ORIGINAL ARTICLE

Relationship between Alveolar Ridge Resorption in Mandible and Masticatory Performance Based on Gender in Complete Denture Wearers at Dental and Oral Hospital University Sumatera Utara

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ABSTRACT

INTRODUCTION: The aim of the study was to observe the relationship between alveolar ridge resorption in mandible and masticatory performance based on gender in complete denture wearers. **MATERIALS AND METHODS**: The subjects included were those wearing complete denture between the ages of 45-69 years-old, treated at the Dental and Oral Hospital of University Sumatera Utara. Alveolar ridge resorption in mandible was analysed using the panoramic radiograph and masticatory performance was evaluated clinically using the colour-changeable chewing gum. **RESULT**: 40 patients were included in this study. 50% were women in which 15 women (37.5%) had mild alveolar ridge resorption whilst 5 (12.5%) had severe alveolar ridge resorption. For masticatory performance, 14 women (35%) had good masticatory performance and 6 (15%) had poor masticatory performance. For the men; 17 (42.5%) had mild alveolar ridge resorption whilst 3 (7.5%) had severe alveolar ridge resorption. For masticatory performance, 16 men (40%) had a good masticatory performance and 4 (10%) had a poor masticatory performance. There was a significant correlation between alveolar ridge resorption in mandible and masticatory performance amongst women (p=0.014). However, there was no significant correlation found between gender and alveolar ridge resorption in mandible (p=0.695), between gender and masticatory performance (p=0.716), and between alveolar ridge resorption in mandible and masticatory performance amongst men (p=0.088). **CONCLUSION**: The alveolar ridge resorption in mandible is associated with masticatory performance amongst women.

Keywords
Auricular acupressure, haemodynamic, intubation, preoperative anxiety

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INTRODUCTION

Teeth play an important role in the human body.[1] Teeth that are not treated well will have problems such as caries and severe periodontal disease that require extraction.[1,2] Edentulism is defined as loss of all permanent teeth in the oral cavity. Edentulism is an important worldwide public health issue because it affects more than 10% of adults above 50-years-old based on the World Health Survey in 2014.[3] Based on the research by Supa et al in 2015, the prevalence of edentulism in Indonesia was 7.2%.[4] In Malaysia, the prevalence of edentulism declined from 53.9% to 41.5% in 2000. However in 2000, 2.8% of 35-44 age group and 32.1% of 60-70 age group were also reported as edentulous.[5]

After a tooth loss, the alveolar bone undergoes resorption that leads to shape alteration and decrease in the size of the alveolar bone continuously.[6] There will be changes in bone structure initiated by the healing process from the tooth loss which forms new bone. The remodelling process results in a rounded ridge-like structure known as the residual alveolar ridge.[7] The exact aetiology of resorption is unknown but is considered as multifactorial viz gender, anatomic, systemic, prosthetic and duration of edentulism factors.[6-8] According to Atwood,[9] the degree of alveolar ridge resorption in mandible is four times higher than alveolar ridge resorption in the maxilla which is due to the smaller denture-bearing in the mandible and

thus greater load.[7-9] Resorption especially in the mandible may lead to problems with denture retention and stability.[6,8,10]

Complete denture (CD) is one of the treatment choices for edentulous patients.[11] CD functions to restore mastication, aesthetics and phonetics.[1,7] Masticatory function can be assessed by measuring masticatory performance.[12] Masticatory performance is defined as a measure of the comminution of food attainable under standardized testing conditions. Masticatory performance is considered to be an important parameter for objectively evaluating masticatory function.[13] One of the methods to evaluate masticatory function objectively is by using colour-changeable chewing gum. The colour-changeable chewing gum appears to be the easiest to use in practice yet shows good validity.[14] Factors that can influence masticatory performance are age, saliva, gender and occlusal scheme.[12]

The relationship between alveolar ridge resorption in mandible and masticatory function is still debatable.[15] Alveolar ridge resorption leads to a decrease in size of the denture-bearing area, thereby reducing denture stability and retention especially in mandible thus interfering with the function of mastication.[16] In addition, the mucosa overlying the denture-bearing area is often thin and is unable to withstand functional loads, causing ulceration and pain which influences the masticatory performance.[10] A study by Huumonen et al in 2015 reported that, there was a significant correlation between alveolar ridge resorption in mandible with poor masticatory function amongst women. 49% of patients with mild resorption had poor masticatory function whilst 70% of patients with severe resorption had a poor masticatory function.[10] The study by Alves et al in 2019 also found that amongst the women, the reduced radiographic mandibular bone height was equivalent to reduction of 8.59% in masticatory performance.[17] This study was performed to observe the relationship between alveolar ridge resorption in mandible and masticatory performance based on gender.

MATERIALS AND METHODS

Ethic Consideration

This study was carried out with the approval from the Health Research Ethical Committee of Medical Faculty of the University Sumatera Utara. Informed consents were obtained from all the subjects after they were given explanation about the study.

Subject

Patients between the ages of 45-69 years, treated at Dental and Oral Hospital of University Sumatera Utara, Indonesia were included in the study. The inclusion criteria were patients with complete denture and have been wearing it between 3 month and 5 years. Patient with implants, history of head trauma or face trauma and patients with symptoms of temporomandibular joint disorder were excluded.

Alveolar Ridge Resorption In Mandible Assessment

The subjects were brought to the Dental Radiology Unit and a panoramic radiography was taken. The panoramic radiography results were viewed on a computer screen. The alveolar ridge resorption in mandible was categorized according to Huumonen which was a modification from Xie.[10] The categorise are i) mild alveolar ridge resorption: the crest of the alveolar ridge is above the mental foramen and mandibular canal on both side of the mandible (Figure 1) and ii) severe alveolar ridge resorption: mandibular canal and/or mental foramen are above the crest of the alveolar ridge or with partially resorbed on one or both side (Figure 2).

Figure 1. Panoramic radiograph showing mild alveolar ridge resorption where the crest of the alveolar ridge is above the mental foramen (white arrow) and mandibular canal (red arrow) on both side of the mandible.

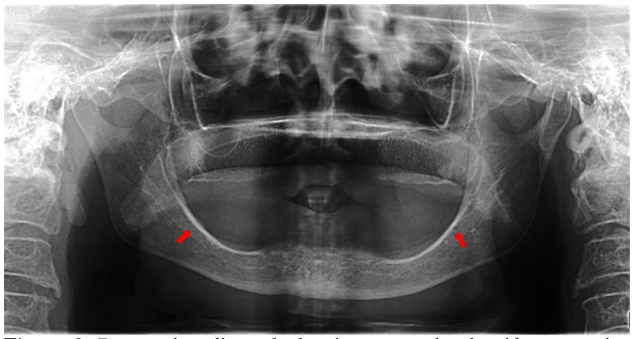

Figure 2. Panoramic radiograph showing severe alveolar ridge resorption where the mandibular canal and/or mental foramen (red arrow) are above the crest of the alveolar ridge or with partially resorbed on one or both sides.

Masticatory Performance Assessment

The subjects were asked to rinse their mouth with water for 15s before chewing the gum at a rate of 1 stroke per second for 100 strokes.[14] The chewing rhythm was kept constant at one stroke per second using a metronome.[18] Thereafter, the chewed gum was flattened to a thickness of 1.5mm in polyethylene films by compression between two glass plates. The colour of the chewed gum was then evaluated using visual analogue scale based on the five-colour scale printed on the chewing gum packet which was scored between 1-5 (Figure 3). Then the subjects were categorized in masticatory performance as; 'Good' (scores 1-3) and 'Poor' (scores 4-5).[19]

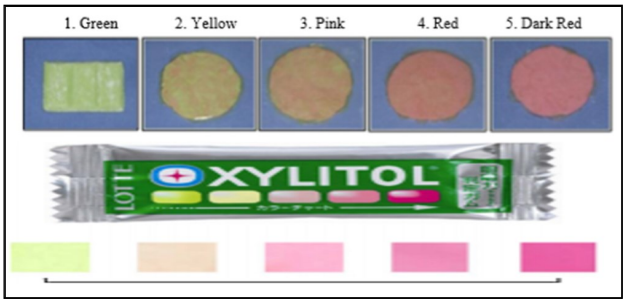

Figure 3. Comparison of visual analogue scale on scores 1,2,3,4,5 based on five colours printed on the chewing gum packet.

RESULT

Forty subjects were evaluated to participate in this study according to the inclusion and exclusion criteria. The alveolar ridge resorption in mandible was measured using panoramic radiograph. Overall, the prevalence of alveolar ridge in the mandible was higher (80%) in mild resorption compared to severe resorption 20% (Table 1). Amongst women, the prevalence of alveolar ridge in mandible was higher (37.5%) in mild resorption compared to severe resorption 12.5%. Amongst men, the prevalence of alveolar ridge resorption in mandible was higher (42.5%) in mild resorption compared to severe resorption 7.5%. Chi-square test was used to analyse the relationship between gender and alveolar ridge resorption in mandible. Statistical analysis showed that there was no significant correlation between gender and alveolar ridge resorption in complete denture wearers (p=0.695).

Table 1. Relationship between gender and alveolar ridge in mandible in completer denture wearers.

Gender	Alveolar Ridge Resorption in Mandible						p
	Mild		Severe		Total		
	n	(%)	n	(%)	n	(%)	
Women	15	(37.5)	5	(12.5)	20	(50)	
Men	17	(42.5)	3	(7.5)	20	(50)	0.695
Total	32	(80)	8	(20)	40	(100)	

Masticatory performance was measured clinically using the colour-changeable chewing gum. Subjects were categorized into good masticatory performance (scores 4-5) and poor masticatory performance (scores 1-3). The masticatory performance based on 40 samples showed that 30 patients (75%) had good masticatory performance whilst 10 patients (25%) had poor masticatory performance. Amongst the 20 women, 14 (35%) had good masticatory performance and 6 (15%) had poor masticatory performance.

In the 20 men,16 (40%) had good masticatory performance and 4 (10%) had poor masticatory performance. The Chi-square test was used to analyse the relationship between gender and masticatory performance. Statistical analysis showed that there was no significant correlation between gender and masticatory performance in complete denture wearers (p=0.716).

Table 2. Relationship between gender and masticatory performance in complete denture wearers.

Gender	Masticatory Performance						p
	Good		Poor		Total		
	n	(%)	n	(%)	n	(%)	
Women	14	(35)	6	(15)	20	(50)	
Men	16	(40)	4	(10)	20	(50)	0.716
Total	30	(75)	10	(25)	40	(100)	

This study showed that in women with mild alveolar ridge resorption in mandible, 65% had good masticatory performance whilst 10% had poor masticatory performance. However, women with severe alveolar ridge resorption in mandible, 20% had poor masticatory performance whilst 5% had good masticatory performance. Statistical analysis showed that there was a significant correlation between alveolar ridge resorption in mandible and masticatory performance among women (p=0.014).

In men with mild alveolar ridge resorption in mandible, 75% showed good masticatory performance whilst 10% showed poor masticatory performance. However, men with severe alveolar ridge resorption in mandible, 10% showed poor masticatory performance whilst 5% showed good masticatory performance. Statistical analysis showed that there was no significant correlation between alveolar ridge resorption in mandible and masticatory performance amongst men (p=0.088).

Table 3. Relationship between alveolar ridge resorption in mandible and masticatory performance based on gender in complete denture wearers.

Gender	Alveolar ridge resorption	Masticatory Performance						p
		Good		Poor		Total		
		n	(%)	n	(%)	n	(%)	
Women	Mild	13	(65)	2	(10)	15	(75)	0.014
	Severe	1	(5)	4	(20	5	(25)	
	Total	14	(70)	6	(30)	20	(100)	
Men	Mild	15	(75)	2	(10)	17	(85)	0.088
	Severe	1	(5)	2	(10)	3	(15)	
	Total	16	(80)	4	(20)	20	(100)	

DISCUSSION

The results of this study showed that men had higher prevalence of mild alveolar ridge resorption in the mandible (42.5%) compared to women (37.5%) whilst women had higher prevalence of severe alveolar ridge resorption in mandible (12.5%) compared to men (7.5%). Similar results were also obtained by Huumonen et al in 2012[10] and AlSheikh et al in 2019[20] which found that women experienced more severe alveolar ridge resorption in mandible compared to men.[10,20] AlSheikh et al[20] in 2019 and Imirzalioglu et al in 2011[21] however reported there was no significant correlation found between gender and alveolar ridge resorption in the mandible.[20,21] A study by Imirzalioglu et al in 2011 also revealed that there was no significant correlation between alveolar ridge resorption in mandible but with increasing age, resorption was found to be higher in women than men.[21]

Gender might be considered as a risk factor for masticatory performance of CD wearers. Greater resorption in women can be related to the effect of the menopausal activity. After menopause, a deficiency of oestrogen occurs which accelerates bone loss and results in a rapid alveolar ridge resorption. Oestrogen deficiency also prolongs the life span of the osteoclasts and contributes to a more intense bone resorption.[22] This was reported by Yuchen et al in 2016 who found that oestrogen deficiency causes mandibular bone loss in mice.[23]

The result of this study contrasted the study by Jayaram et al in 2017 which found that there was a significant correlation between gender and alveolar ridge resorption in mandible. His research showed that women had greater resorption than men.[22] This is also supported by study by AlSheikh et al in 2019.[20] Other than gender, duration and edentulism and patient with systemic disease also can influence resorption. In this study both the factors were not controlled.

The result of this study indicated that men had higher prevalence of good masticatory performance (40%) compared to women (35%). This finding was similar to study by Alves et al in 2019 which found than women presented lower masticatory performance (6.74%) compared to men (15.59%).[17] Although there was a difference in the masticatory performance in gender but the statistical analysis showed that there was no significant correlation between gender and masticatory performance (p=0.716). This finding was in agreement with the study by Ikebe et al in 2011 which found that there was no significant correlation between gender and masticatory performance.[24]

This finding was different from the study by Alves et al in 2019 who found that there was a significant correlation between gender and masticatory performance. His study

stated that the improved masticatory performance in men which may be attributed to the greater muscular strength.[17] Muscular strength can affect maximum bite force. Study by Palinkes et al in 2010[25] showed that gender had a significant correlation with maximum bite force, maximum bite force in men showed an average 30% higher than women but this in contrast with a study by Abu et al in 2010[26] which found there was no significant correlation between men and women in maximum bite force.[25,26] Women might compensate for their low muscle strength by increased coordination of other motor and sensory function.[24]

Bite force and muscle strength are also influenced by the occlusal scheme. Occlusal scheme affects bite force hence can affect masticatory performance.[27] In this study occlusal scheme was not controlled.

The result of this study indicated that there was a significant correlation between alveolar ridge resorption in mandible and masticatory performance amongst women ($p=0.014$) while no significant correlation between alveolar ridge resorption in mandible and masticatory performance amongst men ($p=0.088$).

Denture supporting tissue which is the alveolar ridge is one of the factors that influences masticatory performance.[20] After a tooth loss, alveolar ridge undergoes resorption continuously. The resorption causes decrease in size of the alveolar ridge and resorption especially in the mandible which may lead to problems with denture retention and stability, causing ulceration and pain cause difficulty to masticate and hence influences masticatory performance.[10,16]

The result of this study showed that there was a significant correlation between alveolar ridge resorption in mandible and masticatory performance amongst women. This finding is in agreement with study by Huumonen et al in 2012 which found that women with mild alveolar ridge resorption had a good masticatory function while women with severe alveolar ridge resorption had a poor masticatory performance.[10] Study by Alves et al in 2019 also showed similar result in women patients and the reduced radiographic mandibula bone height was equivalent to a reduction of 8.59% in masticatory performance.[17] This finding is supported by study by Koshino et al in 2007 which showed that the basal area of the denture foundation of the mandible had influence on the masticatory ability in complete denture wearers.[28] The small number of samples of males with severe alveolar ridge resorption in mandible may contribute to the low correlation between alveolar ridge resorption in mandible and masticatory performance in males.

CONCLUSION

The prevalence of mild alveolar ridge resorption in mandible was higher in men whilst the prevalence of severe alveolar ridge resorption in mandible was higher in women. The prevalence of good masticatory performance was higher in men while prevalence of poor masticatory performance was higher in women. There was no significant correlation between gender and alveolar ridge resorption in mandible as well as gender and masticatory performance. Amongst the male subjects, there was no significant correlation between the alveolar ridge resorption in mandible and masticatory performance. However, amongst the female subjects, there was significant correlation between the alveolar ridge resorption in mandible and masticatory performance. Further study is needed using more accurate instrument such as colorimeter. Further study about relationship between alveolar ridge resorption in mandible and masticatory performance should be done by controlling other variable such as systemic disease, duration of edentulism and occlusal scheme.

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