Received: 30 November 2021 | Revised: 14 September 2022 | Accepted: 27 September 2022

DOI: 10.1111/ecc.13744

REVIEW

European Journal of Cancer Care WILEY

Mastication in health-related quality of life in patients treated for oral cancer: A systematic review

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Funding information
No funding was applicable.

Abstract

Introduction: Treatment for oral cancer can impair oral functions such as mastication, which may negatively affect quality of life (QoL). In this review, an overview is provided of masticatory ability in patients treated for oral cancer.

Methods: The PubMed (MEDLINE), Embase and Cochrane databases were systematically searched for scientific literature on masticatory ability in relation to QoL in patients treated for oral cancer. Studies were included when oral cancer treatment was provided, and the University of Washington Quality of Life (UW-QoL) questionnaire was used. Risk of bias (MINORS) was independently assessed by two authors.

Results: The PubMed (MEDLINE), Embase and Cochrane search yielded 575 unique records of which 111 were assessed full text, and 27 studies were included. The UW-QoL mastication scores ranged from 31.9 to 97.4. There was a wide variety in methodology, patient groups, tumour site, treatment and assessment moment, to such a degree that outcome scores are difficult to compare.

Conclusion: The wide variety in studies exploring health-related QoL in relation to mastication in oral cancer patients prevents the identification of possible relations between treatment, masticatory ability and QoL. Our findings underline the limitations in currently available literature and indicate the necessity for more comparable research.

KEYWORDS
health-related quality of life, masticatory ability, MINORS, oral cancer, review, University of Washington quality of life questionnaire

1 | INTRODUCTION

Oral cancer is currently in the top 10 most common cancers worldwide (Rivera, 2015). More insight into oral cancer and advancement in procedures have contributed to a more effective treatment. However, tumour eradication is not the only outcome that should be included in the evaluation of treatment success. Quality of life (QoL) of patients after cancer treatment has become more significant in the past decade (Haraldstad et al., 2019). A patient's self-reported health-related QoL (HR-QoL) contributes to a better understanding of the range of health challenges patients with cancer may encounter (Valdez & Brennan, 2018). Those issues may continue long after initial curative treatment and can be easily overlooked without adequate follow-up and assessment of HR-QoL.

Primary curative treatment for oral cancer is mostly surgical ablation of the tumour, which can be followed by (chemo)radiotherapy,

depending on affected regional lymph nodes (N-stage), extent of radical resection and tumour specific growth factors (Deng et al., 2011; Kerawala et al., 2016). The sequelae of curative treatment can temporarily or permanently impair oral functions, because treatment may affect vital structures for mastication, such as dentition, musculature and nerves (Kirsch, 2007; Valdez & Brennan, 2018). This is one of the considerations for the multidisciplinary team regarding cancer treatment (Chandu et al., 2006; Taberna et al., 2020).

Masticatory performance depends on maximum bite force, tongue function, maximum mouth opening and dental status (Buurman et al., 2020; de Groot et al., 2019). Ideally, to prevent loss of masticatory function, early identification of a lesion and referral to a head and neck cancer (HNC) specialist for further examination is preferred. Early stage oral cancers with a relative small affected area are less likely to drastically impact oral function after treatment. However, treatment of advanced tumours will include a larger area and more likely involve multiple structures, thus having a higher risk of impacting speech, mastication and swallowing (de Groot et al., 2020; Petrovic et al., 2018). Post-surgery deformities may occur, depending on resection procedure. Aesthetics can be (partially) restored by reconstructing the affected site. Unfortunately, reconstruction has its limitations. For example, soft tissue reconstruction following a glossectomy can replace the missing part of the tongue with a free flap such as the radial forearm flap (Vincent et al., 2019). Although the result can be aesthetically acceptable, this is not necessarily equivalent to adequate oral function. Tongue function will mostly depend on the remaining tongue structures after resection (Ji et al., 2017; Vincent et al., 2019). After segmental mandibulectomy, loss of vital structures is linked to the location and extent of the resection (Petrovic et al., 2018). Nonetheless, fibula reconstruction in combination with implant rehabilitation in larger resections can give adequate oral function, provided that there is no tongue impairment, resulting in less impact on masticatory functioning (Kumar & Srinivasan, 2018). In addition, (chemo)radiotherapy may be indicated during treatment with concomitant oral complications such as trismus, xerostomia, mucositis, dyspepsia and increased risk of infectious disease (Carneiro-Neto et al., 2017; Mosel et al., 2011; Wetzels et al., 2014).

Although the importance and value of HR-QoL studies is widely acknowledged, there is little standardisation in these studies (Haraldstad et al., 2019). Use of different HR-QoL questionnaires makes it difficult to compare obtained data. One of the most frequently used questionnaires that specifically focuses on mastication is the University of Washington quality of life (UW-QoL) questionnaire (Valdez & Brennan, 2018). The UW-QoL is a brief and self-administered multi-factorial questionnaire, with questions specific to HNC, and reflects the QoL as indicated by the patient (Hassan & Weymuller, 1993). The mastication question of the UW-QoL has three response options: 'I can chew as well as ever', 'I can eat soft solids but cannot chew some foods' and 'I cannot even chew soft solids' which gives good insight in the masticatory ability of patients with oral cancer. The European Organisation for Research and Treatment of Cancer Head and Neck Cancer Module (EORTC QLQ-HN35) has also a mastication related question; however, there are only the following answer options for chewing problems: 'not at all', 'a bit', 'quite a bit' and 'very much' which gives unfortunately no insight in the hardness of food which can be masticated (Yuan et al., 2016).

To our knowledge, no overview is available regarding UW-QoL outcomes in patients treated for oral cancer with an emphasis on masticatory ability related to the hardness of food. Therefore, this systematic review was conducted, to provide an overview of the available scientific literature on masticatory ability in relation to QoL in patients treated for oral cancer. This will provide insight in the effect of masticatory ability on HR-QoL in oral cancer patients after primary curative treatment.

2 | METHODS

2.1 | Protocol and registration

This systematic review was conducted according to the preferred reporting item for systematic reviews and meta-analyses (PRISMA) guidelines (Liberati et al., 2009).

2.2 | Eligibility criteria

Studies that were eligible were full-text articles focusing on HR-QoL and masticatory ability (the lower the score the worse) in oral cancer patients after primary curative treatment using the validated UW-QoL (Hassan & Weymuller, 1993; Rogers et al., 2002; Valdez & Brennan, 2018). There were no restrictions in year of publication or use of a translated version of the UW-QoL. Exclusion criteria were (1) studies that did not differentiate between different types of HNC, (2) inclusion of the oropharynx, (3) inclusion of the base of the tongue, (4) ameloblastoma or other benign tumours, (5) case reports, reviews, comments or ongoing trials and (6) studies written in a language other than English.

2.3 | Information sources

Studies were retrieved by searching the following electronic databases: PubMed, Embase and Cochrane. No limits were applied in the search. The final search was conducted on 2 November 2021.

2.4 | Search

The search strategies terms were synonyms, variations and associated terms with regard to the following keywords: 'head and neck neoplasms', 'mastication' and 'quality of life'. In PubMed, combinations of MeSH Terms and title/abstract were used. Embase and Cochrane had adapted search strategies based on the PubMed search strategy. Grey literature was not included. The full strategies for each database are presented in Appendix S1.

2.5 | Study selection

All records were imported in reference manager Endnote X9 (Clarivate Analytics 2013). After manual removal of duplicates, the eligibility assessment based on title and abstract was independently conducted by two authors (JV and AP). Afterwards, disagreements between reviewers were resolved by discussion. Full-text articles were obtained and independently assessed on inclusion and exclusion criteria. Conflicts between reviewers were resolved in all cases. If needed, a third author (CMS) was available to resolve any disagreements.

2.6 | Data collection process, data items and summary measures

A data extraction sheet was used, which included clinical and demographic characteristics of patients as well as study related details relevant to our review. One author (AP) extracted the data from included studies and the other author (JV) verified the extracted data. Any seemingly incorrect data were discussed. If needed, a third author (CS) was available to resolve any disagreements. The following information was extracted from each included study: (1) study characteristics (study design and number of included patients), (2) patients characteristics (sex, age, tumour site and tumour stage), (3) type of cancer treatment, (4) assessment (evaluation frequency, assessment moment and follow-up) and (5) UW-QoL outcome regarding masticatory ability (mean with standard deviation [SD] or standard error [SE]). When authors clearly defined different subgroups in their study, composed data and specified data were extracted.

2.7 | Risk of bias in individual studies

The risk of bias was evaluated with the validated methodological index for non-randomised studies (MINORS) (Slim et al., 2003). This instrument contains eight items for non-comparative studies and four additional items for comparative studies. The grading of each item is done by appointing one of three grades: not reported (0), reported but inaccurate (1) and reported and adequate (2). The studies were independently assessed by two authors (JV and AP). Criteria for scoring each item were discussed by the two reviewers before as well as during the assessment of the publications. Any disagreements were resolved by discussion. A third author (CS) was consulted in case of doubt. The ideal score for non-comparative studies is 16 and 24 for comparative studies.

2.8 | Synthesis of results and additional analyses

The ability of MINORS to differentiate between poor or excellent quality studies has not been validated (Slim et al., 2003). Thus, rating the methodological quality as 'poor' or 'excellent' based on MINOR scores cannot be done. However, the scores can be displayed as a fraction of the ideal score and corresponding percentage.

3 | RESULTS

3.1 | Study selection

The search of PubMed ($n = 336$), Embase ($n = 474$) and Cochrane ($n = 53$) provided a total of 863 records. After duplicate deletion, 575 unique records remained. After title and abstract were screened and consensus was reached between authors on all records, 464 studies were discarded. Of the 111 records that were read full text, a total of 27 studies were identified for inclusion in the review. No best evidence synthesis or meta-analysis was performed in this study. An overview of the study selection process is shown in Figure 1.

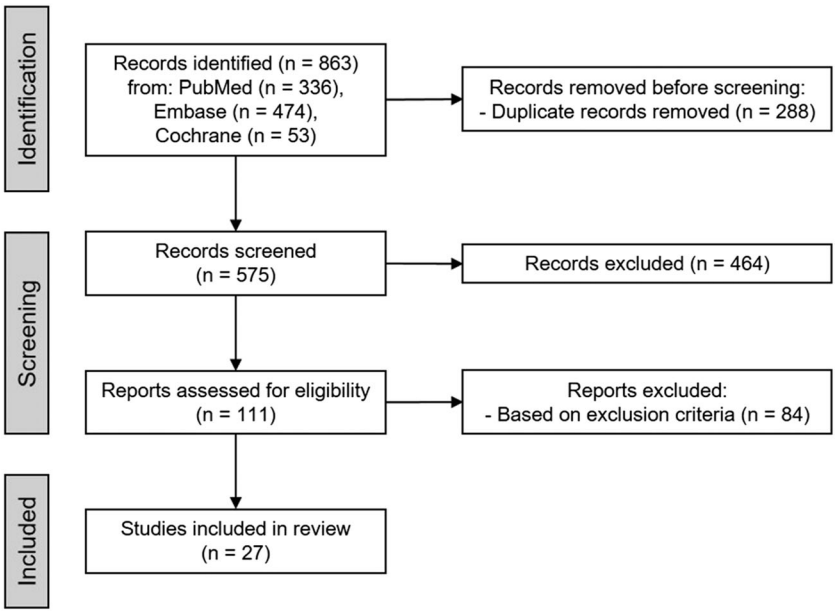

FIGURE 1 PRISMA flowchart of the literature search and study selection. Summarised literature search methodology, in accordance to the PRISMA Statement (Liberati et al., 2009)

3.2 | Study characteristics

The studies selected for this review were 20 cross-sectional studies and seven longitudinal studies, of which 11 were prospective, 10 were retrospective and six did not report prospective or retrospective data collection. The included studies involved a total of 1849 oral cancer patients of which at least 1308 were male, as one study did not report sex of patients (Vakil et al., 2012). Eleven studies only reported mean or median age with SD and did not mention range (Agarwal et al., 2014; Bekiroglu et al., 2011; Gu et al., 2021; Hoene et al., 2021; Larson et al., 2021; Rogers et al., 2004; Rogers & Lowe, 2020; Seferin et al., 2022; Soares et al., 2018; Wu et al., 2020; Zhang et al., 2020). One study did not mention age of patients (Vakil et al., 2012) and three studies categorised patients in age groups without further details about mean and SD (Rogers & Lowe, 2020; Yue et al., 2018; Zhang et al., 2020). Studies were mainly conducted in China (Fang et al., 2014; Fang et al., 2013; Gu et al., 2021; Li et al., 2013; X. Li, Sun, & Guo, 2016; W. Li, Zhang et al., 2016; Wu et al., 2020; Yan et al., 2017; Yang et al., 2014; Yuan et al., 2016; Yue et al., 2018; Zhang et al., 2020; Zhang et al., 2013), followed by India (Agarwal et al., 2014; Ghai et al., 2021; Sakthivel et al., 2017; Vora et al., 2017), the United Kingdom (Bekiroglu et al., 2011; Devine et al., 2001; Rogers et al., 2004; Rogers & Lowe, 2020), Brazil (Seferin et al., 2022; Soares et al., 2018), the United States (Larson et al., 2021; Ochoa et al., 2021), Germany (Hoene et al., 2021) and Pakistan (Vakil et al., 2012).

Tumour sites included tongue, buccal mucosa, gingiva, floor of mouth (FOM), palate, retromolar region, lip, alveolar process and gum. Tumour stage was reported in all studies, except one (Devine et al., 2001). All studies included patients with curative intended treatment, as mentioned in the inclusion criteria. However, the type of primary treatment differed: Besides primary surgery (tumour resection), a (selective/functional) neck dissection was performed in some studies (Agarwal et al., 2014; Bekiroglu et al., 2011; Devine et al., 2001; Fang et al., 2013; Fang et al., 2014; Li et al., 2016; Ochoa et al., 2021; Sakthivel et al., 2017; Seferin et al., 2022; Wu et al., 2020; Yang et al., 2014; Yue et al., 2018). Most surgical treatments included reconstruction (Devine et al., 2001; Fang et al., 2014; Ghai et al., 2021; Gu et al., 2021; Hoene et al., 2021; Larson et al., 2021; Li et al., 2013; Li et al., 2016; Rogers et al., 2004; Rogers & Lowe, 2020; Sakthivel et al., 2017; Soares et al., 2018; Vora et al., 2017; Wu et al., 2020; Yang et al., 2014; Yuan et al., 2016; Yue et al., 2018; Zhang et al., 2013; Zhang et al., 2020). Only two studies did not apply or mention adjuvant therapy (Ochoa et al., 2021; Yang et al., 2014). One study did not report any treatment details (Vakil et al., 2012).

As stated in the inclusion criteria, HR-QoL outcomes were assessed in all studies by using the UW-QoL questionnaire. In addition, some studies also used the Oral Health Impact Profile (OHIP-14 or OHIP-49) questionnaire (Li et al., 2013; Li et al., 2016; Yang et al., 2014; Yuan et al., 2016; Zhang et al., 2020), and one study used the EORTC QLQ-HN35 (Yuan et al., 2016). Evaluation of HR-QoL outcomes was performed at different moments in time. In some studies, patients administered the questionnaire at least once pre- and post-treatment (Agarwal et al., 2014; Yan et al., 2017). Patients in other studies administered the questionnaire only once post-treatment (Bekiroglu et al., 2011; Devine et al., 2001; Fang et al., 2013; Fang et al., 2014; Ghai et al., 2021; Gu et al., 2021; Larson et al., 2021; Li et al., 2013; Li et al., 2016; Ochoa et al., 2021; Sakthivel et al., 2017; Seferin et al., 2022; Soares et al., 2018; Vakil et al., 2012; Vora et al., 2017; Wu et al., 2020; Yang et al., 2014; Yue et al., 2018; Zhang et al., 2013; Zhang et al., 2020). The questionnaire was administered twice post-treatment in two studies (Rogers & Lowe, 2020; Yuan et al., 2016). The follow-up time between treatment and assessment of HR-QoL varied from less than 3 months (Vora et al., 2017) to 10 years (Rogers & Lowe, 2020). Characteristics and assessment details are presented in Table 1.

3.3 | Risk of bias within studies

The methodological quality of all studies was assessed and is presented in Table 2. The MINORS quality scores of non-comparative studies ranged from 44% (Vakil et al., 2012) to 69% (Fang et al., 2013; Vora et al., 2017; Zhang et al., 2020), with an average of 60%. The MINORS quality scores of comparative studies ranged from 54% (Ochoa et al., 2021; Sakthivel et al., 2017) to 75% (Ghai et al., 2021; Gu et al., 2021; Wu et al., 2020; Yan et al., 2017; Zhang et al., 2013; Zhang et al., 2020), with an average of 67%.

3.4 | Synthesis of results and additional analyses

Due to the heterogeneity of the found studies, it was unfortunately not possible to synthesise the chewing results of these studies.

3.5 | Results of individual studies

Detailed outcome scores of each study are presented in Table 1. HR-QoL masticatory ability scores clustered by time are presented in Figure 2.

Vakil et al. (2012) did not report any specific data to compare with other studies included in the present review. Agarwal et al. (2014) showed that the ability to chew solid food at baseline reduced to only semisolids and liquids post-treatment. Li et al. followed 47 hemiglossectomy patients and reported that only seven patients complained about a negative effect on chewing ability (X. Li et al., 2016). Rogers et al. (2004) stated that chewing scores were maintained over time. An 8-year longitudinal study by Yan et al. (2017) showed the worst QoL scores for mastication 3 months post-treatment. The scores improved at the 1-year assessment and remained the same at the 8-year assessment. Nonetheless, overall, the problems with chewing significantly worsened between time of diagnosis and 8 years after treatment. Rogers and Lowe (2020) showed an improvement from 2 to 10 years post-treatment. Bekiroglu et al. (2011) reported a mean decline in chewing of 25 points after

TABLE 1 Demographic, tumour and treatment related details of reviewed studies

Author	Country	Subgroups	Number of participants (% male)	Age in years (mean)	Tumour site (*n*)
1. Agarwal et al. (2014)	India	-	*n* = 39 (87%)	51.62 (SD 21.23)	Tongue: *n* = 39
2. Bekiroglu et al. (2011)	United Kingdom	*I*: no radiotherapy *II*: radiotherapy	*I*: *n* = 69 (38%) *II*: *n* = 60 (43%)	*I*: 61 (SD 11) *II*: 60 (SD 12)	Buccal: *n* = 23 Floor of the mouth: *n* = 40 Gingiva: *n* = 24 Tongue: *n* = 29 Other tumour site: *n* = 13
3. Devine et al. (2001)	United Kingdom	*I*: lip-split mandibulectomy *II*: visor/mandibular lingual release	*n* = 20 (70%) *I*: *n* = 10 (70%) *II*: *n* = 10 (70%)	55.6 (range 43–72) *I*: *n* = 59.3 (range 45–72) *II*: *n* = 51.9 (range 43–65)	Anterior floor of mouth *I*: *n* = 5 *II*: *n* = 4 Buccal and floor of mouth and gingiva and tongue *I*: *n* = 5 *II*: *n* = 6
4. Fang et al. (2013)	China	-	*n* = 21 (100%)	53.1 (range 41–69)	Floor of mouth: *n* = 8 Tongue: *n* = 13
5. Fang et al. (2014)	China	*I*: free flap reconstruction *II*: no free flap reconstruction	*n* = 49 (78%) *I*: *n* = 20 (75%) *II*: *n* = 29 (79%)	*I*: 73.8 (range 70–83) *II*: 73.5 (range 70–89)	Buccal *I*: *n* = 2 *II*: *n* = 4 Floor of mouth *I*: *n* = 4 *II*: *n* = 6 Gingiva *I*: *n* = 8 *II*: *n* = 8 Lip *I*: *n* = 2 *II*: *n* = 6 Tongue *I*: *n* = 4 *II*: *n* = 5
6. Ghai et al. (2021)	India	*I*: T1 without radiotherapy *II*: T2 without radiotherapy *III*: T1–T2 with radiotherapy	*n* = 54 (87%) *I*: *n* = 26 *II*: *n* = 15 *III*: *n* = 13	44 (SD 11; range 18–70)	Buccal: *n* = 54
7. Gu et al. (2021)	China	*I*: neck dissection with submandibular gland preservation *II*: conventional neck dissection	*I*: *n* = 36 (63.9%) *II*: *n* = 131 (76.3%)	*I*: 48.6 *II*: 53.4	Buccal *I*: *n* = 9 *II*: *n* = 35 Floor of mouth *I*: *n* = 5 *II*: *n* = 22 Gingiva *I*: *n* = 7

(Continues)

TABLE 1 (Continued)

Author	Country	Subgroups	Number of participants (% male)	Age in years (mean)	Tumour site (*n*)
					II: $n = 23$ Tongue *I*: $n = 15$ *II*: $n = 51$
8. Hoene et al. (2021)	Germany	-	$n = 15$ (66%)	60 (SD 13.2; range 46–94)	Alveolus: $n = 4$ Buccal: $n = 2$ Floor of mouth: $n = 4$ Lip: $n = 1$ Palate: $n = 1$ Tongue: $n = 3$
9. Larson et al. (2021)	United States of America	*I*: lateral floor of mouth *II*: anterior floor of mouth *III*: alveolar ridge with floor of mouth *IV*: No radiotherapy *V*: radiotherapy	$n = 24$ (66%) *I*: $n = 17$ (35%) *II*: $n = 4$ (50%) *III*: $n = 3$ (100%) *IV*: $n = 16$ *V*: $n = 8$	66.8 *I*: 65.7 *II*: 65.8 *III*: 74.3	Lateral floor of mouth *I*: $n = 17$ Anterior floor of mouth *II*: $n = 4$ Alveolar ridge with floor of mouth *III*: $n = 3$
10. Li et al. (2013)	China	-	$n = 51$ (80%)	55 (median; range 22–75)	Buccal: $n = 3$ Floor of mouth: $n = 14$ Gingiva: $n = 6$ Palate: $n = 2$ Tongue: $n = 26$
11. Li et al. (2016)	China	*I*: pectoralis major myocutaneous flap *II*: radial forearm free flap	$n = 41$ (83%) *I*: $n = 17$ (100%) *II*: 24 (71%)	53.6 (median; range 22–65) *I*: 82% < 50 *II*: 63% < 50	Floor of mouth *I*: $n = 5$ *II*: $n = 6$ Tongue *I*: $n = 12$ *II*: $n = 18$
12. Li et al. (2016)	China	*I*: radiotherapy pre-treatment *II*: radiotherapy post-treatment *III*: radiotherapy pre- and post-treatment *IV*: no radiotherapy	$n = 47$ (72%) *I*: $n = 5$ *II*: $n = 24$ *III*: $n = 9$ *IV*: $n = 9$	58.4 (range 44–72)	Tongue: $n = 47$
13. Ochoa et al. (2021)	United States of America	-	$n = 39$ (54%)	64.4 (range 32–78)	Tongue: $n = 39$
14. Rogers et al. (2004)	United Kingdom	*I*: no resection *II*: rim resection *III*: segment resection	$n = 224$ (66%) *I*: $n = 123$ (63%) *II*: $n = 44$ (68%) *III*: $n = 57$ (68%)	61 (SD 13) 41% 65+ *I*: 37% 65+ *II*: 43% 65+ *III*: 47% 65+	Alveolus *II*: $n = 7$ *III*: $n = 22$ Buccal *I*: $n = 27$ *II*: $n = 8$ *III*: $n = 14$

TABLE 1 (Continued)

Author	Country	Subgroups	Number of participants (% male)	Age in years (mean)	Tumour site (*n*)
					Floor of mouth *I*: $n = 33$ *II*: $n = 26$ *III*: $n = 17$ Tongue *I*: $n = 63$ *II*: $n = 3$ *III*: $n = 4$
15. Rogers and Lowe (2020)	United Kingdom	-	$n = 230$ (60%)	50% <55 40% 55–64 28% 65–74 13% 75+	Buccal: $n = 38$ Floor of mouth: $n = 69$ Gum: $n = 24$ Tongue: $n = 87$ Other: $n = 12$
16. Sakthivel et al. (2017)	India	*I*: surgery *II*: adjuvant therapy	$n = 36$ (78%) *I*: $n = 10$ *II*: $n = 26$	43 (median; range 24–66)	Tongue: $n = 36$ tip *I*: $n = 1$ *II*: $n = 2$ Lateral border *I*: $n = 6$ *II*: $n = 8$ Tip with lateral border *I*: $n = 2$ *II*: $n = 10$ Lateral border with floor of mouth *I*: $n = 1$ *II*: $n = 6$
17. Seferin et al. (2022)	Brazil	*I*: sentinel lymph node biopsy *II*: cervical neck dissection levels I–III	*I*: $n = 15$ (67%) *II*: $n = 9$ (100%)	*I*: 62.6 (SD 10) *II*: 62.2 (SD 9.3)	Floor of mouth *I*: $n = 1$ *II*: $n = 3$ Hard palate *I*: $n = 1$ Lip *II*: $n = 1$ Tongue *I*: $n = 13$ *II*: $n = 1$ Retromolar trigone *II*: $n = 4$
18. Soares et al. (2018)	Brazil	-	$n = 47$ (83%)	61.8 (SD 8.4)	Floor of mouth: $n = 23$ Gingiva: $n = 16$ Other: $n = 8$

TABLE 1 (Continued)

Author	Country	Subgroups	Number of participants (% male)	Age in years (mean)	Tumour site (*n*)
19. Vakil et al. (2012)	Pakistan	-	*n* = 30	-	-
20. Vora et al. (2017)	India	-	*n* = 65 (85%)	50.5 (range 30–60)	Alveolus: *n* = 12 Buccal: *n* = 42 Retromolar trigone: *n* = 4 Tongue: *n* = 7
21. Wu et al. (2020)	China	*I*: classic anterolateral thigh perforator free flap *II*: chimeric anterolateral thigh perforator free flap	*I*: *n* = 27 (96%) *II*: *n* = 21 (95%)	*I*: 46.9 (SD 9.2) *II*: 47.4 (SD 9.8)	Buccal *I*: *n* = 27 *II*: *n* = 21
22. Yan et al. (2017)	China	*I*: long-term survivors (8 years) *II*: non-survivors (<8 years)	*I*: *n* = 30 (57%) *II*: *n* = 25 (56%)	*I*: 57.7 (35–81) *II*: 59.5 (35–90)	Gingiva *I*: *n* = 13 *II*: *n* = 8 Tongue *I*: *n* = 7 *II*: *n* = 13 Other *I*: *n* = 10 *II*: *n* = 4
23. Yang et al. (2014)	China	-	*n* = 34 (74%)	53.4 (median; range 28–65)	Alveolus: *n* = 13 Buccal: *n* = 7 Floor of mouth: *n* = 9 Tongue: *n* = 5
24. Yuan et al. (2016)	China	*I*: Radial forearm free flap *II*: Anterolateral thigh perforator free flap	*n* = 67 (67%) *I*: *n* = 46 (72%) *II*: *n* = 21 (76%)	56.2 (median; range 33–74)	Tongue: *n* = 67
25. Yue et al. (2018)	China	*I*: Tongue *II*: Other *III*: No reconstruction *IV*: Reconstruction	*n* = 139 (65%) *I*: *n* = 68 (63%) *II*: *n* = 71 (66%) T2 *III*: *n* = 53 (57%) *IV*: *n* = 39 (67%) T3–T4 *III*: *n* = 24 (79%) *IV*: *n* = 23 (65%)	% under 70: 24% *I*: 28% *II*: 20% T2 *III*: 85% *IV*: 90% T3–T4 *III*: 88% *IV*: 83%	Buccal, floor of mouth, retromolar trigone, palate: *n* = 71 Tongue: *n* = 68
26. Zhang et al. (2013)	China	*I*: ≤40 years *II*: ≥40 years	*I*: *n* = 21 (43%) *II*: *n* = 42 (43%)	*I*: 34.0 years (5.2 SD, range 22–40) *II*: 58.9 years (SD 7.4, range 42–74)	Tongue: *n* = 63
27. Zhang et al. (2020)	China	-	*n* = 65 (86)	49 years (median, range 25–70)	Tongue: *n* = 65

Abbreviations: IQR: inter quartile range, SD: standard deviation, SE: standard error, —: information is not given.

TABLE 1 (Continued)

Author	Tumour stage (T of TNM)	Involved lymph nodes (N of TNM)	Oncological treatment	Mean assessment moment	Chewing outcome (mean)
1. Agarwal et al. (2014)	T1–T2: $n = 39$	N0; $n = 39$	Hemiglossectomy, selective neck dissection Radiotherapy	Baseline and at 12 months follow-up	Pre-treatment: 76.9 (SD 25.3) Post-treatment: 52.6 (SD 16.0) $p < 0.001$
2. Bekiroglu et al. (2011)	T3–T4: *I*: $n = 44$ *II*: $n = 38$	N0: *I*: $n = 53$ *II*: $n = 41$ N1: *I*: $n = 10$ *II*: $n = 9$ N2+: *I*: $n = 6$ *II*: $n = 10$	Selective neck dissection Soft free flap *I*: $n = 39$ *II*: $n = 32$ Composite free flap *I*: $n = 25$ *II*: $n = 23$ Adjuvant radiotherapy	*I*: 16 months follow-up (IQR 12–23) and 28 months follow-up (IQR 23–35) *II*: 15 months follow-up (IQR 12–20) and 26 months follow-up (IQR 22–33)	±1 year follow-up *I*: 62 (SE 5) *II*: $n = 44$ (SE 6) $p = 0.01$ ±2 years follow-up *I*: 59 (SE 5) *II*: 43 (SE 5) $p = 0.03$
3. Devine et al. (2001)	-	-	Mandible resection *I*: $n = 3$ *II*: $n = 3$ Functional preserving neck dissection and radial forearm free flap: $n = 20$ Adjuvant radiotherapy *I*: $n = 4$ *II*: $n = 5$	*I*: 40.6 months follow-up (range 10–60) *II*: 27.9 months follow-up (range 8–54)	*I*: 65 (SD 24.2) *II*: 40 (SD 21.1) $p = 0.024$
4. Fang et al. (2013)	T2: $n = 5$ T3: $n = 5$ T4: $n = 11$	-	Partial mandible resection: $n = 10$ Segmental mandible resection: $n = 1$ Partial glossectomy, limited floor of mouth resection: $n = 12$ Subtotal glossectomy, total floor of mouth excision: $n = 9$ Unilateral or bilateral neck dissection Selective neck dissection: $n = 18$ Modified radical neck dissection: $n = 3$ Adjuvant radiotherapy: $n = 6$	64.3 months follow-up (range 20–93)	57.1 (SD 17.9)
5. Fang et al. (2014)	T2 *I*: $n = 1$ *II*: $n = 4$ T3 *I*: $n = 7$ *II*: $n = 12$	-	No or marginal mandibulectomy *I*: $n = 18$ *II*: $n = 19$ Segmental mandibulectomy *I*: $n = 2$ *II*: $n = 10$	≥12 months follow-up	*I*: 69 (SD 18.3) *II*: 57 (SD 19.3) $p = 0.039$

(Continues)

TABLE 1 (Continued)

Author	Tumour stage (T of TNM)	Involved lymph nodes (N of TNM)	Oncological treatment	Mean assessment moment	Chewing outcome (mean)
	T4 *I*: $n = 12$ *II*: $n = 13$		Adjuvant radiotherapy *I*: $n = 10$ *II*: $n = 17$		
6. Ghai et al. (2021)	T1: $n = 29$ T2: $n = 25$	N0: $n = 54$	Resection, supraomohyoid neck dissection Local flap, free flap/pectoralis major myocutaneous flap, free fibula bone graft Adjuvant radiotherapy: $n = 13$	8.5 months follow-up (IQR 4–13.5)	75 (SD 32) *I*: 75 (SD 35) *II*: 80 (SD 32) *III*: 69 (SD 25)
7. Gu et al. (2021)	T1 *I*: $n = 14$ *II*: $n = 56$ T2 *I*: $n = 22$ *II*: $n = 75$	N0 *I*: $n = 36$ *II*: $n = 131$	Resection with or without submandibular gland preservation, flap reconstruction *I*: $n = 2$ *II*: $n = 12$	12 months follow-up	*I*: 86.1 (SD 22.7) *II*: 71.0 (SD 24.8) $p = 0.001$
8. Hoene et al. (2021)	Tis: $n = 1$ T1: $n = 6$ T2: $n = 4$ T4: $n = 4$	N0: $n = 14$ N2: $n = 1$	Resection with reconstruction by: local flap: $n = 7$ free flap: $n = 8$	One day preoperatively and 1/2, 1, 3, 6, 9 and 12 month(s) follow-up	Post-operative: 31.9 (SD 26.9)
9. Larson et al. (2021)	T1 *I*: $n = 12$ *II*: $n = 3$ *III*: $n = 3$ T2 *I*: $n = 5$ *II*: $n = 1$	N0 *I*: $n = 8$ *II*: $n = 3$ *III*: $n = 1$ N1 *I*: $n = 2$ *III*: $n = 1$ N2 *I*: $n = 2$ *II*: $n = 1$ *III*: $n = 1$	Resection floor of mouth., partial glossectomy, marginal mandibulectomy, neck dissection, reconstruction with thigh split-thickness skin graft Adjuvant radiotherapy (IV) *I*: $n = 5$ *II*: $n = 1$ *III*: $n = 2$	41.1 months follow-up (range 6–88) *I*: 39.2 months follow-up *II*: 32.5 months follow-up *III*: 63.7 months follow-up	79.2 (SD 25.2) *I*: 85.3 *II*: 50.0 $p = 0.01$ *IV*: 81 (SD 25) *V*: 75 (SD 27) $p = 0.58$
10. Li et al. (2013)	T1: $n = 3$ T2: $n = 16$ T3: $n = 24$ T4: $n = 8$	N0: $n = 38$ N1: $n = 8$ N2: $n = 4$ N3: $n = 1$	Resection, anterolateral thigh perforator free flap reconstruction Adjuvant (chemo)radiotherapy: $n = 33$	Range 12–84 months follow-up	42.7 (SD 1.1)
11. Li et al. (2016)	T1–T2 *I*: $n = 8$ *II*: $n = 10$ T3–T4 *I*: $n = 9$ *II*: $n = 14$	-	Resection, reconstruction Adjuvant (chemo)radiotherapy *I*: $n = 7$ *II*: $n = 8$	Range 13–108 months follow-up	*I*: 43.4 (SD 12.4) *II*: 42.5 (SD 6.2) $p = 0.817$

TABLE 1 (Continued)

Author	Tumour stage (T of TNM)	Involved lymph nodes (N of TNM)	Oncological treatment	Mean assessment moment	Chewing outcome (mean)
12. Li et al. (2016)	T2: $n = 13$ T3: $n = 23$ T4: $n = 11$	-	Hemiglossectomy, radial forearm free flap reconstruction Marginal mandible resection: $n = 9$ Selective neck dissection: $n = 43$ Modified radical neck dissection: $n = 4$ Adjuvant radiotherapy *I*: $n = 5$ *II*: $n = 24$ *III*: $n = 9$	24 months follow-up	Post-treatment: 92.6 (SD 18) *I*: 90 *II*: 94 *III*: 94 *IV*: 89 $p > 0.05$
13. Ochoa et al. (2021)	Tis: $n = 11$ T1: $n = 24$ T2: $n = 4$	Unknown: $n = 11$ N0: $n = 26$ N1: $n = 1$ N2: $n = 1$	Resection Neck dissection: $n = 14$	28.7 months follow-up (range 6–80.4)	97.4 (SD 11.2)
14. Rogers et al. (2004)	T1–T4: $n = 224$	-	Mandibular resection *II*: n 44 *III*: $n = 57$ Soft tissue free flap *I*: $n = 74$ *II*: $n = 37$ Composite free flap reconstruction *III*: $n = 57$ Adjuvant radiotherapy *I*: $n = 35$ *II*: $n = 16$ *III*: $n = 29$	6 months follow-up (range 4.5–9.0) 12 months follow-up (range 9.0–18.0) >18 months follow-up	72 (SE 2) *I*: 79 (SE 3) *II*: 70 (SE 5) *III*: 59 (SE 5) Kruskal–Wallis test: $p = 0.002$ Mann–Whitney *U* test $p = 0.11$
15. Rogers and Lowe (2020)	-	-	Resection: $n = 166$ Resection with radiotherapy: $n = 59$ Reconstruction with: composite free flap: $n = 45$ Soft free flap $n = 103$ Radiotherapy only: $n = 5$	25 months follow-up (median, IQR 20–28) 121 months follow-up (median, IQR 117–124)	2 years follow-up: 66.2 (SE 2.8) 10 years follow-up: 71.2 (SE 2.8) $p = 0.08$
16. Sakthivel et al. (2017)	T1 *I*: $n = 6$ *II*: $n = 4$ T2 *I*: $n = 4$ *II*: $n = 22$	N0 *I*: $n = 9$ *II*: $n = 8$ N1 *I*: $n = 1$ *II*: $n = 10$ N2 *I*: $n = 0$ *II*: $n = 8$	Unilateral extended supraomohyoid neck dissection *I*: $n = 3$ *II*: $n = 7$ Bilateral extended supraomohyoid *II*: $n = 12$ Functional preserving neck dissection *I*: $n = 1$ *II*: $n = 7$ Adjuvant radiotherapy: $n = 26$	45 months follow-up (range 14–65) 34 months follow-up (median)	*I*: 79 (SE 7.3) *II*: 43.5 (SE 4.8) $p < 0.001$

TABLE 1 (Continued)

Author	Tumour stage (T of TNM)	Involved lymph nodes (N of TNM)	Oncological treatment	Mean assessment moment	Chewing outcome (mean)
17. Seferin et al. (2022)	T1 *I*: $n = 14$ *II*: $n = 2$ T2 *I*: $n = 1$ *II*: $n = 5$ T3 *II*: $n = 1$ T4 *II*: $n = 1$	N0 *I*: $n = 15$ *II*: $n = 4$ N+ *II*: $n = 5$	Sentinel lymph node biopsy *I*: $n = 15$ Cervical neck dissection levels I–III *II*: $n = 9$ Adjuvant radiotherapy *I*: $n = 1$ *II*: $n = 6$ Concurrent chemoradiotherapy *II*: $n = 1$	*I*: 31.7 months follow-up (SD 7.8) *II*: 38.0 months follow-up (SD 5.9)	*I*: 86.7 (SD 22.9) *II*: 56.7 (SD 30.0) $p = 0.041$
18. Soares et al. (2018)	T3: $n = 8$ T4: $n = 39$	N0: $n = 26$ N1: $n = 9$ N2: $n = 10$ N3: $n = 2$	Segmental mandibulectomy Myocutaneous flap: (72%) Free flap: 28% Adjuvant radiotherapy: $n = 42$ Adjuvant chemoradiotherapy: $n = 3$	41.5 months follow-up	-
19. Vakil et al. (2012)	-	-	-	-	-
20. Vora et al. (2017)	T1: $n = 14$ T2: $n = 35$ T3: $n = 3$ T4: $n = 13$	N0: $n = 48$ N1: $n = 5$ N2: $n = 12$	Mandibular resection Pectoralis major myocutaneous flap Adjuvant radiotherapy: $n = 46$ Adjuvant chemoradiotherapy: $n = 19$	30 months follow-up (range <3–24)	46.2 (SD 22.2)
21. Wu et al. (2020)	T1 *I*: $n = 8$ *II*: $n = 9$ T2 *I*: $n = 18$ *II*: $n = 10$ T3 *I*: $n = 1$ *II*: $n = 1$ T4 *II*: $n = 1$	N0 *I*: $n = 18$ *II*: $n = 13$ N1 *I*: $n = 5$ *II*: $n = 6$ N2 *I*: $n = 4$ *II*: $n = 2$	Resection with modified radical neck dissection, reconstruction with classical anterolateral thigh perforator flap *I*: $n = 27$ Or chimerical anterolateral thigh perforator flap *II*: $n = 21$	6 months follow-up	*I*: 68.6 (SD 13.6) *II*: 70.7 (SD 15.4) $p = 0.624$
22. Yan et al. (2017)	T1–T2 *I*: $n = 22$ *II*: $n = 12$ T3–T4 *I*: $n = 8$ *II*: $n = 13$	-	Free flap reconstruction *I*: $n = 14$ *II*: $n = 18$ Neck dissection *I*: $n = 20$ *II*: $n = 25$ Adjuvant radiotherapy *I*: $n = 9$ *II*: $n = 16$	3, 12 and 96 months follow-up	At diagnosis *I*: 83.3 (SD 30.3) *II*: 78.0 (SD 29.1) At 3 months follow-up *I*: $n = 53.4$ (SD 18.6) 12 years follow-up: *I*: 69.0 (24.7) *II*: 46.6 (29.1) 8 years: *I*: 66.7 (24.0)

TABLE 1 (Continued)

Author	Tumour stage (T of TNM)	Involved lymph nodes (N of TNM)	Oncological treatment	Mean assessment moment	Chewing outcome (mean)
23. Yang et al. (2014)	T1–T2: $n = 10$ T3–T4: $n = 23$	-	Mandible resection, fibula free flap reconstruction	27.6 months follow-up (range 12–48) 1–3 years: $n = 24$ >3 years: $n = 10$	33.1 (SD 16.1)
24. Yuan et al. (2016)	T1–T2 *I*: $n = 25$ *II*: $n = 13$ T3–T4 *I*: $n = 21$ *II*: $n = 8$	-	Partial glossectomy *I*: $n = 46$ *II*: $n = 5$ Total glossectomy *II*: $n = 16$ Reconstruction *I*: $n = 46$ *II*: $n = 21$ Adjuvant (chemo)radiotherapy *I*: $n = 17$ *II*: $n = 6$	6 and 12 months follow-up	6 months *I*: 64.0 (SD 11.0) *II*: 64.0 (SD 10.2) 12 months *I*: 68.5 (SD 10.6) *II*: 71.0 (SD 9.5) $p = 0.490$ *I*: $p = 0.004$ *II*: $p = 0.036$
25. Yue et al. (2018)	T2 *I*: $n = 53$ *II*: $n = 39$ T3–T4 *I*: $n = 15$ *II*: $n = 32$	-	Maxillectomy or mandibulectomy *I*: $n = 30$ *II*: $n = 42$ *III*: $n = 36$ *IV*: $n = 49$ Neck dissection *I*: $n = 68$ *II*: $n = 71$ *III*: $n = 77$ *IV*: $n = 62$ Anterolateral thigh flap: $n = 9$ Fibular osteomyocutaneous flap: $n = 5$ Radial forearm free flap: $n = 48$ Adjuvant radiotherapy *I*: $n = 12$ *II*: $n = 12$ *III*: $n = 6$ *IV*: $n = 18$ Neo-adjuvant chemoradiotherapy: $n = 47$	>12 months follow-up	*I*: 67.3 (SD 16.9) *II*: 73.9 (SD 19.6) $p = 0.036$ T2 *III*: 72.6 (SD 17.9) *IV*: 73.1 (SD 17.6) $p = 0.888$ T3–T4 *III*: 57.3 (SD 20.2) *IV*: 76.1 (SD 14.1) $p = 0.001$

TABLE 1 (Continued)

Author	Tumour stage (T of TNM)	Involved lymph nodes (N of TNM)	Oncological treatment	Mean assessment moment	Chewing outcome (mean)
26. Zhang et al. (2013)	T1–T2 *I*: $n = 16$ *II*: $n = 32$ T3–T4 *I*: $n = 5$ *II*: $n = 10$	N0 *I*: $n = 16$ *II*: $n = 32$ N1 *I*: $n = 3$ *II*: $n = 6$ N2 *I*: $n = 2$ *II*: $n = 4$	Resection Flap reconstruction: *I*: $n = 6$ *II*: $n = 12$ Adjuvant (chemo)radiotherapy *I*: $n = 8$ *II*: $n = 16$	*I*: 44.4 months follow-up (media, range 12–144) *II*: 38.4 months (median, range 24–120)	*I*: 87.5 (SD 1.3) *II*: 86.7 (SD 1.7) $p = 0.37$
27. Zhang et al. (2020)	T1: $n = 4$ T2: $n = 8$ T3: $n = 31$ T4: $n = 22$	N0: $n = 27$ N1: $n = 12$ N2: $n = 23$ N3: $n = 3$	Resection with anterolateral thigh perforator free flap reconstruction	≥12 months follow-up	41.2 (SD 13.2)

Abbreviations: IQR: inter quartile range, SD: standard deviation, SE: standard error, –: information is not given.

1 year for patients treated with a combination of surgery and RT and a mean decline of 7 points for those treated with surgery without RT.

The percentage of patients considering chewing as one of the three most important domains of the UW-QoL differed between 33.3% (second rank) (Fang et al., 2013) and 94.1% (first rank) (Li et al., 2013). Other studies only reported the rank of the chewing domain: first rank (Li et al., 2016; Vora et al., 2017; Yue et al., 2018), second rank (Sakthivel et al., 2017) and third rank (Sakthivel et al., 2017). Soares et al. (2018) used an alternative way to present outcomes. At 41.5 months, patients scored as follows: cannot chew anything ($n = 26$), chews light food ($n = 20$) and chews light food and solids ($n = 1$). There were no significant associations between chewing scores and demographic or clinical variables. Ochoa et al. (2021) reported patients' scores as follows: I cannot even chew soft solids ($n = 0$), I can eat soft solids but cannot chew some foods ($n = 2$) and I can chew as well as ever ($n = 37$). Chewing was one of the worst scoring domains in this study. Vakil et al. also presented their findings in a slightly different manner. A score from 1 to 3 was used, where 1 indicated no change in chewing function and 3 indicated that patients could not chew soft food. In this study, the most frequently occurring value was 2 with a standard deviation of 0.7 (Vakil et al., 2012).

4 | DISCUSSION

HR-QoL is often impaired in patients with oral cancer (Lalla et al., 2017), and these patients face challenges in masticatory function caused by the tumour itself or oncological treatment (Namaki et al., 2004). Therefore, this review described the HR-QoL mastication scores in patients treated for oral cancer, as measured with the UW-QoL questionnaire. The UW-QoL mastication scores ranged from 31.9 to 97.4 (Hoene et al., 2021; Ochoa et al., 2021). However, there was a wide variety in methodology (e.g., patient groups, treatment and assessment moment), making it impossible to compare outcome scores.

In Figure 1, a deterioration of masticatory ability can be seen ±1 year after treatment. After that, the masticatory ability mostly recovered up to baseline level. Besides tissue recovery after the oral oncological treatment, the dentist, mostly the maxillofacial prosthodontist, has an important role in optimising the dental and/or prosthetic status of these patients. When musculoskeletal deficits of the masticatory system appear, also an orofacial physiotherapist can be consulted to optimise the masticatory system.

In a longitudinal study with oral cancer patients, the same pattern of deterioration and recovery was found by measuring the masticatory function objectively. However, in this study, the recovery increased above the level of masticatory function at baseline (de Groot et al., 2019). The improvement above baseline level was not seen in the included papers of this review. This can probably be explained by a response shift due to a change in the patient's internal standard related to masticatory function (Vanier et al., 2021). Another explanation could be a ceiling effect of the UW-QoL mastication question,

TABLE 2 MINORS assessment tool

	Items													
Author	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**	**%**
1. Agarwal et al. (2014)	1	2	2	2	0	2	1	0	N/A	N/A	N/A	N/A	10/16	63
2. Bekiroglu et al. (2011)	2	2	1	2	0	2	1	0	1	1	1	2	15/24	63
3. Devine et al. (2001)	2	1	1	2	0	2	1	0	N/A	N/A	N/A	N/A	9/16	56
4. Fang et al. (2013)	2	1	0	2	0	2	1	0	1	2	1	2	14/24	58
5. Fang et al. (2014)	2	2	2	2	0	2	1	0	N/A	N/A	N/A	N/A	11/16	69
6. Ghai et al. (2021)	2	2	2	2	0	2	2	0	1	2	1	2	18/24	75
7. Gu et al. (2021)	2	2	0	2	0	2	2	0	2	2	2	2	18/24	75
8. Hoene et al. (2021)	2	1	0	2	0	2	2	0	N/A	N/A	N/A	N/A	9/16	56
9. Larson et al. (2021)	2	2	1	2	0	2	1	0	1	2	1	2	16/24	67
10. Li et al. (2013)	2	2	0	2	0	2	1	0	N/A	N/A	N/A	N/A	9/16	56
11. Li et al. (2016)	2	2	2	2	0	2	1	0	1	2	1	2	17/24	71
12. Li et al. (2016)	1	2	2	2	0	2	1	0	N/A	N/A	N/A	N/A	10/16	63
13. Ochoa et al. (2021)	1	2	2	2	0	2	1	0	1	0	0	2	13/24	54
14. Rogers et al. (2004)	2	2	2	2	0	2	1	0	1	2	1	2	17/24	71
15. Rogers and Lowe (2020)	2	2	1	2	0	2	1	0	N/A	N/A	N/A	N/A	10/16	63
16. Sakthivel et al. (2017)	1	1	0	2	0	2	1	0	1	2	1	2	13/24	54
17. Seferin et al. (2022)	2	1	2	2	0	2	1	0	1	2	1	2	16/24	67
18. Soares et al. (2018)	2	1	2	1	0	2	1	0	N/A	N/A	N/A	N/A	9/16	56
19. Vakil et al. (2012)	2	1	1	1	0	2	0	0	N/A	N/A	N/A	N/A	7/16	44
20. Vora et al. (2017)	2	2	2	2	0	1	2	0	N/A	N/A	N/A	N/A	11/16	69
21. Wu et al. (2020)	2	2	0	2	0	2	2	0	2	2	2	2	18/24	75
22. Yan et al. (2017)	2	2	1	2	0	2	2	0	1	2	2	2	18/24	75
23. Yang et al. (2014)	2	1	0	2	0	2	2	0	N/A	N/A	N/A	N/A	9/16	56
24. Yuan et al. (2016)	2	2	2	2	0	2	1	0	1	2	1	2	15/24	63
25. Yue et al. (2018)	2	2	1	2	0	2	0	0	1	2	2	2	16/24	67
26. Zhang et al. (2013)	2	2	2	2	0	2	1	0	1	2	2	2	18/24	75
27. Zhang et al. (2020)	2	2	1	2	0	2	1	0	N/A	N/A	N/A	N/A	10/16	63

Note: Items: 1. A clearly stated aim. 2. Inclusion of consecutive patients. 3. Prospective collection of data. 4. Endpoints appropriate to the aim of the study. 5. Unbiased assessment of the study endpoint. 6. Follow-up period appropriate to the aim of the study. 7. Loss to follow-up less than 5%. 8. Prospective calculation of the study size. Additional criteria in case of comparative study: 9. An adequate control group. 10. Contemporary groups. 11. Baseline equivalence of groups. 12. Adequate statistical analyses. The items are scored 0 (not reported), 1 (reported but inadequate) or 2 (reported and adequate). The global ideal score being 16 for non-comparative studies and 24 for comparative studies. N/A = not applicable.

because the highest possible outcome was 'I can chew as well as ever', while the used mastication test measures the quality of mixing food (de Groot et al., 2019).

4.1 | Strengths and limitations

This review is strengthened by the fact that the PRISMA guidelines were followed. Another strength of this review is the use of the UW-QoL questionnaire. This questionnaire has been extensively researched, developed and validated and is available in several languages ("UW-QOL v4 Translations,", 2009). Studies utilising the UW-QoL questionnaire have been selected in an attempt to obtain standardised outcome measures. However, our review shows that there is a wide variety in the way the outcomes of the UW-QoL questionnaire are reported, making it difficult to compare data. Another limitation of this review is the overall quality of the included studies. None of the studies had a prospective calculation of the sample size. In addition, some studies had a small number of patients or did not include all eligible patients in their study. Therefore, we cannot exclude a possible bias introduced by differences in patients that participated in the studies. In addition, there was a large heterogeneity between and within studies, both in demographic, tumour and treatment details and in reported outcomes. Tumour site was too heterogeneous for adequate comparison between studies, despite our restriction to oral cancer. Eight studies were restricted to tongue cancer (Agarwal et al., 2014; Li et al., 2016; Ochoa et al., 2021; Sakthivel et al., 2017; Yuan et al., 2016; Zhang et al., 2018; Zhang et al., 2020). Other studies included several tumour sites within the

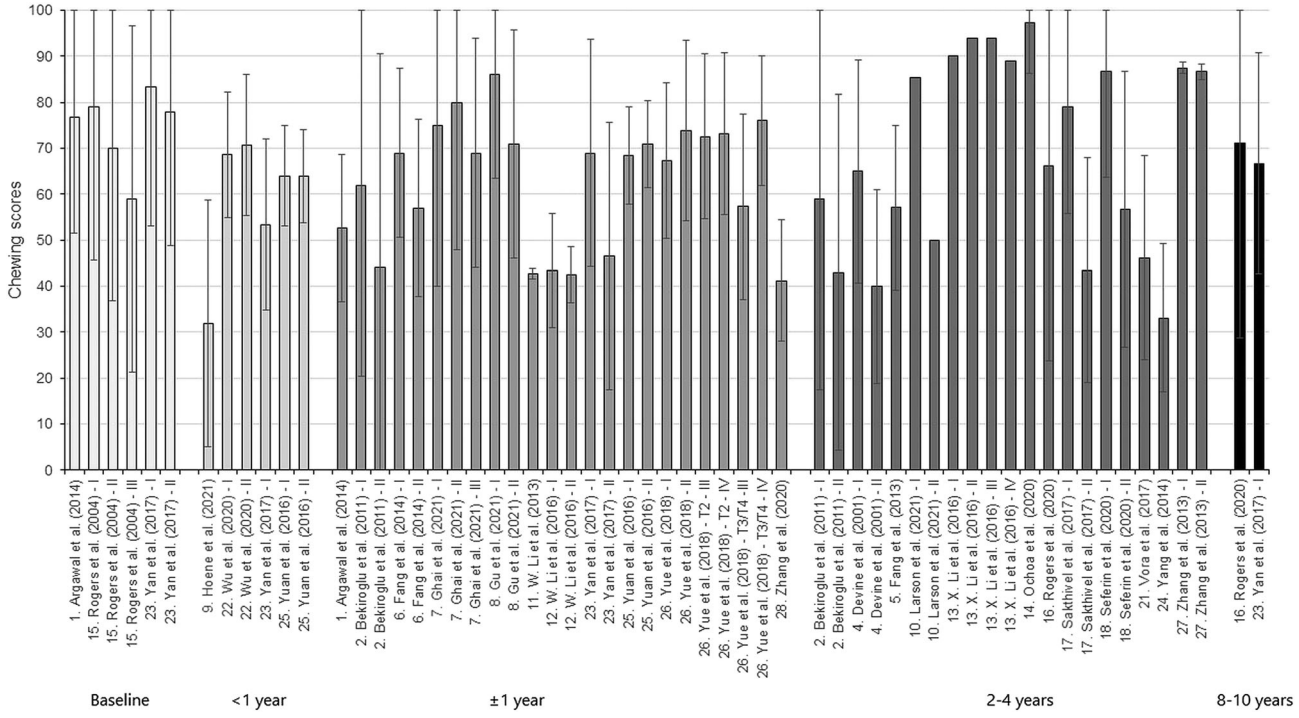

FIGURE 2 UW-QoL chewing scores clustered by time period. QoL chewing scores (mean ± SD) clustered by time (baseline, ≤1 year, ±1 year, 2–4 years, 8–10 years). In case SE instead of SD was provided, SD scores were calculated as $SD = SE * \sqrt{N}$, where N = the number of participants. Subgroups of studies: 2 = Bekiroglu et al. (2011) (*I*: no RT, *II*: RT); 3 = Devine et al. (2001) (*I*: LSM, *II*: V/MLR); 5 = Fang et al. (2014) (*I*: FF rec., *II*: no FF rec.); 6 = Ghai et al. (2021) (*I*: T1 without RT, *II*: T2 without RT, *III*: T1 and T2 with RT); 7 = Gu et al. (2021) (*I*: ND with submandibular gland preservation, *II*: conventional ND); 9 = Larson et al. (2021) (*I*: lateral FOM, *II*: anterior FOM, *III*: alveolar ridge with FOM); 11 = Li et al. (2016) (*I*: PMMF, *II*: RFFF); 12 = Li et al. (2016) (*I*: RT pre-Tx, *II*: RT post-Tx, *III*: RT pre- and post-Tx, *IV*: no RT); 14 = Rogers et al. (2004) (*I*: nil, *II*: rim res., *III*: segment res.); 16 = Sakthivel et al. (2017) (*I*: surgery, *II*: adjuvant therapy); 17 = Seferin et al. (2022) (*I*: sentinel lymph node biopsy, *II*: cervical ND levels I–III); 21 = Wu et al. (2020) (*I*: classic ALTFF, *II*: chimeric ALTFF); 22 = Yan et al. (2017) (*I*: long-term survivors, *II*: non-survivors); 24 = Yuan et al. (2016) (*I*: RFFF, *II*: ALTFF); 25 = Yue et al. (2018) (*I*: tongue, *II*: other, *III*: no rec., *IV*: rec.); 26 = Zhang et al. (2013) (*I*: ≤40 years, *II*: ≥40 years). ALTFF, anterolateral thigh perforator free flap; FF, free flap; FOM, floor of mouth; LSM, lip-split mandibulotomy; ND, neck dissection; nil, no resection; PMMF, pectoralis major myocutaneous flap; rec, reconstruction; RFFF, radial forearm free flap; res, resection; RT, radiotherapy; SD, standard deviation; SE, standard error; Tx, treatment; V/MLR, visor or mandibular lingual release

oral cavity. Due to this heterogeneity, the variation in reported outcomes and the heterogeneous subgroups between studies, it was impossible to perform a best evidence synthesis and/or meta-analysis. Therefore, only a descriptive analysis of the results is provided. In addition, underreporting study details was common across studies, contributing to the inability to compare findings. To quantify this underreporting, the MINORS assessment tool was used (Slim et al., 2003). This is the best suitable tool to assess methodological quality of non-randomised surgical studies. However, the combined scores as measured with the MINORS assessment tool did not identify the underreporting in studies as such, despite the noticeable flaws. One problem of the assessment tool is that the scores for each item range from 0 to 2, were a score of 1 indicates that something is reported but inaccurate. When all items are reported but inaccurate, this will therefore lead to a total score of 50%. One improvement could be to further specify missing items, to get a more detailed image of methodological shortcomings.

Another focus of attention is the survey follow-up time. Twenty of the 27 studies had patients complete the questionnaire only once, making it impossible to evaluate changes in chewing capacity (Devine et al., 2001; Fang et al., 2014; Fang et al., 2013; Ghai et al., 2021; Gu et al., 2021; Larson et al., 2021; Li et al., 2013; Li et al., 2016; Li et al., 2016; Ochoa et al., 2021; Sakthivel et al., 2017; Seferin et al., 2022; Soares et al., 2018; Vakil et al., 2012; Vora et al., 2017; Wu et al., 2020; Yang et al., 2014; Yue et al., 2018; Zhang et al., 2018; Zhang et al., 2020). Three of these studies had an assessment range of 1 year or less (Gu et al., 2021; Vakil et al., 2012; Wu et al., 2020). Patients were asked to complete the questionnaire at baseline in five studies (Agarwal et al., 2014; Hoene et al., 2021; Li et al., 2016; Rogers et al., 2004; Yan et al., 2017). However, one study failed to report the data at baseline (Li et al., 2016), and another study did not report follow-up data in a table (Rogers et al., 2004). Rogers and Lowe (2020) included 230 patients; however, only 111 of them filled in the questionnaires 2 and 10 years after treatment.

As stated in Section 2, our literature search for this review was limited by publication language and eligibility criteria, and therefore, selection bias might have occurred. Moreover, reporting bias may have occurred as statistically significant studies in general have a higher likelihood of publication.

Based on the methodological flaws in the included studies, it is not possible to give plausible clinical implications related masticatory function in patients with oral cancer.

4.2 | Future research

There is a need for standardised methodology across studies, enabling comparison of data. For review and comparison purposes, criteria should be narrowed down and limited to a specific type of (oral) cancer. Ideally, HR-QoL questionnaires should be an integrated part of cancer treatment, because they are a non-invasive way to obtain information about the effect of treatment on patients' HR-QoL. In addition, a baseline assessment followed by multiple assessments over time is favoured to avoid misinterpretation of HR-QoL by a single outcome measure and to be able to identify changes in HR-QoL over time. Finally, we recommend a combination of (a) HR-QoL questionnaire(s) with an objective measurement of chewing function in patients treated for oral cancer in future research. This can contribute to a better understanding of differences between objective findings and the patients' subjective perception.

5 | CONCLUSION

The results of this review provide insight in the available literature regarding HR-QoL in patients treated for oral cancer with an emphasis on masticatory ability by the UW-QoL after primary curative treatment. Currently, there is a lack of comparable UW-QoL studies regarding mastication in oral cancer patients. This prevents identifying possible relations between oral cancer treatment, masticatory ability and QoL. Our findings underline the flaws in the available literature and highlight the necessity for improvement in future HR-QoL research.

CONFLICT OF INTEREST

No conflicts of interest are reported.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analysed in this study.

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How to cite this article: Vermaire, J. A., Partoredjo, A. S. K., de Groot, R. J., Brand, H. S., & Speksnijder, C. M. (2022). Mastication in health-related quality of life in patients treated for oral cancer: A systematic review. *European Journal of Cancer Care*, *31*(6), e13744. https://doi.org/10.1111/ecc.13744