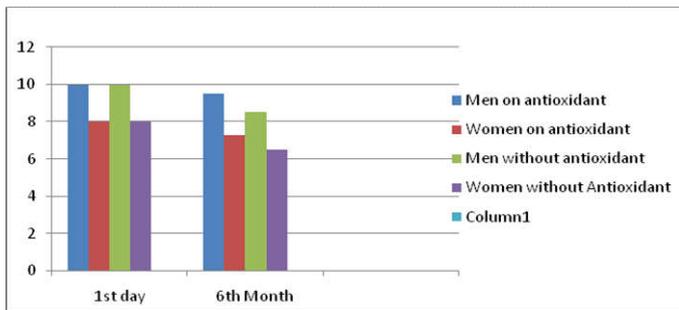
Day of Data Analysis	Height in mm in 1 st molar region	Width in mm 4 mm apical to the crest	Interarch space in mm in the 1 st molar region	Row Total
Women (1 st Day)	13	8	12	33
Women (6th Month)	9.0	6.5	20	35.5
Column Total	22	14.5	32	68.5

The chi-square statistic is 2.795. The *p*-value is 0.2472 (<0 .05, significant)

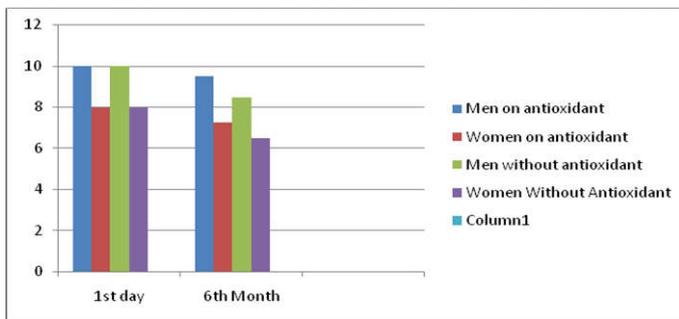
Table 6. Percentage residual ridge resorption for the patients with different gender (sex) of north India residents

Gender	% RRR in Height (6 th month)	% RRR in Width (6 th month)	% RRR in Interarch Space (6 th month)	Row Total
Men	21	15	50	86
Women	30	18.75	66.66	115.41
Column Total	51	33.75	116.66	201.41(Grand Total)

The chi-square statistic is 0.092. The *p*-value is 0.9552 (>0 .05, insignificant)



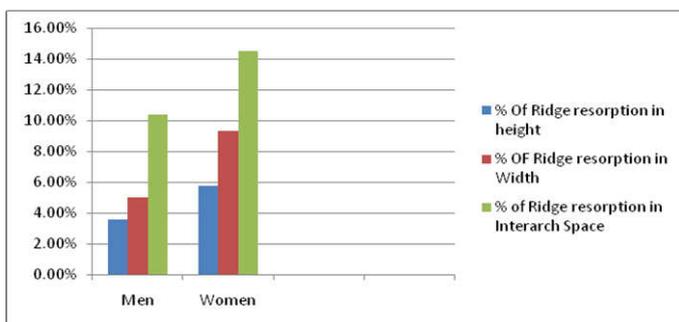
Graph 1. Mean Height



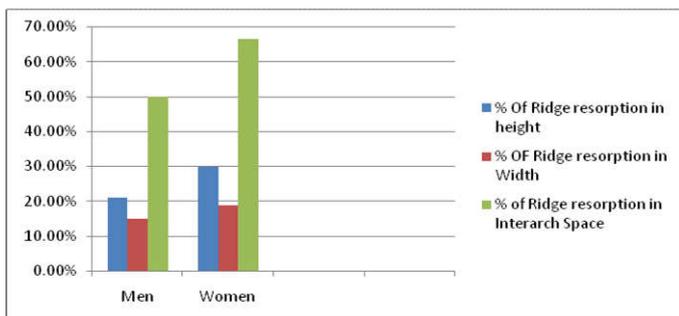
Graph 2. Mean Width



Graph 3. Mean Interarch Space



Graph 4. Relative percentage of RRR in the 6th month of Edentulism for Men and Women of Manipur residents with Antioxidant deficient diet



Graph 5. Relative Percentage of RRR in the 6th month of Edentulism for Men and Women of Manipur residents with Antioxidant Deficient diet

DISCUSSION

Rehabilitation using complete dentures on edentulous patients who has minimal alveolar bone loss requires pre-prosthetic phase to gain adequate inter arch space for prosthetic rehabilitation. Patients having minimal bone loss often encounter problem in denture fabrication because of inadequate interarch space available for the placement of artificial teeth. Patients undergoing implant supported fixed prosthesis or implant supported over denture with attachments (eg. bar attachments) also encounters problem as by placing the attachments it occupies even more of interarch space, hence leading to difficulty in denture fabrication. Alveolectomy or alveoplasty can be performed to gain interarch space depending on the need as per treatment planning for interarch space requirement. Patients on antioxidant deficient diet can be advised to take more of antioxidant rich diet so as to reduce the absorption of alveolar bone and promote alveolar bone healing process after tooth extraction, as proved by Mazen M. Jamil Al-Obaidi et al. in the year 2014 which was published in the scientific world journal. Statistical analysis in this study revealed that in Men and Women on Antioxidant Rich diet, there was not much of significant difference in the Residual alveolar ridge resorption when compaired between the 1st day and 6th month of edentulism ($p > 0.05$) and hence required preprosthetic surgery to gain adequate interarch space, whereas Residual alveolar ridge resorption was significant ($p < 0.05$). For the Men and Women on Antioxidant deficient diet. Residual ridge resorption in Men after 40 years of age is minimal, because of their antioxidant rich diet as they had rich beta carotene and Ellagic acid in their blood serum which reduces the resorption of alveolar bone and promotes alveolar bone healing process after tooth extraction. Women though on menopause after 40 years of age, the Residual Ridge Resorption was minimal because of their antioxidant rich diet and Vice versa. When compared the % of alveolar bone resorption in different sexes, statistical analysis revealed that there was not much of significant difference in the percentage of ridge resorption when compared in Male and Female patients of Manipur ($p > 0.05$). Both sexes reacted equally to the Residual Ridge Resorption weather on antioxidant rich or deficient diet. Only the difference was patients on antioxidant rich diet residual alveolar ridge resorption was insignificantly less as compared to the patients on antioxidant deficient diet where in it resorbed significantly more.

Conclusion

The study results showed insignificant difference in the residual alveolar bone resorption in group I suggesting preprosthetic surgery required in terms of alveolectomy and alveoplasty to gain interarch space for prosthetic rehabilitation. In group II the results showed significant difference in the residual alveolar bone resorption thereby have adequate amount of interarch space for fixed or removable prosthetic rehabilitation. Patients on antioxidant deficient diet can be advised to take more of antioxidant rich diet so as to reduce the absorption of alveolar bone and promote alveolar bone healing process after tooth extraction which would aid in the better prognosis of prosthetic rehabilitation in terms of retention, stability and support of the prosthesis. The use of antioxidants in geriatric patients which are antioxidant deficient, can be advised to take suppliments as they reduces bone resorption and promotes bone remodelling after tooth extraction.. The

limitation of this study was small sample size with short duration of 6 months follow-up period.

Future perspectives

There is a need for further studies with a greater number of sample size and longer duration follow-up, to confirm the results of this study for measuring and calculating residual alveolar bone loss after tooth extraction in geriatric patients.

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Conflicts of interest: There are no conflicts of interest.

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