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Perspective article

New model of tele-healthcare for consultation, diagnosis, and treatment of a cicatricial pemphigoid case using mobile phones for communication among the patient, the clinic dentist, and the oral pathology specialist

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It is well known that the initial differential diagnosis and correct initial diagnosis and treatment of an oral mucosal disease are the most important factors to achieve a good prognosis for a specific oral mucosal disease. An oral pathology specialist (OPS) can evaluate the oral mucosal diseases of the patients and give the differential diagnosis after performing the detailed oral examination, blood tests, and histopathological and immunological studies of the oral biopsy specimens in a hospital. When the patients live in the remote region and have difficulty to access a hospital, they cannot have this advantage to access an OPS for diagnosis and treatment of their oral mucosal diseases. However, advances in telemedicine make it possible.^{1,2}

The telemedicine is a medical specialty that utilizes the evolving telecommunication industry combined with medical information technology to provide the remote medical services.³ The telemedicine using the mobile phones is an efficient and effective form of the remote consultation with a medical specialist, and this deserves a special consideration by a hospital OPS. The mobile phones can provide fast and clear access to the digital images sent by a communication software, and allow the OPSs to obtain the patients' disease information without the need of a desktop personal computer. This in turn can increase the efficiency of the specialist consultations, improve triage, and provide a better care for the patients with oral mucosal diseases ultimately. Many people now own mobile phones, and their use in the telemedicine is expanding due to the convenience and connectivity. Using the mobile phones for the remote consultation can play an effective role in the telemedicine.⁴ This article reported a new model of telehealthcare for consultation, diagnosis, and treatment of a cicatricial pemphigoid case using the mobile phones for communication among the patient, the clinic dentist, and the hospital OPS.

This 65-year-old female patient came to a local dental clinic with a chief complaint of multiple blisters on the gingiva. Intraoral examination revealed multiple freshly broken blisters on the gingiva. According to her statement, in recent several months, the gingival blisters appeared, ruptured, and then healed. The similar episodes repeated. Due to the dynamic changing nature of the affected gingiva, the dentist recommended a follow-up visit two weeks later, and asked the patient to use her mobile phone to take the photographs of the blisters during each episode. The patient returned two weeks later, and there was a different appearance of the blisters on the affected gingiva compared with the photographs taken by herself before this visit. With the patient's consent, the dentist used his own mobile phone to take photographs of the newly affected gingiva (Fig. 1A and B), and obtained the patient's digital images taken by herself previously (Fig. 1C and D) via the mobile phone's built-in communication software. All digital images taken by the dentist and the patient were then promptly transmitted to the mobile phone of an OPS in the National Taiwan University Hospital (NTUH) for consultation and the possible diagnosis of the oral mucosal disease. According to the OPS's initial assessment, an impression of autoimmune blistering oral mucosal disease was most likely. The OPS recommended the patient to go to her oral mucosal disease clinic for further examination, diagnosis, and treatment. Then, the local dentist informed the

patient the results of the initial consultation and wrote the disease referral form to the patient, and further asked the patient to visit the hospital OPS. Subsequently, the patient went to the NTUH to seek for further examination, diagnosis, and treatment from the hospital OPS. After detailed history taking, intraoral examination of the affected gingiva, and obtaining the positive result of the Nikolsky sign, the OPS decided to check the serum levels of the basement membrane zone antibody (for confirmation of the cicatricial pemphigoid diagnosis) and the intercellular substance antibody (for confirmation of the pemphigus vulgaris diagnosis). Moreover, a gingival biopsy of the health-looking gingiva near the affected gingiva was performed. The gingival specimen was sent for the routine histopathological examination and direct immunofluorescence study. Because the serum basement membrane zone antibody result was positive and the serum intercellular substance antibody result was negative, and moreover, the routine histopathological examination showed a separation of the surface epithelium from the underlying connective tissue at the basement membrane region and the direct immunofluorescence study exhibited a continuous linear band of immunoreactants at the basement membrane zone, the histopathological diagnosis of cicatricial pemphigoid (benign mucous membrane pemphigoid) was confirmed finally. Therefore, the patient was treated with systemic administration of prednisolone 30 mg once per day for a week, the steroid dose was tapered for one more week, and finally a maintenance dose of prednisolone 5 mg once per two to three days depending on the disease condition was given to the patient thereafter. In addition, the patient was arranged for a regular follow-up per two months.

Based on the above process of the patient seeking medical assistance, a new model of tele-healthcare for consultation, diagnosis, and treatment of an oral mucosal disease using the mobile phones for communication among the patient, the clinic dentist, and the hospital OPS could be constructed (Fig. 1E). Among the patient, the clinic dentist, and the hospital OPS, there were 5 actions to complete this tele-healthcare process of a specific oral mucosal disease. The patient used the mobile phone to record the initial appearance of her oral mucosal disease and provide them to the clinic dentist (Action 1). The clinic dentist collected the patient's clinical information including the present illness and photographs of oral mucosal lesions, and transmitted them to the hospital OPS via a mobile phone (Action 2). The hospital OPS interpreted the disease process and sent the results of the initial assessment and recommendations back to the clinic dentist through a mobile phone (Action 3). The clinic dentist informed the patient the results of initial assessment and recommendations via a mobile phone and further issued a disease referral form to the patient (Action 4). The patient visited the hospital OPS to seek for further examination, diagnosis, and treatment (Action 5). In this case, due to the prompt referral and the subsequent correct diagnosis and treatment of the disease, the patient's disease process was indeed shortened, and the patient's condition returned to a stable status in a short period of time.

This tele-healthcare model for oral mucosal disease is naturally formed based on the advances in communication

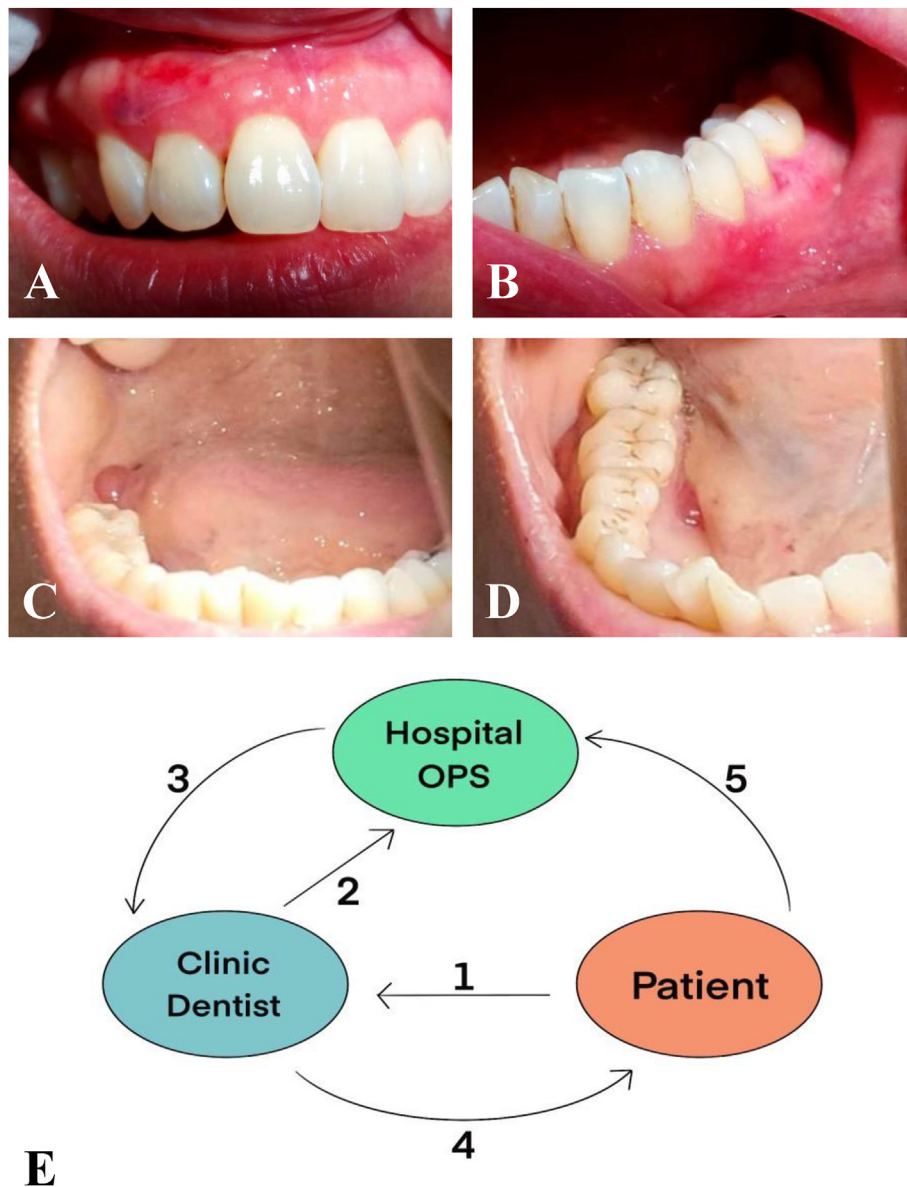


Figure 1 A series of clinical photographs of our cicatricial pemphigoid case and the architecture of the tele-healthcare model for this case. (A) Clinical photograph taken by the clinic dentist revealing a freshly broken blister on the labial gingiva of the teeth 12 and 13. (B) Clinical photograph taken by the clinic dentist showing the freshly broken blisters on the buccal gingiva of the teeth 34 and 35. (C) Clinical photograph taken by the patient demonstrating a blister on the right lower retromolar pad. (D) Clinical photograph taken by the patient exhibiting one blister on the buccal gingiva of the tooth 46 and the other blister on the lingual gingiva of the tooth 45. (E) The architecture of the tele-healthcare model indicating 5 actions among the patient, the clinic dentist, and the hospital oral pathology specialist (OPS). Action 1: The patient used the mobile phone to record the initial appearance of her oral mucosal disease and provide them to the clinic dentist. Action 2: The clinic dentist collected the patient's clinical information including the present illness and photographs of oral mucosal lesions, and transmitted them to the hospital OPS via a mobile phone. Action 3: The hospital OPS interpreted the disease process and sent the results of the initial assessment and recommendations back to the clinic dentist through a mobile phone. Action 4: The clinic dentist informed the patient the results of initial assessment and recommendations via a mobile phone and further issued a disease referral form to the patient. Action 5: The patient visited the hospital OPS to seek for further examination, diagnosis, and treatment.

technology.⁴ The patient, the general dentist in the clinic, and the OPS in the hospital use a mobile handheld device, with the clinic dentist as an intermediary, to complete the oral tele-healthcare process. Although it is not a measure or a plan under the original health insurance and medical system, it does have the advantages of easy operation, high

efficiency, and quick achievement of disease remission without the need of additional cost. For the patients, using their mobile phones to take photographs of the oral mucosal lesions can help themselves to improve their oral health awareness, self-awareness of oral diseases, and health literacy.⁵ During the communication between the

clinic dentists and the hospital OPSs, the clinic dentists can improve their differential diagnosis ability for the oral mucosal diseases. It also helps the OPSs to know the patients' condition early and make recommendations of appropriate treatment for the oral diseases in the initial stage, thereby further promoting the patient safety and achieving the disease remission in a short time. In view of the high efficiency of this model, it is worthy to continue to promote the tele-healthcare for the oral diseases.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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