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Original Research

Correlation Between Residual Ridge Resorption Among Post-Menopausal Women in Mumbai Metropolitan Region: A Prospective OPG Analysis

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ABSTRACT:
Objectives: The aim of this study was to evaluate the correlation between residual ridge resorption (RRR) and post-menopausal status in women from the Mumbai Metropolitan Region using orthopantomograms (OPG). **Materials and Methods**: This prospective study included 300 edentulous post-menopausal women aged 50 years and above, classified into three age groups: 50-60 years, 61-70 years, and over 70 years. Residual ridge resorption was measured using the Wical and Swoop OPG analysis, and classified using the IC/IM index. Statistical analysis was performed using Chi-square tests, independent t-tests, and one-way ANOVA. **Results**: The study found a statistically significant difference in the distribution of residual ridge resorption across age groups ($p < 0.01$). The 50-60 years age group showed a higher frequency of mild resorption (Class I), while more severe resorption (Class III) was observed in older age groups. Significant differences were noted for the IC ($p < 0.01$) and IC/IM index ($p < 0.05$), with higher values in younger post-menopausal women. IM values did not show significant variation between groups. **Conclusion**: The study demonstrated a strong correlation between post-menopausal age and residual ridge resorption, emphasizing the need for early interventions in prosthetic treatment to prevent further bone loss.
Keywords: Residual ridge resorption, post-menopausal women, orthopantomogram, mandibular bone loss

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INTRODUCTION

Residual ridge resorption (RRR) is a progressive process affecting the alveolar bone after tooth extraction, significantly compromising the stability of dentures and overall oral functionality.[1] The exact amount of alveolar bone resorption due to dental disease or tooth extraction cannot be accurately measured using current methods, highlighting the need for more standardized approaches to assess and describe bone loss. Although mandibular ridge resorption is often used as an indicator of bone response in prosthodontic patients, the absence of a universally accepted method for quantifying bone resorption limits clinical assessments and treatment planning. Landa's classification system, which attempts to categorize mandibular resorption, while innovative, lacked clinical reference points, further underscoring the need for a more practical and scientifically valid approach.[2]

Atwood emphasized the importance of studying the reduction of residual ridges as a critical oral condition, advocating for the application of epidemiological principles and precise terminology.[3] To address the ambiguity in current clinical descriptions, replacing vague terms like "high" or "flat" with precise anatomical descriptors is essential. Scandinavian research, for example, has introduced standardized techniques for measuring alveolar bone loss in periodontal disease using panoramic radiographs, demonstrating that accurate radiographic assessment can yield reliable data on bone resorption.[4]

In this context, orthopantomograms (OPG) offer a non-invasive and practical tool for evaluating residual ridge resorption, particularly in prosthodontic and pre-

prosthetic examinations. Despite the limited anatomical landmarks in edentulous jaws, radiographic markers such as the mental foramen and the inferior border of the mandible provide critical reference points for estimating the amount of lost alveolar bone.[5] Studies on the mental foramen have shown that its location relative to the inferior border remains consistent, regardless of age or the extent of resorption.[5,6] Therefore, using this stable anatomical landmark, it may be possible to estimate the original height of the resorbed mandible, aiding in the quantification of bone loss in clinical settings.

Post-menopausal women, in particular, are at higher risk of accelerated alveolar bone resorption due to the reduction in estrogen levels, which is linked to systemic bone density loss.[7] This study aims to analyze the correlation between residual ridge resorption and post-menopausal status in women from the Mumbai Metropolitan Region using prospective OPG analysis. By establishing a clearer understanding of RRR and its extent in this demographic,we hope to inform better clinical practices and interventions to enhance prosthetic outcomes in post-menopausal patients.

METHODOLOGY

Study Design: The present prospective study analyzed the correlation between residual ridge resorption and post-menopausal status among women in the Mumbai Metropolitan Region. The study was conducted in the institutional department of Prosthodontics and Crown and Bridge over a period of three months from February to May 2024.

Sample Size: The sample size for this study was determined based on estimates from an earlier study in the literature.[4] The sample size was calculated using the single proportion formula, assuming a prevalence rate of at least 20% for residual ridge resorption in the target population. Keeping a 5% confidence limit and a 20% prevalence estimate, the calculated sample size was 288.12. Therefore, approximately 300 subjects were included to ensure the generalizability of results to a larger population.A simple random sampling technique was employed to select participants for the study.

Selection and Grouping: The participants were recruited from the patients visiting the outpatient department. Females who had completed five post-menopausal years and had an edentulous mandible were included in the study. Those with pre-existing systemic illnesses or a history of hysterectomy were excluded from the study. Depending on their age they were classified as Group I (<60 years), Group II (60-70 years), and Group III (>70 years)

Measurement Methods: AnOrthopantomogram (OPG) of the participants was obtained. Wical and Swoop OPG analysiswas performed using the formula:R=3x−L, where:

- R = Amount of mandibular residual ridge
- x = Distance from the inferior border of the mandible to the lower border of the mental foramen
- L = Height of mandibular ridge resorption
- Measurements were taken for:

a) Distance from the inferior border of the mandible to the lower edge of the mental foramen.
b) Distance from the inferior border to the upper edge of the foramen.
c) Distance from the inferior border to the superior border of the alveolar bone.

The IC/IM ratio was measured as the numerical ratio of two sections: IC -the distance from the lower edge of the mandible to the upper border of the alveolar part, assessed in the line of the chin opening, and IM - the distance from the lower edge of the mandible to the lower edge of the chin opening

Classification of Residual Ridge Resorption: The residual ridge resorption was classified into three categories based on the IC/IM index:Class I (Mild): >2.34, Class II (Moderate): 1.67−2.33, Class III (Severe): <1.66

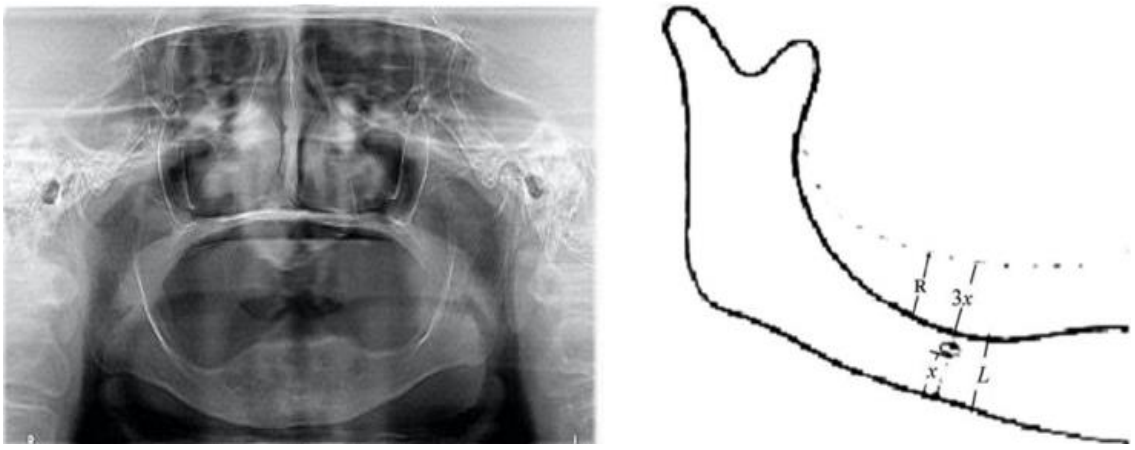

Fig 1: Schematic drawing of wical and swoope analysis; R= 3xl

Data Analysis: The collected data were entered into Microsoft Excel and analyzed using SPSS software. Descriptive statistics such as frequencies and percentages were used for categorical data, while mean and standard deviation were calculated for numerical data. The Chi-square test was applied to compare frequencies with independent variables. In cases where the Chi-square test was not applicable, Z-tests were employed for comparing proportions. Statistical significance was set at $p<0.05$, with an alpha error of 5%, a beta error of 20%, and a power of 80%.

RESULTS

A total of 300 edentulous post-menopausal female patients were included in the study, divided into three age groups: 50-60 years (n=125), 61-70 years (n=121), and over 70 years (n=54). The residual ridge resorption was classified into three categories based on the IC/IM index (Class I: Mild, Class II: Moderate, Class III: Severe).

Residual Ridge Resorption Across Age Groups

Class	50-60 years	61-70 years	Over 70 years	Total
Class I (Mild)	97	34	3	134
Class II (Moderate)	20	34	1	55
Class III (Severe)	8	53	50	111
Total	125	121	54	300

The Chi-square test revealed a statistically highly significant difference in the distribution of residual ridge resorption between the age groups (Chi-square value = 149.200, p = 0.000**). A higher frequency of Class I (Mild) resorption was observed in the 50-60 years age group compared to the other age groups.

Inter-Group Comparison of Variables (IC, IM, and IC/IM Index)
Comparison Between Class I and Class II (50-60 years age group)

Parameter	Group	N	Mean	Std. Deviation	Std. Error Mean	T value	p value
IC	1	70	2.489571	0.8089077	0.0966830	-2.439	0.006**
	2	55	2.899455	1.0704800	0.1443435		
IM	1	70	1.723143	0.4535322	0.0542075	-5.071	0.995#
	2	55	2.156727	0.4999595	0.0674145		
IC/IM Index	1	70	2.551857	0.5796908	0.0692863	-7.932	0.023*
	2	55	3.551818	0.8279651	0.1116428		

There was a statistically significant difference between the groups ($p < 0.01$) for IC values, with higher values observed in Group 2 (Class II). Similarly, a statistically significant difference was seen for the IC/IM Index ($p < 0.05$), with Group 2 showing higher values. There was no significant difference between the groups for IM ($p > 0.05$).

Comparison Between Class I and Class III (61-70 years age group)

Parameter	Group	N	Mean	Std. Deviation	Std. Error Mean	T value	p value
IC	1	84	2.102381	0.7105905	0.0775318	-2.559	0.133#
	2	37	2.478378	0.8176406	0.1344193		
IM	1	84	1.292619	0.4767893	0.0520220	-4.120	0.488#
	2	37	1.688108	0.5081822	0.0835446		
IC/IM Index	1	84	1.739762	0.7856867	0.0857254	-5.131	0.012*
	2	37	2.587027	0.9441924	0.1552243		

There was a statistically significant difference ($p < 0.05$) in the IC/IM Index values between the groups, with Group 2 (Class III) showing higher values. No significant differences were found between the groups for IC and IM ($p > 0.05$).

One-Way ANOVA Comparison Across Age Groups

Parameter	Age Group	N	Mean	Std. Deviation	SEM	F value	p value
IC	50-60 yrs	125	2.669920	0.9512449	0.0850819	17.080	0.000**
	61-70 yrs	121	2.217355	0.7616241	0.0692386		
	>70 yrs	54	1.949815	0.6581320	0.0895604		
IM	50-60 yrs	125	1.913920	0.5196213	0.0464763	58.997	0.000**
	61-70 yrs	121	1.413554	0.5178704	0.0470791		
	>70 yrs	54	1.097222	0.4204464	0.0572155		

IC/IM Index	50-60 yrs	125	2.991840	0.8566762	0.0766235	80.293	0.000**
	61-70 yrs	121	1.998843	0.9209100	0.0837191		
	>70 yrs	54	1.343333	0.7469106	0.1016417		

A statistically highly significant difference ($p < 0.01$) was observed between the groups for IC, IM, and the IC/IM Index, with higher values consistently noted in the 50-60 years age group.

Overall, there was a statistically highly significant difference in the frequency of ridge resorption between age groups, with the 50-60 years group showing higher frequencies of mild resorption ($p < 0.01$). A statistically significant differences were observed between groups for IC and the IC/IM Index ($p < 0.05$), with higher values consistently seen in Group 2 (Class II and Class III) in each age category. There was no statistically significant difference between groups for IM values.

DISCUSSION

RRR is a complex and multifactorial process that significantly impacts the oral health of edentulous patients, especially post-menopausal women. This study aimed to explore the correlation between RRR and post-menopausal status in women from the Mumbai Metropolitan Region using OPG. Our findings demonstrated a statistically significant difference in the distribution of residual ridge resorption across different age groups, with the highest frequency of mild resorption observed in women aged 50-60 years. These results are consistent with earlier studies that highlight the influence of age and hormonal changes on bone density and resorption patterns in post-menopausal women.[7-9]

The classification of RRR based on the IC/IM index revealed important trends across the age groups. In particular, women aged 50-60 years had significantly higher values of the IC and IC/IM index, indicating less severe resorption compared to older age groups. This finding aligns with previous literature suggesting that bone loss tends to accelerate as women age, particularly after the fifth decade of life when estrogen levels further decline.[10]Estrogen plays a critical role in maintaining bone homeostasis, and its reduction in post-menopausal women is linked to increased bone turnover and subsequent alveolar ridge resorption.[11,12]Earlier studies by Atwood and Landa have emphasized the need for more precise methods of categorizing and measuring ridge resorption, a gap that this study sought to address through the use of standardized OPG analysis and the IC/IM index.[2,3]

The results of the current study corroborate with those of Wical and Swoope (1974), who demonstrated the utility of panoramic radiographs in evaluating mandibular bone resorption.[4] The use of the mental foramen as a radiographic landmark provided a reliable and consistent reference for assessing the degree of resorption in our sample population.[5,6] This method allowed for a more precise classification of bone loss, replacing vague descriptors such as “high” or “low” with measurable indices.[5] The statistically significant differences between the IC/IM index values across age groups ($p < 0.05$) reinforce the importance of using such objective measures to assess RRR in clinical settings.

Interestingly, our study found that the 50-60 years age group exhibited significantly less severe resorption compared to the older age groups (61-70 years and over 70 years). This could be attributed to a shorter duration of post-menopausal status, during which the cumulative effects of estrogen deficiency have not yet fully manifested. Furthermore, lifestyle factors such as nutrition, physical activity, and oral hygiene practices in younger post-menopausal women may also play a role in mitigating the extent of bone resorption.[13] As women age, however, the cumulative effects of prolonged estrogen deficiency likely contribute to the more severe resorption observed in the older age groups, as reflected by the higher prevalence of Class II and Class III resorption in these populations.

Our findings also showed a statistically significant difference in IC values between the groups, with higher values observed in the younger age group ($p < 0.01$). This suggests that younger post-menopausal women experience less resorption, possibly due to higher baseline bone density and shorter duration of edentulism. The higher IC/IM index in the younger group could also reflect better preservation of alveolar bone height, which is crucial for denture stability and function. These results highlight the importance of early interventions, such as the use of implant-supported prosthetics, to prevent further resorption and enhance oral rehabilitation outcomes in this population.[14,15]

In contrast, no statistically significant difference was observed for IM values between the groups ($p > 0.05$), indicating that the mandibular inferior border remains relatively stable across different age groups. This supports previous studies that have shown the mandibular inferior border to be less affected by resorption, serving as a reliable reference for measuring ridge resorption in edentulous patients.[5,16]

The results of the one-way ANOVA further reinforce the trend of increasing resorption with age. Statistically significant differences were observed for the IC, IM, and IC/IM index across the three age groups ($p < 0.01$), with the most severe resorption seen in women over 70 years. These findings emphasize the need for continuous monitoring of bone health in post-menopausal women, particularly as they age, to ensure optimal prosthetic rehabilitation and maintenance of oral function.This study highlights the importance of using precise and standardized methods, such as the IC/IM index and OPG analysis, to assess residual ridge resorption in post-menopausal

women. The findings provide valuable insights into the correlation between age, hormonal status, and bone resorption, which can inform prosthetic treatment planning and help clinicians implement early interventions to prevent further bone loss.[17]

Despite the significant findings, this study has several limitations. First, the study was limited to a specific geographic region, and the results may not be generalizable to other populations. Additionally, factors such as the duration of edentulism, the use of dentures, and systemic health conditions, which may influence bone resorption, were not controlled for in this study. Future research should consider these factors and include longitudinal studies to further elucidate the relationship between hormonal status and residual ridge resorption.

CONCLUSION

Findings of the present study demonstrate a clear correlation between age, post-menopausal status, and residual ridge resorption in edentulous women. The use of OPG and the IC/IM index provides an effective and standardized method for assessing the extent of bone resorption, which is essential for prosthodontic treatment planning. The findings underscore the importance of early diagnosis and intervention to minimize the impact of RRR on oral health and prosthetic success in post-menopausal women.

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