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An Epidimiological Study to Assess the Resorption of Completely Edentulous Mandibular Ridge Using Digital Panaromic Radiograph in Patients of Jammu Region

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KEYWORDS

Edentulous, OPG, Residual Ridge, Residual ridge resorption, Mandible, Wical&Swoope

ABSTRACT:

Aim:This clinical and radiological study aimed out to assess how age, gender, and the length of edentulism affected the amount of residual ridge resorption in mandible in the Jammu region.

Method: For the study, 150 individuals who had been entirely edentulous for more than six months and were up to 80 years old were chosen. Every patient had a standardized digital panoramic radiograph.

Digital measurements were taken with Planmecca OPG viewer software, and the Wical and Swoope method was used to determine the amount of resorption. Regression analysis, ANOVA tests, and t tests were used in the statistical study. A significance level of 0.05 was established.

Result:It was discovered that resorption increased as subjects' ages increased, and this difference was statistically significant (p value = 0.047). The mean residual ridge resorption in males was 0.89, while in females, it was 1.03. This difference was statistically significant (p value = 0.037). It was discovered that as the edentulous periods lengthen, the amount of resorption increases, and this difference is statistically significant. (P value: less than 0.001).

Conclusion: Comparing the residual ridge resorption of the Jammu region's population, it was found that a greater proportion of patients had class 2 resorption (47.3%), followed by class 3 (41.3%). Class 1 patients, comprising 11.3% of the total, are far fewer than the former.

Background

Residual ridge resorption is a significant phenomenon observed in completely edentulous patients, which profoundly impacts their oral health and overall well-being. The residual ridge refers to the bony ridge that remains following the loss of teeth in the maxilla and mandible. This resorption process involves the gradual reduction in the volume and height of the alveolar bone, which can lead to a myriad of functional and aesthetic challenges for denture wearers.

Ridge Remains During the first several months following tooth extraction, resorption is higher. In the mandible, the rate of resorption is twice as high as in the maxilla later on. [1]

Any sharp edges that remain after extraction are immediately rounded off. By external osteoclastic resorption, leaving a high, well-rounded residual ridge. The crest of the ridge narrows as resorption from the labial and lingual aspects continues, eventually becoming the knife edge. As this process progresses, the knife edge gets shorter or even disappears, leaving a low, well-rounded or flat ridge that eventually resorbs, leaving a depressed ridge.

According to Atwood and et al, the etiology of residual ridge resorption is multifactorial. Anatomical, prosthetic, metabolic, and systemic variables are the ones that affect the rate of resorption.[2,3].

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Physiological factors

1. The mandible is more significant resorb than the maxilla.
2. A square, short face linked to higher masticatory forces
3. The Alveolar Plastomy

Prosthodontic factors

1. Prolonged usage of dentures
2. An unstable occlusal situation
3. immediate denture wearing

Systemic and metabolic factors

1. Osteoporosis
2. Vitamin and calcium supplements

The consequences of residual ridge resorption are far-reaching. From a functional perspective, it can result in compromised denture stability and retention, leading to difficulties in chewing, speaking, and swallowing. Moreover, the gradual loss of bone can contribute to the collapse of facial features, including a sunken appearance of the lips and cheeks loss of sulcus depth and width, transformed facial esthetic, altered vertical dimension of occlusion, altered inter arch relationship [4]. Additionally, factors such as age, systemic diseases, and denture wearing can exacerbate the rate and severity of ridge resorption. which can have profound psychological effects on patients, impacting their self-esteem and quality of life.

Bone naturally undergoes continuous remodeling during life as a result of the processes of formation and resorption. Bone resorption and formation are typically in equilibrium, with the exception of growth, when bone creation exceeds bone resorption. Osteoporosis is a widespread bone disease caused by an imbalance in bone synthesis due to an excess of bone resorption. The bone around teeth is destroyed locally in periodontal disease, possibly as a result of specific local pathologic processes. When bone matrix breaks down, it typically does not grow back in either localized periodontal disease or generalized osteoporosis.

In the realm of prosthodontics, addressing residual ridge resorption presents a considerable challenge. Traditional complete dentures, while providing a solution for edentulism, often fail to adequately address the dynamic nature of ridge resorption. As the underlying bone continues to undergo changes, dentures that once fit snugly may become loose and uncomfortable, necessitating frequent adjustments and replacements.

Various techniques and materials can be used to augment or rebuild the residual alveolar ridge when necessary, such as bone grafting procedures, implant-supported overdentures or ridge augmentation techniques. These procedures aim to restore the volume and dimensions of the ridge to provide adequate support for dental prostheses and implants, ultimately improving the function and aesthetics of the patient's dentition. Therefore, understanding the mechanisms and consequences of residual ridge resorption is crucial for developing effective treatment strategies for completely edentulous patients. By mitigating the effects of ridge resorption, clinicians can improve the functional outcomes and quality of life for individuals suffering from edentulism.

The residual ridge resorption can be measured using a variety of techniques, including the cephalometric roentgenogram, dento-contourgraph, comparator with cart assistance photogrammetric method, measuring calipees, and visual analogue scale[5]. Initially described by Wical and Swoope, the orthopantomographic approach was employed in this investigation. Estimating the amount of RRR in a patient at a specific time is a straightforward and practical procedure[6,7].

Several experts have confirmed that, despite aging or the resorption of the alveolar process above the foramen, the relationship between the foramen and the inferior border of the mandible is largely constant based on their assessment of anatomic specimens[8-9].

Several scientists employed panoramic radiographs (OPG) because of their ability to visualize a larger region of hard tissues, which enables a more precise localization of the mental foramen in both the horizontal and vertical directions[10].The use of panoramic radiographs has several benefits. Firstly, since they are frequently included in routine patient examinations, using them for research purposes does not expose patients to additional risk or expense. Secondly, because panoramic radiographs are frequently found in medical records dating back several

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years, they can serve as a source of data for retrospective studies[11].

In this study, we will explore the etiology, pathophysiology, clinical manifestations, and treatment modalities related to residual ridge resorption in completely edentulous patients. Through a comprehensive understanding of this phenomenon, we aim to provide insights that will guide clinicians in delivering optimal care and improving outcomes for this patient population.

Procedure:

Inclusion Criteria:

- Both male and female patients with edentulous maxillary and mandibular arch
- Age up to 80 years
- Edentulous period more than 6 month

Exclusion Criteria:

- Edentulous period less than 6 months
- Age above 80 years
- Patients who have undergone prosthetic surgery like sulcus deepening or ridge augmentation
- Patents with neurological deflects
- Patient with metabolic bone disease like cancer with bone metabolism
- Patient with significant renal impairment
- Patient with history of trauma
- Surgical procedure like maxillectomy, mandibulectomy, resected maxilla or mandible
- Cleft lip and palate patient
- Patient under medication like heparin, estrogen etc.

Armamamterium Used

- Digital OPG machine
- Standardized digital OPG
- Planmeca OPG viewer software

Source of Data

150 fully edentulous participants, both male and female, were chosen among the patients who visit the prosthodontic department to participate in this study.

Methodology:

- Study was carried out on 150 patients.
- Patient participated in the study were informed and consent was taken.
- A standard panoramic radiograph OPG was taken.
- All image were taken by same operator and by same OPG machine according to standard protocol
- Resorption was measured by digital software viewer
- Amount of RRR was calculated by Wical and Swoope.

Resorption Index = (Ic/Im) was calculated

Ic = distance between inferior ridge of mandibular body and the ridge of alveolar part adjacent to mandibular foramen.

Im = distance between lower ridge of mandibular body and inferior margin of mental foramen.

- Amount of RRR was calculated according to the formula :

$$R = 3X - L$$

R = Amount of RRR

X = Distance between Inferior Border of Mandible to The Inferior Border Of Mental Foramen **(Fig:1)**

L = Measured Height of Mandibular Residual Ridge **(Fig:2)**

According to wical and swoope :

A. CLASS I = R > 2.34 { mild }
B. CLASS II = R > 1.67 to 2.33 { moderate resorption }
C. CLASS III = R < 1.66 { Severe grade of resorption

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Fig-1

Fig-2

Result:

According to wical and swoope classification, Resorption was calculated and our subjects were divided according to age, gender and edentulous span and result were obtained. It was found that with increase in the age of the subjects, resorption was found to increase and this difference was found to be statistically significant (p value is 0.047) (Table1)(Figure 3).

Table 1: Residual ridge resoption of study patients according to age

Age (Years)	N	Mean	SD	95% CI For Mean	P-value
≤ 60 Years	70	0.82	0.071	0.67-0.96	0.047*
61-70 Years	59	1.03	0.074	0.89-1.18	
71-80 Years	22	1.09	0.128	0.81-1.35	

***Statistically Significant (P-value<0.05); CI: Confidence IntervalLKM**.;

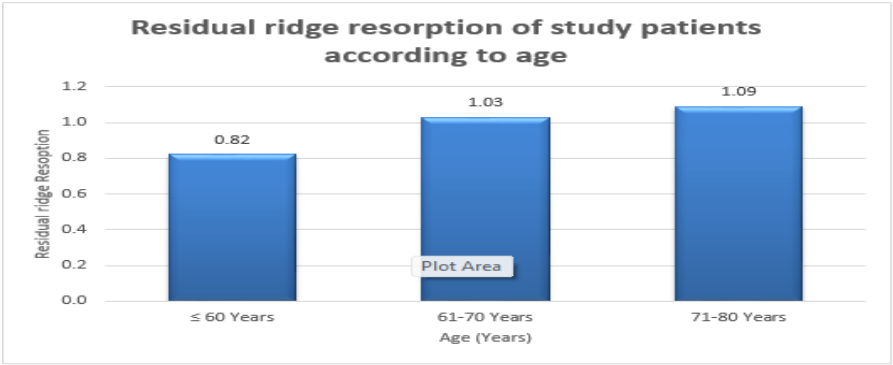

Figure-3

In males there was mean residual ridge resorption of 0.89 whereas in females, the mean resorption was 1.03 is noted, found to be statistically significant (p value is 0.037) (Table2) (Figure: 4).

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Table 2: Residual ridge resorption of study patients according to gender					
Gender	**N**	**Mean**	**SD**	**95% CI For Mean**	**P-value**
Male	95	0.89	0.063	0.76-1.02	0.037*
Female	55	1.03	0.074	0.89-1.18	

***Statistically Significant (P-value<0.05); CI: Confidence Interval**

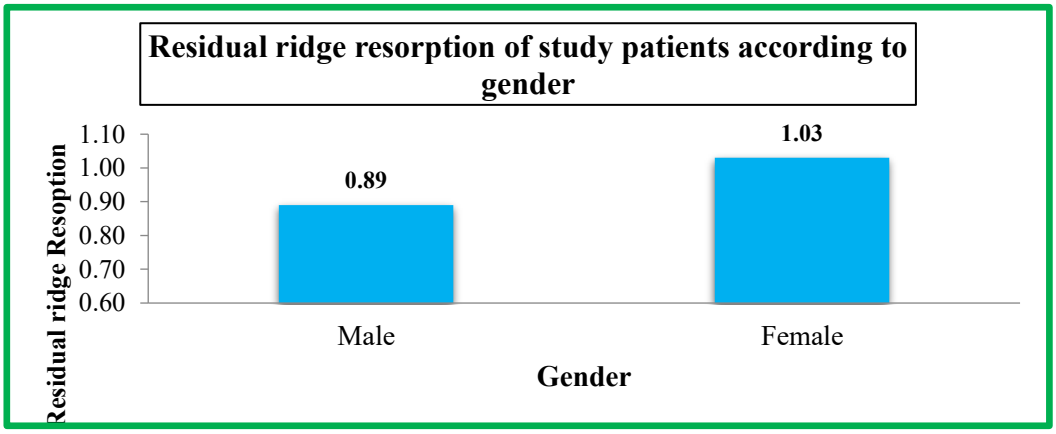

Fig-4

The amount of resorption was found to increases as the edentulous periods increases, and the difference was found to be

Table 3: Residual ridge resorption of study patients according to edentulous span					
Edentulous span	**N**	**Mean**	**SD**	**95% CI For Mean**	**P-value**
6 months to 1 Year	71	0.62	0.062	0.51-0.75	<0.001*
1-2 Years	24	1.05	0.083	0.89-1.23	
2-5 Years	36	1.24	0.053	1.13-1.35	
5-10 Years	19	1.43	0.176	1.05-1.79	

statistically significant. (P value:< 0.001)(Table 3) (Figure: 5)

***Statistically Significant (P-value<0.05); CI: Confidence Interval**

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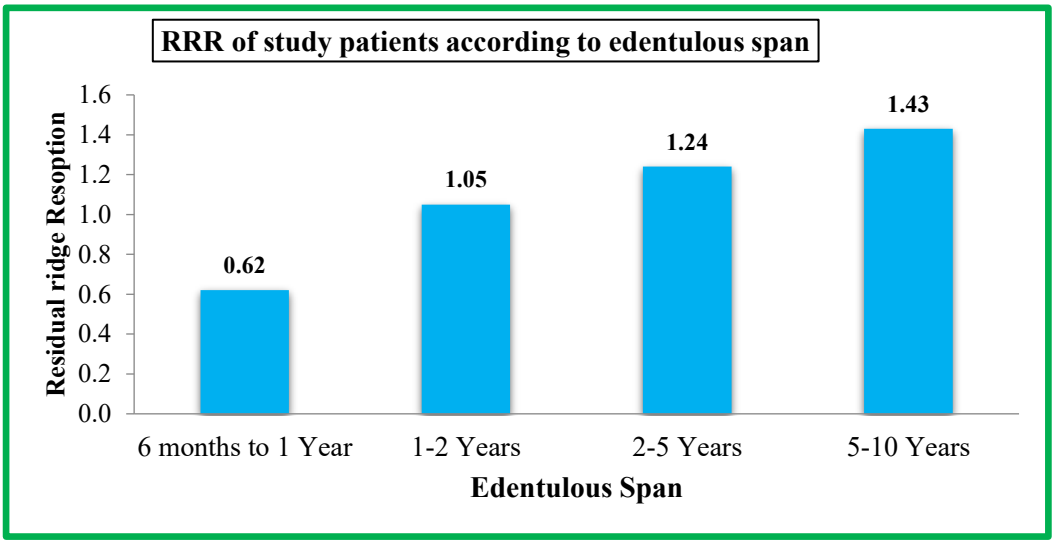

Fig-5

When comparing the residual ridge resorption of the people of jammu region, it was noticed that the number of the patient with class 2 resorption is higher i.e 47.3% followed by class 3(41.3%).The number of class 1 patient(i.e 11.3% is much lesser then the former ones. (Table:4) (Figure:6)

Table 4: Distribution of study patients as per root resorption classification

RRR classification	Number	Percentage
Class I	17	11.3
Class II	71	47.3
Class III	62	41.3
Total	150	100

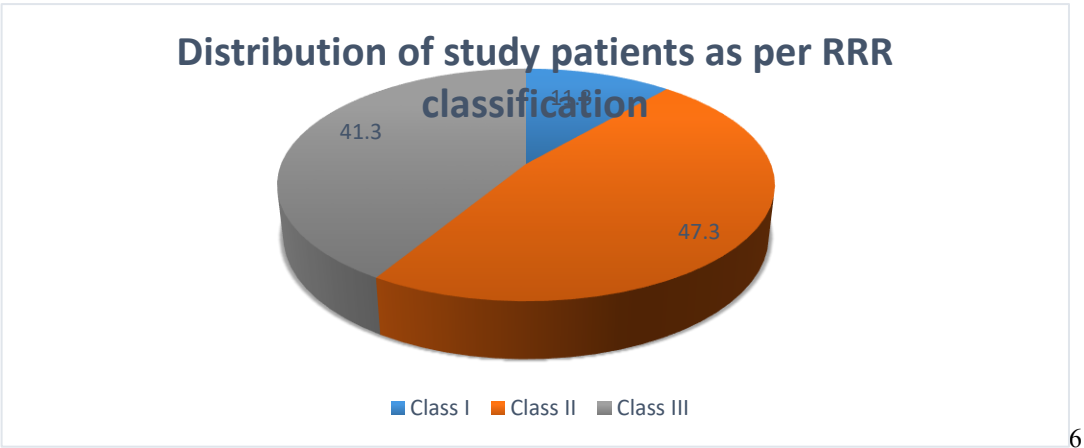

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Fig-6

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Discussion

One of the most challenging restorative issues for a prosthodontist is gross resorption of the edentulous mandibular alveolar process, which results in an excessive loss of denture-bearing ridge (Nahri et al., 2015)[12]. There are other ways to measure residual ridge resorption, but the Wical and Swoope[13] approach is the most often employed. The ratio of 2.90 ± 0.23 was discovered by Wical et al. between the mandible's overall height and the mental foramen's distance from the inferior border of the mandible. The investigations conducted by Bairam L. R. et. al.[14], G. Pakotaet al.[15], and Naeem et al[16] produced similar findings.The amount of resorption can be determined using the formula R=3x-L, where L is the measured height of the mandible, given that the distance between the inferior border of the mandible and the mental foramen (x) is found to be constant and the actual mandibular height is found to be three times that distance.[13]

The study's findings demonstrated a statistically significant increase in mandibular ridge resorption with advancing age. These results are consistent with a research by Bianchi et al[17] that hypothesized a relationship between systemic diseases and the degree of alveolar bone loss, which increases with age.The results also corroborate a study by Bairamet al[14] that observed an age-related decline in the mean ratio of alveolar bone height. Studies conducted by Jagadeeshet al[5], Imirzalioglu P et al[18], and Al-Jabrah et al[19] also produced findings that were comparable.This can be explained by the fact that the skeleton's bone mineral density starts to decline after the age of 40, which results in the loss of around one-third of the bone minerals by the time an individual reaches the age of 65[20]. Rapid RRR in the mandible is recognized to be predisposed by low bone density in the skeleton. Age-related bone loss may be influenced by a number of factors, including food, race, and inheritance, decreased oestrogen secretion, and decreased physical activity.

Atwood and Coy[2], Lopez-Roldan et al[9], and Hirai et al., on the other hand, found conflicting results in their studies and failed to identify any meaningful association between age and ridge resorption. The lack of association found in these studies could be attributed to the measurement of bone resorption rates in various age groups either immediately or shortly after tooth extraction. On the other hand, in long-term investigations, bone resorption persisted during the observation period and was found to positively correlate with age.

The study's findings demonstrated that as edentulousness lasted longer, there was an increase in resorption in both age groups. This increase in resorption was found to be statistically significant for the edentulousness periods of 6M – 5Y and 5 – 10Y, but not significant for the 10 – 15Y period. These results are consistent with a study by Bairam et al[14] that hypothesized that the amount of bone loss does increase with age and with time after extraction, but that it may only occasionally be statistically significant when compared between individuals 16 years and older and those between 0 and 5 years after extraction across all age groups.One possible explanation is that alveolar bone loss occurs more quickly in the first year following extraction, and then the rate of resorption gradually decreases thereafter, building up to a cumulative effect over time. The findings also corroborate a study by Baatet al[21] that indicated longer-term edentulous individuals had higher mandibular alveolar bone resorption. The length of mandibular edentulism and the degree of mandibular resorption were found to be highly correlated in a study by Zmyslowskaet al[20]. Similar outcomes were also seen in the research conducted by Al Jabrah-O et al[19] and Jagadeesh et al[5].

All three of the edentulous periods showed an increase in resorption with age, and the difference was found to be statistically significant. One explanation could be that periodontal diseases caused bone resorption to begin prior to tooth extraction, which could have led to a decrease in alveolar height while the teeth were still in the jaw. This could have further decreased ridge height following tooth extraction.[14]

Resorption was shown to be higher in females than in males. These results corroborate the findings of other studies that found that females have higher alveolar RRR than males [Bianchi & Sanfilippo[17] (2002), Lopez-Roldan et al[9] (2009), Al-Jabrah[19] (2011), Baat et al[21]. According to Kordatzis et al[10].(2003), female gender was associated with a higher risk of resorption and the estimated average height loss for conventional CD was 1.63 mm in 5 years. Additionally, it was shown by Solar

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et al. that the gender of the woman was an independent risk factor for more severe bone resorption. Rusiniak-Kubik et al. found that during the course of an edentulous patient's life, there is a twofold increase in the incidence of severe atrophy in females compared to males. The menopausal activity in females may be the cause of the increase in residual ridge resorption[22]. A shortage of the hormone estrogen was seen after menopause, and this led to a rapid resorption of alveolar bone and an acceleration of the loss of skeletal bone. Additional experimental research verified the mechanism underlying this event, demonstrating that oestrogens trigger osteoclast apoptosis. Therefore, low estrogen increased osteoclast lifespan, which in turn led to increased bone resorption[23].

The study's findings demonstrated that, in females, the amount of resorption increased with age but did not reach a statistically significant level. This finding is consistent with the research conducted by Narhiet al[12], but it differs from the findings of Humphries et al[24], who found that the subject's age significantly influenced RRR. The age range of the study volunteers may be the source of this. Women primarily in the postmenopausal age range were included in the earlier investigations, but the later studies included women in both the premenopausal and postmenopausal age groups.

In males, a statistically significant increase in resorption was observed with increasing age. These results are consistent with a research by Bairamet al[14] that showed the mean ratio of alveolar bone height in males tended to decline with age. This could be the result of an increase in RRR due to a decrease in bone mineral density with aging.

The study's findings demonstrated that resorption increased in females as the duration of edentulousness increased, a finding that was deemed to be statistically significant. The quantity of residual ridge resorption and the length of time that females were edentulous were shown to be strongly associated in a study conducted by Narhiet al[12] which matches our results. Since majority of the participants in this study were older than the average age of menopause, the findings may be explained by the finding that a rise in RRR occurs after menopause[25].

The current study's findings demonstrated that age, gender, and the length of edentulousness all significantly influenced the amount of RRR, with the longest duration of edentulousness having the most impact. These results imply that since the quantity of resorption will increase after tooth loss, efforts should be taken to keep the teeth for as long as feasible (Schwartz-Dabney & Dechow[26] 2002). Furthermore, as the edentulous period lengthens, the mandible's height and width decrease, which complicates implant therapy. According to the findings of a study by Crum and Rooney[27], using a mandibular overdenture preserved the mandible's alveolar bone. They proposed that the teeth beneath an overdenture's unique proprioceptive ability served as a signal to counteract the system's physiological overload, preventing bone resorption. In a similar vein, Van Waaset al[28] reported that keeping dental roots in place reduces the loss of alveolar bone, even in cases where they are in poor health. Research by Wright et al[29] and Kordatzis et al[10] found that when implant-supported dentures were compared to conventional dentures, the amount of remaining alveolar ridges was only slightly reduced.

Conclusion

CONCLUSION: Bone is a dynamic, mineralized, vital tissue which undergoes continuous resorption and formation throughout the life. The residual ridge refers to the bony ridge that remains following the loss of teeth in the maxilla and mandible. Residual ridge resorption: is a term used for the diminishing quantity and quality of residual ridge after teeth are extracted. It is a chronic, progressive and irreversible process with the rate being fastest in the first 6 months after extraction. The resorption rate refers to the speed at which bone is demineralised and absorbed by the body, primarily through the actions of osteoclasts. The residual ridge resorption can be measured using a variety of techniques, including the cephalometric roentgenogram, dento-contour graph, comparator with cart assistance photogrammetric method, measuring calipers, and visual analogue scale. This study was aimed at assessing the resorption of completely edentulous mandibular ridge in patients of Jammu region. Wical and Scoop method was used to measure the resorption rate and OPG was assessed to determine the resorption. Although, OPG is a 2D representation while resorption pattern would be better appreciated three dimensionally, using CBCT.

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Finding of the study: 1. In both male and female patients of Jammu region, there was a statistically significant decrease in mandibular height with increase in age of the subjects. (p value is 0.047) (Table 1)

2. It has been reported that resorption was more in female population of the Jammu region than the male population. In males, there was mean residual ridge resorption of 0.89 whereas in females, it was 1.03, found to be statistically significant. (p value < 0.037) (Table 2)

3. The amount of resorption was found to increase as the edentulous period increases, the difference was found to be statistically significant. (p value <0.001) (Table 3)

4. When comparing the residual ridge resorption of the people of Jammu region, it was also noticed that the number of the patients with Class II resorption is highest (47.3%) followed by Class III (41.3%. The number of Class I patients (11.3%) was found to be much lesser than the other two.

Since residual ridge resorption increases with duration of edentulism, therefore with advancing age, every attempt should be made to preserve bone by either retaining natural teeth or root, by fabrication of overdentures or early placement of implants, application of soft liner under the dentures and proper impression technique with controlled occlusal forces.

The limitations of this study: The small sample size, that might not accurately reflect the entire population ratio. Further studies are needed to evaluate the effect of other variables, such as previous occlusal contacts and chewing patterns. The other technique which can provide information outside the mental foramen can be utilized for evaluation of bone loss. The current study was conducted with the use of OPG which is a two dimensional imaging modality. Three dimensional imaging system such as CBCT can be used for in depth analysis of bony characteristics including bone volume and density, which can yield more accurate results. Limitations of OPG, in order to evaluate the resorption pattern are, that it is two dimensional in nature, images can be magnified or distorted, there can be potential overlapping of structures and it cannot assess the bone density of the patient. Bone mapping or bone sounding can be done while using OPG to assess the height and width, but CBCT remains the gold standard imaging and assessment technique.

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