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Evaluation of Oral Health–Related Quality of Life and Anxiety Levels in Patients with Minor Recurrent Aphthous Stomatitis During Active and Inactive Phases

Meltem Koray[1], Duygu Ofluoglu[1], Hakkı Tanyeri[2]

[1]Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, İstanbul University, İstanbul, Türkiye
[2]Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, İstanbul Kent University, İstanbul, Türkiye

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Abstract

Background: This study aimed to evaluate oral health–related quality of life (OHQoL) and anxiety levels in patients with minor recurrent aphthous stomatitis (RAS) during the active and inactive phases.

Methods: This cross-sectional study included 150 participants: 50 patients with active RAS, 50 patients with inactive RAS, and 50 healthy controls. Pain intensity was assessed using the Visual Analog Scale (VAS). Anxiety was measured using the State–Trait Anxiety Inventory (STAI). Oral health–related quality of life was evaluated using the Oral Health Impact Profile-14 (OHIP-14) and the OHQoL questionnaire. General quality of life was assessed using the Short Form-36 Health Survey (SF-36). Correlation analyses examined associations between pain, anxiety, and quality-of-life measures.

Results: Pain intensity was significantly higher in patients with active RAS (VAS: 7.72 ± 0.57) than in inactive RAS patients and healthy controls. Anxiety levels were also higher in the active RAS group (state anxiety [STAI-S]: 60.5 ± 8.7; trait anxiety [STAI-T]: 49.3 ± 6.6) than in inactive RAS patients (STAI-S: 53.3 ± 1.2; STAI-T: 42.6 ± 7.7) and healthy controls (STAI-S: 52.2 ± 7.8; STAI-T: 42.9 ± 5.9). Active RAS patients had higher OHIP-14 scores (35.2 ± 8.7), lower OHQoL scores (36.7 ± 7.8), and poorer SF-36 scores than the other groups. Correlation analysis showed a positive association between pain severity and trait anxiety ($r = 0.20$) and a negative association between pain severity and OHQoL ($r = -0.50$).

Conclusion: Active RAS is associated with increased pain, elevated anxiety, and impaired oral and general quality of life. These findings highlight the importance of integrating psychological assessment into comprehensive RAS management and improving patient-centered care.

Keywords: Anxiety, OHIP-14, oral health-related quality of life, recurrent aphthous stomatitis, state, trait anxiety inventory

What is already known on this topic?

- *Minor recurrent aphthous stomatitis (RAS) is a recurrent and painful oral mucosal disease that may interfere with eating, speaking, oral hygiene, and daily comfort.*
- *Previous studies have shown that RAS can impair oral health–related quality of life and may be associated with psychological factors such as anxiety and stress.*

What does this study add on this topic?

- *This study shows that patients with active minor RAS have higher pain and anxiety scores and poorer oral and general quality-of-life outcomes than inactive patients and healthy controls.*
- *The findings indicate that the active ulcerative phase is the main period in which disease burden becomes clinically evident, supporting management strategies that address pain, quality of life, and psychological well-being together.*

INTRODUCTION

Recurrent aphthous stomatitis (RAS) is one of the most common inflammatory conditions affecting the oral mucosa, characterized by recurrent, painful ulcerations that can significantly interfere with daily oral functions.[1,2] Minor RAS represents the most prevalent clinical form, accounting for the majority of RAS cases. Although the exact etiology of RAS remains unclear, several contributing factors have been proposed, including

Corresponding author: Meltem Koray
e-mail: mkoray@istanbul.edu.tr

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genetic predisposition, immune dysregulation, nutritional deficiencies, hormonal influences, microbial factors, and psychological stress.[3,4] The recurrent and painful nature of these lesions often leads to substantial discomfort and may negatively affect patients' daily activities.

Pain associated with minor RAS can interfere with essential oral functions such as eating, drinking, speaking, and maintaining oral hygiene.[5] Consequently, the disease may significantly impair oral health–related quality of life (OHRQoL).[6] Oral health–related quality of life is an important multidimensional concept that reflects the impact of oral conditions on an individual's physical, psychological, and social well-being. Previous studies have shown that painful oral mucosal lesions, including RAS, can lead to limitations in daily functioning and social interactions, thereby reducing overall quality of life.[7]

In addition to the physical burden, psychological factors have been increasingly recognized as important components in the development and exacerbation of RAS. Anxiety and emotional stress have been suggested both as potential triggering factors and as consequences of recurrent painful oral lesions.[8] Patients experiencing frequent or severe ulcerative episodes may develop heightened psychological distress due to the unpredictability of the condition and the recurrent discomfort it causes.[9] Therefore, the relationship between RAS and psychological parameters such as anxiety has become an important area of investigation.

The clinical course of minor RAS is characterized by alternating periods of active ulceration and remission.[10] During the active phase, patients experience painful ulcers and functional limitations, whereas the inactive phase is generally symptom-free. Despite this cyclical pattern, limited research has directly compared psychological status and oral health-related quality of life between active and inactive periods in the same patient population.[11] Understanding these differences may provide valuable insights into the broader impact of the disease and contribute to more comprehensive patient management strategies. Therefore, the aim of the present study was to evaluate oral health-related quality of life and anxiety levels in patients with minor RAS and to compare these parameters between the active and inactive phases of the disease.

MATERIALS AND METHODS

Study Design and Ethical Approval

This study was designed as a cross-sectional investigation and was carried out in the Department of Oral and Maxillofacial Diseases and Surgery, Faculty of Dentistry, İstanbul University. Ethical approval was obtained from the Local Ethics Committee of İstanbul University Faculty of Medicine on May 23, 2007, before data collection began (Approval number: 2007/1118). The research process followed the ethical standards of the Declaration of Helsinki. All participants, including both patients and healthy controls, were informed about the purpose and procedures of the study, and written informed consent was obtained before enrollment.

Study Population

Patients admitted to the Department of Oral and Maxillofacial Surgery clinic with a clinical diagnosis of minor RAS were considered for inclusion. Diagnosis was based on oral examination findings and patient history, in accordance with previously accepted diagnostic criteria.[12] In total, 100 patients with minor RAS were included. Disease activity was determined according to the presence or absence of aphthous ulcer episodes during the preceding month. Patients who reported at least 1 RAS episode within this 1-month period were assigned to the active RAS group, while those without any episodes during the same interval were assigned to the inactive RAS group. The control group consisted of 50 healthy individuals who had no history of RAS, systemic disease, or dental problems. These participants were recruited from individuals accompanying patients at the same clinic. For each participant, demographic and clinical information was collected using a standardized patient follow-up form. Recorded variables included age, sex, systemic disease status, occupation, educational level, marital status, smoking and alcohol use, pain score, number of ulcers, and healing duration.

Inclusion and Exclusion Criteria

Patients were eligible for participation when the diagnosis of RAS was supported by both clinical examination and medical history. Participants also had to be able to read, understand the study questions, and complete the questionnaires without assistance. Written informed consent and willingness to take part in the study were required before any data were collected. Individuals were not included if they had a previously diagnosed psychiatric disorder or were receiving psychiatric treatment at the time of enrollment, since these factors could affect anxiety-related measurements. Participants who were unable to read or who lacked the cognitive capacity to complete the questionnaires independently were also excluded. Pregnant women were not enrolled because pregnancy-related physiological and psychological changes could act as confounding factors.

Assessment Tools

State–Trait Anxiety Inventory

Anxiety was measured using the Turkish version of the State–Trait Anxiety Inventory. The scale provides 2 separate scores: state anxiety (STAI-S), which reflects anxiety at the time of evaluation, and trait anxiety (STAI-T), which reflects the individual's general tendency toward anxiety. Each subscale contains 20 items scored on a 4-point response format. After reverse-coded items were adjusted, subscale scores were calculated. Scores range from 20 to 80, with higher values

indicating higher anxiety. The Turkish validation of the scale has previously been reported.[13]

Visual Analog Scale

Pain was quantified using a 10-cm Visual Analog Scale (VAS). Participants indicated their pain intensity on a horizontal line anchored by "no pain" at 1 end and the most severe imaginable pain at the other. The distance from the 0 point was recorded as the pain score. Scores of 0-3 cm were interpreted as no pain, scores between 3 and 7 cm as mild pain, and scores of 7 cm or above as severe pain.

Oral Health Impact Profile-14

The oral health impact profile-14 (OHIP-14) was used to assess the negative impact of oral health problems on daily life. It includes 14 items scored from 0 to 4, giving a total score between 0 and 56. Higher scores indicate a greater oral health–related burden. The Turkish version has been validated for clinical use.[14]

Oral Health–Related Quality of Life Questionnaire

The OHR-QoL questionnaire was used as an additional measure of perceived oral health status. The scale consists of 16 items scored from 1 to 5, with total scores ranging from 16 to 80. Lower scores indicate poorer oral quality of life. Its Turkish validation has been described previously.[15]

Short Form-36 Health Survey

General health status was evaluated with the short form-36 (SF-36). This instrument covers 8 domains: physical functioning, physical role limitation, bodily pain, general health, vitality, social functioning, emotional role limitation, and mental health. Each domain is scored from 0 to 100, with higher scores reflecting better health status. The Turkish version has been validated in earlier studies.[16,17] All questionnaires were completed independently by patients and controls.

Statistical Analysis

Analyses were performed in IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA). Continuous variables were checked for normal distribution using the Kolmogorov–Smirnov test and graphical methods. Numerical data are summarized as mean ± standard deviation, and categorical data as n (%). Three-group comparisons for continuous variables were carried out with 1-way analysis of variance (ANOVA), followed by Bonferroni correction when pairwise testing was required. Categorical variables were evaluated with the chi-square test. Pearson correlation analysis was used to examine associations between clinical variables and patient-reported outcomes. Statistical significance was set at $P < .05$.

RESULTS

The study included 150 participants, with 50 individuals in each group. Mean age was similar in the active RAS, inactive RAS, and control groups (38.8 ± 13.1, 37.7 ± 15.2, and 38.7 ± 12.9 years, respectively; $P = .837$). Sex distribution, education duration, and marital status were also comparable among the groups (Table 1).

Systemic disease was more common in the RAS group than in controls (34% vs. 2%; $P < .001$). Hypertension, diabetes mellitus, and rheumatoid arthritis were the most frequent systemic conditions. Occupation distribution and alcohol use were similar between groups, whereas smoking was less frequent among patients with RAS (7% vs. 24%; $P = .007$) (Table 2).

Pain scores were highest in the active RAS group ($P < .001$). Active RAS was also associated with higher STAI-S and STAI-T scores than inactive disease or healthy status ($P = .001$ and $P < .001$, respectively). Oral health–related quality of life was poorer during active disease, as reflected by higher OHIP-14 and lower OHQoL scores (both $P < .001$). Post hoc comparisons showed that inactive RAS patients and controls did not differ in anxiety scores (Table 3).

All SF-36 domains differed among the 3 groups (all $P < .001$). Patients with active RAS had the lowest scores in every domain, indicating poorer general health-related quality of life during active ulceration. Inactive RAS patients and controls showed similar SF-36 results in post hoc comparisons (Table 4).

Visual analog scale was weakly associated with STAI-T ($r = 0.20$, $P = .050$) and moderately inversely associated with OHQoL ($r = -0.50$, $P < .001$). Oral health impact profile-14 was positively associated with STAI-S, STAI-T, and ulcer count ($r = 0.30$, $r = 0.30$, and $r = 0.70$, respectively; all $P < .001$) (Table 5).

DISCUSSION

The findings of this study indicate that the active phase of RAS is associated with a clear deterioration in patient-reported outcomes. Patients with active lesions reported higher pain

Table 1. Demographic Characteristics of the Study Groups

Variable	Active RAS (n = 50)	Inactive RAS (n = 50)	Healthy Controls (n = 50)	*P*
Age, years	38.8 ± 13.1	37.7 ± 15.2	38.7 ± 12.9	.837
Sex, male/female	25/25	24/26	25/25	.974
Education, years	8.6 ± 3.8	9.4 ± 3.8	9.7 ± 4.4	.368
Marital status				
Married, n (%)	17 (34)	13 (26)	20 (40)	.521
Single, n (%)	31 (62)	34 (68)	26 (52)	
Divorced/widowed, n (%)	2 (4)	3 (6)	4 (8)	

Data are presented as mean ± SD or number (percentage). Differences between groups were analyzed using 1-way analysis of variance (ANOVA) for continuous variables and the chi-square test for categorical variables. A *P* value < .05 was considered statistically significant. Statistically significant *P* values are shown in bold.
RAS, recurrent aphthous stomatitis.

Table 2. Clinical and Lifestyle Characteristics of the Overall RAS Group and Healthy Controls

Variable	RAS Group (n = 100)	Healthy Controls (n = 50)	*P*
Systemic disease present, n (%)	34 (34)	1 (2)	**<.001**
Occupation			
Homemaker (%)	28 (28)	15 (30)	.555
Civil servant (%)	27 (27)	10 (20)	
Worker (%)	6 (6)	1 (2)	
Student (%)	17 (17)	7 (14)	
Retired (%)	10 (10)	7 (14)	
Self-employed (%)	12 (12)	10 (20)	
Smoking status			
Yes, n (%)	7 (7)	12 (24)	**.007**
No, n (%)	93 (93)	38 (76)	
Alcohol use			
Yes, n (%)	3 (3)	2 (4)	.584
No, n (%)	97 (97)	48 (96)	

Data are presented as number (percentage). Group comparisons were performed using the chi-square test.
RAS, recurrent aphthous stomatitis.
A *P* value < .05 was considered statistically significant. Statistically significant *P* values are shown in bold.

intensity and greater state and trait anxiety than both inactive RAS patients and healthy controls. They also had worse oral health-related quality-of-life scores, suggesting that active ulceration has a direct functional and psychological burden. The lower SF-36 scores observed across several domains further show that the effect of RAS is not limited to oral discomfort but may also extend to general physical, emotional, and social well-being. In contrast, the relatively similar results between inactive RAS patients and healthy controls suggest that the negative impact of the disease becomes most evident during ulcerative episodes. Therefore, RAS should be evaluated not only as a recurrent oral mucosal disorder but also as a condition with broader consequences for quality of life and psychological status.

Table 3. Comparison of Pain, Anxiety, and Oral Health-related Quality-of-Life Scores Among Groups

Outcome Measure	Active RAS (n = 50)	Inactive RAS (n = 50)	Healthy Controls (n = 50)	*P*
Pain (VAS)	7.72 ± 0.57	0.00 ± 0.00	0.00 ± 0.00	**<.001**
State anxiety (STAI-S)	60.5 ± 8.7	53.3 ± 1.2	52.2 ± 7.8	**.001**
Trait anxiety (STAI-T)	49.3 ± 6.6	42.6 ± 7.7	42.9 ± 5.9	**<.001**
OHIP-14	35.2 ± 8.7	12.4 ± 11.2	1.2 ± 3.7	**<.001**
OHQoL	36.7 ± 7.8	49.2 ± 5.5	64.4 ± 7.1	**<.001**

Data are presented as mean ± SD. Group comparisons were performed using 1-way analysis of variance (ANOVA). Post hoc pairwise comparisons using Bonferroni correction showed that patients with active RAS had significantly higher VAS, STAI-S, STAI-T, and OHIP-14 scores and significantly lower OHQoL scores compared with both inactive RAS patients and healthy controls ($P < .05$). No significant differences were observed between the inactive RAS and healthy control groups for STAI-S and STAI-T scores.
OHIP-14, oral health impact profile-14; OHQoL, oral health–related quality of life; RAS, recurrent aphthous stomatitis; STAI-S, state–trait anxiety inventory—state subscale; STAI-T, state–trait anxiety Inventory—trait subscale; VAS, visual analog scale.

Table 4. Comparison of SF-36 Subscale Scores Among Active RAS, Inactive RAS, and Healthy Controls

SF-36 Subscale	Active RAS (n = 50)	Inactive RAS (n = 50)	Healthy Controls (n = 50)	*P*
Physical functioning	60.8 ± 25.1	90.15 ± 22.8	96.2 ± 11.0	**<.001**
Role limitations due to physical problems	43.5 ± 48.5	96.0 ± 25.4	95.9 ± 17.2	**<.001**
Bodily pain	41.3 ± 10.6	86.2 ± 11.9	87.9 ± 8.3	**<.001**
General health	41.1 ± 8.8	60.8 ± 13.3	68.4 ± 13.4	**<.001**
Vitality	45.4 ± 9.9	64.7 ± 15.6	64.0 ± 13.1	**<.001**
Social functioning	59.5 ± 17.4	84.8 ± 16.8	93.7 ± 11.9	**<.001**
Role limitations due to emotional problems	48.0 ± 50.5	91.3 ± 32.2	92.5 ± 21.8	**<.001**
Mental health	46.9 ± 10.0	78.4 ± 41.5	67.0 ± 11.2	**<.001**

Data are presented as mean ± SD. Group comparisons were performed using 1-way analysis of variance (ANOVA). Post hoc Bonferroni analysis demonstrated that the active RAS group had significantly lower SF-36 scores across all domains compared with both inactive RAS patients and healthy controls.
RAS, recurrent aphthous stomatitis; SF-36, short form-36 health survey.
A *P* value < .05 was considered statistically significant. Statistically significant *P* values are shown in bold.

Evidence from earlier RAS research indicates that ulcer activity is closely related to deterioration in (OHQoL). Rivera et al[18] compared 33 patients with RAS and 29 healthy controls and assessed OHIP-14 scores during ulceration and remission. Their results showed that quality-of-life impairment was more evident during active ulcer episodes and was linked to lesion burden, particularly ulcer number and size. In another study, Ziaei et al[19] evaluated 100 dental students using the OHIP-14 and General Health Questionnaire-28 and reported poorer oral health-related quality-of-life scores among individuals with a history of RAS than among those without ulcers. The findings extend these observations by showing that the greatest impairment occurred in patients with active RAS, whereas inactive RAS patients

Table 5. Correlation Analysis Between Clinical and Patient-reported Outcomes in RAS Patients

Variables	Correlation Coefficient (*r*)	*P*	Interpretation
VAS vs. STAI-T	0.20	.050	Weak positive correlation
VAS vs. OHQoL	−0.50	**<.001**	Moderate negative correlation
OHIP-14 vs. STAI-S	0.30	**<.001**	Weak positive correlation
OHIP-14 vs. STAI-T	0.30	**<.001**	Weak positive correlation
OHIP-14 vs. ulcer count	0.70	**<.001**	Strong positive correlation

Correlation analyses were performed using Pearson correlation analysis. Correlation coefficients (*r*) and *P* values are presented.
OHIP-14, oral health impact profile-14; OHQoL, oral health–related quality of life; RAS, recurrent aphthous stomatitis; STAI-S, state–trait anxiety inventory—state subscale; STAI-T, state–trait anxiety Inventory—trait subscale; VAS, visual analog scale.
A *P* value < .05 was considered statistically significant. Statistically significant *P* values are shown in bold.

had scores closer to those of healthy controls. This pattern suggests that the patient-perceived burden of RAS is driven mainly by current disease activity rather than by the diagnosis alone.

The relationship between oral ulcer activity and quality of life has also been addressed in studies involving other oral mucosal conditions. Mumcu et al[14] assessed patients with Behçet's disease, patients with RAS, and healthy controls using OHIP-14, OHQoL, and SF-36 instruments. Their study population included 94 patients with Behçet's disease, 24 patients with RAS, and 113 controls. They found that the presence of active oral ulcers was associated with poorer oral and general health-related quality-of-life outcomes, suggesting that current lesion activity is an important determinant of patient well-being. Kürklü-Gürleyen et al[20] also examined symptom burden in 37 patients with RAS by measuring pain and oral health-related quality of life with VAS and OHIP-14 before and after treatment with a citrus essential oil-containing mucoadhesive patch. Following treatment, both pain intensity and OHIP-14 scores improved, indicating that symptom relief may translate into better oral quality of life. In line with these reports, the results showed that active RAS was characterized by higher pain scores and poorer oral health-related quality-of-life measures than inactive disease or healthy status. Taken together, these findings indicate that the impact of RAS on quality of life is strongly influenced by both active ulceration and pain severity.

Psychological status is another dimension that may shape the clinical burden experienced by patients with RAS. Öner et al[21] compared 70 patients with RAS with 70 age- and sex-matched controls and assessed quality of life and psychological symptoms using the Dermatology Life Quality Index and the Hospital Anxiety and Depression Scale. They found poorer quality-of-life outcomes in the RAS group, especially during active ulceration, although anxiety and depression scores were not clearly different from those of controls. Weng et al[22] evaluate24d psychological symptoms and oral health-related quality of life in a larger cross-sectional RAS population using GAD-7, PHQ-9, and OHIP-14. Their results suggested that anxiety symptoms and impaired oral health-related quality of life were common, and that pain severity and ulcer-related characteristics contributed to this burden. In this study, active RAS was accompanied by higher STAI-S and STAI-T scores together with worse oral health-related quality-of-life measures. This supports the interpretation that painful and recurrent ulcer episodes may intensify psychological strain and reduce perceived well-being, particularly during the active disease phase.

Further evidence suggests that psychological symptoms may contribute to the patient-perceived burden of RAS. Altıntaş et al (2023) evaluated 30 patients with RAS and 30 healthy controls using several psychological and quality-of-life instruments, including the Hospital Anxiety and Depression Scale, Brief Symptom Inventory, Childhood Trauma Questionnaire, Dissociative Experiences Scale, and SF-36. They reported higher psychiatric symptom scores in the RAS group, especially in anxiety- and depression-related domains, together with poorer quality-of-life findings.[23] Ye et al[24] studied 229 patients with oral mucosal diseases, including 55 individuals with recurrent aphthous ulcers, and used the Depression Anxiety Stress Scale-21 and OHIP-5 to examine psychological distress and oral quality of life. They found that depression, stress, and anxiety were frequent and were linked to worse oral health-related quality-of-life outcomes. In this cohort, active RAS was accompanied by higher anxiety scores and lower oral quality-of-life scores than inactive disease and healthy status. This suggests that active ulceration and psychological strain may act together in worsening patients' perceived disease burden.

Treatment-focused studies also show that reducing ulcer symptoms can improve patient-centered outcomes in RAS. In the prospective study by Hapa et al,[25] 128 patients with RAS and 40 healthy controls were evaluated with the OHIP-14 before and after treatment. The study showed that frequent ulcer attacks were associated with poorer oral health-related quality of life, and that clinical improvement after systemic therapy, particularly colchicine, was accompanied by lower pain intensity and improved OHIP-14 scores. This observation is relevant to the findings because patients in the active RAS group had the highest pain scores and the most impaired oral and general quality-of-life measures. D'Amario et al[26] also reviewed randomized clinical trials on pharmacological and non-pharmacological treatment approaches for RAS and identified pain control, mucosal healing, and quality-of-life improvement as central therapeutic outcomes. Together with the results, these data suggest that the clinical burden of RAS is closely related to active ulceration and pain, and that effective symptom control may be essential for improving daily functioning and overall well-being.

Several methodological points should be taken into account when interpreting these findings. Because the study had a cross-sectional design, the observed associations between RAS activity, anxiety, and quality-of-life measures should not be interpreted as causal relationships. Another limitation is that all participants were recruited from a single center, which may restrict the applicability of the results to different clinical settings or wider populations. Psychological outcomes were assessed using self-administered questionnaires; therefore, individual perception, reporting style, and response bias may have influenced the scores. The study also compared active and inactive RAS groups at a defined assessment period rather than following the same individuals longitudinally across repeated disease episodes. As a result, changes in anxiety or quality of life over time could not be evaluated. In addition, variables such as current stress level, personality

characteristics, coping strategies, and socioeconomic factors were not examined in detail, although they may affect both psychological status and perceived quality of life. Further multicenter studies with larger samples and longitudinal follow-up would help clarify how disease activity, psychological factors, and quality-of-life outcomes interact over the course of RAS.

Overall, the results show that the clinical burden of minor RAS becomes most apparent during active ulceration. Patients in the active phase experienced greater pain, higher anxiety scores, and poorer oral and general quality-of-life outcomes than both inactive RAS patients and healthy controls. These findings suggest that current disease activity and symptom intensity are major contributors to the perceived impact of RAS. Therefore, management of RAS should address not only ulcer control but also pain relief, functional limitations, quality of life, and psychological well-being.

CONCLUSION

Recurrent aphthous stomatitis significantly affects patients' oral health-related quality of life, particularly during the active disease phase. In the present study, individuals with active RAS showed higher pain and anxiety levels and poorer quality-of-life scores compared with inactive RAS patients and healthy controls. These findings indicate that disease activity and symptom severity play a key role in determining the overall burden of RAS. Therefore, clinical management of RAS should focus not only on controlling ulcerative lesions but also on improving patients' quality of life and psychological well-being.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Artificial Intelligence Usage Statement: The authors declared that no artificial intelligence tool was used in the preparation of the manuscript.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of İstanbul University (Approval No.: 2007/1118; Date: May 23, 2007).

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

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