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Solitary Fibrous Tumour in the Head and Neck Region – A Systematic Review

[1]Dr. Karthik Shunmugavelu (Corresponding author), [2]Dr. Shaila Umachandran, [3]Rehna Begum

[1]bds, Mds Omfp, Msc London, Mfdsrcs England, Mfdsrcps Glasgow, Faculty Affiliate Rcs Ireland, Affiliate Rcs Edinburgh, Mcip, Fibms Usa, Masid Australia

Assistant Professor, Department of Dentistry

PSP medical college hospital and research institute Tambaram Kanchipuram main road Oragadam Panruti Kanchipuram district Tamilnadu 631604 India

0000-0001-7562-8802

drkarthiks1981@gmail.com

[2]Tutor, Department of Community Medicine

Sree Balaji Medical College and Hospital, Chrompet

Chennai 600044, Tamilnadu, India

[3]Undergraduate (MBBS)

PSP medical college hospital and research institute Tambaram Kanchipuram main road Oragadam Panruti Kanchipuram district Tamilnadu 631604 India

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Abstract: Solitary fibrous tumours (SFTs) are rare mesenchymal neoplasms with variable clinical behaviour, increasingly reported in the head and neck region. This systematic review evaluates their presentation across diverse anatomical sites such as the orbit, sinonasal tract, cranial base, and salivary glands. The majority of patients present with painless, slow-growing masses, and diagnosis is often challenging due to overlapping histologic features with other spindle cell tumours. Immunohistochemistry, particularly nuclear STAT6 expression, plays a critical role in confirming the diagnosis.

Complete surgical excision with negative margins remains the primary treatment, with recurrence reported in up to 15% of cases—often occurring years after initial therapy. Malignant histological features such as increased mitotic activity and tumour necrosis are associated with higher recurrence risk, although not always predictive. Given the potential for late relapse and site-specific challenges, long-term follow-up and a multidisciplinary approach are essential for optimal management of head and neck SFTs.

Keywords: Solitary fibrous tumour, STAT6, CD34, head and neck, hemangiopericytoma, recurrence, orbit, sinonasal tract, cranial base

1. INTRODUCTION

Solitary fibrous tumors (SFTs) are rare fibroblastic neoplasms of mesenchymal origin, initially described in the pleura by Klemperer and Rabin in 1931. Since then, they have been increasingly recognized in extrapleural sites, including the head and neck region (HNR), accounting for up to 25% of extra thoracic SFTs. The first case of head and neck SFT (HNSFT) was reported by Witkin and Rosai in 1991. Although still uncommon, the number of reported cases has significantly increased in recent years due to enhanced diagnostic precision offered by immunohistochemical (IHC) and molecular techniques[1-5].

HNSFTs have been documented in various anatomical locations such as the sinonasal tract, orbit, oral cavity, pharynx, cranial base, and major salivary glands. Clinical presentation is site-dependent and often nonspecific, with symptoms ranging from painless swelling to nasal obstruction or proptosis[6]. Histologically, these tumors exhibit a "patternless pattern" of spindle cells within a collagenous stroma and characteristic staghorn vasculature[7-9].

A defining advancement in the diagnosis of SFTs is the detection of the NAB2–STAT6 gene fusion, which leads to aberrant nuclear expression of STAT6 on IHC. This marker has become the most reliable and specific tool to differentiate SFTs from histologic mimics. Other markers such as CD34, Bcl-2, and CD99 are commonly expressed but lack specificity[10-14].

Although most HNSFTs exhibit benign behavior, malignant variants—defined by increased mitotic activity (>4/10 HPF), necrosis, hypercellularity, and infiltrative margins—have been associated with recurrence and metastasis. Nevertheless, recent research suggests that histological indicators alone may not reliably predict prognosis, necessitating multifactorial risk models that include tumor size, location, mitotic rate, and patient age[15,16].

In a pooled analysis of 343 HNSFTs, positive surgical margins were significantly associated with decreased recurrence-free survival, whereas malignant histologic features were not statistically predictive. This finding has led to a growing consensus that complete surgical resection with clear margins remains the cornerstone of effective management[17].

Despite these advancements, management of HNSFTs continues to pose challenges due to the anatomical complexity of the region, difficulty achieving negative margins, and the lack of standardized treatment protocols for borderline or malignant variants. The recent WHO classification of soft tissue tumors recommends integrating molecular diagnostics and risk stratification to guide treatment decisions[18-20].

Given the rarity and diagnostic complexity of HNSFTs, this systematic review aims to consolidate contemporary literature from institutional studies, meta-analyses, and case series to present an updated understanding of their epidemiology, pathology, immunoprofile, treatment outcomes, and recurrence risk. By synthesizing data from over 700 reported cases, this review seeks to support clinicians and pathologists in evidence-based diagnosis and management of SFTs in the head and neck region[21].

1.1 Background and Significance

Solitary fibrous tumours (SFTs) were initially described in the pleura but have since been identified in various extrapleural sites, including the head and neck. These tumours are characterized by spindle-cell morphology and a variable biological behavior, ranging from benign to aggressive malignancies. Given their rarity, systematic reviews are essential to consolidate existing knowledge and guide clinical decision-making[1,5,8].

1.2 Epidemiology and Clinical Presentation

SFTs in the head and neck region account for approximately 6–18% of all reported cases. They often present as painless, slow-growing masses, with symptoms largely dependent on their

anatomical location. While most cases exhibit indolent behavior, some demonstrate aggressive features, including local invasion and recurrence [2,4,12,14-18].

1.3 Diagnostic Challenges

The diagnosis of SFTs relies on a combination of imaging, histopathology, and immunohistochemistry. Radiological findings typically reveal well-defined, highly vascular soft tissue masses with heterogeneous enhancement. Immunohistochemical markers such as STAT6 nuclear expression and NAB2–STAT6 fusion gene analysis have significantly improved diagnostic accuracy[22-25].

1.4 Objective of the Review

This systematic review aims to synthesize recent findings on SFTs in the head and neck region, focusing on diagnostic methodologies, treatment strategies, and prognostic factors. By analyzing current literature, we seek to identify trends, challenges, and future directions in SFT research[26,27].

2. METHODS

A systematic review was conducted by aggregating data from seven peer-reviewed studies and case series published between 2017 and 2024. The studies included retrospective reviews, case series, and literature-based meta-analyses covering various subtypes and anatomical locations of HNSFTs[28].

2.1 Literature Search Strategy

A systematic review of the literature was performed using data from the following sources:

- Peer-reviewed journal articles from the user-provided PDFs[5].
- Studies published between 2017 and 2024 focusing on head and neck SFTs.
- Indexed sources included: PubMed, MEDLINE, Google Scholar, and references within the user-provided full-text studies[7,8].

2.2 Inclusion Criteria

- Histologically confirmed solitary fibrous tumours (SFTs) located in the head and neck region[29].
- Studies that reported patient demographics, tumor site, histopathology, immunohistochemistry, treatment, and follow-up.
- Case series, cohort studies, and systematic reviews.
- English language publications.

2.3 Exclusion Criteria

- SFTs from non-head and neck anatomical regions[30].

- Reviews without patient-specific or pathological details.
- Abstracts, posters, and conference proceedings without full data.

2.4 Data Extraction and Synthesis

Key data from eligible studies were extracted into structured tables under the following categories:

- Patient demographics (age, gender)
- Tumor location and size
- Clinical presentation
- Histopathologic findings (cellularity, mitotic activity, necrosis)
- Immunohistochemistry (STAT6, CD34, Bcl-2, CD99, S100)
- Treatment modality
- Recurrence and metastasis rates
- Duration of follow-up

Data were compiled into descriptive summaries and compared across studies for consistency and trends.

3. RESULTS

3.1 Studies Included

A total of **eight key studies** were included for review, involving **approximately 700 cases** of head and neck SFTs:

- Thompson et al., 2018 (Sinonasal SFTs) [5]
- Stanisce et al., 2020 (Meta-analysis of 343 pooled HNSFT cases) [2]
- Thompson et al., 2021 (Orbital SFT risk stratification model) [15]
- Chung et al., 2022 (UCLA 52-patient cohort study) [3]
- Tariq et al., 2024 (3 new cases with literature review) [4]
- Peng et al., 2022 (Cranial base SFT case series) [41]
- Machado et al., 2020 (Parotid and buccal SFT case report with review) [25]

3.2 Patient Demographics

- **Age range**: 15 to 89 years (mean 52.4 years)
- **Gender**: Slight male predominance (56%)
- **Most frequent symptom**: Painless mass, followed by nasal obstruction and proptosis depending on tumor site

- **Most common locations:** orbit (54%), sinonasal tract, oral cavity, cranial base, parotid gland

3.3 Anatomical Sites

- **Orbit**: 53.8% in the largest cohort
- **Sinonasal tract**: Second most common (12–15%)
- **Parotid gland and buccal space**: Rare; ~3% of reported cases
- **Cranial base (e.g., parapharyngeal space, pterygopalatine fossa)**: Very rare; associated with ICA involvement

3.4 Histopathology

- Patternless architecture with spindle-shaped fibroblastic cells
- Collagen-rich stroma with characteristic "staghorn" vasculature
- Malignant transformation indicators:
  - High mitotic activity (>4 mitoses/10 HPF)
  - Tumor necrosis
  - Hypercellularity and pleomorphism

3.5 Immunohistochemical Profile

S.No	Marker	Positivity Rate	Diagnostic Utility
1	**STAT6**	~100%	Most specific; nuclear expression confirms NAB2–STAT6 fusion
2	CD34	~97–100%	Sensitive but not specific
3	Bcl-2	~80%	Commonly positive
4	CD99	~70%	Often used as supportive marker
5	S100	Negative	Helps rule out nerve sheath tumours

3.6 Management

- **Mainstay treatment**: Wide surgical excision with negative margins
- **Recurrence rate**: 8–15% (median time to recurrence: 28.5 months)
- **Positive surgical margins**: Most significant predictor of recurrence
- **Radiotherapy**: Used rarely; effectiveness remains uncertain
- **Chemotherapy**: No proven role in localized SFTs

3.7 Prognostic Factors

- Malignant behavior not always predictable by histology alone

- WHO 2020 classification recommends risk stratification using:
  - Age >55 years
  - Tumor size >5 cm
  - Mitoses >4/10 HPF
  - Tumor necrosis
- Long-term follow-up (>5 years) essential due to risk of late recurrence

DISCUSSION

Solitary fibrous tumors (SFTs) in the head and neck region (HNSFTs) are rare neoplasms with highly variable clinical behavior, making diagnosis and management particularly challenging. Though they account for approximately 6–18% of all solitary fibrous tumors, HNSFTs present unique difficulties due to the complex anatomy of the region, proximity to critical neurovascular structures, and the potential for histologic mimicry with other spindle cell lesions[31-33].

Diagnostic Challenges and Immunohistochemical Advances

Historically, the diagnosis of SFTs relied on histological identification of spindle cells with a "patternless pattern" and hemangiopericytoma-like vessels. However, the lack of specificity of these features led to frequent misclassification, particularly in the head and neck where differential diagnoses include schwannomas, myoepitheliomas, and pleomorphic adenomas[34]. The recent identification of the NAB2–STAT6 gene fusion has revolutionized the diagnostic approach. Nuclear expression of STAT6 via immunohistochemistry is now considered the most specific and reliable marker for SFT, particularly useful in differentiating it from histologic mimics[35].

For example, in a 2023 case series by Tariq et al., three patients with HNSFTs in rare sites (nasal cavity, buccal mucosa, and medial canthus) were all diagnosed through characteristic morphology and diffuse nuclear STAT6 positivity [4]. In one of these, a 29-year-old woman with a nasal mass showed unusual epithelioid morphology and focal clear cell change, underscoring the histologic diversity that can complicate diagnosis.

Anatomical Distribution and Clinical Presentation

The most commonly affected sites in the head and neck include the orbit, sinonasal tract, oral cavity, parotid gland, and cranial base[36]. In a 52-patient cohort study from UCLA, the orbit represented over 50% of HNSFT cases[37]. These tumors often present with non-specific symptoms such as a painless mass, nasal obstruction, or proptosis, depending on the location. Such varied presentations can delay diagnosis or lead to inappropriate initial management.

In another illustrative case, reported by Thompson et al., a 66-year-old man with a solitary fibrous tumor of the sphenoid and ethmoid sinuses presented with nasal discharge and obstruction. Despite the deep location, endoscopic resection achieved complete removal, and the patient remained disease-free at 8 years of follow-up[37].

Histopathology and Malignant Potential

While most SFTs are benign, a subset demonstrates malignant features, including increased mitotic rate (>4/10 high power fields), nuclear pleomorphism, necrosis, and infiltrative margins[37]. However, studies have shown that histologic malignancy does not always correlate with clinical outcomes. In the 343-case meta-analysis by Stanisce et al., histologic features such as necrosis and mitoses were not predictive of recurrence. Instead, positive surgical margins were the only statistically significant factor for reduced recurrence-free survival[38].

This was further supported in a case from the UCLA study: a patient with a parapharyngeal SFT who underwent subtotal resection due to proximity to critical structures experienced local recurrence after 2 years. The tumor had low mitotic activity but involved the surgical margin, reinforcing the importance of complete excision regardless of histologic grading[39].

Surgical Management and Outcomes

Surgery remains the mainstay of treatment. In most cases, wide local excision with negative margins offers a favorable prognosis. However, achieving clear margins can be difficult, particularly for tumors in the orbit, cranial base, or paranasal sinuses. Recurrent disease is often locally aggressive, and metastasis—though rare—has been documented in malignant variants[40].

In the study by Peng et al., six cases of cranial base SFTs were managed endoscopically, with intraoperative emphasis on protecting the internal carotid artery (ICA) due to its encasement by the tumor in multiple cases. Three patients experienced recurrence, and one died of disease, suggesting that tumors involving the skull base and major vessels carry a worse prognosis[41].

Follow-Up and Risk Stratification

Due to the potential for late recurrence—even in tumors deemed histologically benign—long-term surveillance is recommended. In one report by Thompson et al., an orbital SFT recurred after nearly 9 years despite initial low-risk features [42]. As a result, the use of risk models, such as the Demicco model (age, size, mitotic count, necrosis), can aid clinicians in predicting outcomes and guiding follow-up schedules [43].

Limitations in Current Literature

Although the number of reported cases is increasing, most studies are retrospective, single-institution series or case reports. This limits the generalizability of findings and the development of standardized treatment protocols. Moreover, the role of adjuvant radiotherapy or systemic therapy remains poorly defined and is generally reserved for unresectable or metastatic cases [44].

DISCUSSION

The evolving understanding of solitary fibrous tumors in the head and neck region underscores the importance of molecular diagnostics, particularly STAT6 IHC, in confirming diagnosis. While surgical resection with negative margins remains the treatment cornerstone, the risk of recurrence—even in benign-appearing tumors—warrants long-term follow-up. Future research

should focus on multicenter prospective studies to develop evidence-based guidelines for diagnosis, treatment, and surveillance of HNSFTs.

Key Case-Based Insights

As noted, solitary fibrous tumors of the head and neck (HNSFTs) span a spectrum of clinical behaviors, from indolent to aggressive. This diversity is evident in both the published literature and clinical experience. While immunohistochemical and histologic features aid diagnosis and prognostication, case-based evidence underscores the importance of individualized management and long-term follow-up. The following table highlights representative real and sample cases from recent studies and institutional reports, illustrating variations in presentation, pathology, treatment, and outcomes.

Table 2: Summary of Real and Sample Cases of Head and Neck Solitary Fibrous Tumors

Case No.	Source	Patient Details	Tumor Site	Histology & IHC	Treatment	Outcome
1	Tariq et al. (2024) (42)	29-year-old female	Nasal cavity	Epithelioid morphology, STAT6+, CD34+, mitotic rate: 1/10 HPF	Surgical excision	Local recurrence at 11 months
2	Chung et al. (2022) (3)	55-year-old male	Buccal mucosa	Classic SFT morphology, STAT6+, CD34+, low mitotic index	Complete surgical excision	No recurrence at 12 months
3	Chung et al. (2022) (3)	64-year-old female	Medial canthus	Spindle cells, wavy nuclei, STAT6+, CD34+	Surgical resection	Disease-free at 124 months
4	Thompson et al. (2021) (15)	44-year-old male	Orbit	Bland spindle cells, STAT6+, CD34+, low mitotic activity	Complete excision	Local recurrence at 102 months

5	Thompson et al. (2018) (5)	66-year-old male	Sphenoid/ethmoid sinus	Patternless architecture, STAT6+, CD34+	Endoscopic resection	Disease-free at 96 months
6	Peng et al. (2022) (41)	58-year-old male	Cranial base (ICA encased)	Hypercellular, STAT6+, CD34+, mitoses >4/10 HPF	Partial resection	Recurrence + mortality
7	Stanisce et al. (2020) (2)	343 pooled cases	Multiple HN sites	Variable histology, margin status crucial	Mixed treatments	Recurrence related to margin status
8	Smith et al. (2017) (8)	67-year-old female	Parotid gland	Spindle cells, CD34+, STAT6+	Superficial parotidectomy	No recurrence at 60 months
9	Thompson et al. (2021) (15)	76-year-old male	Upper eyelid	Low mitotic rate, STAT6+, CD34+	Surgical excision	Disease-free at 5 years
10	Sample case (typical)	50-year-old male	Maxillary sinus	Patternless growth, STAT6+, mitotic rate 3/10 HPF	Wide excision	No recurrence at 36 months

Analysis of Table and Key Observations

- **Tumor Location & Recurrence Risk**: Tumors involving deep or anatomically constrained areas (e.g., cranial base, orbit) pose higher surgical risk and potential for recurrence due to incomplete excision. This is evident in Case 6, where ICA involvement led to subtotal resection and eventual mortality (13).
- **STAT6 Immunohistochemistry**: All cases demonstrate strong nuclear STAT6 positivity, reinforcing its central role in confirming diagnosis. It is especially helpful in morphologically ambiguous or atypical presentations such as in Case 1 (7).
- **Histologic Grading and Clinical Course**: Even tumors with low mitotic activity (e.g., Cases 4 and 9) can recur after many years, emphasizing the limited predictive value of histologic grading alone. Conversely, some high-risk histologies (e.g., Case 10) may behave indolently if completely resected.

- **Surgical Margins**: Positive margins were consistently associated with recurrence in both real and pooled cases (Cases 1 and 7). This further supports surgical completeness as the most reliable predictor of long-term disease control (12).
- **Follow-up Duration**: Recurrences can occur several years post-treatment (Case 4, 102 months), highlighting the necessity of long-term clinical and radiologic follow-up even in histologically benign tumors.

Limitations

Despite advancements, challenges remain in accurately predicting tumor behavior and recurrence risk. Limited sample sizes and retrospective study designs restrict the generalizability of findings. Additionally, the role of targeted therapies in SFT management requires further exploration.

Future Scope

Future research should focus on prospective studies with larger cohorts to validate current findings. Molecular profiling and genetic analyses may provide insights into novel therapeutic targets. Additionally, standardized treatment guidelines are needed to optimize patient outcomes.

CONCLUSION

Solitary fibrous tumors of the head and neck region (HNSFTs) are rare, diagnostically challenging neoplasms that exhibit a wide clinical and histological spectrum. Advances in immunohistochemistry, particularly the identification of nuclear STAT6 expression, have significantly improved diagnostic accuracy, allowing better differentiation from histologic mimics. Despite predominantly benign behavior, a subset of HNSFTs demonstrates malignant features and poses a risk of recurrence, particularly when complete surgical excision is not achieved.

Surgical resection with clear margins remains the cornerstone of treatment, but achieving this can be difficult in anatomically complex sites such as the orbit, skull base, and parapharyngeal space. Histologic markers alone may not reliably predict tumor behavior; thus, integrated risk stratification models and long-term clinical follow-up are essential for optimizing patient outcomes. Recurrences may occur many years after treatment, reinforcing the need for vigilance even in low-grade tumors. As literature on HNSFTs continues to grow, multicenter prospective studies are urgently needed to establish standardized protocols for diagnosis, treatment, and follow-up of this uncommon but clinically significant entity.

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