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Incidence of Squamous Cell Carcinoma in Oral Lichen Planus: A 25-Year Population-Based Study

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Abstract

Background: Oral lichen planus (OLP) is a chronic inflammatory condition of the oral mucosae. Multiple studies have shown that approximately 1% of patients with OLP will develop oral squamous cell carcinoma (OSCC), however, no study has taken a population-based multi-center approach to demonstrate this association. Our main objective was to determine the incidence of OSCC in OLP in a specific population. Secondly, to assist physicians regarding appropriate long-term monitoring of patients with OLP.

Methods: We conducted a population-based retrospective cohort study. Patients with OLP from 1986 through 2010 were identified using the Rochester Epidemiology Project (REP) for Olmsted County, Minnesota. For each OLP case (n=303), we randomly selected 2 age- and sex-matched referents (n=606). OLP diagnosis was established based on the World Health Organization (WHO) criteria. Medical records were reviewed for development of OSCC *after* the OLP diagnosis (index date). The association between OLP and development of OSCC was assessed.

Results: In total, 303 patients with incident OLP were identified; the overall incidence of OLP per 100,000 person-years was 11.4 (95% CI, 10.1–12.7). Among the OLP cohort, 7 had OSCC (incidence of OSCC, 3.1%; 95% CI, 0.6%–6.4%) at 20 years after OLP diagnosis. Three OSCC cases were identified among the referents. Patients with OLP were 4.8 times more likely to have OSCC than the matched referents. The median time to OSCC development was 14.7 years earlier for the OLP cohort.

Conclusions: Patients with OLP, particularly the erosive type, have an increased incidence of OSCC development and should be monitored closely.

Introduction

Oral lichen planus (OLP) is a chronic inflammatory disease of the mucous membrane surfaces of the mouth. Its onset involves a cascade of events leading to a cell-mediated immune activation that ultimately leads to tissue necrosis.¹

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The diagnosis of OLP is based on both clinical and histopathologic criteria. In 2003, van der Meij et al² proposed criteria for the diagnosis of OLP based on the 1978 World Health Organization definition, which outlines specific clinical and histopathologic characteristics that should be present. According to these modified criteria, the clinical presentation includes bilateral symmetrical lesions with a reticular pattern and potentially overlapping erosive, atrophic, bullous, or plaquelike lesions. Histologically, a lack of mucosal dysplasia should be seen, with a superficial lymphocytic, bandlike infiltrate causing basal hydropic degeneration.

While cutaneous lichen planus may be a transient eruption, oral lichen planus tends to be more persistent with long-standing inflammation. As a consequence of long-standing inflammation, patients with OLP are believed to be at increased risk for oral squamous cell carcinoma (OSCC). While the World Health Organization (WHO) recognizes OLP as potentially premalignant, the rate of malignant transformation remains unknown. OLP may present as erythematous and atrophic, reticular, or erosive lesions, with squamous cell carcinoma estimated to affect 1% of patients and predominantly those with the erosive or erythematous variants.² Although numerous studies have attempted to determine the incidence of OSCC in OLP (Table 1), no study has taken a population-based approach. Previous studies have generally been single-center studies, with incidence of OSCC in OLP ranging from 0% to 6.5%. Our main objective was to determine the incidence of OSCC in OLP in a population-based study to better characterize the prognosis of patients with OLP related to cancer development and to assist physicians regarding appropriate long-term monitoring of patients with OLP.

Materials and Methods

Cases of OLP diagnosed in the population of Olmsted County, Minnesota, made available through the Rochester Epidemiology Project (REP), were analyzed. The REP is a linkage system for the medical records of Olmsted County residents dating to 1966.²⁷ The Olmsted County population as of the 2011 census was 146,000 persons, the majority (90.3%) of whom are white.²⁸

Using the REP resources, we identified patients who received their first occurrence of *International Classification of Disease, Ninth Edition*, code 697.0 or Hospital Adaptation of the *International Classification of Diseases* code 06970110 from January 1, 1986, through December 31, 2010, while a resident of Olmsted County. On the basis of the review of their medical records, patients were classified as incident OLP cases if they met the following criteria: 1) the location was within the oral cavity (from lips to start of the oropharynx); 2) documented presence of the clinical or histopathologic, or both, characteristics met the modified World Health Organization criteria; and 3) no prior history of OSCC was found. Patients with a prior history of oral lichenoid lesions other than OLP by histopathology or clinical examination were excluded from the study. For each OLP case, we randomly identified 2 age-matched (± 1 year) and sex-matched patients (*referents*) residing in Olmsted County at the time of the OLP case's diagnosis (*index date*). Referents did not have either an OLP or an OSCC diagnosis before the index date. All included patients had provided written authorization for their data to be used in research studies in accordance with the Minnesota

state law. Each patient's medical record was manually reviewed and the following data were collected: sex, race/ethnicity (self-identified; needed to define population), date of birth, date of OLP diagnosis, sites of involvement, predominant form of OLP, hepatitis C virus status, smoking history and alcohol history, and date of last clinical visit to a provider within the REP. For patients who had OSCC, additional data was collected and included date of OSCC diagnosis and sites of involvement. Abstracted data were entered into a REDCap (Research Electronic Data Capture) system designed specifically for this study.²⁹

Age- and sex-specific incidence rates per 100,000 person-years in Olmsted County were calculated using the number of persons with incident OLP as the numerator and age- and sex-specific counts of the population of Olmsted County for 1986 through 2010 as the denominator (population counts obtained from the decennial census for Olmsted County with linear interpolation between census years). Rates were age- and sex-adjusted to the total population structure of the United States in 2010, and corresponding 95% confidence intervals (CI) for the rates were calculated assuming a Poisson error distribution.

Baseline characteristics at the index date were compared between the OLP group and the referents using either χ^2 test or Fisher exact test as appropriate. Duration of follow-up was calculated from the index date to the date of OSCC diagnosis; otherwise, follow-up was censored at the date of a patient's last relevant clinical follow-up. The cumulative incidence of OSCC was estimated with the Kaplan-Meier method. The association between OLP case status and development of subsequent OSCC was assessed with a Cox proportional hazards model in which age was the time scale, to adjust for age. Two additional Cox models were fit to assess this association after adjustment for smoking status (never, former, or current) and alcohol use (none, occasional, or frequent), respectively. The association was summarized using hazard ratio and corresponding 95% CI estimated from the models. Analyses were performed with SAS software version 9.4 (SAS Institute Inc). Mayo Clinic Institutional Review Board approval was received before project initiation.

Results

The medical records of 1,114 patients with a diagnosis of lichen planus were reviewed. From these, we identified 303 patients who first received a diagnosis of OLP while a resident of Olmsted County during the 25-year study period and who did not have a prior diagnosis of OSCC. Table 2 summarizes the age- and sex-specific OLP incidence rates; Table 3 summarizes the characteristics of the OLP patients and the age- and sex-matched referents. No significant differences were identified between our OLP cohort and the referents in terms of race (93.0% vs 95.3% white), immunosuppression (12.0% vs 8.6%), or median duration of follow-up (10.2 years vs 10.6 years). We found a greater percentage of OLP patients with a smoking history, alcohol use, and hepatitis C than age- and sex-matched referents (Table 3).

Among the 303 patients with OLP, 7 had OSCC at a median of 2.9 years (interquartile range [IQR], 0.02–5.7 years) following their OLP diagnosis. Among the other 296 patients without documented OSCC, the median duration of relevant clinical follow-up was 10.3 years (IQR, 6.1–16.7 years). The cumulative incidence of OSCC among the OLP cohort was 1.7%,

2.2%, 3.1%, and 3.1% at 5, 10, 15, and 20 years, respectively, following the OLP diagnosis (Table 4). Of the 7 patients with OLP who had OSCC, 5 had erosive OLP, 1 had reticular OLP, and 1 had plaque OLP. Six patients were noted to have OLP at the site of development of their OSCC. The 8 OSCC sites among the 7 patients were buccal mucosa (n=2), tongue (n=4), gingiva (n=1), and hard palate (n=1) (Table 5). One of the 7 OLP patients with OSCC died of the OSCC. The average age at diagnosis of OSCC in the OLP cohort was 65.8 years (range, 33.1–76.0 years).

Among the 606 matched referents without OLP, 3 had a total of 4 OSCC cases at a median of 17.6 years (IQR, 5.5–21.8 years) after the index date. Among the other 603 patients without documented OSCC, median duration of relevant clinical follow-up was 10.6 years (IQR, 6.2–17.2 years). The cumulative incidence of OSCC among the referent group was 0%, 0.2%, 0.2%, and 0.9% at 5, 10, 15, and 20 years, respectively, after the index date (Table 4). Location of the 4 OSCCs were tongue (n=2), soft palate (n=1), and gingiva (n=1) (Table 5). The average age at diagnosis of OSCC among the referents was 73.0 years (range, 70.9–76.5 years). One of the 3 referents with OSCC died of OSCC.

Patients with OLP were 4.8 times more likely to develop OSCC than their matched referents (hazard ratio [HR] [95% CI], 4.80, [1.24–18.6]; $P=.02$). Similar results were obtained using age as the time scale in a Cox model to more completely adjust for age (HR [95% CI], 4.88 [1.26–18.9]; $P=.02$). The magnitude of this association was unchanged after adjusting for either smoking status (HR [95% CI], 4.86 [1.27–18.6]) or alcohol use (HR [95% CI], 4.86 [1.25–18.8]) in 2 separate Cox models.

Discussion

The risk of malignant transformation of OLP has long been hypothesized.² Although numerous retrospective studies and 1 prospective study have sought to identify the incidence of OSCC in OLP (Table 1), no studies to our knowledge have compared this incidence to age- and sex-matched referents from the same population. Using an extensive database of records from a single county in southeastern Minnesota, we studied the incidence of OLP by sex and age-group and the cumulative incidence of OSCC in OLP patients and their referents and thereby established that patients with OLP were at greater risk of OSCC than patients without OLP. Consistent with the literature,³⁰ we identified a greater incidence of OLP in women (14.4 per 100,000 person-years) than men (8.1 per 100,000 person-years). Mean (SD) [age of diagnosis in a study of 441 patients was 47.5 (13.07) years³⁰; we identified the highest incidence in the 60-to-69-year-old age-group for both sexes. Malignant transformation in our OLP population was 3.1%, which was within the range of malignant transformation seen in previous studies (0–5.8%).

Although only 26.1% of OLP patients had an erosive OLP, it was overrepresented among patients who had OSCC (71.4%). Thus, erosive OLP was the most common type to undergo malignant transformation in our study, in similarity with the published literature.⁶ From the index date, the median time to OSCC development was 14.7 years earlier for the OLP cohort than for the referents (2.9 years vs 17.6 years). In the OLP cohort, all OSCC cases developed in areas of the oral cavity, which were easily examined by a dermatologist and without

special equipment. This finding highlights the important role of dermatologists in identifying OSCC of patients with OLP.

Further consideration should be given by the clinician to distinguishing between true OLP and oral lichenoid lesions (OLL) including lichenoid drug eruptions, contact lichenoid eruptions, and OLL associated with graft-versus-host disease³². Thorough history and examination may help distinguish a true immune-mediated OLP from mimickers of OLP which may not carry the same malignant potential. Independent of oral lichen planus, patients may have oral epithelial dysplasia in the absence of lichenoid inflammation. Notably, these patients carry similar risks of malignant transformation³³. Although we did not study this population, clinicians should pay special attention to dysplasia irrespective of lichenoid mucositis.

A study limitation is the generalizability of the data outside of the southeastern Minnesota population studied (ie, predominantly white). This may account for some of the variability in risk of malignant transformation from previous studies. Although the population studied is less diverse than the general US population, its characteristics of age, sex, and ethnicity are at the very least similar to the Upper Midwest.³¹ In addition, whereas referents were matched for age and sex, we did not match for potentially confounding factors, including tobacco and alcohol use. Additional predisposing factors to oncogenesis including human papillomavirus and candida infection, genetics, nutrition, and immunosuppressive treatment regimens for oral lichen planus were not accounted for due to the retrospective nature of the analysis. Despite these limitations, this study offers compelling evidence that patients with OLP are at significantly higher risk for OSCC. Whether aggressive treatment of OLP mitigates the increased risk of OSCC is a fascinating avenue for future research.

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Table 1.
Studies on Incidence of Squamous Cell Carcinoma Among Patients With OLP, 2000 to Present

Study Authors, Year	No. of Patients	Country	Type of Study	Length of Follow-up	Malignant Transformation, %
Mignogna et al, 2001 ³	502	Italy	Retrospective, single center	4 mo-12 y	3.7
Chainani-Wu et al, 2001 ⁴	229	United States	Retrospective, single center	4 y	1.7
Eisen, 2002 ⁵	723	United States	Retrospective, single center	6 mo-8 y (mean, 4.5 y)	0.8
Lanfranchi-Tizeira et al, 2003 ⁶	719	Argentina	Retrospective, single center	2 mo	4.5 Overall; 6.5 of atypical lichen planus
Rödström et al, 2004 ⁷	1,028	Sweden	Retrospective, single center	6.8 y	0.5
Laeijendecker et al, 2005 ⁸	200	The Netherlands	Retrospective, 1 center, 1991-1993; 1 center, 1994-2003	7-13 y (mean, 10 y)	1.5
Xue et al, 2005 ⁹	674	China	Retrospective, single center	ND	0.6
Bornstein et al, 2006 ¹⁰	145	Switzerland	Retrospective, single center	2.1-8.8 y (mean, 3.7 y)	2.8; 0.7 when patients with initial dysplasia not included
Ingafou et al, 2006 ¹¹	690	United Kingdom	Retrospective, single center	3 mo	1.9
Fang et al, 2009 ¹²	2,119	China	Retrospective, single center	1-41 mo (mean, 16 mo)	1.1
Carbone et al, 2009 ¹³	808	Italy	Retrospective, single center	6 mo-17 y	1.9
Pakferat et al, 2009 ¹⁴	420	Iran	Retrospective, single center	3 mo	0.07
Berniejo-Fenoll et al, 2009 ¹⁵	550	Spain	Retrospective, 1 center and 1 private practice	24 mo	0.9
Bombeccari et al, 2011 ¹⁶	327	Italy	Retrospective, single center	81.7 mo	2.4
Kaplan et al, 2012 ¹⁷	171	Israel	Retrospective, single center	1-16 y (mean, 4.3 y)	5.8
Brzak et al, 2012 ¹⁸	12,508 (~537 with OLP)	Croatia	Retrospective, single center	ND	0
Shen et al, 2012 ¹⁹	518	China	Retrospective, single center	6 mo-21.5 y	0.96

Study Authors, Year	No. of Patients	Country	Type of Study	Length of Follow-up	Malignant Transformation, %
Tovaru et al, 2013 ²⁰	633	Romania	Retrospective, single center	ND	0.95
Gümrii, 2013 ²¹	370	Turkey	Retrospective, single center	ND	0.3
Bardellini et al, 2013 ²²	204	Italy	Retrospective, single center	6 mo-12 y	0.98
Mares et al, 2013 ²³	8	France	Retrospective, single center	154-183 mo (mean, 164 mo)	0
Budimir et al, 2014 ²⁴	563	Croatia	Retrospective, single center	ND	0.7
Casparis et al, 2015 ²⁵	542 (OLP and oral lichenoid lesions)	Switzerland	Retrospective, single center	ND	1.2
Radochová et al, 2014 ²⁶	171	Czech Republic	Retrospective, single center	ND	0

Abbreviations: ND, not described; OLP, oral lichen planus.

Table 2.
Incidence of Oral Lichen Planus per 100,000 Person-Years by Age and Sex in Olmsted County, Minnesota, 1986-2010

Age Range, y	Female Sex			Male Sex			Both Sexes		
	No. of Cases	Rate per 100,000 Person-Years	95% CI	No. of Cases	Rate per 100,000 Person-Years	95% CI	No. of Cases	Rate per 100,000 Person-Years	95% CI
0-19	0	0.0	NA	1	0.2	(0.0-1.2)	1	0.1	(0.0-0.6)
20-29	5	2.2	(0.7-5.2)	11	5.2	(2.6-9.3)	16	3.7	(2.1-6.0)
30-39	15	6.1	(3.4-10.0)	16	6.5	(3.7-10.5)	31	6.3	(4.3-8.9)
40-49	34	15.4	(10.6-21.5)	24	11.1	(7.1-16.5)	58	13.3	(10.1-17.1)
50-59	56	33.6	(25.3-43.6)	24	14.9	(9.6-22.2)	80	24.4	(19.4-30.4)
60-69	46	41.6	(30.4-55.5)	22	21.9	(13.7-33.2)	68	32.2	(25.0-40.9)
70-79	26	32.4	(21.2-47.5)	6	9.9	(3.6-21.5)	32	22.7	(15.5-32.1)
80-89	13	25.0	(13.3-42.8)	2	7.5	(0.9-27.9)	15	19.1	(10.7-31.5)
90	2	14.0	(1.7-50.7)	0	0.0	NA	2	11.0	(1.3-39.6)
Total	197	14.4 ^a	(12.3-16.4)	106	8.1 ^a	(6.5-9.6)	303	11.4 ^b	(10.1-12.7)

Abbreviation: NA, not applicable.

^aIncidence per 100,000 person-years is directly age-adjusted to the structure of the US total population in 2010.

^bIncidence per 100,000 person-years is directly age- and sex-adjusted to the structure of the US total population in 2010.

Table 3.

Demographic Characteristics and Medical History of Patients With Incident OLP From Olmsted County, Minnesota, 1986-2010, and Age- and Sex-Matched Patients Without OLP

Characteristic ^a	No OLP (n=606)	OLP (n=303)	P Value
Age at index date, y			
Mean (SD)	55.4 (14.8)	55.4 (14.8)	
Median (IQR)	55.2 (45.3-64.8)	55.0 (45.5-64.9)	
Sex			
Female	394 (65.0)	197 (65.0)	
Male	212 (35.0)	106 (35.0)	
Race/ethnicity			.19
Unknown	20	26	
White	545 (93.0)	264 (95.3)	
Other	41 (7.0)	13 (4.7)	
Smoking status			.03
Never smoked	367 (60.6)	157 (51.8)	
Former	169 (27.9)	108 (35.6)	
Current	70 (11.6)	38 (12.5)	
Chewing tobacco use			.08
Unknown	4	1	
Never used	600 (99.7)	298 (98.7)	
Former	0 (0)	2 (0.7)	
Current	2 (0.3)	2 (0.7)	
Alcohol use			.09
None	194 (32.0)	102 (33.7)	
Occasional	354 (58.4)	159 (52.5)	
Frequent (daily or near-daily)	58 (9.6)	42 (13.9)	
History of hepatitis C	0 (0)	5 (1.7)	.004
History of immunosuppression	73 (12.0)	26 (8.6)	.11
Type of OLP			
Reticular		170 (56.1)	
Plaque		38 (12.5)	
Erosive		79 (26.1)	
Atrophic		1 (0.3)	
Bullous		6 (2.0)	
Other		9 (3.0)	

Abbreviations: IQR, interquartile range; OLP, oral lichen planus; SD, standard deviation.

^aValues are presented as number and percentage of patients unless specified otherwise.

Table 4.

Cumulative Incidence of Oral Squamous Cell Carcinoma Among Patients With OLP and Age- and Sex-Matched Patients Without OLP

Time After OLP Diagnosis or Index Date, y	No OLP (n=606)		OLP (n=303)	
	Patients Still at Risk, No.	Cumulative Incidence, % (95% CI)	Patients Still at Risk, No.	Cumulative Incidence, % (95% CI)
5	504	0.0 (0-0)	248	1.7 (0.2-3.3)
10	325	0.2 (0-0.7)	156	2.2 (0.4-4.2)
15	193	0.2 (0-0.8)	94	3.1 (0.6-5.7)
20	110	0.9 (0-2.5)	57	3.1 (0.6-6.4)

Abbreviation: OLP, oral lichen planus.

Table 5.

Location of Oral Squamous Cell Carcinoma Among Patients with OLP and Age- and Sex-Matched Referred Patients Without OLP Who Had Oral Squamous Cell Carcinoma

Location	No OLP, No. (%) ^a	OLP, No. (%) ^b
Buccal mucosa	0 (0)	2 (25)
Gingiva	1 (25)	1 (12.5)
Hard palate	0 (0)	1 (12.5)
Tongue	2 (50)	4 (50)
Soft palate	1 (25)	0 (0)

Abbreviation: OLP, oral lichen planus.

^aFour sites of 3 patients.

^bEight sites of 7 patients.