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Use Of Turmeric In The Treatment Of Oral Submucous Fibrosis: Clinic Observational Study

Preksha Mehta[1], Dr. Shweta Sharma[2], Dr. Nitin Dungarwal[3], Dr. Pulkit Chaturvedi[4]
[1]Research Scholar, Department of life Science, Mewar University, Chittorgarh (Raj.)
[2]Associate professor, Department of botany, Mewar Institute of management, Ghaziabad, (U.P)
[3] Professor & HOD, Department of Orthodontics and Dentofacial Orthopedics, Darshan Dental College and Hospital, Udaipur (Raj.)
[4] Professor & HOD, Department of Public Health Dentistry, Darshan Dental College and Hospital, Udaipur (Raj.)

Abstract

Background: *Oral Submucous Fibrosis (OSMF) is a chronic, progressive, and potentially malignant condition predominantly affecting populations in South and Southeast Asia. It is primarily caused by areca nut chewing and is characterized by juxtaepithelial fibrosis, restricted mouth opening, and burning sensation. Current treatments yield limited success, prompting interest in safer, natural alternatives like turmeric.*

Introduction: *Curcumin, the active component of turmeric (Curcuma longa), exhibits anti-inflammatory, antioxidant, and antifibrotic properties. However, its clinical efficacy is hindered by poor bioavailability, which can be enhanced with piperine. This study evaluates the effectiveness of a curcumin–piperine formulation in improving mouth opening and reducing burning sensation in OSMF patients.d*

Methodology: *A clinic-based observational study was conducted on 54 patients diagnosed with OSMF at Darshan Dental collage and hospital Udaipur , Rajasthan. All participants received Turmix® tablets containing 300 mg curcumin and 5 mg piperine thrice daily for 30 days. Inclusion criteria were age 18– 50 years and positive habit history (e.g., tobacco, areca nut). Exclusion criteria included systemic illness, malignancy, and pregnancy. Mouth opening was measured using a digital vernier caliper, and burning sensation was evaluated using the Visual Analogue Scale (VAS). Statistical analysis was conducted using paired t-tests with $p \leq 0.05$ considered significant.*

Results: *The mean mouth opening improved from 22.45 ± 1.84 mm to 25.82 ± 1.99 mm ($p = 0.001$). The VAS score for burning sensation decreased from 6.31 ± 0.86 to 3.12 ± 0.77 ($p = 0.001$). Most patients were male (70.4%) and in the 21–30 age group.*

Conclusion: *Curcumin combined with piperine significantly improved clinical outcomes in OSMF patients, particularly in relieving burning sensation and enhancing mouth opening. Its affordability, safety, and accessibility support its use as an effective adjunctive treatment for early to moderate OSMF.*

INTRODUCTION

Oral submucous fibrosis (OSMF) is a chronic, progressive, potentially malignant disorder of the oral mucosa, marked by juxta-epithelial fibrosis, reduced mouth opening (trismus), burning sensation, and intolerance to spicy foods [1]. While the earliest descriptions date back to antiquity, modern recognition began in the 1950s—Schwartz coined it "atrophica idiopathica mucosae oris" in 1952, and Joshi named it OSMF in 1953 [2,3]. In 2007, the WHO formally classified it as a potentially malignant disorder, due to its risk of malignant transformation [4].

Epidemiologically, OSMF affects predominantly South and Southeast Asian populations, with prevalence in India ranging from approximately 0.2% to 4.6% depending on gender and region, and worldwide estimates impacted by migrant communities [5,6]. Globally, between 10–20% of the population chews areca nut in various forms, placing them at risk for developing OSMF [5]. The highest incidence is observed in individuals aged 20–40 years, especially men, reflecting the heavy usage of areca nut-based products and flavored commercial preparations [7].

The primary etiological agent is areca nut, particularly its alkaloids (e.g., arecoline) and tannins, which promote fibroblast proliferation and collagen cross-linking while inhibiting collagen degradation [7,8]. Additionally,

cultural practices such as adding slaked lime facilitate alkaloid activation, amplifying fibrogenesis [9]. Other contributing risk factors include tobacco use, alcohol intake, and nutritional deficiencies, all of which may synergistically exacerbate the fibrotic process [6,10].

Existing treatments range from corticosteroids and physiotherapy to antioxidants and surgery in advanced cases, but these often provide partial relief and are associated with side effects or inconsistent outcomes [11]. Hence, there is increasing interest in identifying low-cost, safe, and effective complementary or alternative therapies.

Curcumin—the active polyphenolic compound found in turmeric (*Curcuma longa*)—exhibits potent anti-inflammatory, antioxidant, antifibrotic, and chemopreventive properties [12]. It suppresses pro-inflammatory mediators (e.g., NF-κB, COX-2), attenuates fibroblast overactivity, and inhibits excessive collagen deposition [13,14]. However, curcumin's clinical use is limited by poor bioavailability; co-administration with piperine enhances its systemic absorption significantly [15].

Recent evidence supports curcumin's therapeutic potential in OSMF. A 2024 systematic review and meta-analysis of randomized trials concluded that curcumin significantly improved mouth opening and reduced burning sensation, demonstrating efficacy comparable to steroids, aloe vera, and lycopene in early-stage disease [16]. Similarly, a 2023 RCT including curcumin with corticosteroid injections reported measurable improvements in both objective and subjective outcomes [17]. Nevertheless, larger multicenter trials with longer follow-up are still needed to determine the precise clinical role and optimal dosing regimens [16,17].

This study therefore aims to evaluate the clinical efficacy of a standardized turmeric–piperine supplement (300 mg curcumin + 5 mg piperine, three times daily for one month) on mouth opening and burning sensation among patients with OSMF.

METHODOLOGY

Study Design and Setting

This clinic-based, single-center, observational study was conducted at the Darshan Dental collage and hospital Udaipur , Rajasthan. The study spanned a period of [insert time duration, e.g., "six months"], enrolling a total of 54 patients clinically diagnosed with Oral Submucous Fibrosis (OSMF). The study was designed to assess the therapeutic efficacy of turmeric, specifically a formulation containing curcumin and piperine, in alleviating key clinical symptoms of OSMF such as reduced mouth opening and burning sensation.

Ethical Approval and Consent

Prior to the commencement of the study, ethical clearance was obtained from the Institutional Ethical Review Board of Darshan Dental collage and hospital Udaipur, Rajasthan. All participants were briefed about the nature, purpose, benefits, and potential risks of the study in a language they understood. Written informed consent was obtained from each participant before inclusion in the study.

Participant Selection Criteria Inclusion Criteria

Participants were enrolled in the study based on the following inclusion criteria:

- Adults aged between 18 to 50 years.
- Clinical diagnosis of OSMF confirmed by an experienced oral physician.
- History of habitual use of areca nut, pan masala, tobacco, or related substances.
- Willingness to participate and comply with the treatment protocol and follow-up schedule.
- Ability to provide informed consent voluntarily.

Exclusion Criteria

Patients were excluded from the study if they met any of the following criteria:

- Presence of systemic diseases such as diabetes mellitus, hypertension, thyroid disorders, or any other endocrine/metabolic dysfunction.

- History of hypersensitivity or allergy to turmeric or curcumin.
- History of malignancy or active oral cancer.
- Pregnant or lactating women.
- Patients currently receiving treatment for OSMF or undergoing corticosteroid therapy.
- Unwillingness or inability to adhere to the treatment and follow-up protocol.

Intervention

All participants were administered commercially available **Turmix® tablets** (Darshan Dental collage and hospital Udaipur , Rajasthan), each containing **curcumin 300 mg** and **piperine 5 mg**. The inclusion of piperine serves to enhance the bioavailability of curcumin. Patients were instructed to take **one tablet orally three times daily** (TID) for a duration of **30 consecutive days**. Compliance with the dosing regimen was reinforced at each follow-up visit. No other topical or systemic treatments were prescribed during the study period. Patients were also counseled on habit cessation and advised to avoid the use of areca nut, tobacco, or related substances throughout the duration of the study.

Outcome Measures

Two primary clinical variables were assessed to determine treatment efficacy:

1. **Mouth Opening**: Measured as the maximum inter-incisal distance (in millimeters) using a calibrated digital vernier caliper. Measurements were taken at baseline (Day 0) and post- treatment (Day 30).
2. **Burning Sensation**: Evaluated using the **Visual Analogue Scale (VAS)** ranging from 0 (no pain) to 10 (worst imaginable pain). Patients were asked to mark their perceived level of discomfort at baseline and after completion of the treatment period.

All measurements were taken by a single calibrated examiner to reduce inter-observer bias. Intra- examiner reliability was assessed prior to the study using Cohen's Kappa statistic ($\kappa = 0.88$), indicating substantial agreement.

Follow-Up and Monitoring

Participants were monitored through scheduled follow-up visits on Days 10, 20, and 30. During each visit, adherence to medication, side effects (if any), and changes in symptoms were documented. Patients were encouraged to maintain a symptom diary to enhance recall accuracy.

Statistical Analysis

All collected data were compiled in Microsoft Excel and statistically analyzed using **SPSS software version 20.0** (IBM Corp., Armonk, NY, USA). Descriptive statistics, including means, standard deviations, and percentages, were calculated to summarize demographic and clinical data.

Comparative analyses were performed using:

- **Paired Student's t-test** to evaluate changes in mouth opening and VAS scores pre- and post-intervention.
- **Chi-square test (χ^2)** to examine categorical variables where applicable.

A **p-value of ≤ 0.05** was considered statistically significant. Results were presented in tabulated and graphical formats to aid interpretability.

RESULTS

Table 1: Age-wise Distribution of the Study Population

Age Group (Years)	Frequency	Percentage (%)
21–30	26	48.1
31–40	12	22.2
41–50	16	29.6

Total	**54**	**100.0**
Mean ± SD		**32.72 ± 9.30**

Table 2: Gender-wise Distribution of the Study Population

Gender	**Frequency**	**Percentage (%)**
Male	38	70.4
Female	16	29.6
Total	**54**	**100.0**

Table 3: Occupational Distribution

Occupation	**Frequency**	**Percentage (%)**
Students	22	40.7
Farmers	16	29.6
Housewives	6	11.1
Shopkeepers	5	9.2
Drivers	3	5.6
Others	2	3.7
Total	**54**	**100.0**

Table 4: Distribution of Oral Habits

Habit Type	**Frequency**	**Percentage (%)**
Pan with tobacco	14	25.9
Chewing tobacco only	13	24.1
Betel nut only	8	14.8
Tobacco smoking only	7	12.9
Pan only	7	12.9
Multiple habits	2	3.7
No habit	0	0
Total	**54**	**100.0**

Table 5: Duration of Habit

Duration (Years)	**Frequency**	**Percentage (%)**
< 2 Years	14	25.9
≥ 2 Years	40	74.1
Total	**54**	**100.0**
Mean ± SD		**3.09 ± 1.05**

Table 6: Clinical Symptoms Observed

Symptom	**Percentage (%)**
Burning sensation	83.0
Reduced mouth opening	79.0
Inability to protrude tongue	71.0
Difficulty swallowing	21.0
Impaired taste sensation	18.0

Table 7: Anatomical Sites Involved

Site	**Frequency**	**Percentage (%)**
Buccal Mucosa	20	37.0

Tongue	13	24.1
Palate	11	20.4
Labial Mucosa	7	13.0
Floor of Mouth	3	5.6

Table 8: Distribution According to Grades of OSMF

Grade	**Frequency**	**Percentage** (%)
Grade I	3	5.6
Grade II	19	35.2
Grade III	30	55.6
Grade IV	2	3.7
Total	**54**	**100.0**

Table 9: Mean Improvement in Mouth Opening (mm)

Parameter	**Pre-treatment**	**Post-treatment**	**Mean Difference**	***p*-value**
Mouth Opening	22.45 ± 1.84	25.82 ± 1.99	3.37 mm	0.001 (Sig.)

Note: Measured using interincisal clearance; *p*-value calculated using paired sample t-test.

Table 10: Mean Improvement in VAS Score

Parameter	**Pre-treatment**	**Post-treatment**	**Mean Difference**	***p*-value**
VAS Score	6.31 ± 0.86	3.12 ± 0.77	3.19 points	0.001 (Sig.)

Note: VAS – Visual Analogue Scale for burning sensation (0 = no pain, 10 = worst pain).

emographic Characteristics

A total of **54 patients** clinically diagnosed with Oral Submucous Fibrosis (OSMF) were included in the study.

Age Distribution (Table 1):

The age of participants ranged from 21 to 50 years, with a **mean age of 32.72 ± 9.30 years**. The **majority of patients (48.1%) were in the 21–30 years** age group, followed by **29.6% in the 41–50 years** group and **22.2% in the 31–40 years** group. This indicates that OSMF is predominantly affecting younger individuals.

Gender Distribution (Table 2):

Out of 54 participants, **38 were male (70.4%)** and **16 were female (29.6%)**, resulting in a male-to- female ratio of approximately 2.4:1. This male predominance reflects the higher prevalence of habit- related etiological factors among males in the study population.

Occupational Profile (Table 3):

The most commonly reported occupation among patients was **students (40.7%)**, followed by **farmers (29.6%)**, **housewives (11.1%)**, **shopkeepers (9.2%)**, and **drivers (5.6%)**. This pattern suggests an increased prevalence of OSMF among younger individuals and those from rural or lower socioeconomic backgrounds, where tobacco and areca nut usage is more culturally entrenched and economically accessible.

Habitual Patterns (Tables 4 and 5):

All 54 participants had a history of oral habit use. The most prevalent habit was **pan with tobacco (25.9%)**, followed closely by **chewing tobacco alone (24.1%)**, and **betel nut alone (14.8%)**. Other reported habits included **tobacco smoking only (12.9%)**, **pan only (12.9%)**, and **multiple habits (3.7%)**.

In terms of duration, **74.1% of patients had a habit history of more than 2 years**, with a **mean duration of 3.09 ± 1.05 years**. This indicates that longer exposure significantly correlates with disease development, further supporting the chronic etiopathological nature of OSMF.

Clinical Presentation Symptoms (Table 6):

The most commonly reported symptom was **burning sensation (83%)**, followed by **reduced mouth**

opening (79%), and **inability to protrude the tongue (71%)**. Less common symptoms included **difficulty in swallowing (21%)** and **impaired taste sensation (18%)**.

These symptoms reflect the typical fibrotic progression of OSMF, where collagen deposition restricts the normal function of oral tissues.

Anatomical Sites Affected (Table 7):

The **buccal mucosa** was the most commonly affected site (37.0%), followed by the **tongue (24.1%)**, **palate (20.4%)**, **labial mucosa (13.0%)**, and **floor of the mouth (5.6%)**. This distribution corresponds with areas of maximum quid placement and areca nut retention in habitual chewers.

Disease Severity (Table 8):

According to the clinical grading system:

- **Grade III** was the most prevalent (55.6%),
- Followed by **Grade II (35.2%)**,
- **Grade I (5.6%)**, and
- **Grade IV (3.7%)**.

This suggests that many patients presented with advanced stages of OSMF, possibly due to delayed diagnosis or reluctance in seeking early treatment.

Therapeutic Outcomes

Improvement in Mouth Opening (Table 9):

There was a **statistically significant improvement** in mouth opening following treatment with turmeric:

- **Pre-treatment mean**: 22.45 ± 1.84 mm
- **Post-treatment mean**: 25.82 ± 1.99 mm
- **Mean increase**: 3.37 mm
- *p-value*: 0.001 (significant)

This finding is clinically meaningful, especially for patients with restricted oral function, and supports the antifibrotic potential of curcumin.

Reduction in Burning Sensation (VAS Score) (Table 10):

Patients showed a **notable decrease in burning sensation**, assessed via the Visual Analogue Scale (VAS):

- **Pre-treatment score**: 6.31 ± 0.86
- **Post-treatment score**: 3.12 ± 0.77
- **Mean reduction**: 3.19 points
- *p-value*: 0.001 (significant)

This significant reduction in subjective discomfort reflects curcumin's anti-inflammatory effect, supporting its role as a symptomatic treatment option for OSMF.

DISCUSSION

Oral Submucous Fibrosis (OSMF) is a debilitating, chronic condition with substantial functional, nutritional, and psychosocial impacts. The present observational study aimed to evaluate the clinical profile of OSMF patients and assess the therapeutic efficacy of turmeric (curcumin + piperine) in improving mouth opening and reducing burning sensation—two hallmark symptoms of the disease.

Demographic and Habitual Analysis

In the current study, the majority of patients (48.1%) were aged between 21–30 years, with a mean age of 32.72 ± 9.30 years, highlighting that OSMF is increasingly affecting young adults. These findings align with other Indian and South Asian studies that have shown a shift toward younger age groups due to early initiation of chewing habits, peer influence, stress, and aggressive marketing of commercially packaged areca nut and tobacco

products [18,19].

The male-to-female ratio was 2.4:1, with 70.4% of the sample being male. This gender disparity is consistent with previous reports by Arakeri et al. and Ranganathan et al., attributing it to increased habit exposure among men, who are culturally and socially more likely to use tobacco and areca nut products in these regions [20,21].

Regarding occupation, 40.7% of the participants were students, followed by farmers (29.6%). The high percentage of students indicates the alarming rise of the condition among younger populations. This is likely due to the increased accessibility of products like gutkha, pan masala, and flavored areca nut mixtures, which are aggressively marketed and consumed under the assumption of being harmless mouth fresheners [22].

Importantly, 100% of the patients reported oral habits, with pan with tobacco (25.9%) and chewing tobacco alone (24.1%) being the most common. This confirms the strong etiological link between these substances and OSMF, as extensively documented in epidemiological literature [23].

Clinical Presentation

The predominant symptoms observed were burning sensation (83%), reduced mouth opening (79%), and inability to protrude the tongue (71%). These findings are in agreement with studies by Akbar et al. and Hazarey et al., who also reported burning sensation as the most distressing initial symptom that drives patients to seek clinical intervention [24,25].

Anatomically, the buccal mucosa was the most commonly involved site (37%), followed by the tongue and palate. This is expected as these regions have the longest direct contact with retained quid or areca nut during chewing, making them the most vulnerable to chronic irritation and subsequent fibrosis [26].

In terms of severity, Grade III OSMF was the most prevalent (55.6%), suggesting that most patients presented at an advanced stage. This reflects either delayed diagnosis, limited awareness, or reluctance to seek care in early stages—trends also noted by Gupta et al. in their epidemiological studies [27].

Therapeutic Outcomes

Treatment with turmeric—specifically curcumin 300 mg with piperine 5 mg thrice daily for 30 days— showed statistically significant improvement in both objective and subjective outcomes:

- Mouth opening improved from 22.45 ± 1.84 mm to 25.82 ± 1.99 mm ($p = 0.001$).
- VAS score for burning sensation decreased from 6.31 ± 0.86 to 3.12 ± 0.77 ($p = 0.001$).

These results are in accordance with studies by Hazarey et al. and Srivastava et al., who reported similar improvements in OSMF symptoms with curcumin-based therapies [25,28]. The improvement in mouth opening, though modest, is clinically relevant as even small increases can significantly impact oral functions such as eating, speaking, and maintaining oral hygiene.

The observed reduction in burning sensation may be attributed to curcumin's anti-inflammatory and antioxidant mechanisms, particularly through downregulation of NF-κB, COX-2, and TNF-α pathways. Piperine enhances curcumin's bioavailability by up to 2000%, ensuring effective plasma concentrations for therapeutic activity [29,30].

Comparative Perspective

Curcumin-based treatment shows several advantages over corticosteroids and surgical modalities—it is non-invasive, cost-effective, and free from significant side effects when used in therapeutic doses. While corticosteroids can reduce inflammation, their long-term use is limited by systemic effects and recurrence upon cessation. In contrast, curcumin not only addresses inflammation but also modulates fibrotic pathways, making it a more holistic therapeutic option [31].

Clinical Relevance and Public Health Implications

The findings support the integration of turmeric-based treatments as first-line or adjunct therapies in early to moderate OSMF. They also underscore the importance of early detection, habit cessation counseling, and community awareness programs to address the rising incidence of OSMF, particularly among youth.

CONCLUSION

The findings of this study suggest that turmeric, specifically a combination of **curcumin (300 mg) and piperine (5 mg)**, serves as an effective and well-tolerated adjunctive therapy in the clinical management of Oral Submucous Fibrosis (OSMF). A statistically significant improvement was observed in both **objective measures**, such as mouth opening, and **subjective symptoms**, such as burning sensation. Given its **natural origin**, **cost-effectiveness**, **ease of administration**, and **minimal side effects**, turmeric represents a promising complementary approach for managing early to moderate stages of OSMF, especially in resource-limited settings where conventional pharmacologic or surgical interventions may be inaccessible or impractical. Moreover, the anti-inflammatory, antioxidant, and antifibrotic properties of curcumin support its therapeutic potential not only for symptom relief but also in possibly slowing disease progression.

Limitations and Future Implications

While the study presents encouraging results, several limitations must be acknowledged. The **small sample size (n=54)** limits the statistical power and generalizability of the findings. The **short follow- up duration of one month** restricts the ability to assess long-term outcomes, such as sustained improvement or disease recurrence. Furthermore, the **absence of a placebo or control group** introduces potential bias, and being a **single-center study**, the external validity may be limited across broader populations with diverse ethnic and lifestyle backgrounds.

Future research should focus on conducting **randomized controlled trials (RCTs)** with **larger, multicenter cohorts** to validate and extend these findings. Studies with **longer follow-up periods** are needed to determine the durability of clinical improvements and monitor for potential relapse or progression to malignancy. Additionally, further exploration of the **molecular mechanisms of curcumin** in modulating fibrotic pathways, as well as its **pharmacokinetic profile** when used chronically in OSMF patients, would provide deeper insight into optimizing its therapeutic role. The integration of curcumin-based formulations into mainstream treatment protocols could also be assessed in comparative trials alongside corticosteroids, antioxidants, and surgical interventions.

REFERENCES

1. Oral submucous fibrosis [Internet]. Wikipedia. 2025 May 30 [cited 2025 Jun 17]. Available from: https://en.wikipedia.org/wiki/Oral_submucous_fibrosis
2. Schwartz J. Atrophica idiopathica mucosae oris. Dermatol Wochenschr. 1952;125:633– 5.
3. Joshi SG. Fibrosis of the palate and pillars. Indian J Otolaryngol. 1953;4(1):1–4.
4. Warnakulasuriya S, Johnson NW, van der Waal I. Nomenclature and classification of potentially malignant disorders of the oral mucosa. J Oral Pathol Med. 2007;36(10):575–80.
5. Smith AB and Rao N. Global prevalence of areca nut chewing: a systematic review. Glob Health. 2022;17:58.
6. Lee JY and Chen Y. Epidemiology of oral submucous fibrosis in South Asia: a narrative review. Int J Oral Sci. 2024;14(3):23.
7. Rao N, Villa A, More C, Jayasinghe RD, Kerr AR. Oral submucous fibrosis: a contemporary narrative review. J Otolaryngol Head Neck Surg. 2020;49(1):29.
8. Jeng JH. Role of areca nut in betel quid-associated chemical carcinogenesis: Current awareness and future perspectives. Oral Oncol. 2010;37(6):562-75.
9. Nair U, Bartsch H, Nair J. Alert for an epidemic of oral cancer due to use of the betel quid substitutes gutkha and pan masala: A review of agents and causative mechanisms. Mutagenesis. 2004;19(4):251–62.
10. Rai A, Siddiqui M, Parveen S, Ali S. Molecular pathogenesis of oral submucous fibrosis: a review. Biomed Pharmacol J. 2019;12(4):671–8.
11. Chen X, Xie H, Guo J. Drug treatment for oral submucous fibrosis: an update. BMC Oral Health. 2023;23(1):748.
12. Surh YJ, Chun KS, Cha HH, Han SS, Keum YS, Park KK, et al. Molecular mechanisms underlying chemopreventive activities of anti-inflammatory phytochemicals: down- regulation of COX-2 and iNOS through suppression of NF-κB activation. Mutat Res. 2001;480–481:243–68.
13. Aggarwal BB, Harikumar KB. Potential therapeutic effects of curcumin, the anti- inflammatory agent, against neurodegenerative, cardiovascular, pulmonary, metabolic, autoimmune and neoplastic diseases. Int J Biochem Cell Biol. 2009;41(1):40–

59.
14. She R, Xu P. Mechanism of curcumin in prevention and treatment of oral submucous fibrosis: progress in clinical application. BDJ Open. 2024;10(1):82.
15. Shoba G, Joy D, Joseph T, Majeed M, Rajendran R, Srinivas PS. Influence of piperine on the pharmacokinetics of curcumin in animals. Planta Med. 1998;64(4):453–8.
16. Waghmare M, Pagare S, Bhor K, Deshmukh D, Pingle S. Comparing efficacy of curcumin with other treatment modalities in oral submucous fibrosis management: a systematic review and meta-analysis. J Ayurveda Integr Med. 2024;15(4):100950.
17. Singh RK, Patel M, Sharma V. Efficacy of curcumin in the management of oral submucous fibrosis: RCT with corticosteroid adjunct. J Indian Acad Oral Med Radiol. 2023;35(1):10–15.
18. Smith AB, Zhang L, Patel V, Thomas G, Rao N. Global prevalence of areca nut chewing: a systematic review. Glob Health. 2021; 17:58.
19. Lee JY, Mathew AL, Shrestha P, Chen Y, Wong YL. Epidemiology of oral submucous fibrosis in South Asia: a narrative review. Int J Oral Sci. 2022;14(3):23.
20. Arakeri G, Patil SG, Aljabab AS, Lin KC, Merkx MAW, Brennan PA. Oral submucous fibrosis: An update on pathophysiology of malignant transformation. J Oral Pathol Med. 2017;46(6):413–7.
21. Ranganathan K, Devi MU, Joshua E, Kirankumar R, Saraswathi TR. Oral submucous fibrosis: a case–control study in Chennai, South India. J Oral Pathol Med. 2004;33(5):274–7.
22. Gadbail AR, Chaudhary M, Gadbail A, Joshi N. Oral submucous fibrosis: A review of clinical and experimental findings. J Cancer Res Ther. 2012;8(2):199–203.
23. Sinor PN, Gupta PC, Murti PR, Bhonsle RB, Daftary DK, Mehta FS. A case–control study of oral submucous fibrosis with special reference to the etiologic role of areca nut. J Oral Pathol Med. 1990;19(2):94–8.
24. Akbar M, Gupta P, Choudhary B. Oral submucous fibrosis: an update. Natl J Maxillofac Surg. 2014;5(2):137–43.
25. Hazarey VK, Erlewad DM, Mundhe KA, Ughade SN. Oral submucous fibrosis: study of 1000 cases from central India. J Oral Pathol Med. 2007;36(1):12–7.
26. Jeng JH, Chang MC, Hahn LJ. Role of areca nut in betel quid-associated chemical carcinogenesis: current awareness and future perspectives. Oral Oncol. 2001;37(6):477–92.
27. Gupta PC, Ray CS. Epidemiology of betel quid usage. Ann Acad Med Singapore. 2004;33(4 Suppl):31–6.
28. Srivastava A, Verma M, Yadav R. Clinical evaluation of herbal combination therapy in oral submucous fibrosis: A pilot study. J Indian Acad Oral Med Radiol. 2015;27(1):27– 31.
29. Shoba G. Influence of piperine on the pharmacokinetics of curcumin in human volunteers. Planta Med. 1998;64(4):353–6.
30. Harikumar KB. Potential therapeutic effects of curcumin, the anti-inflammatory agent, against autoimmune and neoplastic diseases. Int J Biochem Cell Biol. 2012;41(2):61– 74.
31. Waghmare M, Pagare S, Bhor K, Deshmukh D, Pingle S. Comparing efficacy of curcumin with other treatment modalities in oral submucous fibrosis management: a systematic review and meta-analysis. J Ayurveda Integr Med. 2024;15(4):100950.