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REVIEW ARTICLE

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Comparing Mohs micrographic surgery and wide local excision in the management of head and neck dermatofibrosarcoma protuberans: a scoping review

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ABSTRACT

Dermatofibrosarcoma protuberans (DFSP) is a rare, locally aggressive cutaneous sarcoma with a propensity for recurrence. Its management, particularly in the head and neck (H&N) region, presents unique challenges. This study aimed to evaluate the effectiveness of Mohs micrographic surgery (MMS) compared to wide local excision (WLE) in treating H&N DFSP and its impact on recurrence rates and tissue preservation. A comprehensive search was conducted in PubMed/MEDLINE, yielding 29 relevant studies. We included studies comparing MMS and WLE in adult patients with H&N DFSP and reporting local recurrence outcomes. Data were analyzed using random effects analysis, with a meta-analysis performed for comparative studies. Analysis of studies demonstrated a lower recurrence for MMS. Comparative analysis of five studies involving 117 patients showed a significantly lower recurrence rate in the MMS group (2%) compared to the WLE group (19%). Margin status varied between studies, with some achieving negative margins at shorter distances. In the management of H&N DFSP, MMS has emerged as a superior surgical technique, consistently associated with reduced recurrence rates and the potential for tissue preservation. The adoption of MMS should be considered for its capacity to achieve negative margins with fewer processing steps, particularly in anatomically complex regions like the H&N.

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KEYWORDS
Dermatofibrosarcoma protuberans; Mohs micrographic surgery; wide local excision; head and neck; recurrence

Introduction

Dermatofibrosarcoma protuberans (DFSP) is a low-grade cutaneous sarcoma that can affect the dermis, subcutaneous fat, muscle, and fascia (Figure 1). It is uncommon, slow-growing, and locally aggressive, with extensive tissue infiltration and a propensity for local recurrence (13–73%) (1–5). With only a few case reports in the literature, DFSP metastasis to cervical lymph nodes remains exceedingly uncommon (6–8). Hematogenous spread with distant metastasis is seen more frequently (10–15%) (9). Therefore, the experience of managing patients with regional extension of DFSP is limited but typically includes radical neck dissection.

Due to population-based studies conducted in the United States, Canada, and France, the annual incidence of DFSP ranges between 3.0 and 9.3 per one million people, respectively (10,11). Women are 1.14 times more likely to be affected than men. The condition is mostly found on the trunk (42%), followed by the upper and lower extremities (41%), and in a lesser proportion, in the H&N (10–15%), especially on the scalp, supraclavicular region, and forehead (2,3,12,13). Kreicher et al. reported that patients with DFSP who are older, male, black, and have tumor location in the extremities and H&N, have lower survival (10). Go et al. (14) showed a 94% overall survival rate and 99% disease-specific survival rate for the H&N DFSP group at 5 years in 681 SEER patients from 2000 to 2018 (14).

Negative surgical margins have been considered the most important prognostic factor in patients with DFSP, as local recurrence may predispose to distant metastases (15). Consequently, surgical resection with negative margins is the preferred curative treatment (9). Despite wide resection, it is believed that the high recurrence rate is due to the inability of traditional histopathologic methods to evaluate large portions of tissue from the margins, as the tumor creates occult projections in the form of subclinical tentacular extensions into adjacent tissues that may go undetected (15–17).

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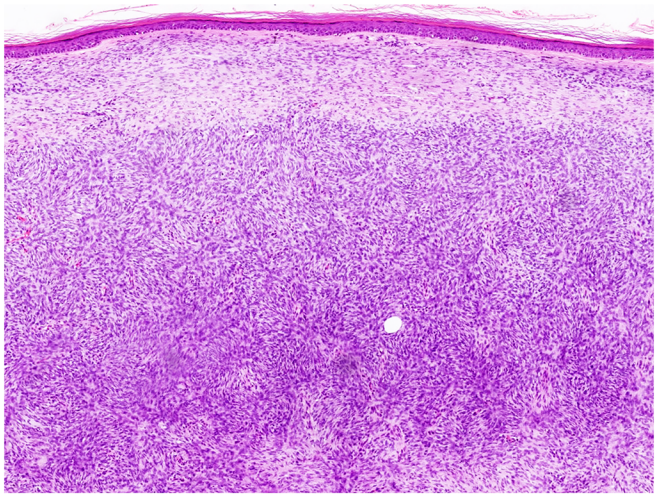

Figure 1. DFSP. Proliferation of uniform spindle cells in the dermis, separated from epidermis by a border zone. (Courtesy: Dr. Daja Šekoranja).

To achieve a complete resection, it has long been recommended that the first surgical approach use wider margins of 2–3 cm, known in the literature as wide local excision (WLE) (3,16,18). However, as a result of high (13–73%) (1) rate of recurrence rate associated with WLE, Mohs micrographic surgery (MMS) approach is now recommended as the first surgical treatment option, although it is not commonly employed, and normal histological techniques are still used in many regions (19,20). MMS was introduced decades ago in other body sites, which has reduced the rate of DFSP recurrence to <1% (0.0–8.3%) due to intraoperative microscopic control of the surgical margin (3,21–25). Moreover, MMS offers other advantages over WLE for DFSP located in the cervicofacial region, where preservation of healthy tissue without impairing local control is essential (5,15,24–26). In the first case, or classic Mohs, the surgeon acts as or in conjunction with the dermatopathologist to intraoperatively evaluate the frozen pathological sections, whereas in the second case, or Slow-Mohs, the margins are embedded in paraffin and evaluated three-dimensionally without the use of frozen sections. The latter is different from the old technique, which does not examine margins in three dimensions (27). However, some authors consider that it is more difficult to define negative margins with the frozen section technique, which is the most common method for non-melanoma skin cancers, although this is the subject of debate. Better results have been seen with the Slow-Mohs method or paraffin-embedded sections, but it costs more and takes longer (28).

Specific information regarding the outcomes of MMS in H&N DFSP is scant.

This scoping review aims to assess the available evidence regarding the surgical resection technique, specifically MMS in patients with DFSP of the H&N, and its influence on the clinical outcomes of complete resection, tissue preservation, and risk of recurrence. The specific research question is: 'Is MMS superior to WLE in reducing the rate of local recurrences and preserving adjacent healthy tissue in patients with head and neck DFSP?'

Materials and methods

The search strategy was performed in the PubMed/MEDLINE database using related terms '("Mohs surgery"[MeSH Terms] OR "Mohs"[All Fields]) AND ("head"[All Fields] AND "and"[All Fields] AND "neck"[All Fields]) OR "head and neck"[All Fields] OR ("head"[MeSH Terms] OR "head"[All Fields] OR ("neck"[MeSH Terms] OR "neck"[All Fields])) AND ("dermatofibrosarcoma"[MeSH Terms] OR ("dermatofibrosarcoma"[MeSH Terms] OR "dermatofibrosarcoma"[All Fields] OR "dermatofibrosarcomas"[All Fields]))'. A 'snowball' search was also performed with the references of the identified studies. The last search was made on 1 August 2023. Two authors (PP and AS) performed the search. We searched all primary references for studies comparing MMS and WLE or case series demonstrating the effectiveness of MMS in primary or recurrent tumor cases. We did not contemplate excluding content based on publication year or language.

We examined the full texts of the selected studies and excluded individual case reports. Selection differences were resolved by consensus. We considered studies that included adult patients with DFSP localized to the H&N or information of H&N location in studies on adult patients with DFSP located anywhere in the body), and who underwent surgical resection with MMS and/or compared MMS with WLE and reported local recurrence outcomes. Patients with DFSP in the H&N had to be characterized in detail and with distinction in primary studies. Only studies with fewer than three subjects were excluded. Excel (Microsoft Corp., USA) spreadsheets were used to capture study data.

Random effects analysis was used to calculate the combined incidence (95% confidence interval) for each outcome because this method provides a conservative summary estimate and integrates between-study variance (29). To derive calculations from data containing zero events, a correction of 0.01 was made. The Higgins I^2 statistic was used to measure statistical heterogeneity. A forest plot graph was used to display the intervention's effects. For the analysis of comparative studies, a meta-analysis was conducted with the RevMan V5.4.1 (Review Manager (RevMan) [Computer program]. Version 5.4. The Cochrane Collaboration, 2020) software using the risk difference (RD) with random effects method. Due to the study's design, approval by a research ethics committee was not required.

Results

The initial search resulted in 364 studies. Twenty-nine articles were evaluated after implementing the inclusion and exclusion criteria and reviewing their titles and abstracts (Figure 2).

There were four systematic reviews, none of which focused explicitly on H&N tumors and none of which included randomized clinical trials (3,17,21,30). Malan et al. (3) included five observational studies with a total of 684 patients, of whom 15.45% were patients with DFSP in the H&N, and is the only meta-analysis describing the specific recurrence rate according to surgical technique, being 38.2% for patients treated with WLE and 16% for those treated with MMS. In 2008 Paradisi et al. (17) compiled data from 29 studies involving 1857 patients, of whom 293 (15.9%) had DFSP of the H&N, with a recurrence rate of 1.9% for patients treated with MMS and 51.8% for WLE patients. None of them were included in the subsequent analyses.

Series of DFSP patients treated with MMS

There were 24 studies having evaluated the recurrence rate in 246 H&N DFSP patients out of a total of 1122 (21.9%) (Table 1) (22,31–52). Three studies exclusively included 70 patients with H&N malignancies (9,51,52), with the majority ($n = 50$) requiring

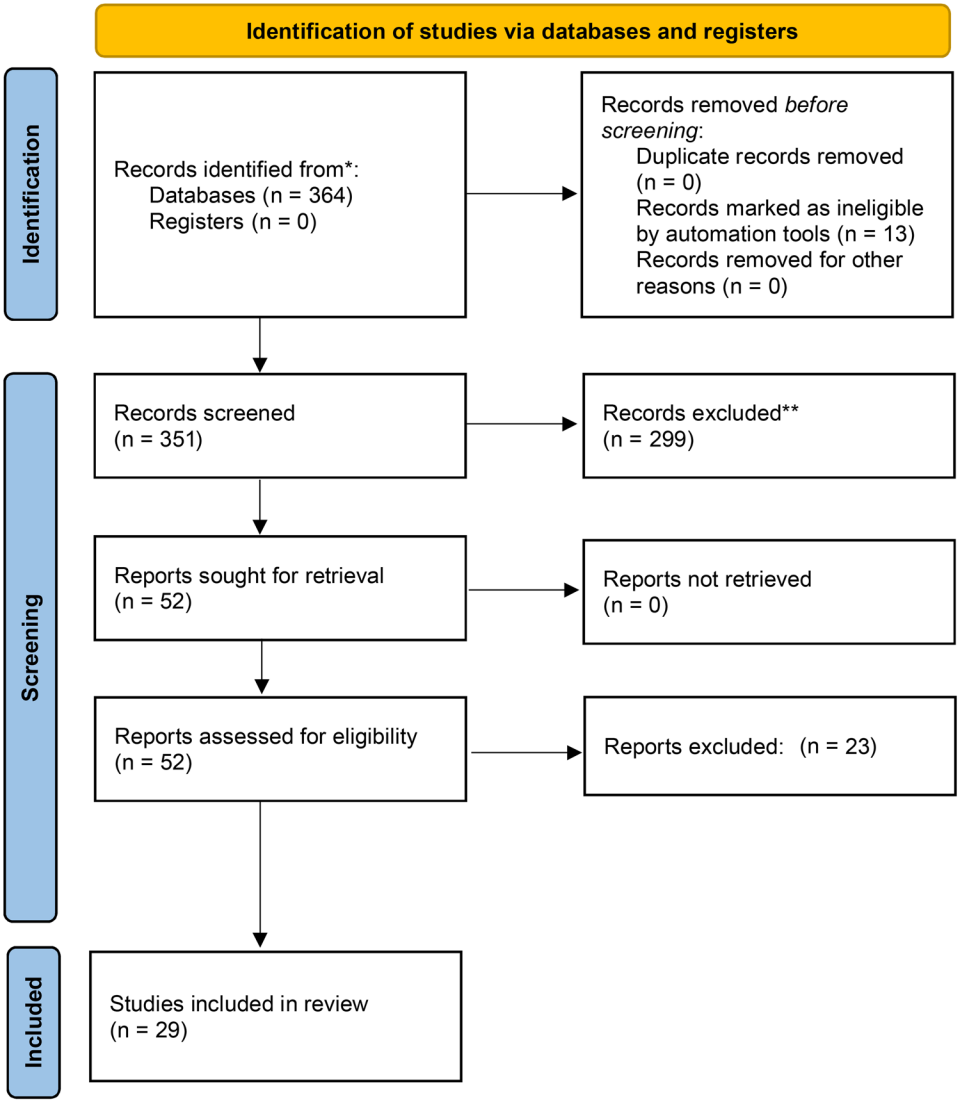

Figure 2. PRISMA flow chart.

between one and four stages for complete resection as primary treatment. Other studies included patients from all locations from which it was possible to extract H&N specific data. No information on the specific sub-sites could be obtained. The studies revealed an overall recurrence frequency of 0% (95% CI: 0–0.4%) (Figure 3).

Comparative analysis of MMS and WLE recurrence

Five studies comparing MMS to WLE involving 117 patients with H&N cancer were identified (16,17,26,53,54) (Table 2). No information on the specific sub-sites could be obtained. In these five studies, the duration of follow-up ranged from 4 to 8.7 years. The mean rate of recurrence was 19% in the WLE group and 2% in the MMS group. The MMS group had a lower recurrence rate (RD −16%) (95% CI −28 to −2%, $p = 0.19$, $I^2 = 35\%$) (Figure 4).

Margin status

Regarding margins, Tom et al. (51) and González et al. (9) reported negative margins in all MMS patients with a tumor distance >2.5 cm, whereas Verbruggen et al. (52) reported a minimal distance of 10 mm. All of these investigations utilized frozen section techniques, and the conclusive results were identical to those reported in definitive paraffin sections.

Discussion

DFSP is a malignant tumor of connective tissue with a favorable prognosis (51). Its traditional treatment is surgical and for many years extensive three-dimensional local resections (distance to the tumor >2 cm) were recommended with the aim of obtaining negative histopathological margins (wide local excision). No consideration to lymph node resection is considered because of the rarity of regional dissemination. Its incidence in the H&N is low (15–20% of all DFSP) (3), but a higher risk of recurrence has been demonstrated than in other body sites, and this has been attributed to the difficulty in achieving negative margins due to anatomical and functional constraints of the surgical site (51). Nonetheless, some authors have proposed a particular histologic behavior using MMS. Gassenmaier et al. (35) performed a retrospective clinicopathologic analysis of 48 patients with DFSP treated by MMS and demonstrated that only 14% of tumors in the H&N region were

Table 1. Non-comparative studies of the treatment of DFSP of the head and neck with Mohs micrographic surgery (MMS).

	Author	Year	Total number of patients with DFSP	Mean number of stages	Number of patients with primary/ recurrent tumor	Number of patients with DFSP in H&N	Patients with recurrence	Follow-up time (years)
General population	Dawes et al.	1996	24	NR	15/9	6	1	5.1
	Garcia et al.	1996	16	3.3	6/0	3	0	4
	Haycox et al.	1997	10	NR	3/7	5	0	3.5
	Ratner et al.	1997	58	2.4	33/25	13	1	3
	Huether et al.	2001	33	NR	26/7	4	0	3.8
	Nouri et al.	2002	20	2.5	17/3	2	0	1.5
	Ah-Weng et al.	2002	21	1.3	16/5	4	0	3.9
	Snow et al.	2004	29	4.1	21/8	13	0	>5
	Wacker et al.	2004	22	1.6	13/9	7	0	1.8
	Thomas et al.	2007	39	2.3	31/4	3	0	3.2
	Hafner et al.	2008	70	NR	54/16	9	0	5.3
	Nelson et al.	2008	44	2.4	31/11	6	0	2.5
	Hancox et al.	2008	25	1.9		6	0	3.1
	Tan et al.	2011	35	1.5	22/13	6	0	2.4
	Irarrazaval et al.	2012	29	1.4	12/17	3	0	4.7
	Chaput et al.	2013	35	NR	35/0	2	0	3.8
	Loghdey et al.	2014	76	NR	67/9	8	0	4.1
	Martín-Fuentes et al.	2018	33	1.3	37/6	4	0	6.25
	Nieto-Benito et al.	2021	163	NR	105/58	25	0	NA
	Gassenmaier et al.	2021	48	2	35/13	7	2	4.1
	Serra-Guillén et al.	2022	222	1.4	113/111	40	0	10.5
Head and neck population	Tom et al.	2003	9	3.9	7/2	9	0	3.9
	Verbruggen et al.	2018	20	1.2	20/0	20	0	3.1
	González et al.	2021	41	1.6	23/18	41	1	7.7

NR: not reported.

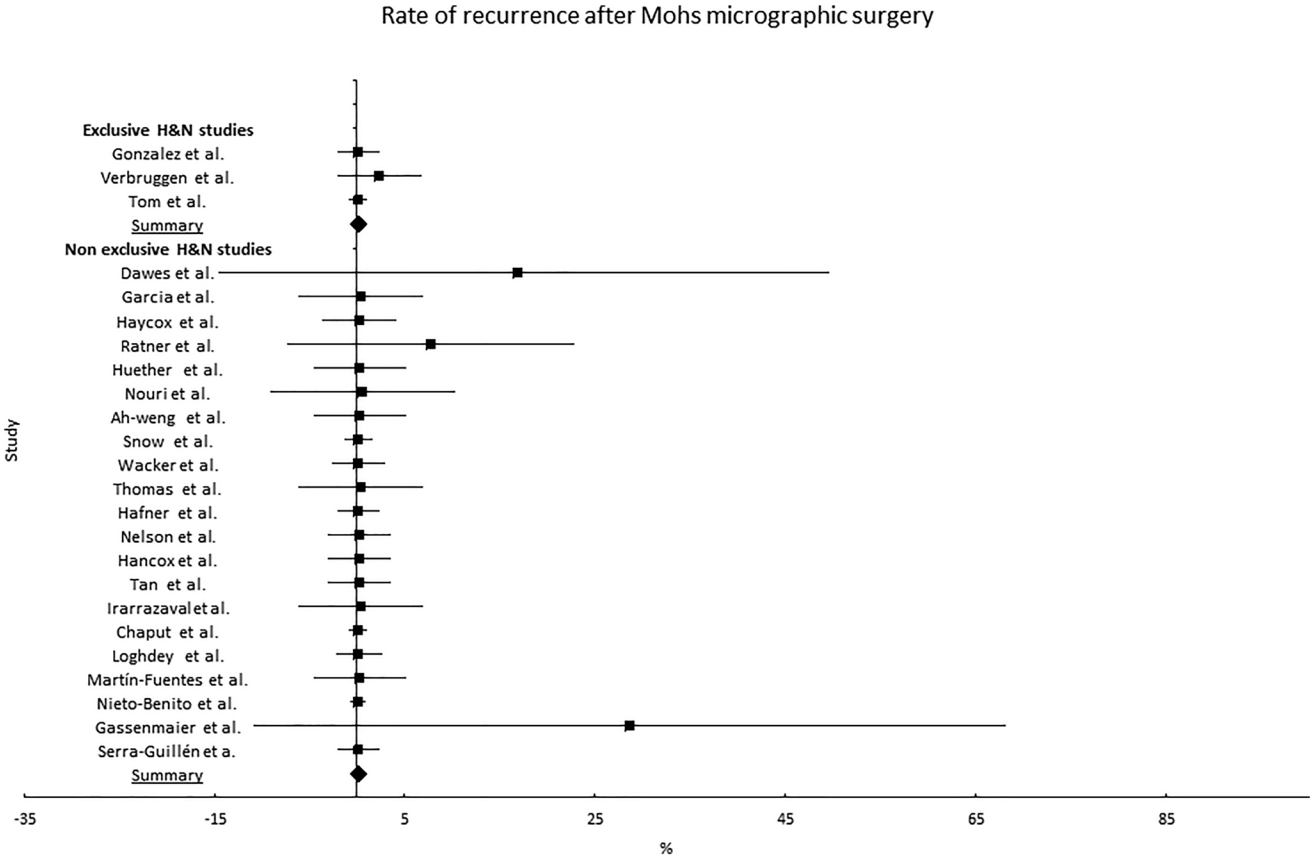

Figure 3. Rate of recurrence of DFSP in head and neck area after Mohs micrographic surgery. Case series.

Table 2. Comparative studies between wide local excision (WLE) and Mohs micrographic surgery (MMS) for the treatment of DFSP of the head and neck.

Author	Year	Total number of patients with DFSP	Patients with DFSP in H&N	Patients treated with Mohs surgery	Recurrence in the Mohs surgery group	Follow-up time in the Mohs surgery group (years)	Patients treated with wide local excision	Recurrence in the wide local excision group	Follow-up time in the wide local excision group (years)
DuBay et al.	2004	62	15	7	0	5.2	8	0	4.0
Paradisi et al.	2008	79	9	2	0	5.4	7	2	4.8
Goldberg et al.	2015	41	9	2	0	9.3	7	0	8.7
Lowe et al.	2017	186	33	10	1	4.8	23	11	5.7
Durack et al.	2021	518	51	20	0	NR	31	3	NR

NR: not reported.

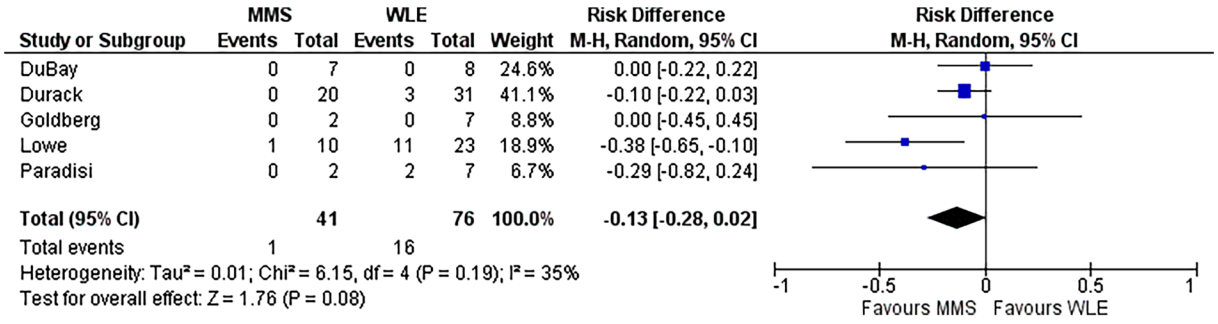

Figure 4. Comparison of rate of recurrence of DFSP in head and neck area after Mohs micrographic surgery. MMS: Mohs micrographic surgery; WLE: wide local excision.

completely located above the fascia compared to 93% of tumors in the trunk and extremities. This may be due to the thinner skin and subcutaneous cellular tissue in this body region.

Other surgical techniques have been described as alternatives to WLE, including frozen section Mohs micrographic surgery (MMS), modified/Slow-Mohs, complete circumferential deep and peripheral margin assessment (CCPDMA) (41). These aim to assure a negative microscopic margin and, secondarily, to preserve tissue to enhance the esthetic and functional outcomes of resection and facilitate reconstruction. The most recent guidelines have recommended MMS as the treatment of choice (19,20).

The differences in recurrence for patients taken to MMS compared to WLE with DFSP of any location evidenced in the meta-analyses of Malan et al. (3) (2.72 *vs.* 9.1%), Martin et al. (30) (1.7 *vs.* 3.73%), and Foroozan et al. (21) (1.1 *vs.* 6.3%) are clear. The frozen section method was used in most of the studies that were included. However, in some centers, the Slow-Mohs paraffin-embedded definitive section method is more used because frozen Mohs is difficult to process in thick sections (such as the scalp and nape of the neck), restricting the evaluation of the cellular morphology and produces more false negative results (9,16,27,51,52,55). Lee et al. found that frozen MMS is equally effective as paraffin MMS for treating DFSP, however, the paraffin MMS group had a far larger number of patients having previous excision. The paraffin group had longer MMS than the frozen group (28). However, its adoption has been restricted by the complexity of its processing, the need for close to 15–20 h, the excessive cost, and the discomfort of the patient (27,56,57). Gonzalez et al. (9) showed that it is possible to use local anesthesia with excellent results in 70% of cases involving large tumors, despite the fact that some authors have stated that this is unfeasible. Using NCDB data from 2004 to 2016, Desai et al. examined MMS adoption predictors. Academic centers used MMS more than community or integrated network programs when compared to all other treatments. Additionally, Caucasian patients with higher wealth had more MMS (58). Lastly, its application will depend on the availability of the necessary equipment and the institution's level of expertise. The important question is why MMS isn't used more often considering its superiority over WLE? Some of the reasons could be that frozen sections may not always be available, the surgical procedure takes longer than expected, MMS can't be used when the bone is involved and composite removal is needed, or the institution doesn't have the required experience.

However, information regarding the efficacy of MMS in the treatment of DFSP of the H&N is limited. In evaluating descriptive studies, pertinent evidence supports the routine use of MMS in cases of H&N DFSP. Even though 30% of patients treated corresponded to incomplete resections or recurrences, the frequency of recurrence at more than 5 years is close to 0%. Reviewing the data provided by the few comparative studies reveals a 16% advantage for MMS in terms of recurrence.

Regarding margin size, the results are even more limited. Verbruggen et al. (52) report a mean margin of 1.5 ± 0.57 cm for MMS-managed DFSP patients, while Serra-Guillén et al. (59) calculated a minimum margin of 1.58 cm for complete resection in 222 patients, slightly larger than the overall group's minimum margin of 1.23 cm. These findings suggest that, with MMS, it is possible to preserve a greater quantity of surrounding tissue, as the standard 3 cm margin recommended for WLE can be reduced (60).

Most scientific literature comes from retrospective studies, which are prone to selection bias. Due to the disease's rarity, randomized clinical studies comparing H&N DFSP resection regimens are improbable. The studies' heterogeneity, which includes individuals with original tumors and recurrences of various sizes and sites, makes this more difficult. This study is the most recently published review of scope aimed at obtaining specific information about DFSP in the H&N.

In conclusion, for the H&N presentation of DFSP, the implementation of MMS has reduced the rate of recurrences to a negligible

level compared to that of WLE. In addition, considering the anatomical, functional, and esthetic conditions of the cervicofacial region, MMS provides an additional advantage by ensuring negative margins with fewer specimen processing steps and by preserving and optimizing tissue through smaller margins than those described for WLE.

Author contributions

Alvaro Sanabria and Pilar Pinillos: conceptualization, methodology, validation, investigation, data curation, formal analysis, writing–original draft, and writing–review and editing. Carlos Chiesa-Estomba, Orlando Guntinas-Lichius, Luiz P. Kowalski, Antti A. Mäkitie, Karthik N. Rao, and Alfio Ferlito: conceptualization, validation, investigation, data curation, writing–original draft, and writing–review and editing.

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