Original Article

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# A multi-center retrospective analysis of oral and maxillofacial lesions in the southernmost region of Thailand

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**Objectives:** This multi-center retrospective study aimed to analyze the demographic distribution, lesion characteristics, and referral patterns of oral and maxillofacial lesions (OMFLs) in Thailand's three southernmost provinces.

**Materials and Methods:** Histopathologically confirmed OMFLs diagnosed from 2018-2024 were reviewed using records of four public hospitals representing Thailand's healthcare system tiers. Lesions were categorized as soft tissue lesions (STLs) or odontogenic and maxillofacial bone tumors (OMBTs), and analyzed by age, sex, anatomical site, and referral level. Statistical analyses included the Mann–Whitney U test and Pearson's Chi-Square test ($p < 0.05$).

**Results:** A total of 512 OMFLs were identified. STLs (53.7%) slightly outnumbered OMBTs (46.3%). Patients with STLs were significantly older than those with OMBTs (median age: 46 [IQR 23-60] vs. 28 [IQR 19-44] years; $p < 0.001$). The most common STLs were mucosal and soft tissue tumors, particularly irritation fibroma (IF) in the buccal mucosa and pyogenic granuloma (PG) in the gingiva. IF was predominant in patients over 40, while PG mainly affected those under 40. Mucoceles were the most frequent salivary gland lesions in younger patients. Jaw cysts were the most common OMBTs, with radicular cysts more prevalent in the maxilla and dentigerous cysts in the mandible. Ameloblastoma, primarily found in the mandible, was the most frequent odontogenic tumor. Within the four-tier healthcare system of the study area, complex cases tended to escalate to higher tiers. All oral cancer (OC) cases appeared at provincial hospitals (third-tier), as at the regional (highest) level they were diverted to ENT, reflecting interdepartmental separation of case management.

**Conclusions:** OMFLs in this region show distribution patterns consistent with previous reports. Progressive management trends reflect Thailand's structured referral system. Lower-tier hospitals can aid OC control through early detection and gatekeeping referral, while bridging interdepartmental gaps may strengthen OC case coordination at the regional level.

**Keywords:** healthcare referral system, oral and maxillofacial lesions, southern Thailand

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## Introduction

Oral and maxillofacial lesions (OMFLs) encompass a broad spectrum of conditions, ranging from benign to malignant, affecting individuals across all age groups [1]. Accurate diagnosis and effective management are essential due to their significant impact on patients' quality of life [2]. Although numerous epidemiological studies have documented the distribution and frequency of histologically confirmed OMFLs worldwide [3–5], most available data are derived from university or teaching hospitals, leading to a paucity of information from government public hospitals.

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In Thailand, the management of OMFLs follows a structured, hierarchical referral system under the supervision of the Ministry of Public Health (MOPH). This system comprises four levels of care: primary health centers (first level, focused on health promotion), district hospitals (second level), provincial or general hospitals (third level), and regional hospitals (fourth level), with increasing specialization at higher levels [6]. In cases of severe disease—particularly advanced oral cancer (OC; plural, OCs)—patients may bypass the standard referral pathway and seek specialized care directly at regional hospitals, university hospitals, or private providers. Treatment for OMFLs is covered under Thailand's Universal Health Coverage Scheme (UCS) when accessed through healthcare facilities under the MOPH. However, access to university hospitals—which operate outside the conventional referral network—typically requires a referral letter to receive public coverage, while care at private hospitals involves out-of-pocket payment. The choice of facility is influenced by factors such as symptom severity, urgency, perceived clinical expertise, and financial capacity [6, 7].

Since 2019, the MOPH has mandated screenings for oral potentially malignant disorders (OPMDs) in dental patients over 40 years of age to promote early detection and timely intervention [8]. This initiative aims to enhance the identification of suspicious lesions and improve treatment outcomes. Supporting this policy, a study at the largest university hospital in southern Thailand reported a reduction in patient delays for OC treatment, attributed to improved access under the UCS [9].

While the etiology of many OMFLs remains unclear, developmental anomalies and inflammatory processes are commonly implicated [10]. In contrast, risk factors for OC are well established [10,11]. Notably, research in Thailand's southernmost province revealed that high-risk individuals—particularly in predominantly Muslim communities—often lack awareness of these risks and prefer traditional remedies over modern medical treatment [12].

This retrospective study analyzed histopathologically confirmed OMFLs diagnosed between January 2018 and December 2024 at four public hospitals located in Thailand's three southernmost provinces: Yala, Pattani, and Narathiwat. The participating institutions included Yala Regional Hospital (YRH), Pattani Provincial Hospital (PPH), Naradhiwasrajanagarindra Provincial Hospital (NPH), and Yi-Ngo District Hospital (YDH), each representing a distinct level within the national healthcare referral system. YDH was the only district-level facility in the region that routinely performed diagnostic biopsies during the study period, primarily handling uncomplicated soft tissue lesions referred from surrounding district hospitals. More complex cases were referred to NPH, which served as a provincial referral center in Narathiwat. PPH functioned as the main referral center for Pattani Province, while YRH operated as both a secondary and tertiary care center, receiving referrals from district hospitals and advanced cases from both PPH and NPH.

This southern border region, located along the Thai-Malaysian border, is predominantly inhabited by Thai Malay Muslims (over 90%), most of whom are ethnic Malays. This contrasts with the national population, which is over 90% Thai Buddhist. The local community is bilingual, speaking both the Patani Malay dialect and official Thai, while maintaining distinct cultural and religious traditions. Since 2004, the area has experienced ongoing insurgency, which has significantly disrupted daily life and strained healthcare services. This population represents a unique socio-cultural and conflict-affected

context, differing notably from other parts of the country in terms of religion, ethnicity, language, and healthcare access [13].

This study aimed to map the epidemiology of OMFLs to support the development of targeted public health interventions. Specifically, the objectives were to:

(1) describe the demographic characteristics of patients diagnosed with OMFLs and compare the mean or median ages across lesion subgroups—soft tissue lesions (STLs) and odontogenic and maxillofacial bone tumors (OMBTs) [14]

(2) examine associations between lesion types within these two subgroups and variables such as gender, age group, and anatomical location; and

3) assess the distribution patterns of OMFLs across the participating hospitals, categorized by referral tier levels within the government healthcare system in the southernmost region of Thailand.

## Materials and Methods

Histopathological records were retrieved from both paper-based archives and electronic databases. Only biopsies obtained from the four participating dental departments were included, while oral biopsies performed by other departments were excluded to maintain data consistency and diagnostic uniformity. Extracted variables included patient demographics, anatomical site of the lesion, and histopathological diagnosis. For cases involving incisional biopsies, surgical specimens, or recurrent lesions, only a single diagnosis per case was included. All data were anonymized prior to analysis. Ethical approval was obtained from the research ethics committees of YRH (No. 23/2567), PPH (No. PTN-012-2567), and the Narathiwat Provincial Public Health Office (No. 07/2567), which oversees both NPH and YDH.

OMFLs were categorized into two major groups: STLs and OMBTs. STLs included mucosal and soft tissue tumors (MSTs), salivary gland tumors (SGTs), non-infective stomatitis (NIS), and OCs. OMBTs included jaw cysts (JCs), odontogenic tumors (ODTs), giant cell lesions and bone cysts, as well as bone and cartilage tumors. OMBTs were classified using the 2022 World Health Organization (WHO) Classification of Head and Neck Tumors [14]. Due to the small number of cases in the 'giant cell lesion and bone cyst' category, these were grouped under a broader category referred to as 'giant cell lesion/bone and cartilage tumors (GCL/BCTs)' for analysis. STLs were classified according to anatomical origin and pathological features, following standard oral pathology conventions. Lesions that did not fit recognized diagnostic categories were placed in a 'miscellaneous (MIS)' category, comprising 39 unclassified soft tissue and 51 OMBTs cases.

Statistical analysis was conducted using R (version 4.5.1). Descriptive statistics, including frequencies, percentages, and male-to-female ratios, were used to summarize the data. Age, the only continuous variable, was tested for normality using the Shapiro–Wilk test. If the *p*-value was greater than 0.05, age was considered normally distributed, and the mean and standard deviation (SD) were reported; otherwise, the median and interquartile range (IQR) were used. Differences in age between groups were assessed using the independent samples t-test or the Mann–Whitney U test, depending on the normality of the data. Associations between lesion types and categorical variables—such as gender, age group (<40 vs. >40 years), and anatomical site—were analyzed using Pearson's Chi-Square test. A $p$-value $<0.05$ was considered statistically significant.

## Results

Between 2018 and 2024, a total of 532 histopathologically confirmed OMFL cases were identified across four public hospitals. Fifteen cases were excluded due to incomplete diagnostic data—primarily from paper-based records—and five entries were excluded as non-diagnostic or incidental findings, comprising three fragments of bone and dentine, one torus, and one dental follicle. After these exclusions, a final cohort of 512 cases was included in the analysis. The excluded cases were distributed as follows: 1 from YDH, 2 from NPH, 7 from PPH, and 10 from YRH. All histopathological diagnoses were confirmed by board-certified pathologists. Specifically, NPH, PPH, and YDH submitted specimens to oral pathologists affiliated with the Faculty of Dentistry, Prince of Songkla University, while YRH relied on anatomical pathologists affiliated with its own hospital laboratory.

The Shapiro–Wilk test indicated that the age data were not normally distributed ($W = 0.966$, $p < 0.001$). Consequently, the mean and standard deviation (SD) were omitted, and age was reported using the median and interquartile range (IQR).

Among the four hospitals, YRH accounted for the largest proportion of cases (n = 212; 41.4%), followed by NPH (n = 159; 31.1%), PPH (n = 92; 18.0%), and YDH (n = 49; 9.6%). The cohort comprised 311 females (60.7%) and 201 males (39.3%), yielding a male-to-female ratio of 0.65:1. Patient ages ranged from 6 days to 98 years, with a median age of 35.5 years (IQR: 21–54).

Of the 512 lesions analyzed, 275 (53.7%) were STLs, and 237 (46.3%) were OMBTs. The median age of patients with STLs was 46 years (IQR: 23–60), which was significantly higher than that of patients with OMBTs, who had a median age of 28 years (IQR: 19–44), as determined by the Mann–Whitney U test ($p < 0.001$; Table 1).

**Table 1** Patient demographics and age difference between diagnostic groups

| Diagnostic group | Diagnostic category | N | Median age (IQR) (years) | Age range (years) | M:F ratio | *p* value |
|---|---|---|---|---|---|---|
| STLs | | 275 | 46 (23–60) | 6 days–98 | 0.53:1 | < 0.001* |
| | MSTs | 123 | 44 (28–59) | 6 days–90 | 0.40:1 | |
| | SGTs | 64 | 16 (11–32) | 6–63 | 0.52:1 | |
| | NIS | 20 | 51 (44–59) | 18–64 | 0.25:1 | |
| | OCs | 29 | 67 (54–75) | 18–98 | 0.71:1 | |
| | MIS | 39 | 55 (27–69) | 4–89 | 1.29:1 | |
| OMBTs | | 237 | 28 (19–44) | 6–76 | 0.81:1 | |
| | JCs | 100 | 29 (18–43) | 7–71 | 1:1 | |
| | ODTs | 70 | 25.5 (19–43) | 6–76 | 0.75:1 | |
| | GCL/BCTs | 16 | 39 (28–55) | 8–67 | 0.23:1 | |
| | MIS | 51 | 28 (19–44) | 9–73 | 0.82:1 | |
| | Total | 512 | 35.5 (21–54) | 6–98 | 0.65:1 | |

Abbreviations. STLs, soft tissue lesions; OMBTs, odontogenic and maxillofacial bone tumors; MSTs, mucosal and soft tissue tumors; SGTs, salivary gland tumors; NIS, non-infective stomatitis; OCs, oral cancers; JCs, jaw cysts; ODTs, odontogenic tumors; GCL/BCT, giant cell lesions/bone and cartilage tumors; MIS, Miscellaneous

*Significance

### Soft tissue lesions (STLs)

MSTs were the most common (44.7%), followed by SGTs, MIS, OCs, and NIS (Figure 1a). Among the MSTs, irritation fibroma (IF) was the most frequently diagnosed (46.3%), followed by pyogenic granuloma (PG) (26.0%). IF was predominantly located on the buccal mucosa (38.6%) and gingiva (35.1%), whereas PG showed a significant association with the gingiva (59.4%) ($p < 0.001$). IF was significantly more common in patients over 40 years of age ($p = 0.007$), while PG predominantly affected those under 40 ($p = 0.02$). No significant gender differences were observed for either lesion. Among the SGTs, mucoceles were the most prevalent (84.4%) with a median patient age of 13.5 years (IQR: 10–24), demonstrating a strong association with younger individuals ($p < 0.001$). Mucoceles also showed a significant predilection for the lower lip (83.3%; $p < 0.001$). In the NIS category, oral lichen planus and oral lichenoid reaction (OLP/OLR) were the most common diagnoses (85%), occurring more frequently in individuals over 40 years of age ($p = 0.03$). Although the buccal mucosa was the most commonly affected site (70.6%), this association was not statistically significant. No gender differences were observed. OSCC, the most frequently diagnosed malignancy (93.1%), was significantly associated with older age ($p < 0.001$). The gingiva was the most commonly affected site (59.3%), though this site-specific association was not statistically significant. No gender differences were noted. Both hyperkeratosis and non-specific chronic oral mucosal inflammation (NCOMI) were significantly more common in older patients ($p = 0.02$ and $p = 0.03$, respectively). Hyperkeratosis showed a significant male predominance ($p = 0.007$) and was most frequently observed on the palate (36.4%), while NCOMI was more common on the gingiva (60%) ($p < 0.001$). Detailed findings are presented in Tables 2 and 4.

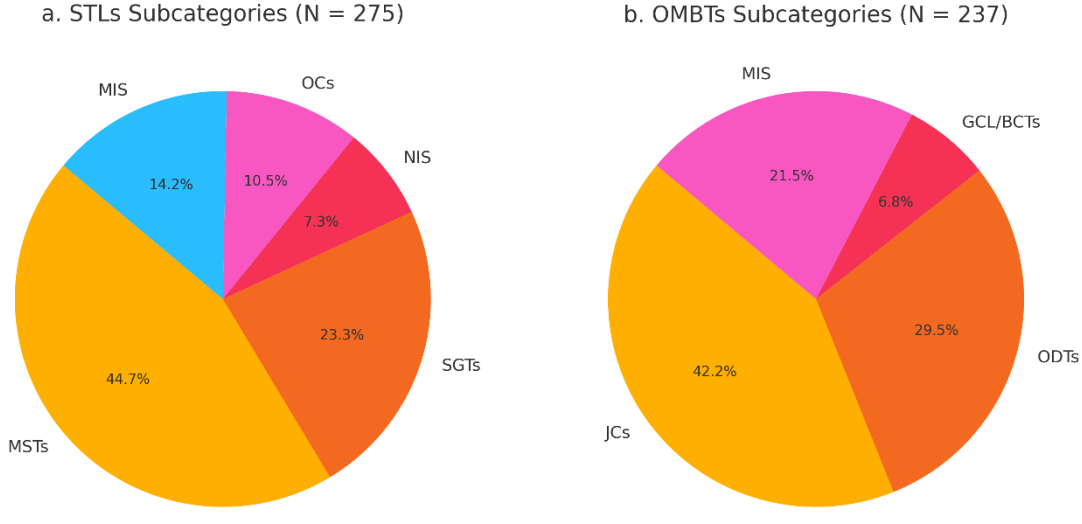


**Figure 1** Subcategory percentage distribution of OMFLs: STLs subcategories (a) and OMBTs subcategories (b).

Abbreviations. OMFLs, oral and maxillofacial lesions; STLs, soft tissue lesions; MSTs, mucosal and soft tissue tumors; SGTs, salivary gland tumors; NIS, non-infective stomatitis; OCs, oral cancers; MIS, Miscellaneous; OMBTs, odontogenic and maxillofacial bone tumors; JCs, jaw cysts; ODTs, odontogenic tumors; GCL/BCT, giant cell lesions/bone and cartilage tumors

Table 2 Soft Tissue Category: Demographic, gender- and age-related distributions (N = 275)

| Category | Top subtypes | n | Median Age (IQR) (years) | M:F ratio | *p* values for gender | Age group ratio (<40:>40) | *p* values for age group |
|---|---|---|---|---|---|---|---|
| MSTs | Irritation fibroma | 57 | 50 (35–60) | 0.46:1 | 0.60 | 0.39:1 | 0.007* |
| | Pyogenic granuloma | 32 | 30 (20–52) | 0.33:1 | 0.23 | 1.67:1 | 0.02* |
| | Peripheral ossifying fibroma | 11 | 38 (23–59) | 0.10:1 | 0.07 | 1.20:1 | 0.46 |
| | Squamous papilloma | 9 | 50 (37–62) | 1.25:1 | 0.18 | 0.29:1 | 0.19 |
| | Lipoma | 3 | 68 | 0.50:1 | 0.96 | 0.50:1 | 0.72 |
| | Giant cell fibroma | 3 | 40 | 0:3 | NA | 0.50:1 | 0.72 |
| | Congenital epulis | 1 | 6 days | 0:1 | NA | 1:0 | NA |
| | Myofibroma | 1 | 15 | 1:0 | NA | 1:0 | NA |
| | Verruxiform xanthoma | 1 | 54 | 0:1 | NA | 0:1 | NA |
| | BPNST | 1 | 66 | 1:0 | NA | 0:1 | NA |
| | Epulis fissuratum | 1 | 77 | 0:1 | NA | 0:1 | NA |
| | Neuroma | 1 | 30 | 0:1 | NA | 1:0 | NA |
| | Verruca vulgaris | 1 | 35 | 0:1 | NA | 1:0 | NA |
| | Hemangioma | 1 | 54 | 0:1 | NA | 0:1 | NA |
| SGTs | Mucocele | 54 | 13.5 (10–24) | 0.46:1 | 0.60 | 12.50:1 | <0.001* |
| | Mucoepidermoid carcinoma | 4 | 54 (48–61) | 1:1 | 0.51 | 0:4 | NA |
| | PACA | 3 | 55 | 2:1 | 0.24 | 0:3 | NA |
| | Pleomorphic adenoma | 2 | 44.5 | 1:1 | 0.64 | 1:1 | 0.86 |
| | Adenoid cystic carcinoma | 1 | 36 | 0:1 | NA | 1:0 | NA |
| NIS | OLP/OLR | 17 | 52 (45–60) | 0.21:1 | 0.13 | 0.21:1 | 0.03* |
| | Eosinophilic granuloma | 1 | 48 | 1:0 | NA | 0:1 | NA |
| | Pemphigus vulgaris | 1 | 18 | 0:1 | NA | 1:0 | NA |
| | MMP | 1 | 58 | 0:1 | NA | 0:1 | NA |
| OCs | OSCC | 27 | 67 (55–75) | 0.80:1 | 0.25 | 0.04:1 | <0.001* |
| | Verrucous carcinoma | 1 | 53 | 0:1 | NA | 0:1 | NA |
| | Nasopharyngeal carcinoma | 1 | 18 | 0:1 | NA | 1:0 | NA |
| MIS | Hyperkeratosis | 11 | 64 (50–70) | 2.67:1 | 0.007* | 0.10:1 | 0.02* |
| | NCOMI | 10 | 63.5 (47–74) | 1.5:1 | 0.08 | 0.11:1 | 0.03* |
| | Parulis/abscess | 5 | 55 (22–64) | 1.67:1 | 0.80 | 0.67:1 | 0.87 |
| | Vascular malformation | 3 | 61 | 0.50:1 | 0.96 | 0.50:1 | 0.72 |
| | Epidermoid/dermoid cysts | 2 | 24.5 | 2:0 | NA | 2:0 | NA |
| | †Others | 8 | 30.5 (21–52) | 0.60:1 | 0.86 | 1.67:1 | 0.27 |

Abbreviations. MSTs, mucosal and soft tissue tumors; SGTs, salivary gland tumors; NIS, non-infective stomatitis; OCs, oral cancers; MIS, Miscellaneous BPNST, benign peripheral nerve sheath tumor; PACA, Polymorphous adenocarcinoma; OLP/OLR, oral lichen planus/ oral lichenoid reaction; MMP, Mucous membrane pemphigoid; OSCC, squamous cell carcinoma; NCOMI, non-specific chronic oral mucosal inflammation

† Others, including Fibromuscular tissue with T and B cells, Intradermal nevus, Poorly differentiated carcinoma, Neuroendocrine carcinoma, Herpetic infected cells, Benign salivary gland neoplasm, Paramedian lip pits, Ulceration, with one instance of each identified

NA, Not Applicable; statistical comparison not possible due to only one sex or one age group represented

*Significance

Table 3 OMBTs: Demographic, gender- and age-related distributions (N = 237)

| Category | Top subtypes | n | Median Age (IQR) (years) | M:F ratio | *p* values for gender | Age group ratio (<40:≥40) | *p* values for age group |
|---|---|---|---|---|---|---|---|
| JCs | Radicular cyst | 52 | 32 (23–43) | 0.68:1 | 0.48 | 1.89:1 | 0.50 |
| | Dentigerous cyst | 33 | 21 (11–38) | 0.94:1 | 0.64 | 3.71:1 | 0.20 |
| | OKC | 8 | 32.5 (20–49) | 7:1 | 0.01* | 1.67:1 | 0.68 |
| | Nasopalatine duct cyst | 3 | 29 | 2:1 | 0.44 | 3:0 | NA |
| | Calcifying odontogenic cyst | 2 | 47.5 | 2:0 | NA | 1:1 | 0.55 |
| | Surgical ciliated cyst | 2 | 36.5 | 2:0 | NA | 1:1 | 0.55 |
| ODTs | Ameloblastoma | 44 | 32.5 (22–50) | 1.10:1 | 0.26 | 1.32:1 | 0.05 |
| | Odontoma | 8 | 22.5 (15–26) | 0.60:1 | 0.30 | 8:0 | NA |
| | COF | 8 | 18 (17–28) | 0.14:1 | 0.06 | 8:0 | NA |
| | Odontogenic myxoma | 3 | 6 | 2:1 | 0.44 | 2:1 | 0.92 |
| | AOT | 2 | 19 | 0:2 | NA | 2:0 | NA |
| | Odontogenic fibroma | 2 | 37.5 | 0:2 | NA | 2:0 | NA |
| | DGCT | 1 | 49 | 0:1 | NA | 0:1 | NA |
| | PODF | 1 | 28 | 1:0 | NA | 0:1 | NA |
| | Odontogenic myxofibroma | 1 | 12 | 0:1 | NA | 1:0 | NA |
| GCL/ BCTs | FOD | 5 | 52 (31–56) | 0:5 | NA | 0.67:1 | 0.15 |
| | FD | 4 | 24 (17–44) | 0:4 | NA | 3:1 | 0.80 |
| | Osteosarcoma | 2 | 32 | 1:1 | 0.88 | 2:0 | NA |
| | Osteoma | 1 | 65 | 0:1 | NA | 0:1 | NA |
| | PGCG | 1 | 56 | 0:1 | NA | 0:1 | NA |
| | CGCG | 1 | 42 | 0:1 | NA | 0:1 | NA |
| | Langerhans cell histiocytosis | 1 | 8 | 1:0 | NA | 1:0 | NA |
| | Non-Hodgkin lymphoma | 1 | 67 | 1:0 | NA | 0:1 | NA |
| MIS | Periapical granulomas | 26 | 29 (20–44) | 1.17:1 | 0.32 | 2.71:1 | 0.65 |
| | JCs NOS | 9 | 24 (10–33) | 0.50:1 | 0.48 | 9:0 | NA |
| | Chronic osteomyelitis | 8 | 32 (19–67) | 0.33:1 | 0.25 | 1.67:1 | 0.68 |
| | †Others | 8 | 39.5 (19-50) | 1:1 | 0.76 | 1:1 | 0.23 |

Abbreviations. OMBTs, odontogenic and maxillofacial bone tumors; JCs, jaw cysts; ODTs, odontogenic tumors; GCL/BCTs, giant cell lesions/bone and cartilage tumors; MIS, Miscellaneous; OKC, odontogenic keratocyst; COF, cemento-ossifying fibroma; AOT, Adenomatoid odontogenic tumor; DGCT, Dentinogenic ghost cell tumor; PODF, Peripheral odontogenic fibroma; FOD, focal osseous dysplasia; FD, fibrous dysplasia; PGCG, Peripheral giant cell granuloma; CGCG, Central giant cell granuloma; JCs NOS, jaw cysts not otherwise specified

† Others including Odontogenic tumor not otherwise specified, Sinus mucosa, Focal osteoporotic marrow defect, Malignant round cell neoplasm, Hypercementosis, Tissue autolysis, Plasma cell neoplasm, Fibro-osseous tissue, with one instance of each identified

NA = Not Applicable; statistical comparison not possible due to only one sex or one age group represented

*Significance

Table 4 Association of most frequent diagnoses and OMFL anatomical site

| Diagnostic category | most frequent diagnoses | Location [n (%)] | | | | | *p* values |
|---|---|---|---|---|---|---|---|
| | | Gingiva | Buccal mucosa | Tongue and FOM | Lips area | Palate | |
| MSTs | Irritation fibroma | 20 (35.1) | 21 (38.6) | 7 (12.3) | 3 (5.3) | 6 (10.5) | <0.001* |
| | Pyogenic granuloma | 19 (59.4) | 4 (12.5) | 2 (6.3) | 6 (18.8) | 1 (3.1) | |
| | POF | 11 (100.0) | 0 | 0 | 0 | 0 | |
| | Squamous papilloma | 3 (33.3) | 1 (11.1) | 0 | 0 | 5 (55.6) | |
| | Others | 6 (42.9) | 3 (21.4) | 2 (14.3) | 2 (14.3) | 1 (7.1) | |
| SGTs | Mucocele | 0 | 2 (3.7) | 7 (13.0) | 45 (83.3) | 0 | <0.001* |
| | Mucoepidermoid CA | 1 (25.0) | 0 | 0 | 0 | 3 (75.0) | |
| | PACA | 0 | 1 (33.3) | 1 (33.3) | 0 | 1 (33.3) | |
| | PA | 0 | 0 | 0 | 0 | 2 (100.0) | |
| | ACC | 0 | 0 | 0 | 0 | 1 (100.0) | |
| NIS | OLP/OLR | 4 (23.5) | 12 (70.6) | 0 | 1 (5.9) | 0 | 0.09 |
| | others | 1 (33.3) | 1 (33.3) | 1 (33.3) | 0 | 0 | |
| OCs | OSCC | 16 (59.3) | 6 (22.2) | 3 (11.1) | 2 (22.2) | 0 | 0.45 |
| | Others | 1 (50.0) | 0 | 1 (50.0) | 0 | 0 | |
| MIS | Hyperkeratosis | 3 (27.3) | 1 (9.1) | 3 (27.3) | 0 | 4 (36.4) | <0.001* |
| | NCOMI | 6 (60.0) | 1 (10.0) | 3 (30.0) | 0 | 0 | |
| | Others | 3 (16.7) | 2 (11.1) | 5 (27.8) | 6 (33.3) | 2 (11.1) | |
| | | Maxilla | Mandible | Extra osseous | | | |
| JCs | Radicular cyst | 39 (75.0) | 13 (25.0) | | | | 0.001* |
| | Dentigerous cyst | 12 (36.4) | 21 (63.6) | | | | |
| | OKC | 3 (37.5) | 5 (62.5) | | | | |
| | NPDC | 3 (100.0) | 0 | | | | |
| | COC | 0 | 2 (100.0) | | | | |
| | Surgical ciliated cyst | 2 (100.0) | 0 | | | | |
| ODTs | Ameloblastoma | 3 (6.8) | 41 (93.2) | | | | 0.01* |
| | Odontoma | 2 (25.0) | 6 (75.0) | | | | |
| | COF | 3 (37.5) | 5 (62.5) | | | | |
| | Others | 4 (40.0) | 5 (50.0) | 1 (10.0) | | | |

Table 4 Association of most frequent diagnoses and OMFL anatomical site (continued)

| Diagnostic category | most frequent diagnoses | Location [n (%)] | | | *p* values |
|---|---|---|---|---|---|
| | | Maxilla | Mandible | Extra osseous | |
| GCL/BCTs | FOD | 1 (20.0) | 4 (80.0) | | 0.20 |
| | FD | 2 (50.0) | 2 (50.0) | | |
| | Others | 1 (14.2) | 3 (42.9) | 3 (42.9) | |
| MIS | Periapical granulomas | 17 65.4) | 9 (34.6) | | 0.002* |
| | JCs NOS | 6 (66.7) | 3 (33.3) | | |
| | Others | 2 (12.5) | 14 (87.5) | | |

Abbreviations. OMFLs, oral and maxillofacial lesions; MSTs, mucosal and soft tissue tumors; SGTs, salivary gland tumors; NIS, non-infective stomatitis; OCs, oral cancers; JCs, jaw cysts; ODTs, odontogenic tumors; GCL/BCTs, giant cell lesions/bone and cartilage tumors
POF, peripheral ossifying fibroma; OLP/OLR, oral lichen planus/ oral lichenoid reaction; OSCC, oral squamous cell carcinoma; NCOMI, non-specific chronic oral mucosal inflammation; OKC, odontogenic keratocyst; COF, cemento-ossifying fibroma; FOD, focal osseous dysplasia; FD, fibrous dysplasia; JCs NOS, jaw cysts not otherwise specified
*Significance

## Odontogenic and maxillofacial bone tumors (OMBTs)

JCs were the most frequently diagnosed, accounting for 42.2% of all cases (Figure 1b). Among these, radicular cysts were the most common subtype (21.9%), showing a strong predilection for the maxilla (75.0%). In contrast, dentigerous cysts and odontogenic keratocysts (OKCs) were predominantly found in the mandible (63.6% and 62.5%, respectively), with these anatomical distributions being statistically significant ($p < 0.001$). OKCs also exhibited a significant male predominance ($p = 0.01$). Among the ODTs, ameloblastoma was the most prevalent (62.9%), occurring in the mandible in 93.2% of cases. Odontoma, the second most common ODT (11.4%), also demonstrated a significant mandibular predilection (75.0%). Both site-specific distributions were statistically significant ($p = 0.01$). No statistically significant differences in age or sex were observed within this tumor category; however, ameloblastoma showed a tendency to occur in younger patients (median age: 32.5 years; IQR: 22–50), with borderline significance ($p = 0.05$). In the category of GCL/BCT, focal osseous dysplasia (FOD) and fibrous dysplasia (FD) were the most frequently identified. Although both tended to occur in the mandible, no statistically significant associations with location, gender, or age group were observed. Within the miscellaneous category, periapical granulomas (PAGs) and jaw cysts not otherwise specified (JCs NOS) were the most commonly reported lesions. Both showed a significant predilection for the maxilla (65.4% and 66.7%, respectively; $p = 0.002$), with no significant differences by gender or age. A comprehensive summary of these findings is provided in Tables 3 and 4.

YRH, a regional referral center, managed nearly half of all cases, including most complex lesions. NPH and PPH handled diverse cases, with more frequent reports of OSCC. YDH, the only district hospital, primarily diagnosed simple lesions like fibromas and mucoceles as shown in Table 5.

Table 5 OMFL category diagnosed by the 4 participating hospitals

| Diagnostic category | YDH [n (%)] | NPH [n (%)] | PPH [n (%)] | YRH [n (%)] | Total |
|---|---|---|---|---|---|
| MSTs | 14 (11.4) | 32 (26.0) | 17 (13.8) | 60 (48.8) | 123 |
| SGTs | 14 (21.9) | 8 (12.5) | 6 (9.4) | 36 (56.3) | 64 |
| NIS | 4 (20.0) | 3 (15.0) | 11 (55.0) | 2 (10.0) | 20 |
| OCs | 4 (13.8) | 15 (51.7) | 10 (34.5) | 0 | 29 |
| MIS (STLs) | 6 (15.4) | 9 (23.1) | 8 (20.5) | 16 (41.0) | 39 |
| JCs | 3 (3) | 41 (41) | 8 (8) | 48 (48) | 100 |
| ODTs | 1 (1.4) | 29 (41.4) | 19 (27.2) | 21 (30.0) | 70 |
| GCL/BCTs | 1 (6.3) | 5 (31.3) | 7 (43.7) | 3 (18.7) | 16 |
| MIS (OMBTs) | 2 (3.9) | 17 (33.3) | 6 (11.8) | 26 (51.0) | 51 |
| Total | 49 (9.6) | 159 (31.1) | 92 (18.0) | 212 (41.4) | 512 |
| Surgeons performing oral biopsy | 1 | 3 | 4 | 4 | 12 |
| Cases per surgeon | 49.0 | 53.0 | 23.0 | 53.0 | 42.7 |

Abbreviations. MSTs, mucosal and soft tissue tumors; SGTs, salivary gland tumors; NIS, non-infective stomatitis; OCs, oral cancers; JCs, jaw cysts; ODTs, odontogenic tumors; GCL/BCTs, giant cell lesions/bone and cartilage tumors; MIS, Miscellaneous; STLs, soft tissue lesions; OMBTs, odontogenic and maxillofacial bone tumors

YDH, Yi-Ngo District Hospital; NPH, Naradhiwasrajanagarindra Provincial Hospital; PPH, Pattani Provincial Hospital; YRH, Yala Regional Hospital

## Discussion

This multi-center study offers a detailed epidemiological profile of OMFLs in Thailand's southernmost provinces, revealing demographic and clinical patterns aligned with regional healthcare dynamics. Lesion type correlated with patient age: OMBTs predominated in younger patients (median age: 28 years; IQR: 19–44), whereas STLs—particularly OSCC and OPMDs such as OLP/OLR—were more frequent in older adults (median age: 46 years; IQR: 23–60), with a statistically significant difference ($p < 0.001$). These results support Thailand's national OC screening guidelines that target individuals aged ≥40 [8].

The female predominance observed in this study (M:F = 0.65:1) aligns with both regional and international reports [3–5]. MSTs, the most common category of STLs, were more frequently diagnosed in females (M:F = 0.40:1), potentially due to the influence of estrogen on oral tissues [15]. Hormonal fluctuations during puberty and pregnancy—particularly elevated levels of estrogen and progesterone—may contribute to the development of PG by promoting gingival vascular proliferation and inflammation via mast cell activation [16]. The higher prevalence of PG in younger females (median age: 30 years; IQR: 20–52) and its gingival localization (59.4%) in our cohort further supports this hormonal association. In contrast, IF—encompassing fibroepithelial and fibrous hyperplasia [17]—was the most frequently diagnosed MSTs, accounting for 46.3% of cases. It was most commonly located on the buccal mucosa (38.6%) and gingiva (35.1%). Although observed across

a wide age range (9–96 years) in this study (data not shown), IF was significantly associated with older age ($p = 0.007$), consistent with previous reports [18–20]. Fibroepithelial hyperplasia is not classified as an OPMDs; however, it is frequently observed among individuals at high risk for OPMDs and OCs in the northeastern Thai population [20].

Mucoceles, often found on the lower lip and tongue, were prevalent among younger patients. This distribution aligns with Brazilian studies that highlight recurrence risks in youth, lesions >2 cm and ventral tongue location [21]. In this cohort, 13% of mucoceles were tongue-based.

OSCC, although less common among oral lesions, warrants particular concern due to its potential for misdiagnosis as periodontal disease—especially in gingival cases [22–24]. While previous studies, including one conducted in the Kelantanese population—who share ethnic roots with the majority of individuals in Thailand's three southernmost provinces—have identified the tongue as the most commonly affected site [25], our findings demonstrate a predominance of gingival involvement, although this did not reach statistical significant. The near-equal gender distribution observed in this study, with a slight female predilection (M:F ratio = 0.80:1), suggests the influence of risk factors shared by both sexes—possibly related to local gingival characteristics. Betel quid chewing has been identified as a significant risk factor for OSCC, particularly in the gingiva, due to direct mucosal exposure to carcinogenic compounds. A study conducted in rural South Myanmar described a case of a 72-year-old woman diagnosed with lower gingival OSCC, who had chewed three to five betel quids daily for 10 years without any history of tobacco smoking or alcohol consumption [26]. Notably, a study from the southernmost region of Thailand reported that individuals in high-risk groups for OCs often perceived betel quid chewing as a protective habit rather than a risk factor [12], underscoring the need for improved public education and awareness regarding OC risk behaviors. Notably, no OSCC cases were diagnosed at YRH, possibly attributable to the referral of all head and neck cancer cases to the otolaryngology (ENT) department of this specialized institute and the limited access to medical records and histopathological data, which are managed through a separate administrative and data management system from the dental department.

OLP/OLR were significantly more common in older individuals ($p = 0.03$) and showed a non-significant tendency toward female predominance. These lesions are of particular clinical concern, as they demonstrated a malignant transformation rate of 1.71% in the southern Thai population [27].

Similarly, hyperkeratosis also deserves close attention due to its potential for malignant transformation [28]. In the present cohort, hyperkeratosis was significantly more prevalent among older male patients ($p = 0.007$ for gender and $p = 0.02$ for age group), a group widely recognized as being at elevated risk. Notably, up to 28% of OSCC cases have been reported to originate from hyperkeratotic lesions [29]. Acanthosis with hyperkeratosis, a frequent histopathological finding in OPMDs and OC screening, may precede or accompany epithelial dysplasia, serving as an early marker of malignant potential [20]. These findings underscore the importance of long-term follow-up and patient counseling as part of standard care.

Radicular and dentigerous cysts were the most common JCs, demonstrating a predilection for the maxilla and mandible, respectively, consistent with previous studies [1,30,31]. OKCs also followed expected patterns, with a higher prevalence in males and a mandibular

predominance [32]. Ameloblastoma was the most frequently encountered ODT, occurring almost exclusively in the mandible (93.2%), in agreement with global reports [33,34]. The relatively low number of odontomas observed in this study (11.4% of ODT cases) is consistent with other reports from Thailand, where ameloblastoma is more frequently diagnosed [30,35]. Similarly, a study conducted in various hospitals across the northern region of Peninsular Malaysia—specifically in Perlis, Kedah, and Penang, which border southern Thailand—also reported a higher prevalence of ameloblastoma (55.5%) compared to odontoma (9.2%) [36]. In contrast, studies from Japan have demonstrated a nearly equal prevalence of odontomas and ameloblastomas [34], likely reflecting regional differences in referral patterns and diagnostic practices. The lower reported incidence of odontomas may be attributed to their typically asymptomatic nature and incidental detection during routine clinical or radiographic examinations. Furthermore, odontomas that are surgically removed are not always submitted for histopathological evaluation, which may contribute to their underrepresentation in institutional records [30,37,38]. Among the miscellaneous OMBTs, periapical granulomas were the most prevalent in this cohort, with a higher incidence in males, while radicular cysts were more commonly found in females. Both lesions predominantly affected younger individuals. Although they share an inflammatory origin, their management differs: radicular cysts, as fluid-filled epithelial-lined cavities, usually require surgical removal, whereas periapical granulomas—composed of inflammatory cells and fibrous tissue—are typically treated with root canal therapy. Improving the diagnostic precision of imaging techniques to differentiate between these two periapical lesions could enhance referral pathways, optimize treatment planning, and potentially reduce the reliance on histopathological examination [39]. JCs NOS comprised 8.1% of all jaw cysts identified in this study, a proportion slightly higher than the 4.5–7.2% reported in previous literature [1,30], yet still within an acceptable range. These cases were classified as NOS due to insufficient clinical or radiographic information, which limited the ability to establish a more definitive diagnosis [1]. To ensure accurate and definitive histopathological evaluation, biopsy submissions should include comprehensive clinical details and relevant imaging findings [1,40].

From a system perspective, the diagnostic distribution across hospital tiers reflects Thailand's structured healthcare referral model. The regional hospital (YRH) accounted for the highest proportion of cases (41.4%), primarily managing complex neoplastic and cystic lesions. Provincial hospitals (NPH and PPH) also reported numerous OC cases, possibly reflecting underreporting at the regional level due to head and neck cancer case redirection to ENT departments. The district hospital (YDH), while contributing fewer cases, predominantly diagnosed soft tissue lesions such as mucoceles and fibromas, serving a critical role in early diagnosis and referral management. District hospitals are well-positioned to support OC control through screening for OPMDs, initial biopsies, and referral of confirmed cases.

## Limitations

This study has several limitations. Its retrospective design may introduce selection bias, as lesions managed without biopsy were excluded, potentially underestimating the prevalence of benign or self-limiting conditions. Incomplete or inconsistent documentation across paper-based and electronic health records (EHRs) may have resulted in the loss of patient history, thereby

limiting the completeness of diagnostic records. Fifteen cases were excluded due to missing diagnostic information, primarily because the corresponding paper-based records were inaccessible. The difficulty in retrieving older data, particularly from before 2018, underscores broader systemic challenges in EHR implementation. Additionally, OCs managed by ENT departments were likely underreported—especially at the regional hospital—due to fragmented and unintegrated record-keeping systems. The increasing adoption of EHRs may help mitigate some of these issues in future studies.

This study was also area-specific, and the findings may not be generalizable to other regions of the country. Furthermore, the study involved multiple comparisons without correction, which may increase the likelihood of false-positive findings. Therefore, results near the threshold of statistical significance should be interpreted with caution. Multivariate analysis, such as logistic regression, could be employed in future studies to adjust for multiple variables simultaneously and reduce the risk of confounding, offering more robust inferences than multiple separate chi-square tests.

### Future research directions

Although this descriptive study offers valuable insights into lesion distribution across different referral levels, a gap persists in translating these findings into improved standards of care and more efficient referral pathways for patients with OMFLs within the healthcare system of Thailand's southernmost provinces. Accordingly, we propose a comprehensive future research agenda that includes the following components:

(1) Deploying prospective, multimodal studies that integrate clinical assessments, imaging, and histopathological data to support robust longitudinal epidemiologic analysis;

(2) Advancing interoperable EHR systems and referral-tracking infrastructures across institutions to optimize continuity of care;

(3) Rigorously evaluating UCS-supported oral screening programs to assess early detection performance, clinical outcomes, and cost-effectiveness;

(4) Integrating teledentistry to facilitate remote lesion detection, prompt consultations, effective follow-up, and workforce development through training—reducing delays and expanding access;

(5) Addressing interdepartmental gaps in case management to improve coordination, streamline referral processes, and enhance the completeness of case reporting; and

(6) Developing and expanding cross-border epidemiological collaborations with Malaysia—facilitated through the existing Border Health Committee and supported by mutual data exchange and coordinated public health planning—primarily aims to mitigate health risks related to OMFLs, particularly OPMDs and OSCC, among populations in border areas affected by transmigration.

## Conclusion

This multi-center retrospective study provides a comprehensive overview of OMFLs in Thailand's southernmost provinces, highlighting demographic trends, anatomical distributions, and referral patterns. The findings underscore the urgent need for enhanced diagnostic capabilities, workforce development with a focus on training, and strengthening gatekeeping functions within lower-tier hospitals to ensure timely detection and appropriate management. Streamlined referral pathways, culturally sensitive health education, and a robust medical record

infrastructure with effective interdepartmental data sharing are also essential. When implemented together, these measures are critical for advancing OMFL care delivery and improving patient outcomes in this underserved region.

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## Conflict of interest

The authors have no conflicts of interest regarding this study.

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