J Oral Med Oral Surg 2025;31:3
https://www.jomos.org
JOMOS
Journal of Oral Medicine and Oral Surgery

https://doi.org/10.1051/mbcb/2025005

Systematic Review

A practical guide to the use of Narrow Band Imaging (NBI) in the early detection of oral cancer: case series and review of the literature

Agostino Guida[1,*], Francesco Perri[2], Marco Annunziata[3], Luis Monteiro[4], Saman Warnakulasuriya[5]

[1] U.O.C. Odontostomatologia A.O.R.N. A. Cardarelli, Naples, Italy
[2] Head and Neck Medical Oncology Unit, Istituto Nazionale Tumori, IRCCS G. Pascale, 80131 Naples, Italy
[3] Multidisciplinary Department of Medical-Surgical and Dental Specialties, University of Campania "Luigi Vanvitelli", Naples, Italy
[4] University Institute of Health Sciences (IUCS), Cooperativa de Ensino Superior Politécnico e Universitário (CESPU), Gandra, Oporto, Portugal
[5] King's College London & WHO Collaboration Centre for Oral Cancer, UK

(Received: 13 January 2025, accepted: 16 January 2025)

Keywords: Oral squamous cell carcinoma / narrow band imaging / early detection

Abstract – Oral Squamous Cell Carcinoma (OSCC) shows an overall 5 yr survival rate of just above 50%. With an estimated 390,000 new cases per year the current therapeutic approaches have failed in the past 20 yr to improve survival. Reducing the burden of this malignancy represents a challenge for clinicians around the globe. Early diagnosis represents the most effective option to reduce the impact of OSCC. Several chairside adjunctive techniques have been researched for the early diagnosis of OSCC but many of them have been found to have limited application due to their low sensitivity and specificity. Narrow Band Imaging (NBI) has the potential to be a useful aid for the clinician involved in the diagnosis and management of Oral Potentially Malignant Disorders (OPMDs) and OSCC. NBI fibroscopy is able to show microvasculature of oral lesions, possibly indicating the likelihood of malignant transformation. Yet, due to its high costs, the long learning curve, and the necessity for calibration of the users its application requires through careful investigation. We performed a review of the existing literature and, by showcasing some clinical cases, we aim to give the clinicians a practical guide to perform NBI when managing OPMD lesions of the different anatomical subsites of the oral cavity, based on the existing clinical evidence.

Introduction

Oral Squamous Cell Carcinoma (OSCC): some facts and figures

The Global Cancer Observatory (GCO), which records data on malignant neoplasms form all around the world, accounts 389,485 new cases of oral squamous cell carcinoma (OSCC) worldwide in 2022 [1]. Surgical treatment of OSCC, especially when performed at advanced stages, may result in tissue mutilation and functional impairment of swallowing, speech, and taste; quality of life of patients may thus be substantially reduced [2,3].

OSCC may have heterogeneous clinical presentation: from a white patch to a red patch, to a mixed white/red area, to an ulcer or a lump [4,5]. Early-stage lesions are often completely symptom-less [6]; as they progress, they can cause discomfort due to ulceration, causing pain and functional disfunction and may spread to regional lymph nodes [7]. OSCC is most common at the posterior lateral border of the tongue, accounting for the highest estimated incidence with 50% of all OSCC cases [8]. OSCC metastases predominantly affect ipsilateral lymph nodes of the neck; more rarely, they may also be found at contralateral lymph nodes or bilaterally. When it spreads outside of the lymphatic network of the neck, OSCC metastases may be found in lungs, bones, and the liver [9].

Patients affected by oral potentially malignant disorders (OPMDs) have an increased risk to develop OSCC. OPMDs include oral leukoplakia (OL), oral erythroplakia (OE), oral submucosal fibrosis (OSMF), and oral lichen planus (OLP) [10].

Treatment of OPMDs is still under debate. There are no standard approaches for treating OL [11,12]. Some suggest, according to presence/absence of dysplasia, that OL should be treated surgically by excision. Nevertheless, literature reveals that surgery may not eliminate the risk of developing OSCC in

* Correspondence: agostino.guida@aocardarelli.it

OL patients [13]. For these reasons, sometimes clinicians prefer a "wait and see" approach, especially in case of wide/recurrent lesions. Similarly, OLP/OLL require continuous follow-up, as it is treated with symptomatic care as opposed to curative care [14].

As a direct consequence of the "wait and see" policy, whether it has been chosen in line with the disease characteristics (OLP/OLL) or it was the clinician's choice, OPMD patients have to undergo frequent clinical follow-up [15,16], periodically undergoing single or multiple biopsies, which also poses the conundrum to the clinician of which site to choose in case of extended/multiple lesions. Selecting an area to perform a biopsy far away from a spot which has already undergone malignant transformation leads to misdiagnosis.

Despite what has been seen for many other cancers such as breast or colon, the OSCC/OPMD situation is thus practically unchanged from the past several decades, with unaltered mortality and survival rates and high morbidity associated with available therapeutic strategies [17].

As advanced therapies fail to effectively reduce the disease burden, surveillance and early detection make up the foundation for reducing the incidence of advanced cancer and possibly reduce mortality [18]. In the past years, in addition to conventional visual and tactile examination scientific literature indicates how non-invasive imaging techniques may represent a key strategy and a valid clinical aid for the early detection of oral cancer [19]. These adjunctive tests include vital staining, oral cytology, light-based examination, alone or in combination [20,21]. Of these tests we propose to review the utility of Narrow Band Imaging as an adjunctive technique in investigating OPMDs and early oral cancer.

Narrow Band Imaging (NBI); instruments, the technique and application

Narrow band imaging (NBI) is a non-invasive fibroscopic technique which uses blue and green light with respective wavelengths of 415 and 540 nm. It consists of a regular fiberscope, by which light emission can be modulated from white light (which comprises every wave length) to one narrowed to 415/540 nm. Those specific wavelengths of light penetrate the epithelial layer and are absorbed by the capillaries in the submucosa immediately underneath the surface epithelium. After filtering the scattered light, the machine, connected to magnifying monitors, highlights the intrapapillary capillary loops (IPCL) of the most superficial layers of connective tissue. When compared to white light, NBI contrasts blood vessels significantly, providing distinct images of IPCLs [22]. Interpretation of NBI images is operator dependent. The most used classification for NBI is based on the 4-pattern system described by Takano *et al* [23]:

- IPCL Pattern I appears with both waved arms together, as a waved line;
- IPCL Pattern II has a similar shape to type I, but their caliber is notably increased compared with others far from the lesion;
- IPCL Pattern III shows elongation, dilation and twisting vessels;
- IPCL Pattern IV shows large vessels with no loops, with destruction of physiological patterns and arborization.

IPCL I and IPCL II are usually associated with normal mucosa. IPCL III and IPCL IV are associated with dysplasia and malignant transformation [23].

Among the different classifications, the Takano classification is the one which has been proved most reliable [24,25].

A recent systematic review of systematic reviews, found out that NBI was the only clinical visual aid for which there is enough evidence for recommendation as a diagnostic adjunctive tool for detecting OSCC or the malignant transformation of OPMD. NBI fibroscopy can be considered as a guide for diagnosis, including tissue biopsy — which still is the gold standard [26].

Taken into account the criticisms on current applications which contribute to diagnostic delays of OSCC, Narrow Band Imaging (NBI) fibroscopy has shown itself capable of differentiating healthy from dysplastic/neoplastic oral epithelium and has a great potential as an adjunctive tool for clinicians in guiding the diagnosis of OSCC.

We have thus performed a review of the published scientific literature on the use of NBI in the oral cavity. After retrieving available evidence on NBI effectiveness, we present some retrospectively selected clinical cases which demonstrate the utility of this optical system in early diagnosis of OSCC. We outline a "step by step" guide to the clinicians who wishes to explore using this diagnostic tool.

Materials and methods

Review of the published literature

A web search was performed on Web of Science, MEDLINE (*via* PUBMED) and Scopus. Terms which would have been useful for research were checked on the Medical Subject Headings (MeSH) of the National Library of Medicine —NLM (https://www.ncbi.nlm.nih.gov/mesh/).

Then to maximize sensitivity, a combination of related free terms combined with MeSH terms were used to fill the search query:

"(mouth) OR (oral) and ((Narrow Band Imaging) OR (NBI) OR (Band Imaging, Narrow) OR (Band Imagings, Narrow) OR (Imaging, Narrow Band) OR (Imagings, Narrow Band) OR (Narrow Band Imagings) OR (Narrowband Imaging) OR (Imaging, Narrowband) OR (Imagings, Narrowband) OR (Narrowband Imagings))".

Regarding search dates, no lower date limit was set, and the upper date limit was September 2024.

Duplicates and papers not written in English were excluded. Through title and abstract analyses, the publications were initially screened. Review articles/commentaries/letters to the editors were excluded. Articles on clinical research and cases series/reports on the use of NBI in the oral cavity were selected. After full text analysis, pertinence of the topic was re-evaluated and only articles which used the 2010 Takano [23]

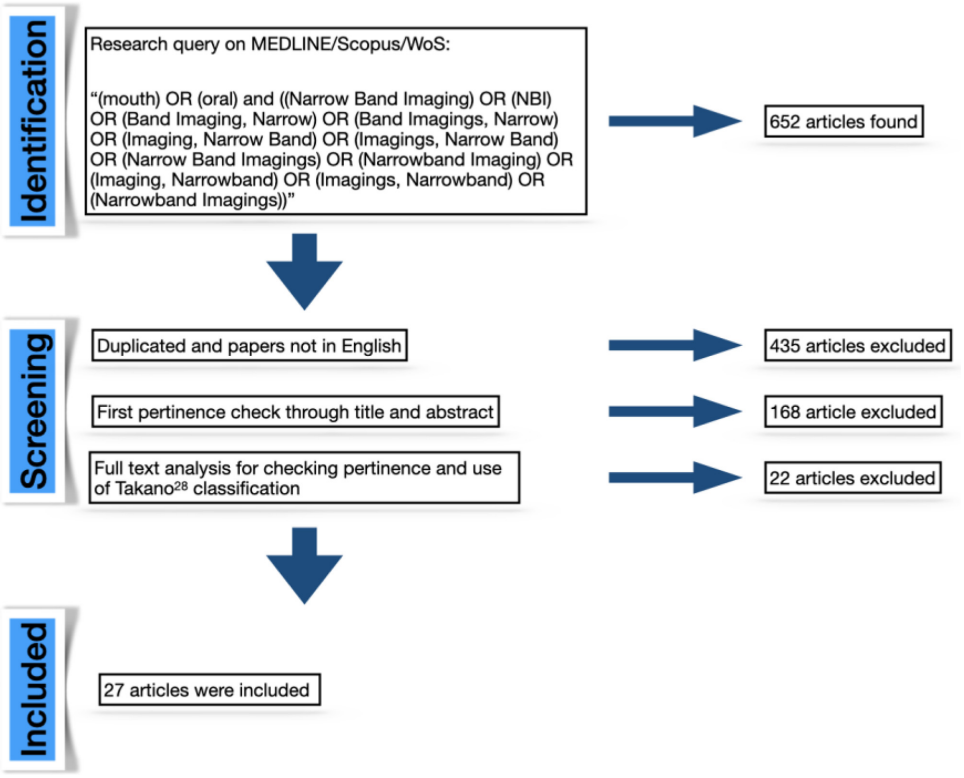

Fig. 1. The flow diagram depicts the results of the literature search, study identification, and selection process.

classification for NBI interpretation were finally included, as it has been proved to be the most effective one for the oral cavity. The study selection is illustrated in Figure 1.

Case series

After retrieving available evidence, we retrospectively selected three cases from our stored archives, in order to give to the readers a practical guide on how to use NBI in the oral cavity.

Results

Review of the published literature

The web search was performed on 22th October, 2024 and produced 652 results. After exclusion of duplicates and articles which were not written in English, the results were narrowed to 217 results. Then, through title and abstract analyses, off-topic, reviews were excluded, we selected 49 articles on the use of NBI in the oral cavity. After full text analysis, pertinent articles of clinical research which used the 2010 Takano classification [23] we included a total of 27 selected articles; the data are summarized in Table I.

From 2011 to 2024, 27 publications were found reporting the clinical research conducted using NBI in the oral cavity. Some of them were on oral cavity and oropharynx; for the purpose of this review, only the data related to the oral cavity were considered. They were all retrospective or prospective, non-randomized, non-case-controlled studies, leading to moderate scientific evidence.

Initially published studies [27–30] focused on the reliability of the technique in detecting OSCC. A high value of sensitivity and specificity (both around or higher than 90%) were found, with a good correlation between high grade IPCL patterns (III or IV) and OSCC/High Grade Dysplasia (HGD). Subsequent studies confirmed NBI ability to differentiate between OSCC and OPMD [35,47,48,50,51,54], with higher specificity and sensitivity than white light [44,47,51]. Four studies focused on NBI and OLP/OLL, suggesting that NBI may detect chronic lesions which may undergo malignant transformation [42,43,45,46].

From 2015, several studies focused on NBI pre/peri-operative evaluation of surgical margins [31,34–41,48,52,53]. Interestingly, in this group of studies we found several that did not find any benefit from the NBI use [52,53]. For example, in a prospective study of 34 patients, Nilsson *et al* [53] reported that the delineation of mucosal tumor borders in oral cancers by NBI was not better than that by white light examination. On the other hand, 10 other studies [31,34–41,48] — which were published by 2 research groups - found a significant benefit from NBI surgical margins evaluation, both in terms of confirming disease-free margins and in long-term disease-free survival.

Some papers underlined that NBI interpretation may require a long learning curve, as it is influenced by operator's experience, variations observed in epithelial thickness of the oral mucosa in different anatomical subsites of the oral cavity and the variations observed in the capillary structure of OLP/OLL [38,42,47,51,52].

Table I. Included papers in chronological order.

Authors & year	Country	Study information	Significant findings
Yang *et al.* 2012 [27]	China	• 154 patients (130 M, 24 F) • 90 buccal mucosa, 18 ventrolateral tongue, 15 retromolar, 1 FOM, 6 lip, 10 dorsal tongue, 8 gum, 6 palate • 60 H-OL, 94 NH-OL	The IPCL patterns shown by NBI system can be helpful in detecting oral leukoplakia with higher grade dysplasia or invasive carcinoma.
Yang *et al.* 2012 [28]	China	• 414 patients (365M, 49 F) • 12 lip, 288 buccal mucosa, 22 gum, 11 dorsal tongue, 38 ventrolateral tongue; 12 palate; 5 FOM; 26 retromolar • 197 H-OL, 217 NH-OL	The NBI images of twisted elongation of IPCL and IPCL pattern destruction are indicators of high-grade dysplasia or carcinomatous lesions in oral leukoplakia.
Yang *et al.* 2014 [29]	China	• 63 patients (41 M, 22 F) • 25 tongue, 19 buccal, 8 lip, 6 gum, 2 hard palate, 2 retromolar, 1 FOM • 63 chronic (persisting for more than 3 weeks) non healing ulcers	NBI pattern is the only independent factor associated with the occurrence of squamous cell carcinoma in oral chronic non-healing ulcers.
Shibahara *et al.* 2014 [30]	Japan	• 137 patients (68 M, 69 F) • OSCC: 35 tongue, 5 gum, buccal 9; palate 2; FOM 1 • 52 OSCC, 25 OL, 18 OLP, 6 OE, 6 ED, 6 other	Type III-IV IPCL patterns sensitivity and specificity for the identification of OSCC were 92.3% and 88.2% respectively
Tirelli *et al.* 2015 [31]	Italy	• 8 patients (M/F proportion unretrievable) • 6 FOM, 2 anterior tongue • 8 OSCC	NBI is useful in determining surgical margins for OSCC
Vu *et al.* 2015 [32]	Australia	• 95 patients (43 M, 52 F) • 272 lesions: 114 buccal, 74 tongue, 34 gum, 19 lip, 18 palate, 13 FOM • 93 biopsied lesions: 5 H-OL, 25 NH-OL, 43 OLP/OLL/LR, 20 other	NBI demonstrates great utility as a visualisation adjunct for detecting and monitoring OPMD
Yang *et al.* 2015 [33]	Taiwan	• 72 patients (66 M, 6 F) • 2 lip, 55 buccal, 1 gum, 6 tongue, 2 palate, 2 FOM, 4 retromolar • 72 OE	Twisted, elongated, and destructive patterns of NBI IPCL are linked to high-grade dysplasia, carcinoma *in situ* and invasive carcinoma in oral erythroplakia
Farah *et al.* 2016 [34]	Australia	• 18 patients (11 M, 7 F) • 7 FOM, 2 gum, 5 tongue, 3 buccal, 1 palate • 18 OSCC	Resection to NBI-defined margins will leave less dysplastic and malignant residual tissue and thereby increase ablative surgery success rates.
Tirelli *et al.* 2016 [35]	Italy	• 42 patients (M/F proportion not provided) • Anatomical sites non specified • 42 OSCC	NBI helps to identify the presence of dysplasia and cancer at excision margin of OSCC
Tirelli *et al.* 2017 [36]	Italy	• 77 OPSCC-OSCC; no other information provided	NBI could represent an added value in the pre-operative and intra-operative assessment of OSCC.
Tirelli *et al.* 2017 [37]	Italy	• 39 patients (25 M, 14 F) • No subsite information provided • 39 OSCC	

Table I. (continued).

Authors & year	Country	Study information	Significant findings
			NBI could allow for real-time definition of superficial tumor extension, not influenced by tumor site.
Tirelli *et al.* 2017 [38]	Italy	• 79 patients (M/F proportion not provided) • No subsite information provided • 79 OSCC	NBI appears useful for follow-up after treatment for OSCC. Learning curve may cause false positives
Farah *et al.* 2018 [39]	Australia	• 18 patients (11 M, 7 F) • 7 FOM, 2 gum, 5 tongue, 3 buccal, 1 palate • 18 OSCC	Surgical margins defined by NBI leave less potentially malignant residual tissue.
Farah *et al.* 2018 [40]	Australia	• 20 patients (13 M, 7 F) • 5 tongue, 7 FOM, 2 gum, 3 buccal, 1 palate, 1 maxilla, 1 mandible • 20 OSCC	Resection to NBI-defined margins improves survival rates and decreases recurrence rates of OSCC
Tirelli *et al.* 2018 [41]	Italy	• 62 patients (M/F proportion not provided) • 24 FOM, 22 tongue, 8 buccal, 8 palate	NBI is useful in determining surgical margins for OSCC
Guida *et al.* 2019 [42]	Italy	• 98 patients (58 M, 40 F) • 106 lesions: 30 tongue, 47 buccal, 11 hard palate, 3 soft palate, 10 gum, 5 FOM • 19 OSCC, 24 OD, 3 PVL, 30 OLP, 30 keratosis	NBI could help in the follow-up of patients with multiple chronic lesions such as OLP
Cozzani *et al.* 2019 [43]	Italy	• 37 patients (14 M, 23 F) • No subsite information provided • 37 OLP	NBI evaluation may increase the accuracy of detection of neoplastic transformation in OLP
Upadhyay *et al.* 2019 [44]	India	• 38 patients, (23 M, 15 F) • No subsite information provided • 31 OSCC, 1 hyperlasia/dysplasia; no other information provided	NBI sensitivity and specificity was higher than white light examination
Guida *et al.* 2021 [45]	Italy	• 84 patients (34 M, 50 F) • 63 buccal, 1 FOM, 3 gum, 8 palate, 9 tongue • 26 OLL, 47 OLP, 8 OLR, 3 OSCC	Interpretation of NBI should be modulated when assessing lichenoid lesions. NBI has potential to discern malignant transformation occurring in lichenoid lesions undergoing long-term follow-up, as IPCL pattern IV may be used as a clinical marker of malignancy
Deganello *et al.* 2021 [46]	Italy	• 56 patients (M-to-F ratio 1:2.6) • 66% buccal, 21% gum, 9% tongue • 47 OLP, 4 OD, 5 HGD/OSCC	NBI improved detection rate of OSCC in OLP patients
Nair *et al.* 2021 [47]	India	• 50 patients (41 M, 9 F) • 23 buccal, 20 tongue, 3 trigonous, 1 gum, 1 hard palate, 3 lip • 27 OSCC, 21 premalignant lesions, 3 normal mucosa	NBI is a highly effective tool to detect invasive carcinomas amongst suspicious lesions of the oral cavity.

Table I. (continued).

Authors & year	Country	Study information	Significant findings
de Wit *et al.* 2021 [48]	The Netherlands	• 16 patients (10 M, 6 F) • 12 tongue, 3 FOM, 1 buccal • 16 OSCC	NBI adequately identified the mucosal margin especially in early-stage OSCC
Ota *et al.* 2022 [49]	Japan	• 55 patients (M/F proportion not provided) • 22 buccal, 1 FOM, 19 tongue, 6 hard palate, 12 gum • 16 OLP, 31 OL, 13 OSCC	NBI is influenced by mucosal thickness; therefore, image interpretation is important for accurate diagnosis.
Nitro *et al.* 2022 [50]	Italy	• 20 patients (8M, 12 F) • 23 buccal, 7 palate, 5 tongue, 2 gum, 2 lip • 20 GVHD	There is rationale for routine use of endoscopy with NBI in patients with oral chronic Graft-*versus*-Host Diesease
Iandelli *et al.* 2023 [51]	Italy	• 76 patients (36 M, 40 F) • No subsite information provided • 76 OSCC	The presence of depapillation did not affect the intralesional pattern detected by the NBI
Mahto *et al.* 2024 [52]	India	• 38 patients (30 M, 8 F) • 23 tongue, 8 buccal; no other information provided • 38 OSCC	NBI can complement WL for margin assessment in OSCC but requires a long learning curve
Nilsson *et al.* 2024 [53]	Sweden	• 34 patients (18 M, 16 F) • 16 tongue, 12 gum, 3 buccal, 3 FOM • 49 OSCC	The delineation of mucosal tumour borders in oral cancers by NBI was not better than that by WL

ED: epithelial dysplasia F: female; FOM: floor of mouth; H: homogeneous; HGD: high grade dysplasia; LR: lichenoid reaction; M: male; NH: non-homogeneous; OE: oral erithroplakia; OL: oral leukoplakia; OLL: oral lichenoid lesion; OLP: oral lichen planus; OPSCC: oropharyngeal squamous cell carcinoma; OSCC: oral squamous cell carcinoma; PVL: proliferative verrucous leukoplakia.

Clinical cases

Clinical case I

G.P., A 42-year-old male was diagnosed with oral lichenoid lesions (OLL) when he was 27 yr old. He developed a micro invasive OSCC and had two surgeries within the last 5 yr. NBI examination of the whole mouth was performed during a follow up visit and the remaining lichenoid lesions showed IPCL patterns II and III. A biopsy was performed that confirmed OLL with no evidence of carcinoma. He is on a regular 6 monthly follow up regime and at each visit COE supported by NBI examination is undertaken. In Figure 2, we show this clinical example of an OLL lesion that demonstrates IPCL patterns II and III by NBI examination.

Clinical case 2

F.D.F.R., a 78-year-old female was referred to our center for an OL. She denied symptoms, comorbidities and previously diagnosed OPMDs. On clinical examination, she had a homogenous leukoplakia of the buccal mucosa of the cheek, of approximately 1.5 cm. At the NBI fibroscopy (Fig. 3), the lesion showed pattern IV (J-K according to Xu 2024 classification). An incisional biopsy performed at most significant NBI spot revealed OSCC Cis. She then underwent Oncological Multidisciplinary Team (OMT) evaluation with Neck Node US and Head & Neck CT Scan, both negative. The patient was thus classified as TisN0M0 and wide excision of the leukoplakia was thus performed after OMT indication. She is now undergoing follow-up, and is free of disease.

Clinical case III

M.B., A 57-year-old male was referred to our center for follow-up, following an excisional biopsy of a small ulcer on the right posterior margin of the tongue. Histopathology revealed surgical margins as “close”. He attended with a post-surgical scar in good condition; he had no clinically recognizable oral lesions. At NBI fibroscopy (Fig. 4), the post-surgical site revealed an anomalous IPCL vascularization, with anomalous arborization and loss of physiological patterns of appearance of capillaries. He was thus classified as IPCL IV and a subsequent biopsy revealed a recurrent OSCC at this site. The patient underwent routine staging, was classified as T1N0M0 and was seen by Oncological Multidisciplinary Team (OMT) for

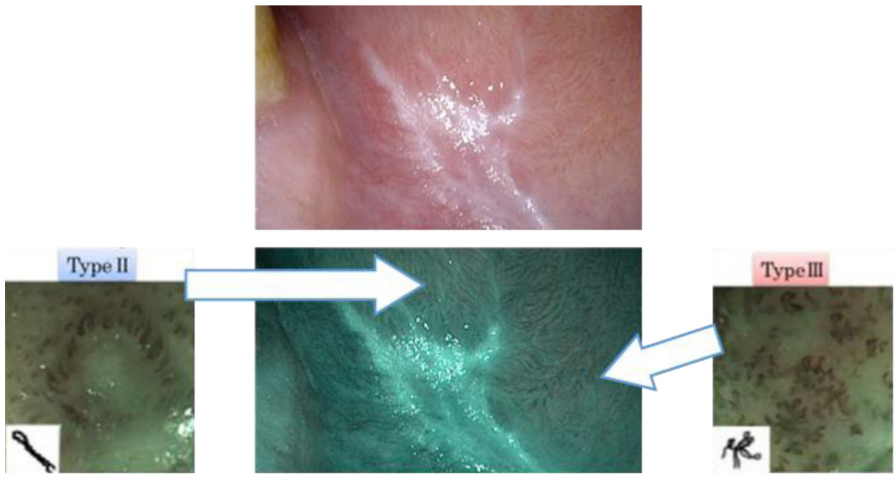

Fig. 2. The appearance of an OLL lesion showing IPCL patterns II and III (graded by Takano *et al* system).

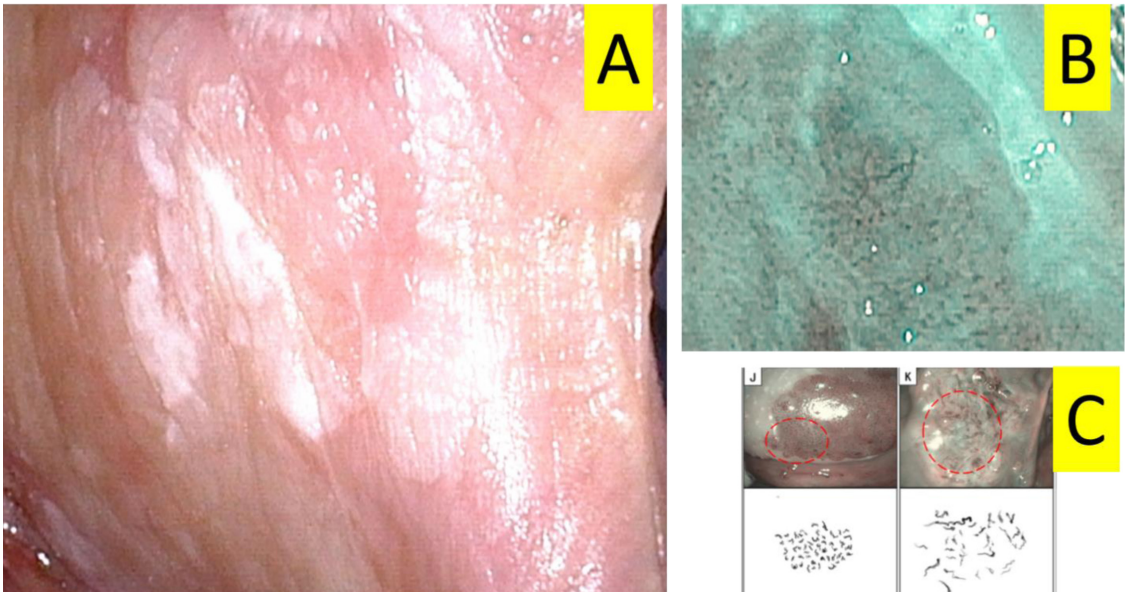

Fig. 3. White light appearances of an OL of buccal mucosa (A), NBI appearance (B), NBI patterns detail (C) showing pattern IVJ/K according to Xu *et al* 2024 [57]. OSCC *In Situ* was found.

further evaluation and for management of his OSCC recurrence. The case illustrates that NBI can detect a recurrent OSCC in the absence of clear clinical signs of a malignancy in an area of scarring following previous surgery.

Discussion: a guide to the clinician

In over 12 yr of published literature on the use of NBI in oral cavity, we found there was a general consensus of a good correlation with of high grade IPCL patterns and HGD/OSCC. Whether it is in predicting high grade dysplasia or OSCC presence in a patch of oral leukoplakia [33] or distinguishing among non-healing oral ulcers [34], studies indicate that OPMD examination could benefit from NBI examination [35]. In particular, NBI use for clinical oral examination was not performing as an alternative to the gold standard biopsy, but as a valid aid tool. Similarly, patients with chronic lesions from OLP/OLL may as well benefit from NBI-assisted follow-up [30,42,43,45,46,51] in terms of anticipating detection of malignant transformation.

NBI fibroscope is an expensive machine, the interpretation of images needs considerable calibration through an experienced instructor and may have a long learning curve [38,42,47]. Its effectiveness in primary care should be carefully evaluated before embarking on its use. Fibroscopy may add some additional chairside time to the patient's visit, as every lesion needs to be carefully examined, keeping the probe as close to the mucosa without losing the focus. Furthermore, especially for patients with a history of OPMD/OSCC, a full mouth NBI fibroscopy is strongly advised.

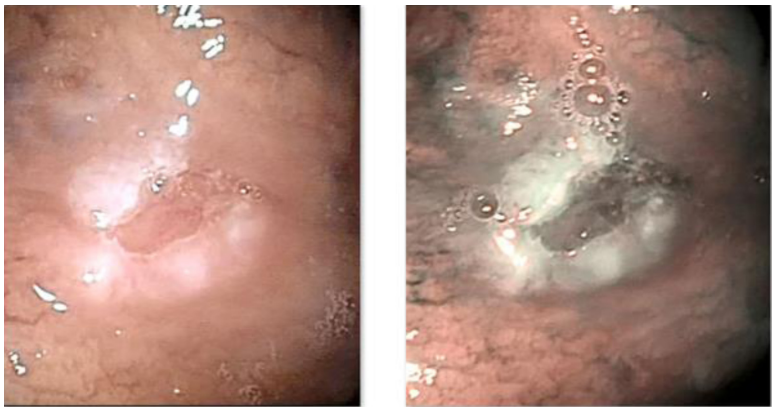

Fig. 4. Post-surgical scar after incomplete OSCC excision, showing IPCL pattern IV according to Takano *et al.* 2010 [23].

As many primary research publications and systematic reviews suggest [21,26,28–30,42,43,45,46,50,54–56], NBI-aided biopsy may become standard of care in the near future, both during first diagnosis and follow-up. Recently, a new classification has been proposed [57] for improved interpretation of IPCL patterns. This classification represents an evolution of the four-grades pattern IPCL system by Takano [23], providing a better description of IPCLs visualized through new generation high definition fibroscopic magnification systems.

So, if a clinician wants to use NBI, the first thing is to understand the cohort of patients who would benefit from its use. It is not likely that general dental practitioners may find much use for it, but Secondary Care centers may on the other hand benefit by performing NBI fibroscopy. NBI may be useful when help is needed in choosing when or selecting the optimal site to perform a diagnostic biopsy, both for first diagnosis or during follow-up, of OPMD lesions and OSCC.

When the clinicians find themselves in a clinical situation whether to biopsy or not to diagnose an oral lesion, or when choosing the site of biopsy in case of an extended/multifocal lesion, or doing periodical follow-up examinations of patients with chronic/recurrent lesions, NBI may actively help the decision tree.

We note there is no high quality scientific evidence from published studies indicating that NBI performs better when compared to standard clinical oral examination. Yet, a recent paper found moderate evidence through performing a systematic review of systematic reviews [26] that NBI may be a useful tool in guiding to undertake a biopsy.

In particular, NBI showed itself to be able to differentiate between OSCC and chronic oral lesions such as OLP/OLL [30,42,43,45,46,51] and in general from OPMDs. There is no evidence in the literature to recommend its use for screening for oral cancer in the general population [26].

Conclusion

NBI has shown incredibly promising results, possibly being a device able to detect OSCC at an early stage in patients at high risk of developing OSCC. NBI is a non-invasive fibroscopy technique that could thus be of great assistance in clinical practice for specialists who routinely deal with follow-up of susceptible patients such as those with a history of OPMD/OSCC, with or without clinically visible lesions.

Our review also indicated that almost every published study on the topic is retrospective; rigorous prospective approaches with the inclusion of the wider disease spectrum is currently required for giving definitive answers about NBI application for early diagnosis of OSCC in high-risk patients.

Funding

The authors declare they have received no funding for performing this review.

Conflicts of interest

The authors declare they have no conflict of interest in performing this review.

Data availability statement

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

References

1. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, Jemal A. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2024;74:229–263.
2. Linsen SS, Gellrich N-C, Krüskemper G. Age-and localization-dependent functional and psychosocial impairments and health related quality of life six months after OSCC therapy. Oral Oncol 2018;81:61–68.
3. Meier JK, *et al.* Health-related quality of life: a retrospective study on local *vs.* microvascular reconstruction in patients with oral cancer. BMC Oral Health 2019;19:1–8.
4. Markopoulos AK, Current aspects on oral squamous cell carcinoma. Open Dent J 2012;6:126–130.

5. Bagan J, Sarrion G, Jimenez Y. Oral cancer: clinical features. Oral Oncol 2010;46:414–417.
6. Brandizzi D, Gandolfo M, Velazco ML, Cabrini RL, Lanfranchi H. Clinical features and evolution of oral cancer: a study of 274 cases in Buenos Aires, Argentina. Med Oral Patol Oral Cir Bucal 2008;13: E544–E548.
7. Cancer Research UK. Head and neck cancers statistics www.cancerresearchuk.org/cancer-info/cancerstats/types/oral/uk-oral-cancer-statistics (accessed 21 October 2024).
8. Saldivia-Siracusa C, Araújo AL, Arboleda LP, Abrantes T, Pinto MB, Mendonça N, *et al.* Insights into incipient oral squamous cell carcinoma: a comprehensive south-American study. Med Oral Patol Oral Cir Bucal 2024;29:e575–e583.
9. Jerjes W, *et al.* Clinicopathological parameters, recurrence, locoregional and distant metastasis in 115 T1-T2 oral squamous cell carcinoma patients. Head Neck Oncol 2010;2:1–21.
10. Warnakulasuriya S, Kujan O, Aguirre-Urizar JM, Bagan JV, González-Moles MÁ, Kerr AR, Lodi G, Mello FW, Monteiro L, Ogden GR, Sloan P, Johnson NW. Oral potentially malignant disorders: a consensus report from an international seminar on nomenclature and classification, convened by the WHO Collaborating Centre for Oral Cancer. Oral Dis 2021;27:1862–1880.
11. Kerr AR, Lodi G. Management of oral potentially malignant disorders. Oral Dis 2021;27:2008–2025.
12. Gates JC, Abouyared M, Shnayder Y, Farwell DG, Day A, Alawi F, Moore M, Holcomb AJ, Birkeland A, Epstein J. Clinical management update of oral leukoplakia: a review from the american head and neck society cancer prevention service. Head Neck 2024;47:733–741.
13. Mehanna HM, Rattay T, Smith J, McConkey CC. Treatment and follow-up of oral dysplasia — a systematic review and meta-analysis. Head Neck 2009;31:1600–1609.
14. Cheng Y-SL, Gould A, Kurago Z, Fantasia J, Muller S. Diagnosis of oral lichen planus: a position paper of the American Academy of Oral and Maxillofacial Pathology. Oral Surg Oral Med Oral Pathol Oral Radiol 2016;122:332–354.
15. Evren I, Najim AM, Poell JB, Brouns ER, Wils LJ, Peferoen LAN, Brakenhoff RH, Bloemena E, van der Meij F EH, de Visscher JGAM. The value of regular follow-up of oral leukoplakia for early detection of malignant transformation. Oral Dis 2024;30:2991–3003.
16. Lombardi N, Arduino PG, Lampiano M, Gambino A, Broccoletti R, Varoni EM, Lodi G. Surgical treatment compared with “wait and see” in patients affected by oral leukoplakia to prevent oral cancer: Preliminary data from a multicenter randomized controlled trial. Oral Dis 2024 Jun 27 DOI: https://doi.org/10.1111/odi.15058. Online ahead of print.
17. Warnakulasuriya S, Greenspan JS. Epidemiology of oral and oropharyngeal cancers. In: Warnakulasuriya S, Greenspan JS, Eds. Textbook of oral cancer Springer Nature: Switzerland, 2020;5–22.
18. Bouvard V, Nethan ST, Singh D, Warnakulasuriya S, Mehrotra R, Chaturvedi AK, Chen TH-H., Ayo-Yusuf OA, Gupta PC, Kerr AR, *et al.* IARC perspective on oral cancer prevention. N Engl J Med 2022;24:1999–2005.
19. Guida A, Warnakulasuriya S. Stomatognathic diseases: State of the art and future perspectives. J Clin Med 2022;11:6525.
20. Walsh T, Macey R, Kerr AR, Lingen MW, Ogden GR, Warnakulasuriya S. Diagnostic tests for oral cancer and potentially malignant disorders in patients presenting with clinically evident lesions. Cochrane Database of Systematic Reviews TBD, Issue TBD. Art. No.: CD 0102 76. DOI: https://doi.org/10.1002/14651858.CD010276.pub3
21. Pierfelice TV, D’Amico E, Cinquini C, Iezzi G, D’Arcangelo C, D’Ercole S, Petrini M. The diagnostic potential of non-invasive tools for oral cancer and precancer: A systematic review. Diagnostics (Basel) 2024;14:2033.
22. Zhang Y, Wu Y, Pan D, Zhang Z, Jiang L, Feng X, *et al.* Accuracy of narrow band imaging for detecting the malignant transformation of oral potentially malignant disorders: a systematic review and meta-analysis. Front Surg 2022;6:1068256.
23. Takano JH, Yakushiji T, Kamiyama I, Nomura T, Katakura A, Takano N, Shibahara T. Detecting early oral cancer: narrowband imaging system observation of the oral mucosa microvasculature. Int J Oral Maxillofac Surg 2010;39:208–213.
24. Vu AN, Farah CS. Efficacy of narrow band imaging for detection and surveillance of potentially malignant and malignant lesions in the oral cavity and oropharynx: A systematic review. Oral Oncol 2014;50:413–420.
25. Yang SW, Lee YS, Chang LC, Hwang CC, Luo CM, Chen TA. Clinical characteristics of narrow-band imaging of oral erythroplakia and its correlation with pathology. BMC Cancer 2015;15:406.
26. Lau JOG, Warnakulasuriya S, Balasubramaniam R, Frydrych A, Kujan O. Adjunctive aids for the detection of oral squamous cell carcinoma and oral potentially malignant disorders: A systematic review of systematic reviews. Jpn Dent Sci Rev 2024;60:53–72.
27. Yang SW, Lee YS, Chang LC, Hwang CC, Luo CM, Chen TA. Use of endoscopy with narrow-band imaging system in evaluating oral leukoplakia. Head Neck 2012;34:1015–1022.
28. Yang SW, Lee YS, Chang LC, Hwang CC, Chen TA. Diagnostic significance of narrow-band imaging for detecting high-grade dysplasia, carcinoma *in situ*, and carcinoma in oral leukoplakia. Laryngoscope 2012;122:2754–2761.
29. Yang SW, Lee YS, Chang LC, Hwang CC, Chen TA. Use of endoscopy with narrow-band imaging system in detecting squamous cell carcinoma in oral chronic non-healing ulcers. Clin Oral Investig 2014;18:949–959.
30. Shibahara T, Yamamoto N, Yakushiji T, Nomura T, Sekine R, Muramatsu K, Ohata H. Narrow-band imaging system with magnifying endoscopy for early oral cancer. Bull Tokyo Dent Coll. 2014;55:87–94.
31. Tirelli G, Piovesana M, Gatto A, Tofanelli M, Biasotto M, Boscolo Nata F F. Narrow band imaging in the intra-operative definition of resection margins in oral cavity and oropharyngeal cancer. Oral Oncol 2015;51:908–913.
32. Vu AN, Matias M, Farah CS. Diagnostic accuracy of narrow band imaging for the detection of oral potentially malignant disorders. Oral Dis 2015;21:519–529.
33. Yang SW, Lee YS, Chang LC, Hwang CC, Luo CM, Chen TA. Clinical characteristics of narrow-band imaging of oral erythroplakia and its correlation with pathology. BMC Cancer 2015;15:406.
34. Farah CS, Dalley AJ, Nguyen P, Batstone M, Kordbacheh F, Perry-Keene J, Fielding D. Improved surgical margin definition by narrow band imaging for resection of oral squamous cell carcinoma: A prospective gene expression profiling study. Head Neck 2016;38:832–839.
35. Tirelli G, Piovesana M, Gatto A, Torelli L, Boscolo Nata F F. Is NBI-guided resection a breakthrough for achieving adequate resection margins in oral and oropharyngeal squamous cell carcinoma? Ann Otol Rhinol Laryngol 2016;125:596–601.

36. Tirelli G, Piovesana M, Gatto A, Torelli L, Di Lenarda R, Boscolo Nata F. NBI utility in the pre-operative and intra-operative assessment of oral cavity and oropharyngeal carcinoma. Am J Otolaryngol 2017;38:65–71.
37. Tirelli G, Piovesana M, Marcuzzo AV, Gatto A, Biasotto M, Bussani R, Zandonà L, Giudici F, Boscolo Nata F. Tailored resections in oral and oropharyngeal cancer using narrow band imaging. Am J Otolaryngol 2018;39:197–203.
38. Tirelli G, Piovesana M, Bonini P, Gatto A, Azzarello G, Boscolo Nata F. Follow-up of oral and oropharyngeal cancer using narrow-band imaging and high-definition television with rigid endoscope to obtain an early diagnosis of second primary tumors: a prospective study. Eur Arch Otorhinolaryngol 2017;274:2529–2536.
39. Farah CS, Fox SA, Dalley AJ. Integrated miRNA-mRNA spatial signature for oral squamous cell carcinoma: a prospective profiling study of narrow band imaging guided resection. Sci Rep 2018;8:823.
40. Farah CS. Narrow band imaging-guided resection of oral cavity cancer decreases local recurrence and increases survival. Oral Dis 2018;24:89–97.
41. Tirelli G, Boscolo Nata F, Gatto A, Bussani R, Spinato G, Zacchigna S, Piovesana M. Intraoperative margin control in transoral approach for oral and oropharyngeal cancer. Laryngoscope 2019;129:1810–1815.
42. Guida A, Maglione M, Crispo A, Perri F, Villano S, Pavone E, Aversa C, Longo F, Feroce F, Botti G, Ionna F. Oral lichen planus and other confounding factors in narrow band imaging (NBI) during routine inspection of oral cavity for early detection of oral squamous cell carcinoma: a retrospective pilot study. BMC Oral Health 2019;19:70.
43. Cozzani E, Russo R, Mazzola F, Garofolo S, Camerino M, Burlando M, Peretti G, Parodi A. Narrow-band imaging: a useful tool for early recognition of oral lichen planus malignant transformation? Eur J Dermatol 2019;29:500–506.
44. Upadhyay A, Saraswathi N, Mundra RK. Narrow band imaging: An effective and early diagnostic tool in diagnosis of oral malignant lesions. Indian J Otolaryngol Head Neck Surg 2019;71:967–971.
45. Guida A, Ionna F, Farah CS. Narrow-band imaging features of oral lichenoid conditions: A multicentre retrospective study. Oral Dis 2023;29:764–771. Epub 2021 May 25.
46. Deganello A, Paderno A, Morello R, Fior M, Berretti G, Del Bon F, Alparone M, Bardellini E, Majorana A, Nicolai P. Diagnostic accuracy of narrow band imaging in patients with oral lichen planus: A prospective study. Laryngoscope 2021;131:E1156–E1161.
47. Nair D, Qayyumi B, Sharin F, Mair M, Bal M, Pimple S, Mishra G, Nair S, Chaturvedi P. Narrow band imaging observed oral mucosa microvasculature as a tool to detect early oral cancer: An Indian experience. Eur Arch Otorhinolaryngol 2021;278:3965–3971.
48. de Wit JG, van Schaik JE, Voskuil FJ, Vonk J, de Visscher SAHJ, Schepman KP, van der Laan F BFAM, Doff JJ, van der Vegt F B, Plaat BEC, Witjes MJH. Comparison of narrow band and fluorescence molecular imaging to improve intraoperative tumour margin assessment in oral cancer surgery. Oral Oncol 2022;134:106099.
49. Ota A, Miyamoto I, Ohashi Y, Chiba T, Takeda Y, Yamada H. Diagnostic accuracy of high-grade intraepithelial papillary capillary loops by narrow band imaging for early detection of oral malignancy: A cross-sectional clinicopathological imaging study. Cancers (Basel) 2022;14:2415.
50. Nitro L, Pipolo C, Castellarin P, Sardella A, Bulfamante AM, De Marco B, Magliano G, Grillo G, Felisati G, Saibene AM. Implementation of routine endoscopy with narrow band imaging in the evaluation of oral and upper airways lesions in oral chronic graft-*versus*-host disease: A preliminary study. J Pers Med 2022;12:1628.
51. Iandelli A, Sampieri C, Marchi F, Pennacchi A, Carobbio ALC, Lovino Camerino P, Filauro M, Parrinello G, Peretti G. The role of peritumoral depapillation and its impact on narrow-band imaging in oral tongue squamous cell carcinoma. Cancers (Basel) 2023;15:1196.
52. Mahto K, Kumar Goldar G, Varshney A, Malhotra M, Priya M, Kumar A, Bhinyaram, Singh A, Bhardwaj A, Vetrivel G, Nag S, Kumar Tyagi A. Achieving negative superficial resection margins with NBI and white light in carcinoma oral cavity: Could it be a norm? Oral Oncol 2024;159:107044.
53. Nilsson O, von Beckerath M, Knutsson J, Landström FJ. Narrow band imaging in oral cancer did not improve visualisation of the tumour borders: a prospective cohort study. Acta Otolaryngol 2024;144:652–656.
54. Kim DH, Kim SW, Lee J, Hwang SH. Narrow-band imaging for screening of oral premalignant or cancerous lesions: A systematic review and meta-analysis. Clin Otolaryngol 2021;46:501–507.
55. Romano A, *et al.* Noninvasive imaging methods to improve the diagnosis of oral carcinoma and its precursors: state of the art and proposal of a three-step diagnostic process. Cancers 2021;13:2864.
56. Mendonca P, Sunny SP, Mohan U, Birur NP, Suresh A, Kuriakose MA. Non-invasive imaging of oral potentially malignant and malignant lesions: A systematic review and meta-analysis. Oral Oncol 2022;130:105877.
57. Xu Y, Zhang T, Liu D, Qiu X, Hou F, Wang J, Luo X, Dan H, Zhou Y, Zeng X, Jiang L, Chen Q. New IPCL classification using NBI for early detection of OPMDs malignant transformation. Oral Dis 2024 Nov 25. doi: 10.1111/odi.15200. Epub ahead of print

Cite this article as: Guida A, Perri F, Annunziata M., Monteiro L, Warnakulasuriya S. 2025. A practical guide to the use of Narrow Band Imaging (NBI) in the early detection of oral cancer: case series and review of the literature. *J Oral Med Oral Surg*. 31: 3. https://doi.org/10.1051/mbcb/2025005