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The effect of the COVID-19 pandemic lockdown on the oral and maxillofacial pathology diagnostic service in New Zealand

Seo B, Hussaini H, Rich AM

Abstract

Background: The COVID-19 pandemic resulted in a nation-wide lockdown and subsequent restrictions to dental practice, potentially affecting the timely diagnosis of oral diseases. As the scale and breath of this effect have not been quantified, this study sought to examine the impact of COVID-19 by retrospectively reviewing cases submitted during the pandemic at a single national specialist centre for oral and maxillofacial pathology.
Methods: Cases received between 21 March and 30 June 2020 representing Alert Levels 2, 4, 3 and the subsequent Level 2 were retrieved from the electronic database of the Oral Pathology Centre, University of Otago. Patient demographic data and clinico-pathological findings were reviewed for each Alert Level and compared with the matching period in the previous year, as well as with previous New Zealand data and comparable international epidemiological studies.
Results: A total of 180 cases were submitted during the assessment period which represented a three-fold reduction compared with the matching 2019 period. Most specimens derived from Wellington, Auckland and Dunedin and other regions were under-represented. Mucosal lesions were the most prevalent disease group followed by Dental Pathology. There was a quantitative reduction in the number of malignant and potentially malignant lesions diagnosed but the proportions of these cases increased compared with previous years.
Conclusion: The findings suggest that many oral diagnostic biopsies were missed or delayed during this period. Given the inherently crucial need for early diagnosis, especially for oral cancers and potentially malignant disorders, dentists and dental specialists should continue to be supported in their diagnostic activities during times of pandemic to ensure better health outcomes in New Zealand.

Introduction

The Coronavirus Disease 19 (COVID-19) pandemic has had an unprecedented impact in the world at multiple levels, particularly in health, and New Zealand has not been exempted from its consequential effects. The novel coronavirus (Severe Acute Respiratory Syndrome coronavirus 2; SARS-CoV-2) consists of a single strand RNA genome and is related to the coronaviruses that caused Severe Acute Respiratory Syndrome (SARS, caused by SARS-CoV-1) and Middle East Respiratory Syndrome (MERS, caused by MERS-CoV) pandemics in 2003 and 2012 respectively (Jin et al., 2020). COVID-19 SARS-CoV-2 causes acute respiratory symptoms with or without accompanying immunological complications involving the cardiopulmonary system in a proportion of infected patients but many individuals remain asymptomatic (Baj et al., 2020). The virus has so far, at the time of writing, infected some 43 million people world-wide and over 1,100,000 people have died as a direct consequence of the disease (CRC, 2020), with the case fatality rate estimated to be much greater than the seasonal influenza virus which typically results in an overall mortality rate of 0.1% (CDC, 2020; He et al., 2020). Furthermore, it is generally regarded that the infection and mortality rates have been significantly under-reported at least initially (Lau et al., 2020), signifying that the true scale of effect of this novel virus to human lives is not yet understood.

New Zealand reported its first case of COVID-19 in February 2020. With a steep increase in the number of cases in the following weeks, the government activated an Alert Level system (DCNZ/MOH, 2020a, b, c, d) in response and the country entered into a temporary Alert Level 2 on 21/03/2020 in preparation to 'lock down' the country under Alert Level 4 from 26/03/2020. In the face of the rapidly evolving situation, the health system became focused on dealing with potential consequences of coronavirus infection, reducing its delivery of routine care to minimum (DCNZ/MOH, 2020d). District Health Boards (DHB) postponed all non-essential and elective procedures and various testing stations were set up nation-wide. The dental community was also severely affected. Dentists and dental specialists closed down with the exception of those services that were considered 'essential', which included oral/ oral and maxillofacial surgeons, DHB-based dental departments and the University of Otago Faculty of Dentistry. As part of the University's essential health delivery system, the Oral Pathology Centre (OPC) operated under the COVID-19 contingency plan to continue to provide diagnostic service to essential clinicians from across the country. The OPC, founded in 1946 by WHO Consultant Professor Frank Shroff, is the country's only specialised oral and maxillofacial pathology diagnostic laboratory and is staffed by consultant oral and maxillofacial pathologists. The OPC provides histopathologic diagnostic services to dentists and dental specialists and acts as a referral

centre for anatomical pathologists (Rich et al., 2007; Seo et al., 2017). It was expected that an urgent oral pathology diagnostic service would be required in the lockdown period. Appropriate laboratory protocols were developed and approved for each Alert Level and all OPC staff were granted essential worker status. As most dental practitioners, who constitute a significant proportion of the OPC's referral base, were shut down or restricted in practice, it was expected that the number of cases accessioned would decrease during Alert Levels 3 and 4. It was also expected that those cases that were submitted would have been considered urgent by the clinician. The purpose of this report was to review the cases diagnosed at the OPC during this time in order to gauge the impact of COVID-19 on the clinical practice of dentistry relevant to oral and maxillofacial pathology. It was expected that this information would provide data that oral health professionals and governing bodies could utilise in case of repeated or new emergence of similar events in the future, in order to be better prepared in the interest of our patients.

Aims and objectives

The overall aim of this study was to examine the cases of oral and maxillofacial pathology diagnosed at a specialist centre during the periods affected by the COVID-19 Alert Levels 2, 3 and 4 in order to quantify the effect of COVID-19 on diagnostic oral and maxillofacial pathology in the OPC. Specific objectives included an examination of the number and range of cases during the above-mentioned COVID-19 affected period in 2020, and a comparative review of the range and volume of diagnosis made with the same period in 2019.

Methodology

Cases received between 21 March and 30 June 2020 were identified and retrieved from the electronic database (Oralpath Pro™) of the OPC, Faculty of Dentistry, University of Otago. This period included the initial Alert Level 2 (L2a; 21/03/20 to 25/03/20- 3 business days), Alert Level 4 (L4; 26/03/20 to 27/04/20- 23 business days), Alert Level 3 (L3; 28/04/20 to 13/05/20- 12 business days) and the second Alert Level 2 (L2b; 14/05/20 to 8/6/20- 18 business days). Collected information included patient age and gender, clinician specialty and location, and the histopathologic diagnoses made. The diagnoses were categorised into 12 groups as previously described (Jones and Franklin, 2006; Yu et al., 2020): Dental, Mucosal, Gingival/ periodontal, Odontogenic cysts, Odontogenic tumours/ hamartomas, Non-odontogenic cysts, Connective tissue/ mesenchymal, Bone, Normal tissues, Malignancies and Miscellaneous, with modifications. The male : female ratio (M:F), age with standard deviation (SD) and percentage of total number of cases in each diagnostic category were determined. Finally, the number of total cases, percentage of diagnosis and the disease categories were compared with the data from the matching period in 2019.

Results

During the entire assessment period, 180 biopsies were processed at the OPC, with a peak observed in the L2b phase (Figure 1), noting that the duration of the levels varied. When the mean number of cases received per day was examined, each Level, in chronological order, showed respectively 5.7, 1.0, 0.7, and 7.3 cases per day.

Put together, more cases were from female patients (n = 103, c.f. n = 77 for males) with an overall M:F ratio of 1:1.3. The mean overall age was 54 (range 4-95, CD: 19.6), 52 years for male patients (rage: 4-88; SD: 19.8) compared with 57 years in females (range: 8-95, SD: 19.2) and there was a trend toward a greater number of

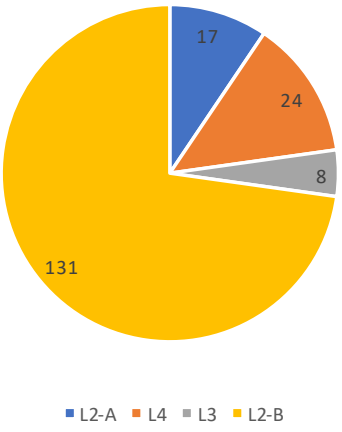

Figure 1. The proportional distribution of cases received under each COVID-19 Alert Levels.

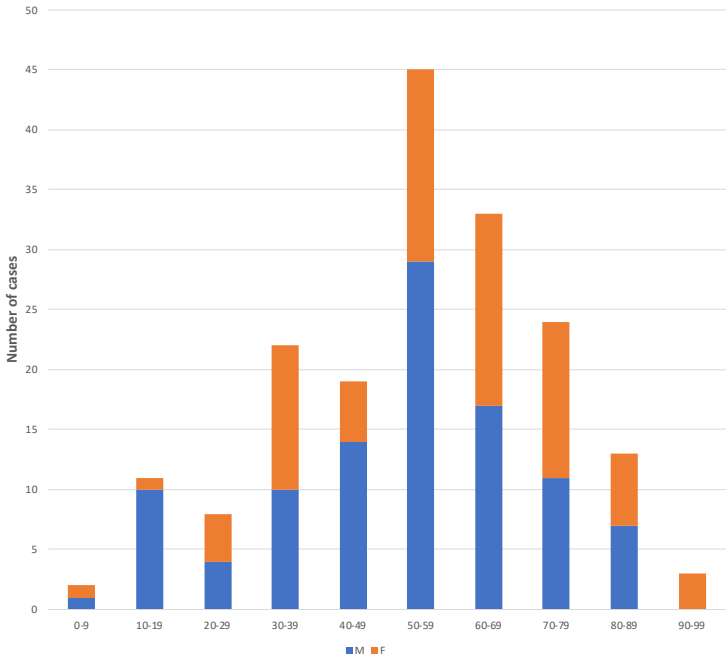

Figure 2. Overall gender and age distribution of patient cases received from 21 March to 8 June 2020 under the COVID Alert System. The greatest numbers of cases derived from patients aged between 50 and 80.

Table 1. Comparison between the proportion (in %) of cases in each disease category.

	2020		2019	
	Number	Proportion	Number	Proportion
Mucosal	70	38.9	231	41.6
Dental	30	16.7	45	8.1
Odontogenic cysts	28	15.6	96	17.3
Gingival/Periodontal	22	12.2	48	8.6
Malignancy	7	3.9	11	2.0
Bone	7	3.9	14	2.5
Miscellaneous	7	3.9	9	1.6
Salivary	4	2.2	35	6.3
Connective tissue	3	1.7	46	8.3
Normal	2	1.1	9	1.6
Odontogenic tumours	0	0.0	7	1.3
Non-odontogenic cysts	0	0.0	4	0.7

Table 2. Assessment of potentially malignant (leukoplakia and dysplasia) oral lesions and oral cancers diagnosed in 2019 and 2020.

2019			2020				
Diagnosis	Cases	% of total	Diagnosis	Cases	% of total	M:F	Mean age (SD)
Low-grade lesions	43	7.7	Low-grade lesions	15	8.3	1:88	69.8 (13.9)
High-grade lesions	7	1.3	High-grade lesions	3	1.7	1:0.5	74 (12.5)
OSCC	7	1.3	OSCC	5	2.8	1:1.5	60 (10.6)
OSCC- WD	4	0.7	OSCC- WD	5	2.8	1:1.5	60 (10.6)
OSCC- MD	1	0.2	OSCC- MD	0	0	NA	NA
OSCC- PD	2	0.4	OSCC- PD	0	0	NA	NA
OPSCC	3	0.5	OPSCC	1	0.6	Male	NA
OPSCC- WD	0	0	OPSCC- WD	0	0	NA	NA
OPSCC- MD	3	0.5	OPSCC- MD	1	0.6	NA	NA
OPSCC- PD	0	0	OPSCC- PD	0	0	NA	NA

NA: not applicable, WD: well differentiated, MD: moderately differentiated, PD: poorly differentiated.

cases with advancing age (Figure 2). Of note, there were more male cases under the age of 20.

Geographically, cases predominately originated from the Wellington region (48%), followed by Dunedin (22%) and Auckland (18%) regions, with small numbers of cases from other regions in the country. Overall, the North Island contributed 72% of cases (n = 129) compared to 28% from the South Island (n = 51), with metropolitan areas predominating with the exception of Dunedin, where the University of Otago Faculty of Dentistry is located.

Surgically-oriented specialties sent most specimens (oral and maxillofacial surgery (OMS), n = 94 and Oral Surgery (OS), n = 32), followed by Periodontics (12%). Endodontics and Oral Medicine contributed 3% of cases each. General dental practitioner (GDP)-derived specimens accounted for less than 10%. Two second-opinion cases were recorded from medical anatomical pathologists.

In terms of diagnosis category, the most prevalent disease group diagnosed was Mucosal lesions (41%) followed by Dental (17%), Odontogenic cysts (15%) and Gingival/periodontal (12%) lesions (Table 1). There were seven malignancies diagnosed over the Alert period, of which five were oral squamous cell carcinomas (OSCC) with a further two comprising oropharyngeal squamous cell carcinoma (OPSCC) and lymphoma. Odontogenic tumours/hamartomas were not represented in this series.

The number of potentially malignant oral disorders (OPMD, excluding oral lichen planus (OLP)) and oral cancer cases in 2020 were further examined and compared with the number in 2019 (Table 2). The former cases included those that were clinically leuko/erythroleukoplakic which upon biopsy showed histopathological changes including epithelial hyperplasia and/or hyper/keratosis with or without oral epithelial dysplasia (OED). These lesions (including actinic cheilitis) were recategorised into low-risk (LR) or high-risk (HR)

depending on the histopathologically assessed evidence of cytological and morphological features (Kujan et al., 2006). In total, there were 18 cases of OPMD lesions identified in the 2020 series (10% of all cases). Three of the 18 were classified high-grade (17%, 1.7% of all cases) and the remaining 15 low-grade lesions (83%, 8.3% of all cases). Oral squamous cell carcinoma (OSCC) was separated from oropharyngeal SCC (OPSCC) to only include those cases derived from the oral cavity proper.

Comparison with 2019

When compared with the same period in 2019, some marked differences were detected. Importantly, 555 cases were received in 2019 compared with 180 in 2020, showing a near three-fold reduction in the total number of pathological specimens due to COVID-19. Mucosal lesions were also the most common disease category in 2019 (41.6%), but Odontogenic cysts (17%), Gingival/periodontal lesions (9%) and Connective tissue/mesenchymal lesions (8%) outnumbered Dental pathologies. Proportionally, malignancies reported in the same period was nearly two-fold higher in 2020 compared with 2019 (Tables 1-2). The 2019 series included 50 leukoplakic lesions (9% of all lesions), of which 43 cases were low-grade (86%, 7.7% of all lesions) and 7 were high grade (14%, 1.3% of all lesions).

In 2020, the most common diagnosis made was periapical granuloma (12%) followed by fibro-epithelial hyperplasia (FEH)/polyp (FEP) (11%), oral lichen planus (OLP; 7%), radicular cyst (6%) and dentigerous cyst (5%) (Table 3). On the other hand, FEP/FEH were the most diagnosed lesions in the 2019 series, followed by non-specific (NS) mucosal inflammation, radicular cyst, dentigerous cyst, periapical granuloma and OLP (Table 3).

2020 cases by Alert Levels

In total, 17 cases were diagnosed during Alert Level 2a. The cases were mostly from patients in their 50s and 60s and the overall gender ratio was 1:1.1. In terms of disease categorisation, Mucosal lesions were most prevalent, followed by Dental lesions and Odontogenic cysts. During Alert Level 4 twenty-four cases were diagnosed. Demographically, patients were of the mean age of 53 and the gender ratio was 1:0.4. Only 4 disease categories were represented during this period with the most common category being Mucosal lesions, followed by Dental lesions. Three cases of OPMD and two cases of malignancies were reported. Eight cases were received during Alert Level 3. All patients were females with a mean age of 71. Odontogenic cysts (50%) were most prevalent followed by Mucosal lesions (25%). Three cases of OPMD were detected. The largest number of cases were received during Alert level 2b with the total diagnosis count of 131 (72% of all cases received during the assessment period). The mean patient age was 56 (range 11-95) with a M:F ratio of 1:0.7. Diagnoses made

Table 3. Comparison of the most commonly diagnosed cases in 2020 with that data from the matching period in 2019.

	2020				2019	
Diagnosis	**Cases**	**% of total**	**M:F**	**Mean age (SD)**	**Cases**	**% of total**
Periapical granuloma	22	12.2	1:0.6	59.3 (15.6)	33	5.9
FEH/FEP	20	11.1	1:0.8	61.7 (12.1)	64	11.6
OLP	13	7.2	1:2.3	47.0 (14.5)	32	75.8
Radicular cyst	11	6.1	1:2.7	56.9 (20.1)	41	7.4
Dentigerous cyst	9	5.0	1:0.1	35.4 (24.2)	35	6.3
OED mild	8	4.4	01:00.5	77.1 (13.4)	10	1.8
NS mucosal inflammation	6	3.3	1:0.5	58.3 (13.3)	50	9
Pyogenic granuloma	6	3.3	1:0.2	54.3 (13.9)	15	2.7
Hyperplastic dental follicle	5	2.8	1:0.3	25 (15.7)	8	1.4
TUGSE	5	2.8	1:0.7	48 (11.8)	1	0.2
Gingival inflammation	5	2.8	1:1.5	70 (12.9)	13	2.3
OSCC	5	2.8	1:1.5	60 (10.6)	10	1.8

Mean age with SD and gender ratio was computed only for the 2020 cases.
TUGSE: traumatic ulcerative granuloma with stromal eosinophilia.

Table 4. Characteristics of cases received during each Alert Levels.

Alert Level	Number	% of total	Mean age (range)	M:F	Most common category (top 2)	Most common diagnosis (top 2)	OPMD	Malignancy
2a	17	9.4	55.8 (8-91)	1:1.1	Mucosal (29.4%) Dental/Odontogenic cysts (17.4%)	FEP/FEH Periapical granuloma	0	0
4	24	13.3	52.5 (4-87)	1:0.4	Mucosal (62.5%) Dental (16.7%)	TUGSE OLP	3	2
3	8	4.4	70.89 (53-82)	F only	Odontogenic cysts (50%) Mucosal (25%)	Radicular cyst OED	3	0
2b	131	72.8	53.27 (11-95)	1:0.7	Mucosal (36.4%) Dental (16.8%)	FEP/FEH Periapical granuloma	12	5

mostly comprised of Mucosal lesions, followed by Dental, Odontogenic and Gingival lesions. This period saw more specimens received from non-surgical specialties and also had greater regional representations (Table 4).

Discussion

The COVID-10 pandemic has disrupted the delivery of anatomical pathology services (Lamas et al., 2020) and necessitated changes in the way oral and maxillofacial pathology is practiced. Its influence on diagnostic histopathology can be indirectly estimated by the assessment and comparison of the clinical input and diagnostic output with preceding years and comparable epidemiological studies. It was shown that the diagnostic volume decreased nearly three-fold at the OPC and the proportion of disease categories also changed. The former reflects the fact that most dentists and dental specialists were 'locked-down' and under Alert Levels 4 and 3, and were only allowed to perform urgent and essential services in strictly regulated settings. Therefore, the second observation with regard to the alteration in the proportion of cases received under the Alert Level systems, is likely to reflect the patient's presenting concern at urgent care/specialist practices or hospitals, and the clinician's triage principles and their diagnostic judgement of the need for a biopsy (Chigurupati et al., 2020; Zimmermann and Nkenke, 2020). For example, whilst mucosal lesions remained the most prevalent diagnostic category, there was a proportional increase in the dental, gingival and malignant lesions. Indeed, dental and gingival conditions may often be symptomatic and cause patients to seek dental/specialist care during lockdown. In the current series periapical granulomas and inflammatory gingival conditions accounted for a significant proportion of cases in their respective categories. Despite the pandemic, clinical review and biopsy of OPMD cannot cease, due to the increased risk of malignant transformation of these lesions, and the 2020 data supports this expectation. The two-fold increase in the proportion of malignancies diagnosed in 2020 compared with 2019 also reflects this pattern. However, it is of note that when the absolute count of diseases was used rather than proportions, there were fewer of OPMD (excluding OLP) and malignancy biopsies diagnosed in 2020 period compared with 2019. This observation is of concern as this implies delayed/missed diagnosis of precancerous and cancerous lesions, as a consequence of COVID-19-associated restriction of dental practice.

The only currently available data about New Zealand prevalence of oral pathology diagnoses is the study by Rich and colleagues in 2007 (Rich et al., 2007). This study used a different disease categorisation based on the previous WHO classifications. Due to this, whilst a direct comparison is difficult to achieve, indirect reference can be made between the COVID-19 affected period with the 'normal' situations. The 2007 study indicated that the Auckland (35%) and Otago (29%) regions were the predominant referral base, followed by Wellington and Canterbury regions, in contrast to the current data which suggested regional dominance, in descending order, of Wellington (48%) followed by Dunedin (22%) and Auckland (18%). In terms of specialty of the clinician who sent the biopsy, similar patterns were shown in which OMF was the lead contributing specialty in both periods (52% in 2007 *vs* 53% in 2020) followed by GDP (15% in 2007 *vs* 17% in 2020), Periodontics and Endodontics (each 11% in 2007 vs 12 and 3% in 2020) in 2007. It is not clear why these differences exist and whether this is truly due to COVID-19. However, the laboratory has evolved and expanded significantly since 2007 and has a far greater overall work volume as well as a wider referral base of clinicians. In terms of diseases in category, 45% were then classified as 'mucosal' lesions in the 2007 study, compared with 39% in the current study, and they comprised mostly non-specific inflammation and reactive hyperplastic lesions but also included 81 cases of immune-mediated conditions including OLP (5.8% *vs* 7.2% in the current series) and 55 cases of epithelial dysplasia (3.9% *vs* 7.8% in the current series) and 19 SCC's (1.4% *vs* 3.4% in the current series). Salivary gland lesions comprised 7% (*vs* 4% in the current series) and included mostly immune-inflammatory conditions but also included 6 benign and 3 malignancies. Soft tissue (connective tissue lesions) mostly consisted of haemangiomas similar to the current series. Intra-bony cases made up 41% of which 23% (n = 133, 9.4% overall) were periapical granulomas. In the current series, periapical granulomas were categorised in the Dental category and made up 77% of cases within the category and 12% overall. In the 2007 study, there were 212 odontogenic cysts (15% *vs* 28% in the current series) and 39 odontogenic tumours (2.8%). This comparison also suggests that there were higher than usual proportions of potential OPMD's and mucosal cancers diagnosed during the COVID-19 affected period, adding to the complexity of the issue, as illustrated when the 2020 data was compared with the 2019 data.

Studies using the same diagnostic categorisation showed similar results to the current study. For example, Mucosal lesions were the most common diagnostic category followed by Dental, Odontogenic cysts and Periodontal pathologies in all the three studies (Jones and Franklin, 2006; Kelloway et al., 2014). Nevertheless, peculiar differences were also detected in reference to OPMDs and SCCs. The study of Jones and Franklin reported 3.1% and that of Kelloway and co-workers only 1.2%, whereas in the current study epithelial dysplasia made up 7.8% of all cases. Also, SCC made up 2.8% (3.4% if OPSCC is included) in the current study as opposed to 2.6% and 1.8% reported respectively in the studies of Jones et al and Kelloway et al. These suggest that there was an increase in the diagnosis of OPMDs and squamous malignancies in New Zealand during the first wave of COVID-19. The apparent increase does not in any way indicate that there is any association between COVID-19 and OPMD/SCC. It does however highlight that clinicians were carefully triaging cases to preferentially biopsy these lesions.

The current study is limited by the relatively small number of cases included due to the fact that only the cases during the first phase of COVID-19 pandemic were included. Whilst there is a benefit in specifically

examining this particular period, it would also be important to examine the overall impact of the pandemic over a longer period of time. Despite such limitations, it appears that COVID-19 during the assessment period had multiple effects. Firstly, there was a decrease in the number of pathology specimens received and this was due to limitations imposed on the clinical practice of many dentists and dental specialists. Secondly there was a geographic variation with several regions in New Zealand being potentially under-represented, raising the possibility that some communities were more vulnerable to being excluded from oral health care during COVID-19 affected period. Finally, there was also a variation in the proportion of mucosal biopsies subsequently diagnosed as OPMDs and oral cancers. Whilst their reported proportions were higher compared with the matching 2019 period and other studies, the actual number of potentially malignant and malignant diagnoses made in fact decreased. Given these three key observations identified in this study, it appears that continued support for dentists and oral healthcare professionals who treat and manage oral and maxillofacial pathologies is warranted, so that despite disturbances consequent to pandemics, patients can continue to receive timely and accurate diagnosis. This will in turn improve patient prognosis in relation to morbidity and mortality, and ultimately reduce societal burden of oral diseases.

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Author details

Benedict Seo *BDS, DClinDent, PhD*
Corresponding author: benedict.seo@otago.ac.nz
Haizal Hussaini *BDS, MDentSci, PhD, FDSRCSE*
Alison M. Rich *BDS, MDSc, PhD, FRACDS, FFOP (RCPA), FRCPath*

Oral Pathology Centre, Faculty of Dentistry, University of Otago, PO Box 56, Dunedin 9054

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