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Oral potentially malignant disorders – An assessment of knowledge and attitude to future education in undergraduate dental students

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Abstract

Introduction: The aim of this study was to assess the knowledge and clinical experience of oral potentially malignant disorders (OPMDs) in undergraduate dental students in six European countries (Croatia, France, Italy, Portugal, Spain and United Kingdom) and assess student's attitude and preference to future education on the topic. A secondary aim was to identify gaps in student's knowledge and clinical practice. The study was a part of the Erasmus+ project "Oral Potentially Malignant Disorders: Healthcare Professionals Training" (Grant No: 2020-1-UK01-KA202-078917).

Materials and Methods: An online questionnaire was distributed to all final-year students in six partner universities. This consisted of four parts assessing: (1) knowledge on OPMDs, (2) clinical experience with this group of patients, (3) self-rated competence in the management of OPMDs and (4) preferences with regard to future education.

Results: Two hundred and sixty final-year dental students from six partner universities responded to the questionnaire. Response rates varied from 12% to 92% between partner universities. Significant differences in clinical experience and knowledge were found between students. Students with more clinical exposure to OPMDs rated their knowledge and competence in the management of OPMDs higher than students with less clinical experience. The majority of students were interested in future education on OPMDs, preferably via short educational videos.

Conclusion: The majority of students have received theoretical knowledge of OPMDs during their undergraduate studies, however, not all had clinical exposure to this group of patients. Students were open to further education on OPMDs. Important deficiencies in knowledge were identified that need to be addressed and it is anticipated that

[Correction added on 20 September 2022 after first online publication: Affiliation 8 was updated in this version]

the e-learning platform and e-book that are in development by partner institutions will help to improve overall knowledge of OPMDs.

KEYWORDS
dental students, education, malignant transformation, oral cancer, oral potentially malignant disorders

1 | INTRODUCTION

Oral potentially malignant disorders (OPMDs) are defined as "any oral mucosal abnormality that is associated with a statistically increased risk of developing oral cancer".[1] OPMDs are a clinically heterogeneous group of disorders with different prevalence, clinical presentation, treatment modalities and malignant transformation rates (MTR). Due to the low prevalence of <1% in the general population, OPMDs are not frequently encountered amongst healthcare professionals (HCP), especially in general dental practice.[2] Because of their potentially serious clinical course, general dental practitioners (GDPs) need to possess the necessary knowledge and skills to recognise suspicious oral lesions and make an appropriate referral. Current literature suggests this is not the case amongst those currently practicing, as well as future GDPs. GDPs often lack knowledge on aetiology, risk factors, clinical appearance and treatment modalities, as well as the skills and experience to perform a clinical examination of the oral mucosa.[3–6] Although GDPs exhibit a higher level of knowledge and clinical skills than general medical practitioners on the topic, the need for further education and training is well recognised. A recent systematic review further emphasises this.[7]

Six university-based oral medicine units in Europe (King's College London, UK, CESPU University, Portugal, University of Bordeaux, France, University of Milan, Italy, University of Santiago de Compostela, Spain, and University of Zagreb, Croatia) engaged in an Erasmus+ project entitled "Oral Potentially Malignant Disorders Healthcare Professionals Training "(Grant No 2020-1-UK01-KA202-078917). The aim of this 2-year project (31 December, 2020, to 30 December, 2022) was to create an online resource/e-learning tool for healthcare professionals (HCPs) that will encompass all relevant aspects of OPMD patient management. The e-learning tool will consist of several modules covering the following topics: clinical presentation, diagnostic procedures, differential diagnoses, treatment and follow-up of OPMDs. The e-learning tool will be freely available to HCPs across Europe and accessible in all partner languages (English, French, Italian, Croatian, Portuguese and Spanish).

Prior to creating the e-learning tool, the investigators aimed to assess the current level of competence in OPMDs amongst future GDPs. The aim was to investigate the knowledge and clinical experience of OPMDs amongst undergraduate dental students with the secondary aim to identify deficiencies in knowledge and clinical practice to determine relevant training needs.

2 | MATERIALS AND METHODS

The study formed part of an Erasmus+ project "Oral Potentially Malignant Disorders: Healthcare Professionals Training "(Grant No 2020-1-UK01-KA202-078917). Ethical approval was obtained by the coordinator of this survey (University of Zagreb, Croatia) and internal ethics was approved by the remaining five universities involved. Final year dental students from all partner universities (King's College London, UK, CESPU University, Portugal, University of Bordeaux, France, University of Milan, Italy, University of Santiago de Compostela, Spain, and University of Zagreb, Croatia) participated in the survey.

The questionnaire was composed in a survey administration software (Google Forms®). The survey was anonymous and did not collect any personal data of participants. Prior to proceeding with the completion of the questionnaire, students were obliged to consent and confirm their understanding of the study aims. The participation in the survey was voluntary.

The questionnaire was designed based on similar questionnaires used in previous studies.[4,8–10] Questions were composed in several iterations until a consensus was reached by all partners.

The questionnaire consisted of four parts. In the first part, general data on demographics were collated (sex and country). In part 2, students considered their clinical experience and competence to diagnose OPMDs on a 5-point Likert scale (1 – poor, 5 – excellent and 1 – completely inadequate and 5 – completely adequate). In part 3, student attitude towards future education strategies on OPMDs, learning modalities and knowledge assessment was assessed by multiple-choice questions. In part 4, student knowledge of risk factors, clinical presentation, malignant transformation and classification of OPMDs were assessed by multiple-choice questions. Individual knowledge scores were calculated as a sum of correct answers from this section obtained by each student.

Data were organised on Microsoft Excel® and stored in a secure shared online folder (Google Drive®). "Find and Replace" function was used for data coding to eliminate errors that may have occurred with manual entry. SPSS® version 11 was used for statistical analysis (performed by VB). Kolmogorov–Smirnov test was used to assess the normality of distribution. Data were a non-normal distribution, therefore non-parametric methods were used for analysis. Nominal variables were expressed as proportions and continuous variables were expressed as median (interquartile range [IQR]). Differences between nominal variables were assessed by Chi-square test and differences between continuous variables were

assessed by Kruskal–Wallis or Mann–Whitney test, where appropriate. Spearman rank correlation was used to assess the relationship between individual knowledge and self-rated knowledge and competence with OPMDs. p value lower than .05 ($p < .05$) was considered statistically significant.

3 | RESULTS

3.1 | Demographics

Two hundred and sixty final-year dental students from six partner universities responded to the questionnaire. Response rates varied from 12% to 92% between partner universities (Table 1). Details on participants are presented in Table 1. Significant differences in sex were observed between countries ($p < .0001$). Females were most represented in Croatia (64; 92.8%) and least represented in France (25, 27.8%). Males were most represented in United Kingdom (13; 50%) and least represented in Croatia (5; 7.2%).

3.2 | Clinical experience in OPMDs

Student clinical experience is presented in Table 2. Almost all students (257/260; 98.8%) received teaching on the topic of OPMDs during their undergraduate dental education. Significant differences between countries were observed. The proportion of students who routinely performed a systematic oral soft tissue examination on patients ranged from 50% to 100%. One hundred sixty-five (65%) students had examined a patient with an OPMD. The proportion of students who have examined a patient with oral cancer ranged from 11.1% to 79.7%. Up to 82.6% (range 31.1%–82.6%) observed a biopsy of an oral lesion, up to 76.7% (range 11.1%–76.7%) assisted with a biopsy of an oral lesion and up to 42.9% (range 0%–42.9%) performed a biopsy of an oral lesion. Although the majority of students (190; 73.4%) would refer patients to an oral medicine department if they suspected an OPMDs, a statistically significant difference between countries was observed ($p < .0001$).

3.3 | Self-rated knowledge and competence in OPMD

Student perception of their own knowledge and competence in OPMDs is presented in Figure 1. On a 5-point Likert scale (1 = poor, 5 = excellent), students rated their current knowledge of risk factors and aetiology of OPMDs as very good (4) and knowledge on clinical features of OPMDs as good (3). Students rated their ability to identify and diagnose OPMDs as good (3) on a 5-point scale (1 = completely inadequate, 5 = completely adequate). A significant difference in self-perceived knowledge was observed between countries. A significant difference was also observed in relation to clinical experience. Those students who routinely performed a routine systematic examination of soft tissues on their patients, examined a patient with OPMD, examined a patient with oral cancer and who had observed, assisted or performed a biopsy of an oral lesion rated their knowledge and competence significantly higher than those students who did not participate in these clinical activities.

3.4 | Future education on the topic of OPMD

Data regarding future education strategies, learning modalities and assessment preferences are displayed in Table 3. The majority of students (252; 97.3%) expressed a desire for further education on OPMDs (range 88.5%–100%). Significant differences between countries were observed ($p = .046$). The preferred modality of learning was short (up to 5 min) videos. No significant difference in preferred modes of learning was observed amongst students from different countries ($p = .096$). The online quiz-based assessment was selected

TABLE 1 Structure of the survey respondents

Sex N (%)		Difference between males and females p
Male	75 (28.8)	N/A
Female	150 (57.7)	
Prefer not to say	35 (13.5)	
Country N (response rate %)		
Croatia	69 (72.6)	<.0001*
France	90 (91)	
Italy	43 (71.7)	
Portugal	14 (12)	
Spain	18 (45)	
United Kingdom	26 (15.8)	

*Significant difference ($p < .05$).

TABLE 2 Students' clinical experience with OPMD and the self-assessment of their knowledge and competence to diagnose an OPMD

Clinical experience	CR	FR	IT	PT	SP	UK	Total	*p*
During your university undergraduate education and training, did you learn about OPMD? *N* (%)								
Yes	69 (100)	90 (100)	43 (100)	14 (100)	18 (100)	23 (88.5)	257 (98.8)	NA
No	0	0	0	0	0	3 (11.5)	3 (1.2)	
Do you routinely perform systematic oral soft tissue? examination on your patients? *N* (%)								
Yes	50 (72.5)	45 (50)	31 (72.1)	10 (71.4)	18 (100)	21 (80.8)	175 (67.3)	<.0001*
No	19 (27.5)	45 (50)	12 (27.9)	4 (28.6)	0	5 (19.2)	85 (32.7)	
Have you ever examined a patient with OPMD? *N* (%)								
Yes	65 (94.2)	39 (43.3)	34 (79.1)	9 (64.3)	6 (33.3)	16 (61.5)	169 (65)	<.0001*
No	4 (5.8)	51 (56.7)	9 (20.9)	5 (35.7)	12 (66.7)	10 (38.5)	91 (35)	
Have you ever examined a patient with oral cancer? *N* (%)								
Yes	55 (79.7)	21 (23.3)	22 (51.2)	6 (42.9)	2 (11.1)	6 (23.1)	112 (43.1)	<.0001*
No	14 (20.3)	69 (76.7)	21 (48.8)	8 (57.1)	16 (88.9)	20 (76.9)	148 (56.9)	
Have you ever observed a biopsy procedure of an oral lesion? *N* (%)								
Yes	57 (82.6)	28 (31.1)	35 (81.4)	8 (57.1)	7 (38.9)	15 (57.7)	150 (57.7)	<.0001*
No	12 (17.4)	62 (68.9)	8 (18.6)	6 (42.9)	11 (61.1)	11 (42.3)	110 (42.3)	
Have you ever assisted a biopsy of an oral lesion? *N* (%)								
Yes	39 (56.5)	30 (33.3)	33 (76.7)	8 (57.1)	2 (11.1)	8 (30.8)	120 (46.2)	<.0001*
No	30 (43.5)	60 (66.7)	10 (23.3)	6 (42.9)	16 (88.9)	18 (69.2)	140 (53.8)	
Have you ever performed a biopsy of an oral lesion? *N* (%)								
Yes	1 (1.4)	3 (3.4)	7 (16.3)	6 (42.9)	0	4 (15.4)	21 (8.1)	<.0001*
No	68 (98.6)	86 (96.6)	36 (83.7)	8 (57.1)	18	22 (84.6)	239 (91.9)	
Do you think you are competent to diagnose an OPMD? *N* (%)								
Yes	54 (78.3)	45 (50)	19 (44.2)	5 (35.7)	16 (88.9)	10 (38.5)	149 (57.3)	<.0001*
No	15 (21.7)	45 (50)	24 (56.8)	9 (64.3)	2 (11.1)	16 (61.5)	111 (42.7)	
Where would you refer your patient if you suspected OPMD? *N* (%)								
Oral medicine	67 (97.1)	37 (41.1)	40(93)	9 (64.3)	17 (94.4)	20 (80)	190 (73.4)	<.0001*
Oral surgery	1 (1.4)	41 (45.6)	1 (2.3)	2 (14.3)	0	1 (4)	46 (17.8)	
Maxillofacial surgery	1 (1.4)	6 (6.7)	2 (4.7)	1 (7.1)	1 (5.6)	3 (12)	14 (5.4)	
ENT (ear nose and throat)	0	4 (4.4)	0	1 (7.1)	0	1 (4)	6 (2.3)	
Other	0	2 (2.2)	0	1 (7.1)	0	0	3 (1.2)	

* Significant difference ($p < .05$).

as the most preferred assessment method by 131/260 (50.4%) of students. A significant difference between countries was observed ($p < .0001$).

3.5 | Knowledge on OPMD – summary data

Student knowledge of OPMDs is displayed in Table 4. Oral leukoplakia (OL), lichen planus (OLP), erythroplakia and proliferative verrucous leukoplakia (PVL) were correctly classified as OPMDs by the majority of the students (242 (93.4%), 218 (83.8%), 219 (84.2%) and 220 (84.6%), respectively). Oral graft versus host disease (GVHD), oral lichenoid lesion (OLL), oral discoid lupus (DLE) and oral submucous fibrosis (OSF) were classified as OMPDs less frequently (36(13.8%), 72(27.7%), 68(26.2%) and 103(39.6%), respectively). Tobacco smoking was the only risk factor for the development of OPMD recognised by 100% of the students. Other risk factors including alcohol consumption, UV exposure and betel quid chewing were recognised by a smaller proportion of students (238/260 (93.3%), 204 (78.5%) and 202 (77.7%), respectively). One hundred seventy-three students (173/260; 66.8%) recognised all early signs of oral cancer. Students were most familiar with the malignant transformation rate (MTR) of OLP with 169/260 (61.6%) students. The correct MTR of OL and PVL was provided by 34.4% (88/260) and 16.9% (44/260). Betel quid chewing was recognised as the main aetiological factor for the development of OSF by 36.7% (95/260) of students. The lower lip as the most common site for the development of actinic cheilitis was recognised by 75.1% (193/280) of students. With regards to risk factors for malignant transformation of OL, non-homogenous appearance was recognised by the greatest

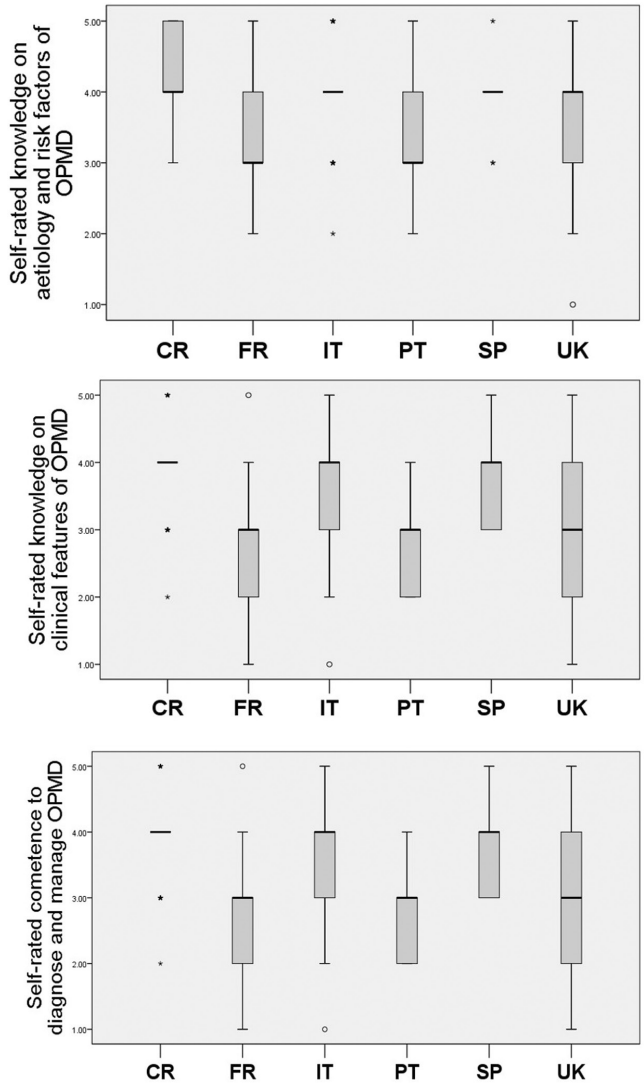

FIGURE 1 Self-rated knowledge and competence on OPMD – the difference between countries

proportion (245;94.6%), whilst female sex was the risk factor recognised by the lowest proportion of the students (148; 57.1%). A smaller subset of students correctly labelled severe dysplasia and invasive carcinoma as the most common histological findings in oral erythroplakia (134/260; 51.5% and 73/260; 28.1%, respectively). One hundred and fifty students (150/260; 58.4%) were correct on the most common clinical presentation of DLE as radiating hyperkeratosis with central atrophy. Significant differences between countries were found in almost all responses.

3.6 | Individual knowledge of OPMD

Individual knowledge was expressed as a sum of all correct answers obtained by each individual student. The total score was 25. The minimum individual knowledge score obtained by a student was seven and the maximum individual score was 24. The median individual knowledge score was 16 (14–18). Significant differences between countries were observed ($p < .0001$) (Figure 2).

A significant difference in knowledge scores was found in relation to clinical experience with OPMDs: students who routinely performed soft tissue oral examination had higher knowledge compared to those not undertaking this activity (17 (14–19) vs. 15 (14–16); $p < .0001$), students who examined a patent with OPMDs had higher knowledge compared to students who did not(16 (14–19) vs. 15 (13–17); $p < .0001$), students who examined a patient with oral cancer OPMD had higher knowledge compared to students who did not (17 (14–19) vs. 15 (14–17); $p = .004$) and students who observed a biopsy of an oral lesion had a higher level of knowledge compared to students who did not undertake this activity (16 (15–18.75) vs. 15 (13–17); $p = .001$). There was no significant difference between students who assisted in a biopsy of an oral lesion compared to those who had not (16 (14–18) vs. 14 (15–18); $p = .055$). Students who felt competent to diagnose an OPMDs had higher knowledge compared to students who did not feel competent to diagnose an OPMDs (17 (15–19) vs. 15 (13–17); $p < .0001$).

3.7 | Relationship of individual knowledge score and self-rated knowledge and competence with OPMD

A statistically significant correlation between individual knowledge score and self-rated knowledge on aetiology and risk factors for OPMDs ($r = .398$; $p < .0001$) was found. A statistically significant correlation between individual knowledge score and self-rated knowledge on aetiology and clinical features of OPMDs ($r = .468$; $p < .0001$) was also found. Finally, a statistically significant correlation between individual knowledge score and self-rated competence to identify and diagnose an OPMDs ($r = .412$; $p < .0001$) was observed (Table 5).

4 | DISCUSSION

To our knowledge, this is the first international study assessing knowledge, competence and educational preferences on OPMDs. Previous studies that assessed knowledge and/or competence of dental practitioners or undergraduate dental students were performed in a single university or a single country.[6,8–12] This study revealed significant differences amongst European countries regarding student knowledge and clinical experience on OPMDs. Moreover, this study identified important deficiencies in the knowledge that will need to be addressed in further education strategies and curriculum design.

The majority of students (257/260; 98.8%) stated they received teaching on the topic of OPMDs during their undergraduate education and training. Based on our results, one-third of students were not clinically exposed to OPMD. Almost two-thirds (169/260; 65%) encountered an OPMD patient during their clinical training and less

TABLE 3 Future education on OPMD preferences

	CR	FR	IT	PT	SP	UK	Total	*p*
Are you interested in updating your knowledge and skills about the diagnosis and management of OPMDs? *N* (%)								
Yes	69 (100)	88 (97.8)	40 (97.8)	14 (100)	18 (100)	23 (88.5)	252 (97.3)	.046*
No	0	2(2.2)	2 (4.8)	0	0	3 (11.5)	7 (2.7)	
Out of the listed modes of learning, which mode would you prefer the most? *N* (%)								
Hard copy information (Information leaflets, books, etc)	10 (14.5)	8 (8.9)	4 (9.5)	2 (14.3)	2 (11.1)	0	26 (10.1)	.096
Media information (including social media)	4 (5.8)	2 (2.2)	4 (9.5)	0	0	1 (4)	11 (4.3)	
Peer-reviewed/evidence-based articles	3 (4.3)	2 (2.2)	1 (2.4)	0	2 (11.1)	0	8 (3.1)	
Digital books	2 (2.9)	1 (1.1)	1 (2.4)	0	1 (5.6)	1 (4.)	6 (2.3)	
Infographics	0	2 (2.2)	1 (2.4)	1 (7.1)	0	2 (8)	6 (2.3)	
Face-to-face lectures	10 (14.5)	19 (21.1)	6 (14.3)	7 (50)	4 (22.2)	3 (12)	49 (19)	
Online synchronous lectures	6 (8.7)	2 (2.2)	5 (11.9)	2 (14.3)	0	1 (4)	16 (6.2)	
Online asynchronous lectures	2 (2.9)	3 (3.3)	6 (14.3)	0	1 (5.6)	2 (8)	14 (5.4)	
Online workshops/seminars	5 (7.2)	8 (8.9)	1 (2.4)	1 (7.1)	2 (11.1)	1 (4)	18 (7)	
Case-based quizzes	10 (14.5)	18 (20)	2 (4.8)	0	3 (16.7)	5 (20)	38 (14.7)	
Short (up to 5 min.) educational videos (video portal)	17 (24.6)	25 (27.8)	11 (26.2)	1 (7.1)	3 (16.7)	9 (36)	66 (25.7)	
How would you like to assess your learning outcomes? *N* (%)								
Face-to-face assessment by tutor	19 (27.5)	29 (32.2)	14 (32.6)	9 (64.3)	10 (55.6)	4 (15.4)	85 (32.7)	<.0001*
Online quiz-based assessment	39 (56.5)	48 (53.3)	15 (34.9)	3 (12.4)	5 (27.8)	21 (80)	131 (50.4)	
Peer assessment	0	7 (7.8)	10 (23.3)	0	1 (5.6)	0	18 (6.9)	
Self-assessment	11 (15.9)	6 (6.7)	4 (9.3)	2 (14.3)	2 (11.1)	1 (3.8)	26 (10)	

* Significant difference ($p < .05$).

TABLE 4 Knowledge on OPMD – summary data

	CR	FR	IT	PT	SP	UK	Total	*p*
Which of the following are classified as OPMDs (according to the latest definition criteria)? *N* (%)								
Leukoplakia	68 (98.6)	82 (91.1)	41 (95.3)	11 (78.6)	18 (100)	22 (88)	242 (93.4%)	.042*
Nicotinic stomatitis / palatitis / smoker's palate	2 (2.9)	16 (17.8)	4 (9.3)	3 (21.4)	7 (38.9)	8 (30.8)	40 (15.4)	<.0001*
Oral lichen planus	68 (98.6)	64 (71.1)	41 (95.3)	11 (78.6)	14 (77.8)	20 (76.9)	218 (83.8)	<.0001*
Oral lichenoid lesion	7 (10.1)	22 (24.4)	21 (48.8)	5 (35.7)	6 (33.3)	11 (42.3)	72 (27.7)	<.0001*
Frictional keratosis	4 (5.8)	2 (2.2)	2 (4.7)	2 (14.3)	0	3 (11.5)	13 (5)	.193
Oral discoid lupus	110 (14.5)	32 (35.6)	7 (16.3)	3 (21.4)	10 (55.6)	6 (23.1)	68 (26.2)	.002*
Chronic traumatic ulcer	34 (49.3)	8 (8.9)	6 (14)	5 (35.7)	6 (33.3)	4 (15.4)	63 (24.2)	<.0001*
Oral submucous fibrosis	44 (63.8)	10 (11.1)	17 (39.5)	4 (28.6)	9 (50)	19 (73.1)	103 (39.6)	<.0001*
Actinic cheilitis	61 (88.4)	59 (65.6)	16 (37.2)	5 (35.7)	16 (88.9)	7 (29.6)	164 (63.1)	<.0001*
Erythroplakia	69 (100)	62 (68.9)	42 (97.7)	13 (92.9)	16 (88.9)	17 (65.4)	219 (84.2)	<.0001*
Chronic hyperplastic candidiasis	23 (33.3)	6 (6.7)	7 (16.3)	1 (7.1)	9 (50)	10 (38.5)	56 (21.5)	<.0001*
Proliferative verrucous leukoplakia	55 (79.7)	82 (91.1)	39 (90.7)	11 (78.6)	15 (83.3)	18 (69.2)	220 (84.6)	.061
Pseudomembranous candidiasis	4 (5.8)	4 (4.4)	5 (11.6)	0	5 (27.8)	4 (15.4)	22 (8.5)	.012*
Graft versus host disease	3 (4.3)	13 (14.4)	12 (27.9)	2 (14.3)	2 (11.1)	4 (15.4)	36 (13.8)	.028*
Which of the followings are risk factors for OPMD? Select four options *N* (%)								
Tobacco smoking	69 (100)	90 (100)	43 (100)	14 (100)	18 (100)	26 (100)	260 (100)	N/A
Betel quid chewing	49 (71)	74 (82.2)	32 (74.4)	6 (42.9)	16 (88.9)	25 (96.2)	202 (77.7)	.002*
Chronic trauma	49 (71)	8 (8.9)	25 (58.1)	9 (64.3)	10 (55.6)	6 (23.1)	107 (41.2)	<.0001*
UV exposure	49 (71)	84 (93.3)	25 (58.1)	11 (78.6)	15 (83.3)	20 (76.9)	204 (78.5)	<.0001*
Ill-fitting dentures	10 (14.5)	4 (4.4)	10 (23.3)	5 (35.7)	2 (11.1)	0	31 (11.9)	.001*
Alcohol consumption	62 (88.9)	88 (97.8)	37 (86)	13 (92.9)	15 (83.3)	23 (88.5)	238 (93.3)	.007*
Chronic periodontal disease	3 (4.3)	7 (7.8)	4 (9.3)	3 (21.4)	1 (5.6)	1 (3.8)	19 (7.3)	.322
Which of the following mucosal lesions can be considered an early sign of oral cancer? *N* (%)								
Red patch	1 (1.5)	6 (6.7)	4 (9.3)	1 (7.1)	0	1 (3.8)	13 (5)	<.0001*
Non-healing ulcer	2 (2.9)	32 (35.6)	6 (14)	3 (21.5)	3 (16.7)	3 (11.5)	49 (18.9)	
Red and white patch	6 (8.8)	2 (2.2)	0	0	0	0	8 (3.1)	
Granulated mucosal appearance	0	3 (3.3)	0	0	0	0	3 (1.2)	
Hardness on palpation	0	11 (12.2)	1 (2.3)	1 (7.1)	0	0	13 (5)	
All the above	59 (86.8)	36 (40)	32 (74.4)	9 (64.3)	15 (83.3)	22 (84.6)	173 (66.8)	
What is the annual malignant transformation rate of oral lichen planus? *N* (%)								

(Continues)

TABLE 4 (Continued)

	CR	FR	IT	PT	SP	UK	Total	*p*
<1%	55 (79.7)	46 (51.1)	29 (67.4)	4 (30.8)	8 (44.4)	17 (68)	169 (61.6)	.003*
6%–10%	12 (17.4)	36 (40)	10 (23.3)	5 (38.5)	7 (38.9)	7 (28)	77 (29.9)	
10%–15%	2 (2.9)	7 (7.8)	4 (9.3)	3 (23.1)	3 (16.7)	1 (4)	20 (7.8)	
>20%	0	1 (1.1)	0	1 (7.7)	0	0	2 (0.8)	
What is the annual malignant transformation rate of oral leukoplakia? *N* (%)								
1%–2%	30 (43.5)	16 (17.8)	23 (53.5)	3 (21.4)	2 (11.1)	15 (60)	89 (34.4)	<.0001*
5%–10%	32 (46.4)	42 (46.7)	13 (30.2)	6 (42.9)	9 (50.9)	7 (28)	109 (42.1)	
10%–20%	5 (7.2)	26 (28.9)	6 (14)	4 (28.6)	5 (27.8)	2 (8)	48 (18.5)	
20%–50%	2 (2.9)	6 (6.7)	1 (2.3)	1 (7.1)	2 (11.1)	1 (4)	13 (5)	
What proportion of patients diagnosed with proliferative verrucous leukoplakia (PVL) eventually develop oral cancer? *N* (%)								
5%	9 (13)	37 (41.1)	8 (18.6)	2 (14.3)	5 (27.8)	6 (23.1)	67 (25.8)	.008*
10%	34 (49.3)	18 (20)	14 (32.6)	5 (35.7)	4 (22.2)	6 (23.1)	81 (31.2)	
25%	17 (24.6)	19 (21.1)	14 (32.6)	5 (35.7)	4 (22.2)	9 (34.6)	68 (26.2)	
>50%	9 (13)	16 (17.8)	7 (16.3)	2 (14.3)	5 (27.8)	5 (19.2)	44 (16.9)	
What is the main aetiologic factor for the development of submucous fibrosis? *N* (%)								
Tobacco smoking	6 (8.7)	22 (24.4)	9 (20.9)	3 (21.4)	4 (22.2)	5 (20)	49 (18.9)	<.0001*
Betel quid chewing	44 (63.8)	6 (6.7)	19 (44.2)	2 (14.3)	7 (38.9)	17 (68)	95 (36.7)	
Chronic trauma	10 (14.5)	34 (37.8)	8 (18.6)	9 (64.3)	7 (38.9)	2 (8)	70 (27)	
UV exposure	0	4 (4.4)	0	0	0	0	4 (1.5)	
Ill-fitting dentures	7 (10.1)	21 (23.3)	7 (16.3)	0	0	1 (4)	36 (13.9)	
Alcohol consumption	1 (1.4)	3 (3.3)	21 (23.3)	0	0	0	4 (1.5)	
Chronic periodontal disease	1 (1.4)	0	3 (3.3)	0	0	0	1 (0.4)	
Actinic cheilitis most commonly affects which of the following sites? *N* (%)								
Lower lip	64 (92.8)	62 (68.9)	26 (61.9)	10 (71.4)	18 (100)	13 (54.2)	193 (75.1)	<.0001*
Upper lip	4 (5.8)	9 (10)	2 (4.8)	1 (7.1)	0	7 (29.2)	23 (8.9)	
Both lips equally	1 (1.4)	19 (21.1)	14 (33.3)	3 (21.4)	0	4 (16.7)	41 (16)	
Which of the following are risk factors for malignant transformation of oral leukoplakia? Select 4 options. *N* (%)								
Female sex	46 (66.7)	50 (55.6)	20 (46.5)	10 (71.4)	15 (83.3)	7 (28)	148 (57.1)	.02*
Non-homogenous appearance	66 (95.7)	84 (93.3)	42 (97.7)	13 (92.9)	18 (100)	22 (88)	245 (94.6)	.484
Size	57 (82.6)	67 (74.4)	35 (81.4)	10 (71.4)	18 (100)	23 (92)	210 (81.1)	.085
Localisation on the floor of the mouth	66 (95.7)	66 (73.3)	40 (93)	14 (100)	18 (100)	20 (80)	224 (86.5)	<.0001*
Localisation on the hard palate	4 (5.8)	20 (22.2)	8 (18.6)	3 (21.4)	0	9 (36)	44 (17)	.003*
Homogenous appearance	2 (2.9)	2 (2.2)	0	1 (7.1)	0	1 (4)	6 (2.3)	.653
Male sex	20 (29)	15 (16.7)	15 (34.9)	2 (14.3)	3 (16.7)	11 (44)	66 (25.5)	.031*

TABLE 4 (Continued)

	CR	FR	IT	PT	SP	UK	Total	p
Which of the following are the most common histological findings in oral erythroplakia? Select two options. *N* (%)								
Moderate dysplasia	20 (29)	35 (38.9)	26 (60.5)	5 (35.7)	9 (50)	12 (46.2)	107 (41.2)	.034*
Severe dysplasia	50 (72.5)	39 (43.3)	24 (55.8)	7 (50)	11 (61.1)	3 (11.5)	134 (51.5)	<.0001*
Invasive carcinoma	33 (47.8)	21 (23.3)	10 (23.3)	4 (28.6)	2 (11.1)	3 (11.5)	73 (28.1)	.001*
Hyperkeratosis	12 (17.4)	19 (21.1)	3 (7)	4 (28.6)	5 (27.8)	9 (34.6)	52 (20)	.084
Mild dysplasia	5 (7.2)	23 (25.6)	11 (25.6)	2 (14.3)	3 (16.7)	11 (42.3)	55 (21.2)	.004*
None of the above	0	5 (5.6)	1 (2.3)	1 (7.1)	2 (11.1)	3 (11.5)	12 (4.6)	.118
What is the most common clinical presentation of discoid lupus in the oral and perioral region? *N* (%)								
Radiating hyperkeratosis with central atrophy	60 (80.7)	34 (38.2)	28 (66.7)	3 (21.4)	15 (83.2)	10 (40)	150 (58.4)	<.0001*
White patch	1 (1.4)	18 (20.2)	4 (9.5)	0	1 (5.6)	1 (4)	25 (9.7)	
Red patch	3 (4.3)	9 (10.1)	5 (11.9)	5 (35.7)	1 (5.6)	3 (12)	26 (10.1)	
White reticular lesion	4 (5.8)	26 (29.2)	3 (7.1)	6 (42.9)	1 (5.6)	9 (36)	49 (19.1)	
None of the above	1 (1.4)	2 (2.2)	2 (4.8)	0	0	2(8)	7 (2.7)	

* Significant difference ($p < .05$).

than half (112/260; 43.1%) had examined a patient with oral cancer. Similar studies have reported differences in student exposure to OPMD patients (19.4%–79%) and oral cancer (14.7%–20%).[9,10] Our study demonstrated over half of students observed (150/260; 57.7%) or assisted in a biopsy of an oral lesion (120/260; 46.2%) which correlates with other studies.[9,10] Few students performed an intraoral biopsy (8.1%), however, this varied significantly between countries (0%–42.9%). These findings highlight the need for students to have more clinical exposure to OPMD patients since this significantly impacts on confidence level in the management of OPMD and/or oral cancer patients.[11,12] In this study, students with more clinical experience rated their competence to diagnose and manage OPMDs higher than students who did not take part in these clinical activities. Our results demonstrate the need to emphasise the importance of routine oral soft tissue examination as this was performed by only 67.3% (175/260). This may be due to the large focus on dentition and supporting structures during undergraduate training. Similar studies amongst dental students revealed routine examination of oral mucosa was completed by 98%–99% of dental students.[8,12] Amongst GDPs, routine examination of the oral mucosa was performed by 11%–99%.[7] Since GDPs may be the first healthcare provider to detect a suspicious oral lesion, examination of the oral mucosa should be routinely performed at every routine dental appointment. This project emphasises the importance of systematic examination of oral mucosa in every patient. Similar to other studies, oral medicine was the specialty most commonly selected as a point of referral.[8,12] Significant differences in referral patterns in this study may be attributed to oral medicine not being a formally recognised dental specialty in some of the partner countries by their respective regulatory bodies.

Despite differences between countries, the majority of students (88.5%–100%) stated they wanted to expand their knowledge with further education on OPMDs. This is promising since almost half of them (111;42.7%) stated that they do not feel competent in diagnosing an OPMD. Unlike other studies assessing learning modalities in oral cancer where information packs were the most popular learning

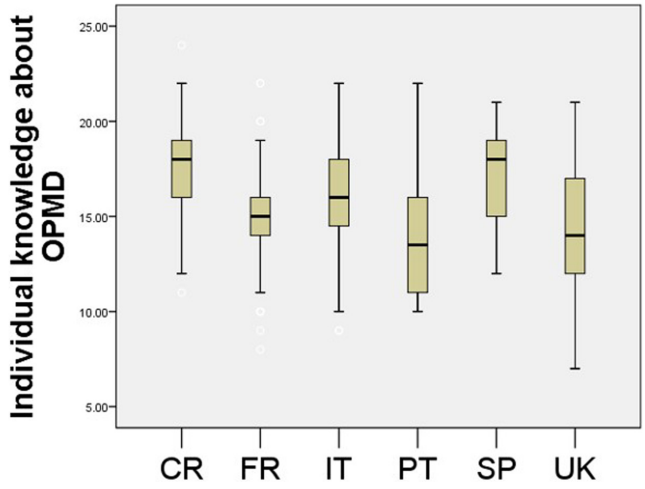

FIGURE 2 Individual students' knowledge about OPMD – the difference between countries

TABLE 5 Correlation between individual knowledge score and self-rated knowledge and competence with OPMD

	Correlation with individual knowledge (*r*)	*p*
How would you rate your current knowledge about the risk factors and aetiology of OPMD? (1 – poor and 5 – excellent)	.398	<.0001*
How would you rate your current knowledge about the clinical features of OPMD? (1 – poor and 5 – excellent)	.468	<.0001*
On a scale 1–5 (1 – completely inadequate and 5 – completely adequate), how would you rate your competence level to identify and diagnose an OPMD?	.412	<.0001*

* Significant difference ($p < .05$).

modality, video portal was selected as the preferred modality of delivery.[8,12] There is an expanding body of evidence suggesting that video material can enhance the learning process in medicine and facilitates the adaptation of course and curriculum material.[13,14] This mode of knowledge delivery is very popular amongst students and patients, although the quality of content may be variable.[15–17]

Regarding knowledge of OPMDs, important deficiencies in knowledge were identified. The majority of students correctly identified OL, OLP, oral erythroplakia and PVL as OPMDs. Similar to other studies, OL was the most common OPMD identified.[10] Knowledge on less frequent OPMDs such as DLE, OLL and GVHD was found to be lacking. The goal of our e-learning platform will be to emphasise the importance of these conditions. Knowledge of the clinical presentation of OPMDs and oral cancer was good, with the majority of students answering correctly on the clinical presentation of oral cancer, DLE and actinic cheilitis. Conversely, knowledge on histology of OPMDs was found to be deficient, and only a smaller subset of students correctly identified the two most common histologic features of oral erythroplakia, i.e., severe dysplasia (134; 51.5%) and invasive carcinoma (73; 28.1%).

Students were knowledgeable on aetiology and risk factors for OPMDs. Tobacco smoking and alcohol consumption were identified as risk factors by 100% and 93.3% respectively. This is not surprising due to their well-known roles as carcinogenic agents in the oral cavity.[18] Similar results were obtained in a study by Carter et al.[12] Chronic trauma was identified as a risk factor for OPMDs by a significant proportion of the students (41.2%) and also as a main aetiological factor of OSF by 27% of the students, although there is no evidence of an association between chronic trauma and any OPMDs.[1] A recent systematic review showed low evidence to support an association between chronic trauma and oral cancer.[19] Betel quid chewing was identified as the main aetiological factor for the development of OSF by a smaller subset of students (95; 36.7%), which may be explained by the rarity of OSF in Europe.[20]

Knowledge of the malignant transformation of OPMDs was found to be homogenously deficient. Students were familiar with the annual MTR of OLP, however, tended to overestimate the annual MTR of OL and underestimate the MTR of PVL. Again, the latter may be due to the rarity of PVL and lack of exposure to this condition.[21,22] Knowledge of risk factors for MTR of OL was good with the majority of students correctly identifying non-homogenous appearance (245;94.6%), size (210;81.1%) and localisation on the floor of the mouth (224;86.5%) as risk factors for malignant transformation. Female sex was identified as a risk factor by 57.1%. A recent systematic review found only female sex, non-homogenous appearance and the presence of epithelial dysplasia to be risk factors for malignant transformation of OL. Students had completed their oral medicine course before this review was published.[23]

Our results indicate that there is an association between individual knowledge and clinical exposure to OPMDs. Students who were exposed to OPMDs and oral cancer, who assisted biopsy of an oral lesion, had higher knowledge compared to those who were not exposed to these groups. Clinical exposure is known to positively impact student learning motivation, increasing adoption of the course material and provide an opportunity to learn professional behaviour.[24,25] Individual knowledge correlated with self-rated knowledge and confidence in OPMD management. This finding suggests that additional training in OPMDs can have a positive impact not only on theoretical knowledge but also on student confidence in OPMD management.

Our study has several limitations. The response rate was low in some countries and may not be representative of all undergraduate students in correspondent universities. We can only speculate on the reason(s) for this. The survey was distributed in June, July and September which may have coincided with student examinations and the holiday period. Low response rates may have been improved by more frequent reminder emails and personal communication with students. A prolonged period since local oral medicine teaching and distribution of the questionnaire may have impacted student willingness to participate. Nonetheless, the results will allow us to focus on education strategies to adequately address gaps in knowledge and increase interest and confidence in OPMD management.

5 | CONCLUSION

In conclusion, this study demonstrates dental undergraduate curriculums in Europe incorporate teaching on OPMD, however, not all students have clinical experience in assessing this cohort of patients. There is a need for dental schools to increase clinical exposure to OPMD as this greatly influences student confidence in

OPMD detection and management. Our analysis demonstrates that students are keen for further education, preferably with the use of modern technologies, to enhance the learning process and facilitate content adaptation. Important deficiencies in knowledge were identified that will be addressed in the e-learning platform.

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[Correction added on 20 September 2022 after first online publication: Logo (Co-funded by the Erasmus+Programme of the European Union) was added in this version]

CONFLICT OF INTEREST

None to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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