Original Article

Digital Cephalometric Analysis of Pharyngeal Airway Space Changes in Oral Submucous Fibrosis Patients: A Cross Sectional Observational Study

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Abstract

Background: Oral submucous fibrosis (OSMF) causes changes over the pharynx that may cause changes in airway dimensions. Cephalometry could be a reliable diagnostic tool for evaluation of the changes happening in the pharyngeal structures, so that preventive measures such as areca nut habit cessation could be initiated at an earlier stage. **Aim:** To test pharyngeal changes and airway dimensions in OSMF patients using digital lateral cephalograms. **Setting and Design:** This was a crossectional observational study done in the Department of Oral Medicine and Radiology. **Material and Method:** Twenty-two subjects with clinically diagnosed OSMF formed the study group A, and 30 healthy subjects formed the control group B. OSMF subjects were further divided into stage I, II, III according to Nagesh And Bailoor (1993) criteria. We tested all study subjects for velopharyngeal and upper airway dimensions as measured on Digital Lateral Cephalographs using Sirona Sidexis software. The findings were compiled to arrive at data in the study population. **Result:** Statistically significant difference was observed for mouth opening tongue between different stages of OSMF ($p = 0.000$) and significant difference was also observed for hyoid position to vertical, AH-FH ($p = 0.023$), tongue length (VT) ($p = 0.002$), mid airway width ($p = 0.031$), soft palate width ($p = 0.012$) between the groups. **Conclusion:** There was a significant change in the pharyngeal airway with the advancing stage of OSMF. Lateral cephalometric radiographs are a useful, non-invasive diagnostic tool to analyze pharyngeal airway changes in OSMF patient's to prevent the development of complications associated with advanced stages.

Keywords: Digital lateral cephalogram, oral submucous fibrosis, pharyngeal changes, soft palate

Introduction

Oral submucous fibrosis (OSMF) is a premalignant condition that has received considerable attention in the recent past because of its chronic debilitating and resistant nature. The major presenting complaint of patients is a progressive narrowing of the mouth (because of the accumulation of inelastic fibrous tissue in the juxta-epithelial region of the oral mucosa), and a burning sensation to spicy foods. Other clinical features associated with this condition include blanching of the oral mucosa, ulceration, and pain, hypomobility of the soft palate and tongue, loss of gustatory sensation, and occasional mild hearing impairment because of the blockage of the Eustachian tube.[1] The presence of palpable fibrous bands is a diagnostic criterion for OSMF which are commonly present in the buccal mucosa, retromolar areas, and faucial pillars. The epithelium overlying the fibrous condensation becomes atrophic in 90% of cases and is the site of malignant transformation in 4.5% of patients.[2]

OSMF affects approximately 0.5% (5 million people) of the population in the Indian subcontinent with most cases concentrated in central India where the habit of chewing areca nut along with tobacco is more common.[3] It affects

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persons of all ages and both sexes with male predominance and causes changes over the pharynx that may cause changes in airway dimensions. The involvement of palatal and para tubal muscles such as levator veli palatini, tensor veli palatine, tensor tympani, and salpingopharyngeo may decrease the function of the pharyngeal orifice leading to trismus, difficulty in swallowing, taste alteration and hearing deficit.[2] By our literature research, very few studies have tested dimensional changes and morphology of soft palate in OSMF patients, and to our best knowledge, the present is the first research conducted to test the upper airway dimensions in OSMF patients using lateral cephalogram.

Materials and Method

The cross-sectional observational pilot study was conducted on 52 patients aged between 18-50 years randomly selected from the outpatient department of Oral Medicine and Radiology in New Horizon Dental College and Research Institute, Bilaspur (C.G) who volunteered to take part after explaining the aim and method. The lottery method selected randomly sixty subjects enrolled for the study, the calculated power of the study was 60% assuming the incidence of OSMF to be 1% to 6% in both general and hospital-based population. In small sample studies, the central limit theorem justifies the use of sample mean which approaches the population mean for a minimum sample of 30 subjects. Sixty subjects were selected to participate in the study, comprised of 30 subjects with clinically diagnosed OSMF and 30 normal subjects. Out of 30 OSMF patients, 8 refused to give their informed consent, hence the final sample included total 52 subjects , divided into two groups : Group A, 22 subjects (15 male and 7 female) with clinically diagnosed OSMF , and Group B , 30 normal subjects (20 male and 10 female). OSMF subjects were further divided into three stages I, II, and III according to Nagesh And Bailoor (1993) classification. Maximum mouth opening between upper and lower incisors at mesio-incisal line angle was measured using vernier calipers in millimeters (mm). Normal mouth opening in males has been documented to be 35–45 mm; and in females, 30–42 mm.[3]

Group B comprised 30 normal individuals (20 male and 10 female) with a pleasing facial profile requiring orthodontic treatment for minor dental corrections. Patients with Cleft lip and palate, with skeletal malocclusions leading to airway obstructions, craniofacial syndromes and growth abnormalities were excluded. The ethical clearance was taken from the institutional ethical clearance committee (Ethical Clearance Approval Number: NHDCRI/BSP/OMR/2017/EC/68-a dated 14-6-2017). All procedures followed were by the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1964 and later versions.

Digital lateral cephalometric radiographs were taken with SIRONA ORTHOPHOS XG with an exposure parameters: 73 kVp, 15 mA, 9.4 sec using a standardized technique, with the teeth in occlusion and jaw in centric relation, the lips were relaxed, and the head was in the natural head position. A cephalometric evaluation was done using Sidexis software by a single experienced oral and maxillofacial radiologist, and magnification error was removed (10%).

The following variables were measured [Figure 1]:

1. Position of the hyoid bone in a horizontal plane — AH-CV [from AH to CV and parallel to FH]
2. Position of the hyoid bone in the vertical plane - AH-FH
3. Soft palate length—PM-U
4. Soft palate thickness —SPT
5. Tongue length - VT
6. Tongue thickness—H-VT

The width of the upper airway space was measured in the sagittal plane at three levels:

1. Upper Airway width, nasopharynx (PM-UPW)
2. Mid Airway width, or oropharynx (U-MPW)
3. Lower Airway width, hypopharynx (V-LPW)

Statistical analysis

Data obtained was analyzed with the Statistical Package for Social Service (SPSS) version 21 software (SPSS Inc, Chicago, IL, USA). Descriptive analysis for mouth opening and parameters evaluated were expressed as mean ± standard deviation (SD). The mean values were subjected to statistical analysis using analysis of variance (ANOVA). An Independent Sample Test was applied to compare the parameters between the OSMF subjects and controls. P value ≤ 0.05 was considered statistically significant.

Results

Twenty-two OSMF patients were divided into three stages

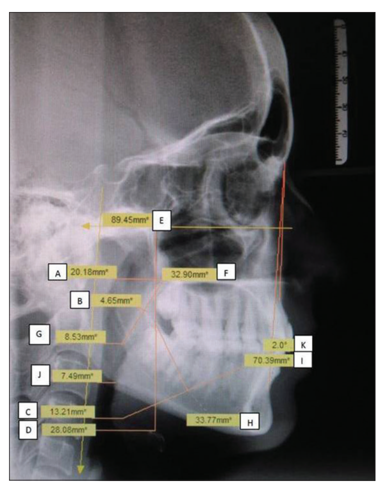

Figure 1: Parameters evaluated on Lateral Cephalogram using Sidexis software for oral submucous fibrosis patients A) upper airway width (PM-UPW), B) mid airway width (U-MPW), C) lower airway width (V-LPW), D) hyoid position in horizontal plane (AH-CV) , E) hyoid position in vertical plane (AH-FH), F) soft palate length(PM-U), G) soft palate thickness(SPT), H) tongue length (VT), I) tongue thickness (H-VT), J) tongue position, K) ANB angle.[7]

based on Nagesh and Bailoor Criteria; stage I comprised (8 patients), stage II (11 patients), and stage III (3 patients). ANOVA showed that mean interincisal mouth opening was greatest in stage I (34.7761 ± 1.16496) and least in stage III patients (18.2324 ± 0.57735). Stage II patients had a mean mouth opening of (25.8536 ± 3.33030) [Table 1].

Statistically, a significant difference was observed for mouth opening between and within the groups ($p < 0.001$) and degree of freedom was 48.905 [Table 2]. Table 3 illustrates the mean value of parameters tested for three stages of OSMF patients. Statistically, a significant difference was observed for soft palate width between and within the groups ($p = 0.012$). The degree of freedom between and within the groups was 2 and 19 [Table 4].

Pharyngeal airway dimensions were measured, and a comparison was done between the OSMF subjects and the control group. Independent sample test showed statistically a significant difference for the hyoid position to vertical, AH-FH ($p = 0.023$), tongue length (VT) ($p = 0.002$) and mid airway width ($p = 0.031$) between OSMF subjects and control group. Upper airway width ($p = 0.433$) and lower airway width ($p = 0.971$) did not show statistically significant difference between the groups for OSMF subjects [Table 5]. On comparison within the groups, statistically significant difference was observed in soft palate thickness ($p = 0.012$), and statistically insignificant difference was seen for other parameters i.e., hyoid position to vertical ($p = 0.699$), tongue length ($p = 0.443$), horizontal hyoid position ($p = 0.372$), soft palate length ($p = 0.225$), tongue thickness ($p = 0.790$), upper airway width ($p = 0.135$), mid airway width ($p = 0.106$), and lower airway width ($p = 0.146$) [Table 4].

Results showed that there was a significant change in pharyngeal airway dimensions at 3-point measurement, i.e., upper, mid, and lower with advancing stage of OSMF. In advanced stages of OSMF (Stages 2 and 3), the hyoid bone was seen to be positioned superiorly and anteriorly suggesting the role of attached muscles. Soft palate appeared shorter and thinner and the tongue was flat secondary to fibrosis or atrophy of the muscles.

Discussion

Oral submucous fibrosis is a chronic disorder leading to changes over the texture and tone of the oropharyngeal muscles. According to existing literature, there is an alteration in the morphology of soft palate and in pharyngeal airway dimensions with advancing OSMF.[4,5] So, there is a need to test the above changes at an early stage for initiation of treatment before the progression of this condition to advanced stages thus preventing associated complications. Cephalometry may prove to be a non-invasive, reliable diagnostic tool for evaluation of the changes happening in the pharyngeal structures. The lateral cephalogram is a two-dimensional representation of the lateral aspect of the head and neck region used routinely for orthodontic treatment. It facilitates evaluation of the nasopharynx, oropharynx, hypopharynx, and supportive structures such as hyoid bone, tongue, and soft palate.[6,7] Also, cephalometric radiographs could also be used as a motivational tool for patients to quit the areca nut chewing habit. To the above consideration, the present study tested the pharyngeal dimensional changes in OSMF patients on lateral cephalogram and compared the findings to the normal.

In several studies, significant differences were obtained in pharyngeal airway measurements and dentofacial morphology in normal individuals with different growth patterns.[6-9] Morphometric studies on soft palate have found a significant decrease in anterior-posterior soft palate dimensions in OSMF patients as compared to normal individuals, but literature on evaluation of pharyngeal airway in OSMF patients was not found to date.[10,11] The present study is the first by our search to analyze airway dimensional changes on lateral cephalogram in OSMF subjects.

In the current study, airway dimensions at 3-point measurement, upper, mid, and lower were seen to be changed in OSMF subjects. The hyoid bone was seen to be positioned superiorly, and anteriorly suggesting the role of attached muscles. In OSMF subjects, soft palate appeared shorter and thinner and tongue was flat secondary to fibrosis or atrophy of the muscles. When cases and control groups were compared not much significant difference was observed, however on comparing between different stages of OSMF subjects, significant changes were seen with stage III subjects. Although the anteroposterior dimension appears to be changed significantly, they only represented localized changes affecting the tongue, uvula, soft palate, and the pharyngeal walls at the site of measurement.

Recent epidemiological data have revealed OSMF to be a progressive condition that adversely affects the patient's

Table 1: Comparison of mean inter incisal opening between Stage 1, Stage 2 and Stage 3 Oral submucous Fibrosis Patients By Analysis of Variance (ANOVA)

	N	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Stage I	8	1.16496	.41188	34.7761	36.7239	34.00	38.00
Stage II	11	3.33030	1.00412	25.8536	30.3282	24.00	33.00
Stage III	3	.57735	.33333	18.2324	21.1009	19.00	20.00
Total	22	5.95364	1.26932	27.0876	32.3670	19.00	38.00

quality of life. Studies have reported alteration in Eustachian tube function and conductive hearing loss in advanced grade III OSMF, thus resulting in difficulty in deglutition and ear pain.[12] Devi *et al*.[13] found significant conductive hearing loss in advanced stage OSMF ($p < 0.01$) relative to the control group. Besides this, morphology and configuration of the soft palate have been studied to be altered in OSMF patients, Lakshmi *et al*.[11] suggested that there is a gradual shortening of soft palate and uvula with progression in the staging of OSMF. On using digital lateral cephalometry they found that as the OSMF progresses in staging, there is a gradual decrease in the antero-posterior dimensions and an increase in supero inferior dimensions of the soft palate. Similar results were observed by Patil *et al*.[14] in 2017, therefore knowledge about the varied morphological pattern of the soft palate in OSMF patients can show about disease progression and helps in the planning of treatment interventions based on clinical staging for a successful outcome. Based on the above correlations, we measured pharyngeal airway space dimensions and found a statistically significant difference for mid airway space width ($p = 0.03$) between OSMF patients and the control group. The hyoid bone was seen to be positioned superiorly and anteriorly,

Table 2: Comparison of inter incisal mouth opening between and within the study groups by ANOVA

	Sum of Squares	Mean Square	*F*	Sig.
Between Groups	623.288	311.644	48.905	0.000
Within Groups	121.076	6.372		
Total	744.364			

Table 3: Mean Value of parameters for different stages of oral submucous fibrosis

		Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Hyoid position (AH-CV)	Stage I	36.2550	2.01186	.71130	34.5730	37.9370	33.60	39.96
	StageII	35.6764	4.72774	1.42547	32.5002	38.8525	27.99	43.05
	Stage III	39.6967	7.04217	4.06580	22.2030	57.1904	33.79	47.49
	Total	36.4350	4.30691	.91824	34.5254	38.3446	27.99	47.49
Hyoid position to vertical (AH-FH)	Stage I	81.4013	7.47699	2.64352	75.1503	87.6522	68.89	90.71
	Stage II	80.6600	4.26051	1.28459	77.7978	83.5222	75.96	89.21
	Stage III	84.1800	9.71835	5.61089	60.0383	108.3217	73.19	91.64
	Total	81.4095	6.13715	1.30844	78.6885	84.1306	68.89	91.64
Soft palate length (PM-W)	Stage I	30.4475	3.93712	1.39198	27.1560	33.7390	25.47	36.49
	Stage II	30.5836	3.68890	1.11225	28.1054	33.0619	24.43	36.76
	Stage III	26.0533	5.52627	3.19059	12.3253	39.7813	20.46	31.51
	Total	29.9164	4.12651	.87977	28.0868	31.7460	20.46	36.76
Soft palate thickness (SPT)	Stage I	10.5063	1.03979	.36762	9.6370	11.3755	8.94	11.53
	Stage II	9.2227	1.13706	.34284	8.4588	9.9866	7.69	11.39
	Stage III	8.3667	.58705	.33894	6.9083	9.8250	7.69	8.74
	Total	9.5727	1.26997	.27076	9.0097	10.1358	7.69	11.53
Tongue length (VT)	Stage I	66.6338	5.82998	2.06121	61.7598	71.5077	59.57	74.02
	Stage II	69.2255	6.37737	1.92285	64.9411	73.5098	62.00	79.88
	Stage III	71.8167	6.90370	3.98585	54.6669	88.9664	65.34	79.08
	Total	68.6364	6.19599	1.32099	65.8892	71.3835	59.57	79.88
Tongue thickness (H-VT)	Stage I	33.8963	3.19921	1.13109	31.2216	36.5709	28.35	36.73
	Stage II	33.3036	1.94703	.58705	31.9956	34.6117	30.27	37.36
	Stage III	32.5233	5.69379	3.28731	18.3792	46.6675	28.96	39.09
	Total	33.4127	2.91765	.62205	32.1191	34.7063	28.35	39.09
Upper airway width	Stage I	22.6175	2.78953	.98625	20.2854	24.9496	19.38	27.99
	Stage II	21.1836	4.33361	1.30663	18.2723	24.0950	15.06	28.26
	Stage III	17.1200	4.38402	2.53111	6.2295	28.0105	14.46	22.18
	Total	21.1509	4.06304	.86624	19.3495	22.9524	14.46	28.26
Mid airway width	Stage I	10.0075	1.99746	.70621	8.3376	11.6774	6.17	12.26
	Stage II	10.5127	1.48276	.44707	9.5166	11.5089	8.89	12.35
	Stage III	8.1367	.16166	.09333	7.7351	8.5382	7.95	8.23
	Total	10.0050	1.73582	.37008	9.2354	10.7746	6.17	12.35
Lower airway width	Stage I	19.5350	4.38303	1.54964	15.8707	23.1993	11.42	25.27
	Stage II	20.4882	2.62997	.79296	18.7213	22.2550	16.29	24.33
	Stage III	15.8433	3.39213	1.95845	7.4168	24.2698	12.25	18.99
	Total	19.5082	3.63528	.77504	17.8964	21.1200	11.42	25.27

Table 4: Comparison of parameters between and within the study groups by ANOVA

		Sum of Squares	df	Mean Square	*F*	Sig.
Hyoid position (AH-CV)	Between Groups	38.505	2	19.253	1.042	0.372
	Within Groups	351.033	19	18.475		
	Total	389.539	21			
Hyoid position to vertical (AH-FH)	Between Groups	29.207	2	14.603	.364	0.699
	Within Groups	761.750	19	40.092		
	Total	790.956	21			
Soft palate length (PM-W)	Between Groups	51.924	2	25.962	1.614	0.225
	Within Groups	305.666	19	16.088		
	Total	357.589	21			
Soft palate thickness (SPT)	Between Groups	12.683	2	6.341	5.687	0.012
	Within Groups	21.186	19	1.115		
	Total	33.869	21			
Tongue length (VT)	Between Groups	66.244	2	33.122	.850	0.443
	Within Groups	739.952	19	38.945		
	Total	806.196	21			
Tongue thickness (H-VT)	Between Groups	4.374	2	2.187	.238	0.790
	Within Groups	174.393	19	9.179		
	Total	178.767	21			
Upper airway width	Between Groups	65.964	2	32.982	2.232	0.135
	Within Groups	280.711	19	14.774		
	Total	346.675	21			
Mid airway width	Between Groups	13.308	2	6.654	2.530	0.106
	Within Groups	49.967	19	2.630		
	Total	63.275	21			
Lower Airway width	Between Groups	50.863	2	25.432	2.132	0.146
	Within Groups	226.657	19	11.929		
	Total	277.521	21			

Table 5: Independent t test showing comparison of the parameters between the two study groups

Groups		Mean	Std. Deviation	Std. Error Mean	Sig.
Hyoid position (AH-CV)	cases	36.4350	4.30691	.91824	0.304
	controls	37.0688	3.31257	.74071	
Hyoid position to vertical (AH-FH)	cases	81.4095	6.13715	1.30844	0.023
	controls	81.9756	3.79381	.84832	
Soft palate length (PH-W)	cases	29.9164	4.12651	.87977	0.462
	controls	31.8798	3.19513	.71445	
Soft palate thickness (SPT)	cases	9.5727	1.26997	.27076	0.872
	controls	10.0215	1.27056	.28411	
Tongue length (VT)	cases	68.6364	6.19599	1.32099	0.002
	controls	72.7209	3.48593	.77948	
Tongue thickness (H-VT)	cases	33.4127	2.91765	.62205	0.474
	controls	33.2163	2.58079	.57708	
Upper airway width	cases	21.1509	4.06304	.86624	0.897
	controls	22.3034	5.32803	1.19138	
Mid airway width	cases	10.0050	1.73582	.37008	0.031
	controls	11.4035	2.30943	.51640	
Lower airway width	cases	19.5082	3.63528	.77504	0.897
	controls	19.4666	3.67299	.82131	

soft palate appeared shorter and thinner and tongue was flat secondary to fibrosis or atrophy of the muscles in advanced stages of OSMF.

Malignant transformation of this condition is another major concern. Therefore, the primary goal of management should be to relieve the patient's symptoms and to control the progression of the disease. Counseling the patients to quit areca nut chewing should be the primary basis of management.[15] The present study suggested that lateral cephalogram could analyze pharyngeal airway changes in OSMF patients to prevent the development of complications associated with advanced stages.

Limitations and Future prospects

To conclude, this study would be premature to conclude the compromise of the airway, and further evaluation of the airway volume is required using a larger sample size and other three-dimensional imaging modalities such as cone beam computed tomography with proper optimization for more radiation exposure than 2 D radiography. This study gives a direction towards the hypothesis of a change in the airway in OSMF subjects.

Declaration of patient consent

Patient (s)/study participants were informed about the nature of the study and their consent was obtained to use the relevant clinical details and images for the scientific publication purpose without revealing the identity.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Gupta SC, Singh M, Khanna S, Jain S. Oral submucous fibrosis with its possible effect on eustachian tube functions: A tympanometric study. Indian J Otolaryngol Head Neck Surg 2004;56:183-5.
2. Pammar C, Nayak RS, Kotrashetti VS, Hosmani J. Comparison of microvessel density using CD34 and CD105 in oral submucous fibrosis and its correlation with clinicopathological features: An immunohistochemical study. J Can Res Ther 2018;14:983-8.
3. Ranganathan K, Mishra G. An overview of classification schemes of OSMF. J Oral Maxillofac Pathol 2006;10;55-8.
4. Sudarshan R, Annigeri RG, Vijayabala GS. Pathogenesis of oral submucous fibrosis: The past and current concepts. Int J Oral Maxillofac Pathol 2012;3:27-36.
5. Tekchandavi V, Thakur M, Palve D, Mohale D, Gupta R. Co-relation of clinical and histologic grade with soft palate morphology in oral submucous fibrosis patients: A histologic and cephalometric study. J Dent Specialties 2015;3:68-75.
6. Shastri D, Tandon P, Nagar A, Singh A. Pharyngeal airway parameters in subjects with Class I malocclusion with different growth patterns. J Orthod Res 2015;3:11-6.
7. Guttal KS, Burde KN. Cephalometric evaluation of upper airway in healthy adult population. A preliminary study. J Oral Maxillofac Radiol 2013;1:55-60.
8. Min GU, Colman Mc Grath PJ, Ricky Wong WK, Hagg U, Yang Y. Cephalometric norms for the upper airway of 12 year old Chinese children. Head Face Med 2014;10:38.
9. de Freitas MR, Alcazar NMPV, Janson G, De Freitas KMS, Henriques JFC. Upper and lower pharyngeal airways in subjects with Class I and Class II malocclusions and different growth patterns. Am J Orthod Dentofac Orthoped 2006;130:742-5.
10. Shankar VN, Hegde K, Ashwini NS, Parveena V, Prakash SMR. Morphometric evaluation of soft palate in orsl submucous fibrosis. A digital cephalometric study. J Cranio Maxillofac Surg 2014;42:48-52.
11. Lakshmi CR, Thabusum DA, Bhavana SM. An innovative approach to evaluate the morphological patterns of soft palate in oral submucous fibrosis patients: A digital cephalometric study. Int J Chronic Dis 2016;2016:5428581.
12. Siddiqui SN, Saawarn N, Nair PP, Singh P, Gharote HP, Kegde K. Eustachian tube dysfunction in OSMF-often present seldom discovered. J Clin Exp Dent 2014;6:e369-73.
13. Devi P, Singh I, Setru R, Tyagi K, Singh D, Thiyam B. Evaluation of hearing deficit in patients with oral submucous fibrosis. J Oral Sci 2015;57:109-13.
14. Patil BM, Ara SM, Katti G, Ashraf S, Roohi U. Velar morphological variants in oral submucous fibrosis: A comparative digital cephalometric study. Indian J Dent Res 2017;28:623-8.
15. Shah N, Sharma PP. Role of chewing and smoking habits in the etiology of oral submucous fibrosis (OSF): A case-control study. J Oral Pathol Med 1998;27:475-9.