Oral Dysfunction in Patients With Head and Neck Cancer: A Systematic Review

Shu-Ching CHEN

ABSTRACT

Background: Head and neck cancers (HNCs) and their treatment may cause oral function impairment.

Purpose: This study was designed to identify oral dysfunction in patients receiving treatment for HNCs using a systematic review.

Methods: The PubMed, Embase, and CINAHL databases were searched for studies on oral function impairment in patients receiving treatment for HNCs published between January 2014 and May 2019. Only descriptive, correlational, and interventional quantitative studies that included patients receiving treatment for HNCs who presented with oral dysfunction, were published in English during the aforementioned time frame, and were accessible in full-text versions were selected.

Results: Twenty-eight studies (13 cross-sectional, two longitudinal, 12 randomized controlled trial, and one retrospective chart review) fulfilled the inclusion criteria. Oral mucositis, dysphagia, xerostomia, trismus, and chewing and speech problems were the most common oral dysfunctions. Age, cancer stage, tumor location, treatment modalities, treatment status, treatment dose, and pretreatment oral function were factors associated with oral dysfunction. Although individual interventions were shown to improve oral dysfunction, the related evidence was inconclusive.

Conclusions/Implications for Practice: Primary HNCs and their treatment significantly deteriorate oral function. A holistic and interdisciplinary approach may maximize oral function.

KEY WORDS: head and neck cancer, oral dysfunction, systematic review.

Introduction

Head and neck cancers (HNCs) are one of the most common cancers globally, accounting for 500,000 new cases diagnosed and more than 380,000 deaths annually (Bray et al., 2018). In Taiwan, approximately 6,000 new cases of HNC are diagnosed each year (Taiwan Cancer Registry, 2019). More than 50% of all HNCs present at an advanced stage at initial diagnosis (Bray et al., 2018). Radical resection plus reconstruction combined radiotherapy (RT) or concurrent chemoradiation therapy (CCRT) are the major treatment modes used to treat advanced-stage HNCs (National Comprehensive Cancer Network, 2018). However, surgical resection may change the anatomy of the oral cavity, and postoperative RT or CCRT induces oral mucous membrane lesions in the oral cavity and oropharyngeal region, leading to varying levels of oral dysfunction such as oral mucositis (OM), dysphagia (difficulty swallowing), xerostomia, trismus, and communication dysfunction during and after treatment (Lailla et al., 2017; Tolentino Ede et al., 2011). These dysfunctions may threaten oral intake and eventually lead to malnutrition, frailty, dependence, and cachexia, which increase recurrence rates and reduce survival rates (Büntzel, Micke, Kisters, Büntzel, & Mücke, 2019; Crowder, Douglas, Yanina Pepino, Sarma, & Arthur, 2018).

Studies have investigated the effects of interventions on relieving the levels of oral dysfunction. Many types of interventions may be applied to manage an individual’s symptom. These interventions include the use of thyme honey (Charalambous et al., 2017, 2018; Hawley, Hovan, McGahan, & Saunders, 2014), swallowing exercises (Chen, Huang, Chung, et al., 2018; Lazarus et al., 2014; Messing et al., 2017), dental care (Funk, Warmling, & Baldisserotto, 2014), mouth rinsing (Huang et al., 2018), mouth-opening exercises (Loorents et al., 2014; Pauli, Andrëll, Johansson, Fagerberg-Mohlin, & Finizia, 2015; Zatarain et al., 2018), psychosocial interventions (van der Meulen et al., 2014), and voice rehabilitation training (Zhang, Mu, Chen, Zhang, & Feng, 2018). Although interventions appear to affect oral dysfunction positively and to alleviate related symptoms, the evidence for these effects remains inconclusive. In this systematic review, we aimed to identify (a) oral dysfunction in patients with HNCs and (b) gaps and future directions for research and practice.

Methods

Search Strategy

We conducted an electronic search of the PubMed, Embase, and CINAHL databases using the following terms: “head and
Inclusion and Exclusion Criteria

Studies were included if they (a) were published in an English peer-reviewed journal between January 2014 and May 2019; (b) included adult patients with HNCs; (c) specifically identified concepts of health-related quality of life (HRQoL) related to oral dysfunction such as dysphagia, difficulty swallowing, difficulty chewing, OM, trismus, speech, and communication dysfunctions; and (d) used a quantitative design. Studies were excluded if they (a) were summary reports, literature reviews, systematic reviews, letters, or case reports; (b) included patients who were diagnosed with HNCs combined with other cancer types; (c) included adolescent or younger patients; (d) focused on pain not specific to oral dysfunction or investigated generic and disease-specific HRQoL (i.e., physical, emotional, social, cognitive, or social); and (e) included interventions that were not led by nurses or other healthcare professionals (e.g., physician, speech-language pathologist, and physical therapist), used an invasive medical intervention (e.g., acupuncture) or medicines, or were designed as RT dose and modality trials.

Data Extraction

The methodological and outcome variables collected from each of the included studies were as follows: author, publication year, sample, main results, and oral function impact symptoms.

Results

Study Selection

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart in Figure 1 presents the stages of the review process, including study identification, inclusion, and exclusion. A search of PubMed, Embase, and CINAHL yielded 487 studies. After duplicates were removed and titles and abstracts were screened, 58 full-text studies were assessed. Of these, 28 fulfilled the inclusion criteria. Of the 30 excluded studies, one investigated HNCs combined with breast cancer, 16 included interventions provided by healthcare professionals other than the aforementioned ones, five applied invasive medical interventions (acupuncture), one was a trial for RT dose and modalities, and seven did not fulfill the oral dysfunction criterion of HRQoL.

![Flowchart Diagram](image-url)

**Figure 1.** Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart.
Characteristics of the Selected Studies
The characteristics of the 28 selected studies are summarized in Table 1. The mean participant age range, determined at the time of diagnosis, was 51.13–66.5 years. In terms of research design, 13 were cross-sectional (Study nos. 1, 4, 5, 8, 9, 11, 14–16, and 22–25), two were longitudinal (Study nos. 7 and 20), 12 were randomized controlled trial (Study nos. 2, 3, 6, 10, 12, 13, 17–19, 21, 26, and 27), and one was a retrospective chart review (Study no. 28).

The included studies were conducted in 12 countries: six in Taiwan (Study nos. 4–8 and 13), six in the United States (Study nos. 15, 17, 19, 22, and 27), two in Japan (Study nos. 16 and 20), two in Brazil (Study nos. 14 and 24), two in the Netherlands (Study nos. 25 and 26), two in Turkey (Study nos. 2 and 3), two in Sweden (Study nos. 18 and 21), one in France (Study no. 1), one in Norway (Study no. 11), one in Canada (Study no. 12), one in Switzerland (Study no. 23), and one in China (Study no. 28).

Across all studies, oral dysfunction was assessed at various time points: from pretreatment to posttreatment (surgery, RT, or CCRT; Study nos. 7, 10, and 20), undergoing treatment (RT or CCRT; Study nos. 11–14, 17–19, 22, and 24), during treatment to posttreatment (RT; Study nos. 2, 3, and 27), and posttreatment (surgery, RT, or CCRT; Study nos. 1, 5, 6, 8, 9, 15, 16, 23, 25, 26, and 28).

Oral Dysfunction Outcomes
Overall, patients experienced vital oral functional impairments as a result of surgery, RT, or CCRT because of their treatment of HNC. In this review, six of the studies found OM as the most common acute side effect of RT or CCRT (Study nos. 3, 7, and 10–13). Dysphagia (i.e., swallowing impairment) was the most common problem during treatment, with this problem persisting through posttreatment (Study nos. 5, 6, 9, 14–17, 19, 20, 22, 23, and 26). Other oral dysfunctions included xerostomia (Study nos. 2, 4, 14, 17, and 22), trismus (restricted mouth opening; Study nos. 4, 18, 21, and 25–27), difficulty chewing (teeth or gum problems; Study nos. 11, 14, 15, and 20), and speech problems (Study nos. 1, 8, 14, 23, 24, and 28).

Oral Mucositis
OM was assessed in six of the studies. Chen, Lai, et al. (2015) revealed that patients reported the highest prevalence of OM at 5 weeks after beginning RT and 6 weeks after beginning CCRT; patients who received CCRT reported a higher prevalence than those receiving RT alone. The peak of OM-related symptoms was at 8 weeks after beginning RT and CCRT. High cumulative radiation dose, smoking, and low body mass index were associated with an increased OM risk. CCRT, high cumulative radiation dose, and smoking were also associated with greater numbers of OM-related symptoms. Guussgard (2015) observed that patients with HNC who received RT or CCRT experienced OM and its impacts when eating hard foods. Hawley et al. (2014) investigated patients with HNCs undergoing RT or CCT who received honey oral rinses and reported no improvement in OM. Charalambous et al. (2018) investigated patients with HNCs and demonstrated that thyme honey mouth rinsing alleviated radiation-induced OM. Funk et al. (2014) observed that patients with HNCs who underwent a dental care program showed candidiasis and OM alleviation. Huang et al. (2018) showed that patients with oral cavity cancer (OCC) who received saline oral rinses had better physical and socioemotional quality of life (QoL) compared with the standard care group at 8 weeks. Taken together, radiation therapy may cause OM, which may impact on eating and nutritional intake and may be improved through appropriate oral care regimens.

Dysphagia (Difficulty Swallowing)
Dysphagia was assessed in 13 of the studies. Chen, Huang, Hung, et al. (2018) surveyed 151 patients with OCC and classified 7.3% (n = 11) with dysphagia. The most common swallowing impairments were as follows: difficulty swallowing dry or hard food and swallowing problems interfering with QoL. Patients with tumors of the tongue had worse functional dysphagia QoL than those with cancers in other locations. Chen, Huang, Chung, et al. (2018) observed that following the swallowing exercise education program effectively improved dysphagia-related emotional QoL during the initial 6 months of treatment in patients with OCC. Dixon et al. (2018) observed that poorer performance status, abnormal pretreatment diet, and enteral feeding during RT were all significantly associated with lower composite and dysphagia in oropharyngeal cancer after CCRT within 2 years. Iriya et al. (2017) surveyed 57 patients with HNCs and observed that oral function did not differ significantly by tumor location. Kamal et al. (2019) surveyed 152 patients with HNCs and observed that 67% of the survivors reported a restricted oral diet (without tube use), 3% had partial tube dependence for some oral intake, and 2% could consume nothing through their mouths (or nothing per oral).

Symptom severity for difficulty swallowing and tooth and gum problems remained significantly associated with functional oral intake. Kamiyanagi et al. (2018) observed that patients with HNCs who had undergone maxillectomy and were wearing the prosthesis had better swallowing ability during the oral stage than their healthy peers. Lazarus et al. (2014) studied patients with oral and oropharyngeal cancer undergoing RT or CCRT and showed that patients who participated in their swallowing exercise program reported no improvements in tongue strength and swallowing efficiency after the program. Messing et al. (2017) included patients with advanced HNCs who participated in prophylactic swallowing therapy with active exercises and reported oromotor functions, pharyngeal impairments, oral pharyngeal swallowing efficiencies, and incisal opening at early time points (i.e., 3–6 months). Ohkoshi et al. (2018) surveyed 52 patients with oral cancer and observed that patients treated with anterior or extensive mandibular bone resection reported swallowing
**TABLE 1.**

**Summary of Studies on Oral Dysfunction in Patients With HNCs**

| Author (Year), Country | Study Design | Sample | Main Result | Oral Function Impact Symptom |
|------------------------|--------------|--------|-------------|-----------------------------|
| 1. Balaguer et al. (2019), France | CSS | - N = 87  
- Mean age = 65.8 years  
- Oral and oropharyngeal cancer posttreatment within 6 months | Surgery has a significant impact on severity of the speech disorder. | Speech problem |
| 2. Charalambous et al. (2017), Turkey | RCT | - N = 72  
- Intervention group (n = 36, 59.97 years)  
- Control group (n = 36, 63.08 years)  
- Patients with HNCs undergoing RT at least 3 weeks until 24 months posttreatment  
- Intervention protocol: thyme honey program included 20 ml of thyme honey diluted in 100 ml of purified water just before the RT session, immediately after the RT session, and 6 hours after the session, starting from the fourth week of RT treatment. Patients were required to perform thyme honey rinses of the oral mucosa and then slowly smear the honey on the oral and pharyngeal mucosa (posterior wall of the oropharynx). After completion of RT, the participants continued the treatment protocol (three times a day) at home for 4 more weeks. | Significant effect of the intervention on unbearable pain, dysphagia, xerostomia, and overall QoL. | Xerostomia |
| 3. Charalambous et al. (2018), Turkey | RCT | - N = 72  
- Mean age = 61.53 years  
- Intervention group (n = 32)  
- Control group (n = 32)  
- Patients with HNCs undergoing treatment and posttreatment  
- Intervention protocol: Patients were advised to dilute 20 ml of thyme honey in 100 ml of purified water making gargles in the oral cavity (15 minutes before and after the RT session and 6 hours later), three times a day for 7 weeks (starting from the first day of the fourth week of RT). | Patients in the intervention group were graded lower in the objective assessment of OM (p < .001), maintained their body weight (p < .001), and improved their global health (p = .001) compared with the control group. | OM |
| 4. Chen et al. (2016), Taiwan | CSS | - N = 151  
- Mean age = 52.26 years  
- Patients with NPC who completed RT or CCRT for at least 3 months up to 5 years. | Patients who received intensity-modulated RT had less trismus and xerostomia than patients who received two-dimensional RT. Patients who were female, at an advanced stage, had completed treatments within 1 year, had higher levels of depression, had more severe trismus, and had higher symptom severity tended to have malnutrition or were at risk of malnutrition. | Trismus |
### TABLE 1.
**Summary of Studies on Oral Dysfunction in Patients With HNCs, Continued**

| Author (Year), Country | Study Design | Sample | Main Result | Oral Function Impact Symptom |
|------------------------|--------------|--------|-------------|-------------------------------|
| 5. Chen, Huang, Hung, et al. (2018), Taiwan | CSS | - $N = 151$ - Mean age = 52.26 years - OCC undergoing RT or CCRT | Top swallowing impairments were difficulty swallowing dry foods, difficulty swallowing hard food, and swallowing problems interfering with enjoyment or QoL. Patients with tumors of the tongue had worse functional dysphagia QoL than those with cancers in other locations. | Dysphagia |
| 6. Chen, Huang, Chung, et al. (2018), Taiwan | RCT | - $N = 83$ - Experimental group ($n = 38, 53.03$ years) - Control group ($n = 38, 51.13$ years) - OCC undergoing RT - Intervention protocol: Swallowing exercise education, and practice, including postural changes (chin tuck, head turn, head tilt, and head back), swallow maneuvers (supraglottic swallow, super-supraglottic swallow, Mendelsohn maneuver, and effortful swallow), and SEEP three times/day for 6 months. | The SEEP was effective in improving emotional dysphagia QoL during the initial 6 months after treatment of patients with OCC. | Dysphagia |
| 7. Chen, Lai, et al. (2015), Taiwan | Longitudinal study | - $N = 77$ - Mean age = 51.64 years - OCC received RT or CCRT | Patients reported the highest prevalence of severe OM after 5 weeks of RT and 6 weeks CCRT; patients receiving CCRT reported a higher prevalence than those receiving RT alone. The peak of OM-related symptoms was at 8 weeks after beginning RT, with primary symptoms of mouth pain, mouth dryness, eating difficulties, swallowing difficulties, and taste change. In patients with CCRT, those with a higher cumulative radiation dose, smokers, and those with a lower body mass index were at a high risk of developing severe OM. CCRT, higher cumulative radiation dose, and smoking were associated with more OM-related symptoms. | OM |
| 8. Chen, Yu, et al. (2015), Taiwan | CSS | - $N = 130$ - Mean age = 58.8 years - HNC posttreatment (mean = 16.8 months) | Poorer performance status, abnormal pretreatment diet, and use of enteral feeding during RT were all significantly associated with lower composite and swallowing problem. | Speech problems |
| 9. Dixon et al. (2018), United Kingdom | CSS | - $N = 201$ - Mean age = 56 years - Oropharyngeal cancer post CCRT within 2 years | 70.8% of patients reported speaking less after surgery compared with the period before having HNC surgery. Patients with higher distress over body image, higher symptom severity, and hypopharyngeal and laryngeal cancer reported speaking less. | Swallowing problems |

(continues)
| Author (Year), Country | Study Design | Sample | Main Result | Oral Function Impact Symptom |
|-----------------------|--------------|--------|-------------|-----------------------------|
| 10. Funk et al. (2014), Brazil | RCT | - N = 46  
- Test group (n = 23, 54.0 years)  
- Control group (n = 23, 54.4 years)  
- Patients with HNCs posttreatment  
- Intervention protocol: Dental care program included (a) preoncological treatment, dental examination, and anamnesis; (b) oral hygiene of the teeth, gums, and prosthesis + oral health education about low-sugar diet to patients and caregivers; (c) use of fluoride toothpaste and mouth rinse; (d) surgical procedures (minimum 15 days before the oncological treatment); (e) periodontal treatment and topical fluoride; and (f) restorative treatment.  
- Postoncological treatment was (a) dental examination and anamnesis; (b) oral hygiene of the teeth, gums, and prosthesis + oral health education about low-sugar diet to patients and caregivers; (c) use of fluoride toothpaste and mouth rinse; (d) use of artificial saliva when needed; and (e) complementary surgical and restorative treatment. | A reduction in candidiasis and mucositis was observed in the test group. | OM |
| 11. Gussgard, Jokstad, Hope, Wood, & Tenenbaum (2015), Norway | OS/CSS | - N = 33  
- Mean age = 60 years  
- Patients with HNCs undergoing RT or CCRT | Impairment of eating hard foods was more when the mucous ulceration is anywhere in the mouth or in the soft palate. | OM, Impairment of eating hard foods |
| 12. Hawley et al. (2014), Canada | RCT | - N = 100  
- Honey arm (n = 40)  
- Placebo arm (n = 41)  
- Patients with HNCs undergoing RT  
- Intervention protocol: Honey and placebo gels were provided in single-use 5-ml sachets and were to be taken after every oral rinse, i.e., four times a day. Subjects were instructed to pour the product into their mouths directly from the sachets, to circulate the gel in their mouth for at least 30 seconds, and then to swallow. Treatment started on the first day of radiation and was to continue to include the 7 days after the last radiation treatment. | No statistically significant difference was observed between the honey and placebo arms in any of the outcome indicators. Those who completed the study in both treatment arms had low rates of RTOG greater than or equal to Grade 3 mucositis: 35% in the honey group and 43% in the placebo group. | OM |
| 13. Huang et al. (2018), Taiwan | RCT | - N = 91  
- Experimental group (n = 48)  
- Control group (n = 43)  
- Patients with HNCs undergoing RT  
- Intervention protocol: 4 weeks of normal saline mouth rinses with wet dressing gauze administered at least four times per day over the course of treatment began 4–8 weeks after the RT or CCRT. The duration of each saline mouth rinse was 3–4 hours after meals. | Patients in both groups had significantly higher levels of physical and social–emotional QoL at 8 weeks after beginning RT or CCRT compared with the first visit. Patients in the saline rinse group had significantly better physical and social–emotional QoL compared with the standard care group at 8 weeks. | OM |

(continues)
| Author (Year), Country | Study Design | Sample | Main Result | Oral Function Impact Symptom |
|------------------------|--------------|--------|-------------|-------------------------------|
| 14. Iriya, Romaniszen, Fernandes, & Poleti (2017), Brazil | OS/CSS - N = 57 | Patients with HNCs received maxillectomy (n = 27, 66.0 years) - Oral cavity (n = 15, 59.89 years) - Pharynx (n = 7, 61.07 years) - Larynx (n = 5, 59.8 years) - HNC undergoing treatment | Oral function did not differ significantly according to tumor location. | Taste, chewing, saliva, swallowing, speech problems |
| 15. Kamal et al. (2019), United States | OS/CSS - N = 152 | Mean age = 60 years - Patients with HNCs posttreatment | 67% of survivors reported a restricted oral diet (without tube), 3% were partially tube-dependent on some oral intake, and 2% were NPO. The most severe items in decreasing order were dry mouth, difficulty swallowing/chewing, problems with mucus, tasting food, and choking/coughing. Symptom severity for difficulty swallowing and problems with teeth/gums remained significantly associated with functional oral intake. | Dysphagia, Teeth problem, Gum problem |
| 16. Kamiyanagi et al. (2018), Japan | Comparative and CSS - N = 57 | Patients with HNCs received maxillectomy (n = 27, 66.0 years) - Healthy controls (n = 30, 44.9 years) - Patients with HNCs wearing the prosthesis posttreatment | Swallowing ability in maxillectomy patients could be improved by wearing an obturator prosthesis, particularly during the oral stage. | Dysphagia |
| 17. Lazarus et al. (2014), United States | RCT - N = 18 | Experimental group (n = 8) - Control group (n = 10) - Patients with HNCs undergoing RT - Intervention protocol: Patients were instructed to press against a tongue depressor with their tongue in four directions, namely, left, right, on protrusion, and on elevation, while resisting with the tongue depressor. Patients were instructed to push with as much effort as possible with the tongue against the tongue depressor while manually resisting with the depressor for 2 seconds on each repetition for each direction. The frequency and dosage of the tongue strengthening exercise programmed were to perform the exercises 5 days per week for 6 weeks, five times per day, with 10 repetitions per practice session. | Differences in tongue strength and oropharyngeal swallow efficiency (OPSE) were not observed within or between groups. QoL in the eating and speech domains improved after treatment in both groups. The experimental group showed greater impairment in QoL in the social disruption domain after treatment, whereas the control group showed a slight improvement in functioning. | Dysphagia, Xerostomia |
| 18. Loorents et al. (2014), Sweden | RCT - N = 53 | Intervention group (n = 27, 59.3 years) - Control group (n = 26, 60.2 years) - HNC undergoing RT - Intervention protocol: Prophylactic training with the Thera-Bite program: five stretches performed five times daily, with each stretch held for 15 seconds. Training continued for the entire 12-month follow-up period. | No significant differences were observed in maximum interincisal openings between the intervention and control groups at any of the measurement points. | Trismus | (continues) |
TABLE 1.
Summary of Studies on Oral Dysfunction in Patients With HNCs, Continued

| Author (Year), Country | Study Design | Sample | Main Result | Oral Function Impact Symptom |
|------------------------|--------------|--------|-------------|-----------------------------|
| 19. Messing et al. (2017), United States | RCT | - $N = 57$
- Exercise group ($n = 29, 55$ years)
- Control group ($n = 28, 58$ years)
- Advanced HNC
- Intervention protocol: Prophylactic swallow therapy with active exercises, completed twice daily, 7 days per week during CRT (exception was a CRT break week in Week 4) and up to 3 months post CRT. | Oromotor function, pharyngeal impairment, OPSE, and incisal opening were noted at early time points (3–6 months) in the exercise group. | Dysphagia |
| 20. Ohkoshi et al. Longitudinal study (2018), Japan | - $N = 52$
- Mean age = 66.5 years
- Advanced oral cancer before surgery and 1 and 3 months after surgery | Both anterior or extensive mandibular bone resection and postoperative radiation therapy were associated with poor oral intake after surgery. | Chewing problem, Swallowing problem |
| 21. Pauli et al. (2015), Sweden | RCT | - $N = 50$
- TheraBite group ($n = 25, 57.4$ years)
- Engstrom jaw device group ($n = 25, 58.4$ years)
- Patients with HNCs undergoing treatment and posttreatment
- Intervention protocol: Exercise program consisted of a 10-week structured exercise program with exercise five times per day. The program was designed as follows: (a) warm-up movements comprising jaw opening 10 times and small sideways movements of the jaws 10 times without using the jaw device; (b) passive stretching, with the jaw mobilizing device, 30 seconds (if possible), repeated five times; (c) five repetitions of active exercise (bite toward resistance); and (d) passive stretching again. | No statistically significant differences were observed in the mean GTQ score between the groups before or after the exercise program (data not shown). However, both groups statistically improved in jaw-related problems, eating limitations, and muscular tension at the 3-month follow-up compared with before exercise. | Trismus |
| 22. Rogus-Pulia et al. (2016), United States | Comparative and CSS | - $N = 42$
- Patients with HNCs undergoing CCRT ($n = 21$)
- Healthy control participants ($n = 21$) | Significantly lower tongue endurance measures for patients posttreatment compared with controls. Salivary flow rates also were lower compared with pretreatment and controls ($p = .000$). Change in salivary flow rate was predictive of change in swallow efficiency measures from pretreatment to posttreatment for 1 ml of thin liquid, 3 ml of nectar-thick liquid ($p = .026$), and 3 ml of standard barium pudding boluses. | Dysphagia, Tongue endurance, Salivary flow rate |
| 23. Romer et al. (2019), Switzerland | CSS | - $N = 63$
- Mean age = 61 years
- Early-stage OCC posttreatment within 1 year | In all assessments for speech and swallowing, the entire study cohort achieved high scores, with mean values located in the highest 10% of the scales. Patients who received neck dissection and old age significantly affected speech and swallowing function and associated QoL. | Speech problem, Swallowing problem |

(continues)
TABLE 1.  
**Summary of Studies on Oral Dysfunction in Patients With HNCs, Continued**

| Author (Year), Country | Study Design | Sample | Main Result | Oral Function Impact |
|------------------------|--------------|--------|-------------|---------------------|
| Rosa, Mituuti, & Ghirardi (2018), Brazil | OS/CSS | N = 152  
- Mean age = 60 years  
- Laryngeal cancer posttreatment | Chemoradiotherapy treatment had a greater impact on the voice than on swallowing. | Speech |
| van der Geer et al. (2019), Netherlands | CSS | N = 730  
- Mean age = 63.6 years  
- HNC postsurgery | Prevalence of trismus was 23.6%. Factors associated with trismus were advanced age; partial or full dentition; tumors located at the maxilla, mandible, cheek, major salivary glands, oropharynx, an unknown primary, and/or a free soft tissue transfer after surgery; reirradiation; and chemotherapy. | Trismus |
| van der Meulen et al. (2014), Netherlands | RCT | N = 46  
- Intervention group (n = 88, 60.1 years)  
- Control group (n = 91, 60.7 years)  
- HNC posttreatment  
- Intervention protocol: Nurse-led psychosocial intervention was problem focused, patient driven, and provided by trained nurses. Patients received a maximum of six counseling sessions of 45-60 minutes every 2 months over a period of 1 year, starting 6 weeks after the completion of cancer treatment. | At 12 months, the intervention group showed a significant improvement in emotional and physical functioning, pain, swallowing, social contact, mouth opening, and depressive symptoms. At 18 months, global QoL, role and emotional functioning, pain, swallowing, mouth opening, and depressive symptoms were significantly better in the intervention group than in the control group. At 24 months, emotional functioning and fatigue were significantly better in the intervention group. | Dysphagia, Mouth opening |
| Zatarain et al. (2018), United States | RCT | N = 40  
- Dynasplint arm (n = 20, stretching plus use of the Jaw Dynasplint, 57.7 years)  
- Control arm (n = 20, conventional stretching, 57.0 years)  
- Patients with HNCs undergoing RT until 6 months posttreatment  
- Intervention protocol: Jaw stretching regimen was composed of stretching the mouth open and laterally for a 30-second hold, moving the jaw in a circle with five repetitions in each direction, passive stretching by applying downward pressure on the mandible with the index finger held for 30 seconds, and circular jaw massage for 30 seconds plus adjunctive use of the Jaw Dynasplint. The Jaw Dynasplint instructions were to wear the device for 30 minutes, three times a day, during cancer treatment and in the early recovery period (3 months posttreatment). | At 6 months after initiation of the preventative regimen, 50% of patients in the Dynasplint arm and 75% in the conventional stretching arm groups continued their assigned therapy. Trismus was diagnosed in two patients in the control arm and in four patients in the Dynasplint arm. Only 25% of patients in the Dynasplint arm used the device as prescribed. | Trismus |

(continues)
problems and had poor intake at 3 months after surgery. Kamiyanagi et al. (2018) observed that patients with HNCs who received maxillectomy and who wore the prosthesis had better swallowing ability during the oral stage than their healthy peers. Rogus-Pulia et al. (2016) observed that patients with HNCs undergoing CCRT reported significantly lower tongue endurance than reported by healthy people. Romer et al. (2019) identified an impact on postsurgery swallowing function in patients with early-stage OCC who underwent resection. van der Meulen et al. (2014) showed that patients with HNCs who participated in a nurse-led psychosocial program had better swallowing ability 12 months after the intervention. Patients with HNC may experience dysphagia because of tumor location, treatment modalities, or intervention participation.

Trismus
Trismus was assessed in six studies. In their cross-sectional study of 110 nasopharyngeal carcinoma survivors, Chen et al. (2016) observed that patients with HNCs undergoing CCRT reported significantly lower tongue endurance than reported by healthy people. Romer et al. (2019) identified an impact on postsurgery swallowing function in patients with early-stage OCC who underwent resection. van der Meulen et al. (2014) showed that patients with HNCs who participated in a nurse-led psychosocial program had better swallowing ability 12 months after the intervention. Patients with HNC may experience dysphagia because of tumor location, treatment modalities, or intervention participation.

Xerostomia
Xerostomia was assessed in five studies. Chen et al. (2016) observed that, in 3 months to 5 years of treatment, patients with nasopharyngeal carcinoma who received two-dimensional RT had significantly more severe trismus and xerostomia than did those who received tomotherapy and IMRT. Lazarus et al. (2014) investigated oral and oropharyngeal cancer treated with RT or CCRT and showed that patients who participated in a swallowing exercise program reported no improvement in tongue strength, swallow efficiency, or salivary flow after the training. Rogus-Pulia et al. (2016) showed that patients with HNCs who received CCRT experienced lower tongue endurance and decreased salivary flow rate during the posttreatment period. Charalambous et al. (2017) included patients with HNCs and showed that thyme honey mouth rinsing during RT improved RT-related xerostomia through 6 months posttreatment. In summary, modern RT techniques, including tomotherapy and IMRT and greater protection of salivary glands from RT, offer complementary and alternative palliative treatments for dry mouth.

Difficulty Chewing
Chewing was assessed in four of the studies. Gussgard et al. (2015) observed that patients with HNCs who received RT or CCRT had oral mucosal ulceration and thus had impaired abilities to consume hard foods. Iriya et al. (2017) showed that chewing was not correlated with tumor location. Kamal et al. (2019) observed that HNC survivors had gum problems and that 67% of the survivors reported a restricted oral diet (without tube), 3% had partial tube dependence for some oral intake, and 2% were nothing per oral. Ohkoshi et al. (2018)

### TABLE 1.
**Summary of Studies on Oral Dysfunction in Patients With HNCs, Continued**

| Author (Year), Country | Study Design | Sample | Main Result | Oral Function Impact Symptom |
|------------------------|--------------|--------|-------------|-----------------------------|
| Zhang et al. (2018), China | Retrospective and RCT | N = 83 | VRT may not benefit vocal quality for patients with LC after RT. | Speech |

Note. HNC = head and neck cancer; CSS = cross-sectional study; RCT = randomized controlled trial; QoL = quality of life; NPC = nasopharyngeal carcinoma; RT = radiotherapy; CCRT = concurrent chemoradiation therapy; OCC = oral cavity cancer; SEEP = swallowing exercise education program; OM = oral mucositis; OS = observational study; RTOG = Radiation Therapy Oncology Group; NPO = nothing per oral; CRT = chemoradiotherapy; GTQ = Gothenburg Trismus Questionnaire; VRT = voice rehabilitation training; LC = laryngeal cancer.
Factors Associated With Oral Dysfunction

Impairment in the oral function of patients with HNCs is often complicated by multiple oral dysfunctions. The results of this study are similar to those of Chiang, Ho, Wang, and Lin (2018), which reported that patients with HNCs who received postoperative RT reported symptom clusters including pain, dry mouth, lack of appetite, sleep disturbance, fatigue, drowsiness, distress, and sadness in Cluster 1 and nausea, vomiting, numbness, shortness of breath, and difficulty remembering in Cluster 2. As this review study was limited to individual problems, additional research will be necessary to understand multiple oral dysfunctions under a diverse set of influencing factors.

Interventions for Oral Dysfunction in Patients With Head and Neck Cancers

Three studies examined the effects of thyme honey mouth rinsing on oral dysfunction, including OM and xerostomia, in patients with HNCs, with the related evidence proving to be inconclusive (Charalambous et al., 2017, 2018; Hawley et al., 2014). Nonsignificant improvement was shown in one study (i.e., low, severe OM rate), probably because of participant selection bias. In addition, patients with severe OM had a high dropout rate. Therefore, samples should be identified before initiating an intervention.

Discussion

The Impact on Oral Function of Head and Neck Cancer and Related Treatments

Patients with HNCs experience oral dysfunction during active treatment and follow-up, with major oral cavity function impairments including OM, dysphagia, trismus, xerostomia, chewing, and speech problems. These findings are similar to those of Kirca and Kütültürkan (2017), who indicated that mouth sores, changes in the taste of food, difficulties in swallowing, and a loss of appetite are highly distressing problems during active treatment and peak at the end of treatment. Psychological problems (e.g., feeling vulnerable, feeling sad, and worrying) may co-occur with oral dysfunction. These findings may be attributable to differences in treatment status. Because the time since treatment completion varied across studies, some patients may have developed late or long-term side effects of surgery, RT, or CCRT. Additional studies exploring concurrent oral dysfunction and psychological concerns and comparing oral dysfunction among different stages of cancer treatment trajectories are warranted.

Strengths and Limitations

This review is affected by several limitations. First, this review focused on the oral dysfunction of patients with HNCs without reviewing other literature on dysfunction...
as additional studies (e.g., neck or shoulder dysfunction). Further research should integrate the full range of functional impairments attributable to HNCs and their treatments. Second, most of the outcome measures were quantitative. Clinically meaningful, qualitative interviews were not considered. Patients perceive meaning, feeling, and thinking. Thus, qualitative studies are necessary to more completely identify the oral dysfunction concerns of these patients. Finally, the variations in the disease phase (e.g., undergoing treatment, short-term posttreatment, long-term posttreatment/survival phase) were attributable to differences in the oral dysfunction identification in individual studies. Additional reviews comparing the differences in oral dysfunction between patients undergoing treatment and completing treatment are warranted.

**Implications for Practice**

This review showed that oral dysfunction is a critical part of the oral-related QoL of patients with HNC. There are differences in oral dysfunction between tumor location and treatment modalities. Healthcare providers should actively assess oral function based on individual factors. Moreover, the review identified the commonly reported oral-dysfunction-related symptoms and related concern experiences of patients with HNCs during treatment and survivorship trajectories. Although the current evidence suggests that interventions play a key role in the way patients adjust to oral dysfunction, methodological issues limit the generalization of the results. Healthcare providers should encourage patients to express their oral dysfunction experiences and characteristics and guide patients to use the most effective strategies to minimize functional impairments.

**Implications for Research**

Findings from this review inform that oral dysfunction involves multiple aspects. There are currently no instruments that address multiple oral functions. Development and validation of an effective and brief screening tool is needed to quickly assess multiple oral dysfunctions in patients with HNC. Although previous studies have reported that the thyme honey mouth-rinsing intervention improves OM and xerostomia and that mouth-opening exercises improve trismus, further high-quality studies with considerations of confounding factors such as pretreatment oral function and compliance should be performed to identify the effects of interventions and of individual factors.

**Conclusions**

This systematic review provided an overview of the current knowledge concerning the associated factors and changes over time of oral dysfunction in patients with HNCs during the treatment and posttreatment phases. Overall, patients with HNCs reported oral dysfunction 3–4 weeks after the initiation of treatment and reported the highest level of oral dysfunction at the end of treatment. Oral dysfunction included a range of symptoms, including OM, mouth dryness, eating difficulties, swallowing difficulties, taste changes, and speech dysfunction. Patients with HNC may continue to struggle with these problems into survivorship, which diminishes long-term QoL. We also identified the associated factors of oral dysfunction, including age, cancer stage, tumor location, treatment modalities, treatment status, treatment dose, and pretreatment oral function. Individual interventions reduced the levels of single oral dysfunction in patients with HNCs during treatment and posttreatment. This complex and necessary oral dysfunction is common in patients with HNCs because of the primary disease and its treatment. Healthcare professionals and providers may use holistic and interdisciplinary approaches to maximize oral function.

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