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Original Article

Impact of a Multidisciplinary Rehabilitation Program on Quality of Life in Oral Cancer Survivors: A Randomised Controlled Trial

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Abstract

Background: Oral cancer survivors often experience long-term functional impairments, including dysphagia, speech difficulties, trismus, pain, nutritional problems, and psychosocial distress, which significantly reduce HRQoL. Evidence on the effectiveness of structured rehabilitation in low- and middle-income countries is limited. This study assessed the impact of a multidisciplinary rehabilitation programme on HRQoL among Bangladeshi survivors.

Methods: A randomized controlled trial at Bangabandhu Sheikh Mujib Medical University from July 2023 to July 2024 involved 80 oral squamous cell carcinoma survivors, randomly assigned to intervention (n=40) or control (n=40) groups. The intervention included a 12-week multidisciplinary rehab program with therapy, exercises, nutrition, oral hygiene, and psychosocial support, while controls received routine care. HRQoL was measured with EORTC QLQ-C30 and QLQ-H&N35. Secondary outcomes were mouth opening, weight, nutrition, adherence, satisfaction, and adverse events.

Results: Baseline demographic, clinicopathological, and HRQoL characteristics were comparable between the groups (all p> 0.05). Following rehabilitation, the intervention group demonstrated significantly greater improvement in global HRQoL than the control group (+13.8 ± 6.2 vs. +3.7 ± 5.5; mean difference, 10.1; 95% CI, 7.5–12.7; p< 0.001). Significant improvements were also observed in swallowing (p< 0.001), speech (p = 0.002), pain (p = 0.004), mouth opening (p = 0.006), body weight (p = 0.031), nutritional status (p< 0.001), rehabilitation adherence (p< 0.001), and patient satisfaction (p< 0.001). No significant differences in adverse events were identified between the groups.

Conclusions: A structured multidisciplinary rehabilitation program significantly improved HRQoL and multiple functional outcomes in oral cancer survivors while demonstrating excellent adherence and a favorable safety profile. These findings support the integration of multidisciplinary rehabilitation into routine survivorship care, particularly in resource-limited settings.

Keywords: Oral cancer; multidisciplinary rehabilitation; quality of life; survivorship; dysphagia; randomized controlled trial.

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Introduction

Oral cancer is a major public health concern and remains one of the most prevalent malignancies in South Asia.

Bangladesh bears a substantial disease burden owing to the widespread use of smokeless tobacco and betel quid, both of which are well-established risk factors for oral carcinogenesis [1,2]. Recent epidemiological evidence indicates that South and South-East Asia account for more than half of global oral cancer mortality, with Bangladesh continuing to experience a high incidence and mortality rate [3].

Advances in surgical techniques and multimodal oncological treatment have significantly improved survival among patients with oral cancer. However, oral cancer survivors frequently experience persistent treatment-related complications, including dysphagia, speech impairment, trismus, xerostomia, nutritional deterioration, and psychosocial distress, which substantially impair health-related quality of life (HRQoL) [4,5]. These long-term functional deficits adversely affect eating, communication, social participation, and emotional well-being, making HRQoL an important outcome in oral cancer survivorship and highlighting the need for comprehensive rehabilitation.

Multidisciplinary rehabilitation is increasingly recognized as an essential component of survivorship care for patients with head and neck cancer. Rehabilitation programs integrating speech and swallowing therapy, nutritional counseling, physical therapy, and psychosocial support have demonstrated improvements in functional recovery and several quality-of-life domains [6,7]. Nevertheless, the overall effectiveness of these programs remains uncertain. Recent evidence indicates that although multidisciplinary rehabilitation improves functional outcomes, its impact on overall HRQoL varies considerably because of differences in rehabilitation protocols, intervention intensity, outcome measures, and follow-up duration [8].

Despite improvements in cancer survival, rehabilitation remains an underutilized component of oral cancer survivorship care in Bangladesh. Rehabilitation services are fragmented and are rarely delivered through a coordinated multidisciplinary approach. Consequently, many survivors continue to experience preventable long-term functional disability, nutritional compromise, and poor quality of life despite successful oncological treatment. Furthermore, most rehabilitation studies have been conducted in high-income countries with well-established rehabilitation infrastructure, limiting the applicability of their findings to resource-constrained healthcare systems such as Bangladesh [9,10]. Differences in healthcare infrastructure, availability of rehabilitation specialists, socioeconomic conditions, and access to supportive care may substantially influence both the feasibility and effectiveness of multidisciplinary rehabilitation in this setting.

Therefore, an important evidence gap exists regarding the effectiveness of structured multidisciplinary rehabilitation programs for improving HRQoL among oral cancer survivors in low- and middle-income countries. To date, no published randomized controlled trial has comprehensively evaluated a structured multidisciplinary rehabilitation program for oral cancer survivors in Bangladesh. Consequently, robust evidence to support the routine integration of multidisciplinary rehabilitation into oral cancer survivorship care in Bangladesh remains lacking.

Accordingly, the present randomized controlled trial aimed to evaluate the effectiveness of a structured multidisciplinary rehabilitation program comprising speech and swallowing therapy, nutritional counseling, physical therapy, and psychosocial support on health-related quality of life among oral cancer survivors in Bangladesh. The findings of this study are expected to provide context-specific evidence to guide clinical practice, strengthen multidisciplinary survivorship care, and inform rehabilitation policy in resource-limited healthcare settings.

Materials and Methods

Study design and setting

This prospective, parallel-group, randomized controlled trial was conducted at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from July 2023 to July 2024. The study was designed and reported in accordance with the Consolidated Standards of Reporting Trials (CONSORT) 2010 statement (Schulz et al., 2010).

Study participants

A total of 80 oral cancer survivors were enrolled and randomly assigned in a 1:1 ratio to either the intervention group (n = 40) or the control group (n = 40). Eligible participants were aged 18 years or older, had histopathologically confirmed oral squamous cell carcinoma, had completed primary treatment (surgery with or without radiotherapy and/or chemotherapy) within the preceding 6–12 months, were disease-free at enrollment, were able to understand and complete the study questionnaires, and provided written informed consent. Patients were excluded if they had recurrent or metastatic disease, severe neurological or psychiatric disorders that could interfere with participation, another active malignancy, medical conditions precluding rehabilitation, or were unwilling or unable to complete follow-up.

Sample size calculation

The sample size was calculated using G Power version 3.1 [11]. Based on the primary outcome of health-related quality of life (HRQoL), a moderate standardized effect size (d = 0.65), a two-sided significance level (α) of 0.05, and 80% statistical power were assumed. The minimum required sample size was 72 participants. To compensate for an anticipated 10% attrition rate, the sample size was increased to 80 participants, with 40 participants allocated to each study group.

Randomization and blinding

Participants were randomly allocated to the intervention or control group using a computer-generated block randomization sequence with a block size of four. Allocation concealment was maintained using sequentially numbered, opaque, sealed envelopes prepared by an independent investigator who was not involved in participant recruitment or outcome assessment. Owing to the nature of the intervention, blinding of participants and therapists was not feasible. However, outcome assessors and the statistician were blinded to treatment allocation.

Intervention

Participants allocated to the intervention group received a 12-week comprehensive multidisciplinary rehabilitation program in addition to routine postoperative care. The rehabilitation program was delivered by a multidisciplinary team comprising an oral and maxillofacial surgeon, speech and language therapist, physiotherapist, dietitian, and clinical psychologist.

The program consisted of supervised 60-minute sessions conducted once weekly, together with daily home-based exercises. Rehabilitation components included speech and swallowing therapy, jaw-opening and mandibular mobility exercises, nutritional assessment with individualized dietary counseling, physical therapy focusing on neck and shoulder mobility, oral hygiene education, and psychosocial counseling. Home exercise compliance was monitored during each follow-up visit.

Control group

Participants assigned to the control group received routine postoperative follow-up care, including regular clinical assessment, standard medical advice, nutritional recommendations, and symptom-based management, but did not participate in the structured multidisciplinary rehabilitation program.

Outcome measures

The primary outcome was the change in health-related quality of life (HRQoL) following completion of the rehabilitation program.

HRQoL was assessed using the validated European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire-Core 30 (EORTC QLQ-C30) and the EORTC Head and Neck Cancer Module (QLQ-H&N35) [12,13]. Questionnaire scoring was performed according to the EORTC Scoring Manual. The instruments evaluated global health status, physical, role, emotional, cognitive, and social functioning, together with head and neck cancer-specific symptoms, including pain, swallowing difficulties, speech problems, xerostomia, and taste impairment.

Secondary outcome measures included mouth opening (maximum inter-incisal distance, mm), body weight (kg), nutritional status, rehabilitation adherence, patient satisfaction, and adverse events. All assessments were performed at baseline and immediately after completion of the 12-week rehabilitation program.

Data collection

Baseline demographic and clinicopathological characteristics, including age, sex, body mass index (BMI), smoking history, alcohol consumption, primary tumor site, AJCC stage, treatment modality, and time since completion of treatment, were recorded using a standardized case record form. Clinical and questionnaire assessments were performed by trained investigators who were independent of the rehabilitation team.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Data normality was assessed using the Shapiro–Wilk test. Continuous variables were expressed as mean ± standard deviation (SD), whereas categorical variables were presented as frequencies and percentages.

Baseline characteristics between groups were compared using the independent-samplest-test for continuous variables and the chi-square test or Fisher's exact test for categorical variables. Within-group changes from baseline to post-intervention were analyzed using the paired-samples t-test. Between-group differences in outcome changes were assessed using the independent-samples t-test, and mean differences with 95% confidence intervals (CI) were calculated where appropriate. All statistical tests were two-sided, and a p-value <0.05 was considered statistically significant.

Ethical considerations

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board of Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. Written informed consent was obtained from all participants before enrollment. Participant confidentiality and anonymity were maintained throughout the study.

Results

Table 1 summarizes the baseline demographic and clinicopathological characteristics of the study participants. The intervention and control groups were comparable with respect to age, sex, body mass index, smoking status, alcohol consumption, primary tumor site, AJCC stage, treatment modality, and time since completion of treatment, with no statistically significant differences observed between the groups (all $p> 0.05$). These findings indicate that the two groups were well balanced at baseline.

Table 1: Baseline demographic and clinicopathological characteristics of participants in the intervention and control groups

Characteristic	Intervention (n = 40)	Control (n = 40)	p-value
Age (years), mean ± SD	54.1 ± 9.6	53.4 ± 10.2	0.748
Sex, n (%)			0.816
Male	29 (72.5)	28 (70.0)	
Female	11 (27.5)	12 (30.0)	
BMI (kg/m^2), mean ± SD	23.6 ± 3.2	23.3 ± 3.5	0.682
Smoking history, n (%)			0.821
Current/Former smoker	26 (65.0)	25 (62.5)	
Never smoker	14 (35.0)	15 (37.5)	
Alcohol consumption, n (%)			0.641
Yes	13 (32.5)	11 (27.5)	
No	27 (67.5)	29 (72.5)	
Primary tumor site, n (%)			0.934
Buccal mucosa	18 (45.0)	17 (42.5)	
Tongue	12 (30.0)	13 (32.5)	
Floor of mouth	6 (15.0)	6 (15.0)	
Gingiva/Alveolus	4 (10.0)	4 (10.0)	
AJCC stage, n (%)			0.884
Stage II	9 (22.5)	10 (25.0)	
Stage III	18 (45.0)	17 (42.5)	
Stage IV	13 (32.5)	13 (32.5)	
Treatment modality, n (%)			0.917
Surgery only	8 (20.0)	7 (17.5)	
Surgery + Radiotherapy	20 (50.0)	21 (52.5)	
Surgery + Chemoradiotherapy	12 (30.0)	12 (30.0)	
Time since completion of treatment (months), mean ± SD	8.9 ± 2.7	9.2 ± 2.9	0.635

Values are presented as mean ± standard deviation (SD) or number (%). Continuous variables were compared using the independent-samples t-test, and categorical variables using the chi-square test or Fisher's exact test, as appropriate. P< 0.05 was considered statistically significant.

BMI, body mass index; AJCC, American Joint Committee on Cancer; SD, standard deviation.

Table 2 presents the baseline quality-of-life (QoL) scores of participants assessed using the EORTC QLQ-C30 and EORTC QLQ-H&N35 questionnaires. Baseline global health status and all functional domains, including physical, role, emotional, cognitive, and social functioning, were comparable between the intervention and control groups (all p > 0.05). Similarly, no significant differences were observed in symptom domains, including pain, swallowing, speech, dry mouth, and taste problems, indicating that both groups had similar quality-of-life status before initiation of the multidisciplinary rehabilitation program.

Table 2: Baseline quality-of-life scores of participants measured using the EORTC QLQ-C30 and EORTC

QoL Domain	Intervention (n = 40) Mean ± SD	Control (n = 40) Mean ± SD	p-value
Global health status	61.8 ± 11.2	60.5 ± 10.8	0.602
Physical functioning	73.4 ± 12.5	72.1 ± 11.9	0.638
Role functioning	69.2 ± 13.6	68.0 ± 14.2	0.701
Emotional functioning	66.5 ± 11.8	65.2 ± 12.1	0.627
Cognitive functioning	79.3 ± 10.5	78.5 ± 11.0	0.741
Social functioning	71.0 ± 12.7	69.8 ± 13.2	0.680
Pain*	38.5 ± 16.3	39.7 ± 15.9	0.736
Swallowing*	42.8 ± 18.1	44.1 ± 17.6	0.744
Speech*	35.4 ± 15.2	36.6 ± 14.9	0.718
Dry mouth*	46.9 ± 19.4	48.1 ± 18.8	0.776
Taste problems*	40.7 ± 17.8	42.3 ± 18.5	

Values are presented as mean ± SD. Higher EORTC QLQ-C30 functional scores indicate better functioning, whereas higher EORTC QLQ-H&N35 symptom scores indicate greater symptom burden. P< 0.05 was considered statistically significant.

QoL, quality of life; SD, standard deviation; EORTC, European Organisation for Research and Treatment of Cancer; QLQ-C30, Quality of Life Questionnaire-Core 30; QLQ-H&N35, Head and Neck Cancer Module.

Table 3 compares quality-of-life and functional outcomes before and after the multidisciplinary rehabilitation programme. The intervention group showed significantly greater improvement in global QoL than the control group (61.8 ± 11.2 to 75.6 ± 10.4 vs. 60.5 ± 10.8 to 64.2 ± 11.1; $p < 0.001$). Significant reductions were also observed in swallowing (42.8 ± 18.1 to 24.6 ± 15.3 vs. 44.1 ± 17.6 to 38.7 ± 16.9; $p < 0.001$), speech (35.4 ± 15.2 to 21.8 ± 13.7 vs. 36.6 ± 14.9 to 32.5 ± 14.3; $p = 0.002$), and pain scores (38.5 ± 16.3 to 23.9 ± 14.1 vs. 39.7 ± 15.9 to 34.8 ± 15.2; $p = 0.004$). In addition, the intervention group showed greater improvement in mouth opening (28.6 ± 6.4 to 35.2 ± 6.1 mm vs. 28.9 ± 6.7 to 30.4 ± 6.5 mm; $p = 0.006$) and body weight (55.8 ± 8.9 to 58.4 ± 8.6 kg vs. 56.2 ± 9.1 to 56.8 ± 8.8 kg; $p = 0.031$) than the control group.

Table 3: Comparison of quality-of-life and functional outcomes before and after the multidisciplinary rehabilitation program

Outcome	Intervention Baseline	Intervention Post	Control Baseline	Control Post	p-value
Global QoL score	61.8 ± 11.2	75.6 ± 10.4	60.5 ± 10.8	64.2 ± 11.1	<0.001
Swallowing score *	42.8 ± 18.1	24.6 ± 15.3	44.1 ± 17.6	38.7 ± 16.9	<0.001
Speech score *	35.4 ± 15.2	21.8 ± 13.7	36.6 ± 14.9	32.5 ± 14.3	0.002
Pain score*	38.5 ± 16.3	23.9 ± 14.1	39.7 ± 15.9	34.8 ± 15.2	0.004
Mouth opening (mm)	28.6 ± 6.4	35.2 ± 6.1	28.9 ± 6.7	30.4 ± 6.5	0.006
Weight (kg)	55.8 ± 8.9	58.4 ± 8.6	56.2 ± 9.1	56.8 ± 8.8	0.031

Values are presented as mean ± SD. Lower scores for swallowing, speech, and pain indicate improvement, whereas higher QoL, mouth opening, and weight indicate better outcomes. QoL, quality of life; SD, standard deviation.

Table 4 shows the mean changes in functional and psychological outcomes following the multidisciplinary rehabilitation program. Compared with the control group, the intervention group demonstrated significantly greater improvements in Global QoL (+13.8 ± 6.2 vs. +3.7 ± 5.5; mean difference [MD]: 10.1, 95% CI: 7.5–12.7; $p < 0.001$), physical function (MD: 8.7, 95% CI: 5.8–11.6; $p < 0.001$), and emotional function (MD: 7.7, 95% CI: 4.9–10.5; $p < 0.001$). Significant reductions in swallowing (MD: −12.8, 95% CI: −16.3 to −9.3; $p < 0.001$) and speech impairment (MD: −9.5, 95% CI: −12.5 to −6.5; $p < 0.001$) were also observed, along with greater improvement in nutritional status (MD: 2.0, 95% CI: 1.4–2.6; $p < 0.001$).

Table 4: Mean changes in functional and psychological outcomes following the multidisciplinary rehabilitation program

Variable	Intervention Mean Change (Mean ± SD)	Control Mean Change (Mean ± SD)	Mean Difference (95% CI)	p-value
Global QoL	+13.8 ± 6.2	+3.7 ± 5.5	10.1 (7.5 to 12.7)	<0.001
Physical function	+11.5 ± 7.0	+2.8 ± 6.1	8.7 (5.8 to 11.6)	<0.001
Emotional function	+10.2 ± 6.8	+2.5 ± 5.9	7.7 (4.9 to 10.5)	<0.001
Swallowing*	−18.2 ± 8.4	−5.4 ± 7.6	−12.8 (−16.3 to −9.3)	<0.001
Speech *	−13.6 ± 7.2	−4.1 ± 6.4	−9.5 (−12.5 to −6.5)	<0.001
Nutritional status†	+2.8 ± 1.5	+0.8 ± 1.2	2.0 (1.4 to 2.6)	<0.001

Values are presented as mean change ± SD. MD, mean difference; CI, confidence interval; QoL, quality of life; SD, standard deviation. Negative values indicate symptom improvement.

Table 5 summarizes compliance, safety, and patient satisfaction following the rehabilitation program. The intervention group demonstrated significantly higher rehabilitation adherence (91.4 ± 6.8% vs. 74.8 ± 10.9%; $p < 0.001$) and patient satisfaction (9.2 ± 0.7 vs. 7.4 ± 1.1; $p < 0.001$), with fewer missed sessions (1.8 ± 1.2 vs. 4.6 ± 2.1; $p < 0.001$) than the control group. Study completion rates (92.5% vs. 90.0%; $p = 0.692$) and the incidence of adverse events (7.5% vs. 12.5%; $p = 0.456$) and serious adverse events (0% vs. 2.5%; $p = 0.314$) were comparable between the groups, indicating good compliance and a favorable safety profile of the multidisciplinary rehabilitation program.

Table 5: Compliance, safety, and patient satisfaction following the rehabilitation program

Variable	Intervention (n = 40)	Control (n = 40)	p-value
Completed study, n (%)	37 (92.5%)	36 (90.0%)	0.692
Rehabilitation adherence (%), mean ± SD	91.4 ± 6.8	74.8 ± 10.9*	<0.001
Missed sessions, mean ± SD	1.8 ± 1.2	4.6 ± 2.1*	<0.001
Patient satisfaction score (0 – 10), mean ± SD	9.2 ± 0.7	7.4 ± 1.1	<0.001
Any adverse events, n (%)	3 (7.5%)	5 (12.5%)	0.456
Serious adverse events, n (%)	0 (0%)	1 (2.5%)	0.314

Values are presented as mean ± SD or n (%). SD, standard deviation. Higher adherence and satisfaction scores indicate better outcomes. P < 0.05 was considered statistically significant.

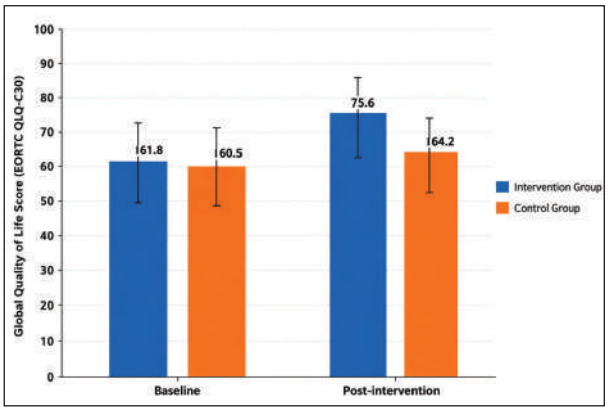

Figure 1: Changes in global quality-of-life scores before and after the multidisciplinary rehabilitation program in the intervention and control groups.

Figure 1 illustrates the changes in Global Quality of Life (QoL) scores before and after the multidisciplinary rehabilitation program. Both groups showed improvement following the intervention; however, the intervention group demonstrated a markedly greater increase in Global QoL than the control group (61.8 to 75.6 vs. 60.5 to 64.2). This finding indicates that the multidisciplinary rehabilitation program significantly improved overall quality of life compared with standard care (p < 0.001).

Discussion

The present randomized controlled trial demonstrated that a structured multidisciplinary rehabilitation program significantly improved health-related quality of life (HRQoL) and functional outcomes among oral cancer survivors compared with routine postoperative care. Participants in the intervention group showed significantly greater improvement in global QoL than controls (+13.8 ± 6.2 vs. +3.7 ± 5.5; MD: 10.1, 95% CI: 7.5–12.7; p< 0.001), together with better swallowing, speech, pain control, mouth opening, nutritional status, body weight, rehabilitation adherence, and patient satisfaction. These findings support the role of coordinated multidisciplinary rehabilitation as an essential component of oral cancer survivorship care [14,15].

Baseline demographic, clinicopathological, treatment-related, and HRQoL characteristics were comparable between the two groups, indicating successful randomization. Therefore, the post-intervention differences are likely attributable to the rehabilitation program rather than baseline imbalance. This methodological strength is particularly important because previous rehabilitation studies have often been limited by heterogeneous study populations and non-randomized designs [16,17].

The most important finding was the clinically meaningful improvement in global QoL. The intervention group improved from 61.8 ± 11.2 to 75.6 ± 10.4, whereas the control group improved only modestly from 60.5 ± 10.8 to 64.2 ± 11.1 (p< 0.001). The 13.8-point improvement in global QoL exceeds the threshold generally considered clinically meaningful for EORTC quality-of-life instruments [18-19]. Similar improvements in functional recovery and quality-of-life domains have been reported following multidisciplinary rehabilitation among head and neck cancer survivors [20].

Swallowing function also improved substantially after rehabilitation. Swallowing scores decreased from 42.8 ± 18.1 to 24.6 ± 15.3 in the intervention group compared with 44.1 ± 17.6 to 38.7 ± 16.9 in controls (MD: −12.8, 95% CI: −16.3 to −9.3; p< 0.001). This finding is consistent with randomized trials showing that structured swallowing exercises improve swallowing function in patients treated for head and neck cancer [21-22]. Logemann et al. also demonstrated that early postoperative swallowing exercises improve long-term swallowing outcomes following head and neck cancer surgery [23]. The improvement observed in the present study may be

explained by the combined effect of supervised swallowing therapy, home-based exercises, nutritional counseling, and pain reduction.

Speech function improved significantly in the rehabilitation group. Speech scores decreased from 35.4 ± 15.2 to 21.8 ± 13.7 compared with 36.6 ± 14.9 to 32.5 ± 14.3 in the control group (MD: −9.5, 95% CI: −12.5 to −6.5; p< 0.001). This finding agrees with previous studies demonstrating that structured speech rehabilitation improves communication and swallowing outcomes after oral cancer surgery [24,25]. Improved speech likely contributed to enhanced emotional well-being and social participation, which are important determinants of overall HRQoL.

Pain and mouth opening also improved significantly. Pain scores decreased from 38.5 ± 16.3 to 23.9 ± 14.1 in the intervention group, compared with 39.7 ± 15.9 to 34.8 ± 15.2 in controls (p = 0.004). Mouth opening increased from 28.6 ± 6.4 mm to 35.2 ± 6.1 mm in the intervention group, compared with 28.9 ± 6.7 mm to 30.4 ± 6.5 mm in the control group (p = 0.006). These findings are consistent with previous studies demonstrating that jaw-opening exercises and physiotherapy improve trismus and oral function after head and neck cancer treatment [26,27]. Exercise-based rehabilitation has also been shown to reduce pain and improve functional recovery in this patient population [28].

Nutritional recovery was another important benefit. Nutritional status improved more in the intervention group than in controls (+2.8 ± 1.5 vs. +0.8 ± 1.2; MD: 2.0, 95% CI: 1.4–2.6; p< 0.001). Body weight also increased significantly in the intervention group, from 55.8 ± 8.9 kg to 58.4 ± 8.6 kg, compared with 56.2 ± 9.1 kg to 56.8 ± 8.8 kg in the control group (p = 0.031). These findings are biologically plausible because improved swallowing, reduced pain, and individualized dietary counseling can enhance oral intake and nutritional recovery. Similar observations have been reported in the NUTRI-HAB randomized controlled trial [20]. Furthermore, oral functional impairment and dysphagia have been shown to be major contributors to malnutrition following oral cancer treatment [29,30].

The intervention was also feasible and safe. Rehabilitation adherence was significantly higher in the intervention group than in the control group (91.4 ± 6.8% vs. 74.8 ± 10.9%; p< 0.001), missed sessions were fewer (1.8 ± 1.2 vs. 4.6 ± 2.1; p< 0.001), and patient satisfaction was higher (9.2 ± 0.7 vs. 7.4 ± 1.1; p< 0.001). Importantly, adverse events and serious adverse events did not differ significantly between groups, indicating that the structured rehabilitation program was well tolerated. These findings are consistent with recommendations emphasizing multidisciplinary management as the safest and most effective approach to managing treatment-related complications in head and neck cancer survivors [31, 14].

These findings have important implications for Bangladesh and other low- and middle-income countries, where oral cancer burden is high but structured rehabilitation services remain limited. Survivorship care often focuses on oncological follow-up, while functional rehabilitation receives less attention. The present study suggests that a coordinated rehabilitation model addressing swallowing, speech, nutrition, pain, physical function, and psychosocial support can improve recovery and quality of life in this population. Given the increasing incidence of oral cancer in South Asia and other resource-limited regions, integrating multidisciplinary rehabilitation into routine survivorship care may substantially reduce long-term disability and improve patient outcomes [32-34].

Strengths and Limitations: This study has several strengths, including its randomized controlled design, balanced baseline characteristics, use of validated EORTC QoL instruments, and assessment of multiple clinically relevant outcomes. However, some limitations should be noted. This was a single-center study with a modest sample size, which may limit generalizability. The follow-up period was limited to 12 weeks; therefore, the long-term durability of the observed benefits remains uncertain. Blinding of participants and therapists was not feasible because of the nature of the intervention. In addition, objective instrumental assessments of swallowing and speech were not performed.

Future multicenter randomized trials with larger sample sizes and longer follow-up are needed to confirm these findings. Further studies should also evaluate cost-effectiveness, optimal rehabilitation intensity, timing of intervention, and the feasibility of tele-rehabilitation models in resource-limited settings.

Conclusion

This randomized controlled trial demonstrated that a structured multidisciplinary rehabilitation program significantly improved HRQoL, swallowing, speech, pain, mouth opening, nutritional status, body weight, adherence, and patient satisfaction among oral cancer survivors compared with routine postoperative care. The intervention was safe, feasible, and clinically beneficial. These findings support the integration of multidisciplinary rehabilitation into standard oral cancer survivorship care, particularly in resource-limited settings such as Bangladesh.

Authors' Contributions

All authors contributed to the conception and design of the study. Data collection, analysis, and interpretation were performed by the authors. The manuscript was drafted, critically revised, and approved by all authors. All authors agree to be accountable for all aspects of the work.

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The authors declare that they have no competing interests or conflicts of interest related to this study.

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References
1. Lucky JS, Islam MZ. Smokeless tobacco consumption and oral cancer: a case-control study. J Prev Soc Med. 2025;43(1). doi:10.3329/jopsom.v43i1.82421.

2. Hossain MS, Akhter M, Azam S. Association between smokeless tobacco uses and oral cancer. ARC J Dent Sci.2020;5(3):17-21. doi:10.20431/2456-0030.0503005.

3. Warnakulasuriya S, Miranda-Filho A. Oral cancer in the South and South-East Asia region, 2022: incidence and mortality. Oral Dis. 2025;31(5):1398-1405. doi:10.1111/odi.15369.

4. Morioka R, Nakayama M, Matsuda Y, et al. Oral functional impairment may cause malnutrition following oral cancer treatment in a single-center cross-sectional study. Sci Rep. 2022;12(1):14787. doi:10.1038/s41598-022-19177-6.

5. Parke SC, Langelier DM, Cheng JT, Kline-Quiroz C, Stubblefield MD. State of rehabilitation research in the head and neck cancer population: functional impact vs. impairment-focused outcomes. Current Oncology Reports. 2022 Apr;24(4):517-32.

6. Kristensen MB, Primdahl H, et al. Effects of a multidisciplinary residential nutritional rehabilitation program in head and neck cancer survivors: results from the NUTRI-HAB randomized controlled trial. Nutrients. 2020;12(7):2117. doi:10.3390/nu12072117.

7. Hajdú SF, Wessel I, et al. Swallowing exercise during head and neck cancer treatment: results of a randomized trial. Dysphagia. 2022;37(4):749-762.-doi:10.1007/s00455-021-10320-5.

8. Cheng JT, Ramos Emos M, Leite V, Capozzi L, Woodrow LE, Gutierrez C, et al. Rehabilitation interventions in head and neck cancer. Am J Phys Med Rehabil. 2024;103(3 Suppl 1):S62-S71. doi:10.1097/PHM.0000000000002384.

9. Anwar SL, Adistyawan G, Wulaningsih W, Gutenbrunner C, Nugraha B. Rehabilitation for cancer survivors. Am J Phys Med Rehabil. 2018;97(10):764-771. doi:10.1097/PHM.0000000000000982.

10. Shahjalal M, Rahman MM, et al. Assessing health-related quality of life among cancer survivors during systemic and radiation therapy in Bangladesh: a cancer-specific exploration. BMC Cancer. 2023;23(1):1208. doi:10.1186/s12885-023-11670-z.

11. Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. Behavior research methods. 2009 Nov;41(4):1149-60.

12. Aaronson NK, Ahmedzai S, Bergman B, Bullinger M, Cull A, Duez NJ, Filiberti A, Flechtner H, Fleishman SB, Haes JC, Kaasa S. The European Organization for Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. JNCI: Journal of the National Cancer Institute. 1993 Mar 3;85(5):365-76.

13. Bjordal K, Ahlner-Elmqvist M, Tollesson E, Jensen AB, Razavi D, Maher EJ, Kaasa S. Development of a European Organization for Research and Treatment of Cancer (EORTC) questionnaire module to be used in quality of life assessments in head and neck cancer patients. Acta Oncologica. 1994 Jan 1;33(8):879-85.

14. Cohen EEW, LaMonte SJ, Erb NL, Beckman KL, Sadeghi N, Hutcheson KA, et al. American Cancer Society head and neck cancer survivorship care guideline. CA Cancer J Clin. 2016;66(3):203-39. doi:10.3322/caac.21343.

15. Taberna M, Gil Moncayo F, Jané-Salas E, Antonio M, Arribas L, Vilajosana E, et al. The multidisciplinary team (MDT) approach and quality of care. Front Oncol. 2020;10:85. doi:10.3389/fonc.2020.00085.

16. Rodríguez AM, Dunne S, Quinn G, Wiseman T. A scoping review of rehabilitation interventions for survivors of head and neck cancer. Disabil Rehabil. 2019;41(17):2093-107. doi:10.1080/09638288.2018.1459880.

17. Ihara Y, Fujimoto Y, Hasegawa Y, Saito Y, Takahashi M, Haraguchi M, et al. Changes in oral function, swallowing function, and quality of life in patients with head and neck cancer: A prospective cohort study. BMC Oral Health. 2022;22:293. doi:10.1186/s12903-022-02329-5.

18. Musoro JZ, Coens C, Greimel E, King MT, Sprangers MAG, Groenvold M, et al. Minimally important differences for interpreting European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire Core 30 scores in patients with head and neck cancer. Head Neck. 2020;42(11):3141-52. doi:10.1002/hed.26363.

19. Kyrgidis A, et al. Minimal clinically important differenc

es in the Cancer Quality of Life Questionnaires in patients with head and neck cancer. Clin Pract (Basel). 2024;14(6):2329-40. doi:10.3390/clinpract14060182.

20. Kristensen MB, Primdahl H, Johansen J, Andersen E, Andersen LJ, Pedersen JL, et al. Effects of a multidisciplinary residential nutritional rehabilitation program in head and neck cancer survivors: Results from the NUTRI-HAB randomized controlled trial. Nutrients. 2020;12(7):2117. doi:10.3390/nu12072117.

21. Hajdú SF, Wessel I, Stubblefield MD, et al. Swallowing exercise during head and neck cancer treatment: Results of a randomized trial. Dysphagia. 2022;37(4):749-62. doi:10.1007/s00455-021-10320-5.

22. Hsiang CC, Tsai MH, Wang TG, et al. Early postoperative oral exercise improves swallowing function among patients with oral cavity cancer: A randomized controlled trial. Ear Nose Throat J. 2019;98(6):E73-E80. doi:10.1177/0145561319839822.

23. Logemann JA, Pauloski BR, Rademaker AW, Colangelo LA, Kahrilas PJ, Smith CH. Speech and swallowing rehabilitation for head and neck cancer patients. Oncology (Williston Park). 1997;11(5):651-6.

24. Balbinot J, Mantovani K, de Campos RJDS, et al. Quality of life in tongue cancer treated patients before and after speech therapy: A randomized clinical trial. Braz J Otorhinolaryngol. 2022;88(4):491-6. doi:10.1016/j.bjorl.2020.10.005.

25. Jain SK, Kumar S, Sharma N, et al. Post-operative speech and swallowing in partial glossectomy patients: Role of effective rehabilitation. Int J Otorhinolaryngol Head Neck Surg. 2018;4(6):1473-7. doi:10.18203/issn.2454-5929.ijohns20184362.

26. Karlsson O, et al. Jaw exercise therapy for the treatment of trismus in head and neck cancer: A prospective three-year follow-up study. Support Care Cancer. 2021;29(7):3793-800. doi:10.1007/s00520-020-05517-7.

27. Pauli N, Johnson J, Finizia C, Andréll P. Exercise intervention for the treatment of trismus in head and neck cancer. Acta Oncol. 2014;53(4):502-9. doi:10.3109/0284186X.2013.837583.

28. Pérez IMM, Capozzi LC, McNeely ML, et al. Exercise-based rehabilitation on functionality and quality of life in head and neck cancer survivors: A systematic review and meta-analysis. Sci Rep. 2023;13:8523. doi:10.1038/s41598-023-35503-y.

29. Cristofaro MG, et al. The health risks of dysphagia for patients with head and neck cancer: A multicentre prospective observational study. J Transl Med. 2021;19:472. doi:10.1186/s12967-021-03144-2.

30. Gellrich NC, Handschel J, Holtmann H, et al. Oral cancer malnutrition impacts weight and quality of life. Nutrients. 2015;7(4):2145-60. doi:10.3390/nu7042145.

31. Epstein JB, Thariat J, Bensadoun RJ, Barasch A, Murphy BA, Kolnick L, et al. Oral complications of cancer and cancer therapy: From cancer treatment to survivorship. CA Cancer J Clin. 2012;62(6):400-22. doi:10.3322/caac.21157.

32. Gupta N, Gupta R, Acharya AK, Patthi B, Goud V, Reddy S, et al. Changing trends in oral cancer: A global scenario. Nepal J Epidemiol. 2016;6(4):613-9. doi:10.3126/nje.v6i4.17255.

33. Shield KD, Ferlay J, Jemal A, Sankaranarayanan R, Chaturvedi AK, Bray F, et al. The global incidence of lip, oral cavity, and pharyngeal cancers by subsite in 2012. CA Cancer J Clin. 2017;67(1):51-64. doi:10.3322/caac.21384.

34. Du M, Nair R, Jamieson L, Liu Z, Bi P. Incidence trends of lip, oral cavity, and pharyngeal cancers: Global Burden of Disease 1990-2017. J Dent Res. 2020;99(2):143-51. doi:10.1177/0022034519894963.