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Management of head & neck sarcomas in adults: A retrospective study

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ABSTRACT

The research purpose is to review the surgical approach and evaluate the results in adult patients with head and neck sarcomas.

The histopathology varied, including two leiomyosarcomas, six malignant fibrous histiocytomas, two malignant peripheral nerve sheath tumors, four dermatofibrosarcomas protuberans, three osteosarcomas, two angiosarcomas, one liposarcoma, one Ewing sarcoma, one synovial sarcoma, two unclassified/non-differentiated sarcomas and one solitary fibrous tumor. Surgical resection included maxillectomy, mandibulectomy, craniectomy, parotidectomy, scalp resection, face skin resection and laminectomy. The reconstruction was performed with one rectus abdominis flap, four radial forearm flaps, two latissimus dorsi flaps, two vascularized fibula flaps, two pectoralis major myocutaneous flaps, two trapezius flaps, two temporalis flaps, seven scalp flaps and two nasolabial flaps.

The total patient number was 24. The hospitalization was uncomplicated, followed by postoperative radiotherapy in the majority of cases. In a mean 15-year follow-up period, 11 patients are still alive and disease-free. There were four recurrences treated with palliative radiotherapy.

The surgical approach for head and neck sarcomas, including the achievement of a functionally acceptable result by organ sparing techniques, remains challenging. Wide resection combined with the appropriate reconstruction, particularly with microsurgical techniques, and followed by adjuvant radiotherapy or chemotherapy offer improved prognosis and quality of life.

1. Introduction

Sarcomas are rare, malignant bone and soft-tissue tumors of mesenchymal origin and their overall incidence accounts for 1% and 0.2% of all malignancies, respectively (Pellitteri et al., 2003; Tajudeen et al., 2014; Kalavrezos and Sinha, 2020). Sarcomas account for about 1% of all solid malignancies in adults (Tran et al., 2020; Owosho et al., 2017; Meyer, 2022; Weskamp et al., 2022) and 15–21% of those in children (Tran et al., 2020; von Mehren et al., 2022; Ding et al., 2018). Head and neck locations are infrequent with annual incidence around 5 per 100,000 (Galy-Bernadoy and Garrel, 2016; Pellitteri et al., 2003). These locations are the rarest, representing approximately 5–15% of all sarcomas in adults (Galy-Bernadoy and Garrel, 2016; Swallow and Catton, 2007; Tran et al., 2020) and 1% of all head and neck malignancies (Tran et al., 2020). They show a biphasic age of distribution: 80%–90% affect adults, whereas 10–20% are seen in the pediatric age group (Pellitteri et al., 2003). Sarcomas are malignancies that arise from transformed cells of mesenchymal origin (Tajudeen et al., 2014). Metastases are relatively uncommon and are only seen in approximately 10% of patients at presentation (Peng et al., 2014). Current classification schemes attempt to group sarcomas into subtypes that are useful for determining prognosis and formulating treatment strategies. In general, these neoplasms are grouped by mesenchymal cell of origin, head and neck anatomical site and histologic grade (Tajudeen et al., 2014). The vast majority of tumors, approximately 80%, are of soft-tissue origin while the remaining 20% are of bony or cartilaginous origin (Kowa et al., 2021; Tran et al., 2020). The histologic grade is a consistent predictor of prognosis and its importance is illustrated in the American Joint Committee on Cancer (AJCC) staging system for sarcomas. Difficulty can arise in formulating a standardized treatment algorithm for sarcomas, as there are often inconsistencies in pathologic evaluations both from a histologic and grading standpoint. This inconsistency often makes it difficult to pool multi-institutional studies (Tajudeen et al., 2014).

As sarcomas comprise less than 1% of all head and neck malignancies, there are no prospective, randomized-controlled trials to guide

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management. Current guidelines are based on the collective efforts of retrospective studies from tertiary-care centers as well as treatment guidelines extrapolated from sarcomas of the trunk and extremities (Tajudeen et al., 2014).

The purpose of this study is to review the surgical approach and evaluate the results of adult patients with head and neck sarcomas, treated in the Greek Anticancer Institute, a tertiary referral centre. Taking into consideration the postoperative complications along with the disease recurrence rates, the present study is aiming to demonstrate that the surgical resection remains the gold standard for the management of sarcomas of the head and neck region, as it can not only improve the quality of life but also prolong the disease-free survival and the overall survival of these patients.

2. Patients and methods

The present study is a retrospective one. All procedures were performed in compliance with relevant laws and institutional guidelines and have been approved by the appropriate institutional committee (reference number of ethical approval: 28/448,361). All patients have given consent for possible publication of their cases and illustrations. No recognizable features are included in the illustrations. Details regarding personal information and identification remain absolutely anonymous and confidential.

The selection criteria included adult patients with primary bone and soft tissue sarcomas of the head and neck region.

2.1. Histopathology

The histopathology varied including two leiomyosarcomas (LMS), six malignant fibrous histiocytomas (MFH), two malignant peripheral nerve sheath tumors (MPNST), four dermatofibrosarcomas protuberans (DFSP), three osteosarcomas (OsS), two angiosarcomas (AS), one liposarcoma (LiS), one Ewing sarcoma (EWS), one synovial sarcoma (SS), two unclassified/non-differentiated sarcomas (NDS) and one solitary fibrous tumor (SFT). The anatomical site also varied and associated with the histological subtype, as described below. The most common histological subtype of head and neck sarcomas in this study was malignant fibrous histiocytoma (MFH). Totally six patients have developed this type of sarcoma. Scalp was affected in all cases. The next most common subtype was dermatofibrosarcoma protuberans (DFSP), with four patients suffering from this malignancy. In the three of these four cases DFSP have developed in the face or forehead, while in the fourth case DFSP arose from the supraclavicular area. Among the three cases of osteosarcomas, two of them arose from the mandible, while the other one from the frontal bone of scalp. Concerning angiosarcomas, both cases were cutaneous scalp angiosarcomas. Regarding the two patients with malignant peripheral nerve sheath tumors (MPNST), this sarcoma in both cases has developed in the upper nasal tract. Interesting is the fact that one of these patients with MPNST presented a synchronous cervical spine soft tissue sarcoma; a synovial sarcoma. Two cases of leiomyosarcomas, one developed in the scalp, while the other one in the maxilla, specifically in the right orbit, are also included in this study. One case of liposarcoma and one case of solitary fibrous tumor have both developed in the supraclavicular area of the neck. There was also one patient with Ewing sarcoma of the cervical spine and two patients with unclassified/non-differentiated sarcomas (NDS). One of these NDS has developed in the temple area, while the other one in the shoulder (subclavicular area).

2.2. Anatomical site

Regarding the anatomical site, the scalp represented the most common area for sarcomas development in the present study, including a total of eleven patients (n = 11). Face and forehead were affected in three patients (n = 3), while neck, supraclavicular area and shoulder in four cases (n = 4). Less common subsites were mandible (n = 2), nasal tract (n = 2) and cervical spine (n = 2), each of them involved in two cases, while the rarest site was the maxilla and specifically the orbit, affected only in a single case (n = 1).

2.3. Surgical approach

Surgical treatment of head and neck sarcomas achieves acceptable results of local control and survival (Galy-Bernadoy and Garrel, 2016; Pellitteri et al., 2003; Potter and Sturgis, 2003; Swallow and Catton, 2007; Rastatter et al., 2021; Aguín et al., 2011; Rapidis et al., 2005). The majority of surgical approaches included scalp resections, in a total of twelve patients (n = 12). In five cases (n = 5) craniectomy was performed. In two cases (n = 2) mandibulectomy was performed, while one patient (n = 1) underwent maxillectomy. Parotidectomy was performed in two patients (n = 2). Two patients (n = 2) underwent face skin resection, while laminectomy was performed in two other cases (n = 2).

2.4. Selective neck dissection

Selective neck dissection (SND) was performed in six cases. Nodal metastases are very uncommon except for certain subtypes (Swallow and Catton, 2007). Sarcomas tend to spread by local extension or give hematogenous metastasis (Kalavrezos and Sinha, 2020; Blazer et al., 2003), while lymph node metastasis is extremely rare in bone and soft tissue sarcomas (Tanaka and Ozaki, 2019) and the spread through lymphatic vessels represents less than 5% (Maduekwe et al., 2009). However, synovial, epithelioid, and clear cell subtypes (Tanaka and Ozaki, 2019; Blazer et al., 2003) as well as rhabdomyosarcoma and vascular sarcomas (Blazer et al., 2003) reportedly have a much higher risk of lymph node metastasis. Taking this into consideration, in the present study neck dissection was selective and only performed in order to facilitate free flaps microvascular anastomoses with branches of common carotid artery and internal jugular vein. The histopathological examination of these cervical nodes was negative for metastatic disease in all these six cases.

2.5. Reconstruction methods

Reconstruction methods included local or free flaps. Two vascularized fibula free flaps were used for mandible reconstruction after mandibulectomy. Four radial forearm free flaps (RFF) were used, one for scalp reconstruction after wide field surgical resection of a malignant fibrous histiocytoma (MFH) combined with craniectomy, while the other three RFF covered the defects after face and forehead skin resections. Two pectoralis major myocutaneous flaps were used, one of them for shoulder reconstruction after wide surgical resection of an unclassified/non-differentiated sarcoma in the subclavicular area, while the other one covered the defect in the supraclavicular area after a DFSP resection. Regarding scalp flaps, they were used in seven cases after wide surgical excision of MFH in five patients, osteosarcoma in one patient and leiomyosarcoma in the other one. After wide surgical resection of cutaneous scalp angiosarcomas in two patients, reconstruction was performed with latissimus dorsi free flaps in both cases. One rectus abdominis free flap was used for maxilla reconstruction after maxillectomy for orbit leiomyosarcoma. Temporalis muscular flap was used in two patients. One of them for maxilla reconstruction after leiomyosarcoma wide field surgical resection, while the other one for scalp reconstruction after excision of an unclassified/non-differentiated sarcoma of the temple area. Two trapezius myocutaneous flaps were used to cover cervical spine defects after Ewing sarcoma and synovial sarcoma excisions. After resection of two nasal tract MPNSTs, local nasolabial rotation flaps were used for defect reconstruction. Liposarcoma and solitary fibrous tumor resections in supraclavicular area were followed by primary wound closure, without any specific reconstructive method, since these sarcomas have developed as masses inside the

supraclavicular fold (Table 1, Table 2).

3. Results

During the study interval (2001–2021) the medical records of 24 consecutive patients admitted for the management of head and neck sarcomas were reviewed by the head and neck oncology clinic. Demographic data of these patients were recorded. The anatomical site of the tumor along with the surgical approach and reconstruction technique were also recorded. Where necessary, the histopathology was reviewed to confirm diagnosis or derive additional information not included in the original report.

There were 15 male and 9 female patients with an average age of 50 years. One patient has developed two different sarcomas, one nasal MPNST and a synchronous synovial sarcoma of the cervical spine. Taking this into consideration, the total head and neck sarcomas were 25.

Excision margins were histologically complete in the vast majority (n = 22). Positive excision margins were reported in two cases of scalp angiosarcomas, as well as in one case of scalp osteosarcoma.

Patient postoperative hospitalization was almost uncomplicated. A case of wound dehiscence 2 weeks postoperatively after mandibulectomy and reconstruction with a vascularized fibula free flap was treated with wide field surgical debridement followed by defect reconstruction with a pectoralis major myocutaneous flap. Eventually the patient dill well. Postoperative planned adjuvant radiotherapy followed the surgical resection in the majority of cases. It was administered almost to all patients, except for patients with DFSP.

All sarcomas with positive excision margins recurred. These two patients with cutaneous scalp angiosarcomas as well as the patient with scalp osteosarcoma presented disease recurrence in less than two years postoperatively, treated with palliative radiotherapy. However, due to the aggression of these histological subtypes and the poor prognosis, despite the well-differentiated tumor cells in histopathological examination, these three patients died in a less than 3-year follow-up period.

Interesting is that the patient with the leiomyosarcoma, developed in the scalp, also died due to disease recurrence, although the histological margins were negative and this histological subtype tends to have a more favourable outcome and prognosis. The results of this study were evaluated in a 15-year mean follow-up period.

The following illustrations demonstrate patients with different head and neck sarcomas subtypes, as well as the surgical approach followed. The reconstruction methods and the decision of a specific free flap depend on the anatomical site of the primary tumor as well as the size of the defect after the wide surgical resection of the sarcoma. A vascularized fibula free flap was chosen for mandible and oral cavity reconstruction after mandible osteosarcoma resection (Fig. 1). The local excision of a malignant fibrous histiocytoma combined with craniectomy was followed by defect reconstruction with a radial forearm free flap (Fig. 2). For larger defects, occurred after an extended cutaneous scalp angiosarcoma resection, a latissimus dorsi muscular free flap was preferred (Fig. 3).

Finally, in an average 15-year follow-up period, 11 patients are still alive and disease-free. Nine patients died due to comorbidities, like chronic cardiac or pulmonary issues. Only four patients died due to disease recurrence in a shorter time period, as mentioned above (Table 3).

Table 2
Anatomical site independent of sarcoma histological subtype and reconstruction method followed after resection.

Anatomical site of sarcoma	Reconstruction method after surgical resection
Scalp (n = 11)	- scalp flap (n = 7) - RFF (n = 1) - LD (n = 2) - temporalis flap (n = 1)
Face/forehead (n = 3)	- RFF (n = 3)
Neck/supraclavicular area (n = 3)	- PM (n = 1) - primary closure (n = 2)
Mandible (n = 2)	- fibula free flap (n = 2)
Nasal tract (n = 2)	- nasolabial flap (n = 2)
Cervical spine (n = 2)	- trapezius flap (n = 2)
Maxilla/orbit (n = 1)	- RA/temporalis (n = 1)
Neck/shoulder (n = 1)	- PM (n = 1)

RFF = radial forearm free flap, PM = pectoralis major, LD = latissimus dorsi, RA = rectus abdominis.

4. Discussion

The present study aimed to review the 20-year experience of a tertiary referral centre regarding the surgical management of head and neck sarcomas.

Sarcomas of the head and neck are associated with significant mortality. Overall survival (OS) differs based on histologic subcategorization. Resection of the primary tumor with clear margins demonstrates improved OS for all histologies, suggesting that this modality remains the preferred primary treatment when feasible (Galy-Bernadoy and Garrel, 2016; Pellitteri et al., 2003; Potter and Sturgis, 2003; Swallow and Catton, 2007; Rastatter et al., 2021; Aguín et al., 2011; Rapidis

Table 1
Histological subtypes of head & neck sarcomas, the involved anatomical sites, the surgical approach and the reconstruction methods performed in each case.

Histological subtype	Total number (n)	Anatomical site	Surgical approach	Reconstruction method
MFH	6	- scalp (n = 6)	- scalp resection (n = 6)/craniectomy (n = 2)	- scalp flaps (n = 5) - RFF (n = 1)
DFSP	4	- face (n = 2) - forehead (n = 1) - supraclavicular (n = 1)	- face skin resection (n = 2) - scalp resection (n = 1) - SND (n = 1)	- RFF (n = 2) - RFF (n = 1) - PM (n = 1)
Osteosarcoma	3	- mandible (n = 2) - frontal bone-scalp (n = 1)	- mandibulectomy (n = 2) - scalp resection (n = 1)/craniectomy (n = 1)	- fibula free flap (n = 2) - scalp flap (n = 1)
Angiosarcoma	2	- scalp (n = 2)	- scalp resection (n = 2)/craniectomy (n = 2)	- LD (n = 2)
Leiomyosarcoma	2	- maxilla (n = 1) - scalp (n = 1)	- maxillectomy (n = 1) - scalp resection (n = 1)	- RA/temporalis (n = 1) - scalp flap (n = 1)
NDS	2	- neck/shoulder (n = 1) - temple (n = 1)	- local resection (n = 1) - scalp resection (n = 1)	- PM (n = 1) - temporalis flap (n = 1)
MPNST	2	- nasal tract (n = 2)	- local excision (n = 2)	- nasolabial flap (n = 2)
Synovial sarcoma	1	- cervical spine (n = 1)	- laminectomy (n = 1)	- trapezius flap (n = 1)
Liposarcoma	1	- neck/supraclavicular (n = 1)	-SND (n = 1)	- primary closure (n = 1)
SFT	1	- neck/supraclavicular (n = 1)	- SND (n = 1)	- primary closure (n = 1)
Ewing sarcoma	1	- cervical spine (n = 1)	- laminectomy (n = 1)	- trapezius flap (n = 1)

MFH = malignant fibrous histiocytoma, DFSP = dermatofibrosarcoma protuberans, NDS = non-differentiated sarcoma, MPNST = malignant peripheral nerve sheath tumor, SFT = solitary fibrous tumor, RFF = radial forearm free flap, PM = pectoralis major, LD = latissimus dorsi, RA = rectus abdominis, SND = selective neck dissection.

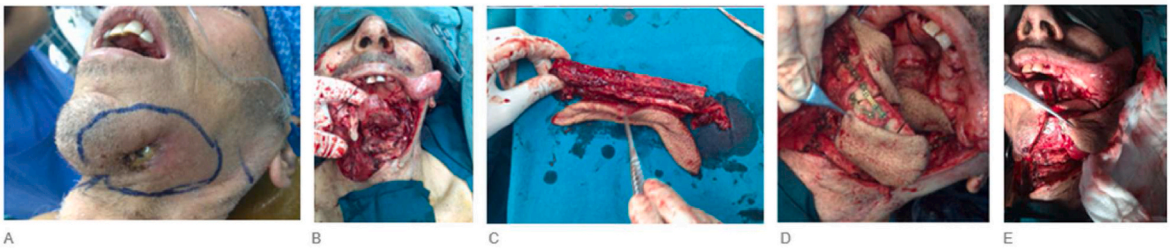

Fig. 1. A 50-year-old male patient with a mandible osteosarcoma developed many years after radiotherapy received for oral squamous cell carcinoma (Fig. 1A). The patient underwent LC mandibulectomy (Fig. 1B). A vascularized fibula free flap was used (Fig. 1C) for mandible reconstruction (Fig. 1D) and oral cavity contour (Fig. 1E). In a 10-year follow up period this patient is still alive and disease free.

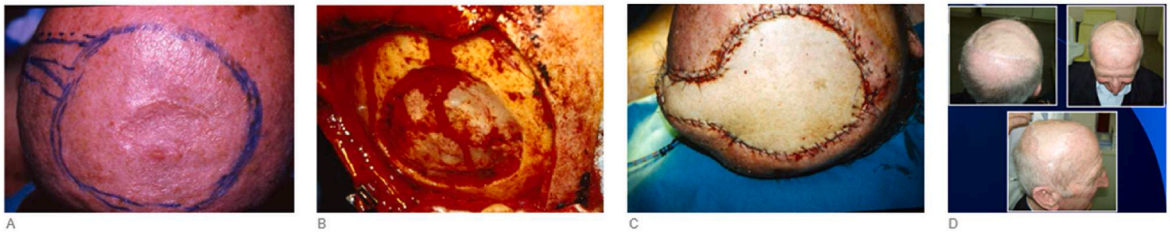

Fig. 2. A 65-year-old male patient with a scalp MFH (Fig. 2A). Wide field surgical resection along with craniectomy were performed (Fig. 2B), followed by reconstruction with radial forearm free flap-RFF (Fig. 2C). The final postoperative result one year later (Fig. 2D). In a 10-year follow up period this patient is still alive and disease free.

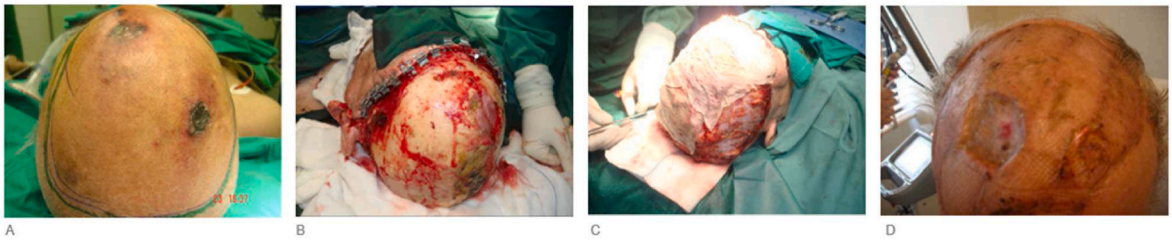

Fig. 3. A 55-year-old male patient with a cutaneous scalp angiosarcoma (Fig. 3A) underwent wide field surgical resection along with craniectomy (Fig. 3B). For the defect reconstruction a latissimus dorsi muscular free flap was used along with a split-thickness skin graft (Fig. 3C). The final postoperative result 6 months later (Fig. 3D). This patient developed extended local disease recurrence in less than 2 years postoperatively, treated will palliative radiotherapy. One year later the patient died due to distal pulmonary metastases.

Table 3
Histological subtypes of head & neck sarcomas, adjuvant radiotherapy administration cases, tumor recurrence and disease related deaths.

Histological subtype	Adjuvant radiotherapy	Tumor recurrence	Disease-related death
MFH (n = 6)	✓	–	–
DFSP (n = 4)	–	–	–
Osteosarcoma (n = 3)	✓	✓ (1 scalp osteosarcoma)	✓
Angiosarcoma (n = 2)	✓	✓ (2 scalp angiosarcomas)	✓
Leiomyosarcoma (n = 2)	✓	✓ (1 scalp leiomyosarcoma)	✓
NDS (n = 2)	✓	–	–
MPNST (n = 2)	✓	–	–
Synovial sarcoma (n = 1)	✓	–	–
Liposarcoma (n = 1)	✓	–	–
SFT (n = 1)	✓	–	–
Ewing sarcoma (n = 1)	✓	–	–

MFH = malignant fibrous histiocytoma, DFSP = dermatofibrosarcoma protuberans, NDS = non-differentiated sarcoma, MPNST = malignant peripheral nerve sheath tumor, SFT = solitary fibrous tumor.

et al., 2005).

4.1. Impact of histological subtype

There are some 50 histologic subtypes of sarcoma, classified by the WHO. In the head and neck the most frequent forms, taking all series together, are first of all pleomorphic sarcoma or malignant fibrous histiocytoma: MFH (Galy-Bernadoy and Garrel, 2016; Peng et al., 2014; Borucki et al., 2018; Swallow and Catton, 2007; Tran et al., 2020), followed by fibrosarcoma, angiosarcoma, malignant peripheral nerve sheath tumor and non-classified/non-differentiated sarcoma (Galy--Bernadoy and Garrel, 2016; Peng et al., 2014; Swallow and Catton, 2007). This statement is in agreement with this study's results, as MFH represented the most common histological subtype. Some histologic subtypes, notably angiosarcoma and rhabdomyosarcoma, are more liable to recurrence than others with a significantly poorer overall survival rate when compared to that of other sarcomas (Galy-Bernadoy and Garrel, 2016; Lee et al., 2019).

Angiosarcomas are characterized by a challenging clinical course with limited treatment options and a dismal prognosis. Compared with truncal and extremity angiosarcoma, the prognosis of cutaneous angiosarcoma (cAS) of the head and neck is even worse (Chow et al., 2018). Contemporary treatment of localized angiosarcoma involves a

multimodality approach incorporating surgical resection with wide margins when feasible, as well as adjuvant radiotherapy and/or chemotherapy in select clinical scenarios (Chan et al., 2020; Lee et al., 2019; Chow et al., 2018). Local recurrence rates are high because multifocal extension makes obtaining negative margins difficult (Lee et al., 2019). Therefore, extensive angiosarcomas of the scalp should be treated with multimodality therapy combining surgery and wide-field radiation therapy in an attempt to achieve local control (Potter and Sturgis, 2003). Previous studies evaluating cAS of head and neck reported 3-year and 5-year OS rates of 31–71% and 12–43%, respectively (Lee et al., 2019). In the present study patients suffered from scalp angiosarcomas died in a less than three years follow-up period, reflecting the poorer prognosis of this histological subtype.

Another histological subtype, Kaposi sarcoma of the head and neck is uncommon. However, due to the rarity of head and neck sarcomas in general, it represents 20–25% of all head and neck sarcomas in large epidemiological studies (Agaimy et al., 2018). However, in this study there were no patients suffering from this sarcoma subtype.

Concerning synovial sarcomas (SS), they comprise about 10% of all soft tissue sarcomas, with SS of the head and neck (*SS*–HN) representing less than 0.1% of all head and neck cancers. SS represents less than 10% of all head and neck sarcomas and the head and neck region accounts for less than 10% of all cases of SS (Owosho et al., 2017). In the present study there was only a case of cervical spine synovial sarcoma, which has been treated with laminectomy, followed by reconstruction with trapezious flap.

Other subtypes like Rhabdomyosarcoma (RMS) are relatively rare in adults and very infrequently in the head and neck region (Chen et al., 2017). In this study there were no cases of RMS.

It is worth mentioning that even if the tissue type is different, the biological property could be similar if the pathologic grade of the sarcoma is the same (Tanaka and Ozaki, 2019).

4.2. Impact of anatomical site

Given the anatomic and functional specificities of the head and neck region, tumor site is an important therapeutic decision factor, influencing surgical options, the feasibility of negative margins as well as the functional and aesthetic prognosis. The most frequent sites are superficial areas of face skin and scalp, followed by neck and parotid, bones of the skull and face, nasal sinuses and cavities and lastly the visceral spaces of the neck (pharynx, larynx) (Galy-Bernadoy and Garrel, 2016; Peng et al., 2014). In the present study the majority of head and neck sarcomas have also developed in scalp, face skin, forehead and supraclavicular area of the neck.

Anatomical site has an impact in recurrence and disease-free survival. Mandibular and oral cavity location are significant prognostic factors associated to local recurrence and shorter disease-free survival (Yanzon et al., 2021). Also, sinonasal sarcomas are highly malignant and locally aggressive, with a high recurrence rate. Distant organ failure due to hematogenous metastases is often observed. Multidisciplinary treatments involving surgery, radiotherapy and chemotherapy are necessary to improve the outcomes of patients with these diseases (Ding et al., 2018; Thompson et al., 2018). In this study there were two patients with sinonasal tract MPNST, treated with wide local excision followed by adjuvant radiotherapy and remaining up to now disease-free.

4.3. Survival rates

Most survival statistics for head and neck sarcomas suggest worse outcomes than for their extremity counterparts with 5-year survival rates between 49 and 55% (Pellitteri et al., 2003). While sarcomas not arising in the head and neck largely confer mortality via metastatic disease, patients with sarcomas in the head and neck primarily succumb to local recurrence (Peng et al., 2014). This has generally been attributed to the proximity of vital structures in the head and neck and may be related to the inherent difficulty in obtaining wide margins during surgical resection while limiting concomitant morbidity (Peng et al., 2014). Overall survival in head and neck sarcomas is poorer than that in other locations. This may be partly due to the distribution of histologic subtypes, with more frequent angiosarcoma and fibrosarcoma, and to the anatomic difficulty of ensuring negative margins in the head and neck. Five-year overall survival ranges from 31 to 80%, for a mean around 60%, versus around 80% for trunk and limb sarcoma (Galy-Bernadoy and Garrel, 2016; Peng et al., 2014). In an 11-year retrospective review in Newcastle the estimated 5-year disease-specific survival for head and neck sarcomas was 72% and overall estimated survival was 61% (Breakey et al., 2017).

4.4. Management and treatment

Surgical resection, consisted of en bloc excision with R0 margins, has been established as the mainstay of therapy (Peng et al., 2014; Potter and Sturgis, 2003; Swallow and Catton, 2007; Gronchi et al., 2021). Wide local excision with a 20 mm margin has been recently reported to be associated with a superior progression free survival (Logan et al., 2022). It is important to note that higher biological grade do not correlate with the inability to achieve negative margins. A margin negative resection is still impactful in these cases and the ability to do so has a long-term impact on tumor control rates (Habib et al., 2022). Surgery is feasible in more than 80% of patients, with an acceptable overall and disease-free survival (Yanzon et al., 2021). However, unlike sarcomas of the trunk and extremities, adjacent visceral and neurovascular structures frequently preclude wide-margin en bloc resection of these tumors in the head and neck (Pellitteri et al., 2003). Physical disability like facial disfigurement or swallowing impairment, caused by the surgical procedure itself, must also be taken into consideration (Lawrence, 1994). Therefore, radiation therapy is an important component of multimodality therapy, particularly in treating patients with high-grade tumors or positive margins following surgical resection (Peng et al., 2014). Bone sarcomas are radioresistant, and radiotherapy is only administered for palliative purposes when no surgical option exists, with Ewing sarcoma being an exception (Kalavrezos and Sinha, 2020). In the present study the majority of patients received postoperative planned adjuvant radiotherapy. On the other hand, the role of chemotherapy is not well established. Adjuvant chemotherapy has given contrasting results. The most widely used molecules are doxorubicine, dacarbazine and ifosfamide (Galy-Bernadoy and Garrel, 2016; Schmoll et al., 2021; Grünwald et al., 2020; Gronchi et al., 2021). For patients with advanced sarcomas that are not amenable to surgery, chemotherapy is the standard of care. Besides the established first-line agents, like doxorubicin and ifosfamide, several agents (targeted therapies) have shown histology-specific efficacy in later line settings in randomized phase 3 trials (e.g. pazopanib, trabectedin or eribulin) (Schmoll et al., 2021; Grünwald et al., 2020; von Mehren et al., 2022; Gronchi et al., 2021). The advent of immunotherapy in solid tumors provides welcome strategies for overcoming the limitations of traditional therapies in the field of sarcoma. Checkpoint inhibitor trials (e.g. pembrolizumab, ipilimumab and nivolumab, pembrolizumab with axitinib, as well as durvalumab and tremelimumab or atezolizumab) presented some of the first clinical opportunities to assess the efficacy of immune-mediated responses in sarcoma (Meyer, 2022; Keung et al., 2022; Logan et al., 2022).

4.5. Prognostic factors

Histological type, grade, size, and margin status are prognostic indicators of recurrence and survival (Tajudeen et al., 2014; Gronchi et al., 2021). Therefore, larger tumor size, high-grade histology and positive surgical margins consider to be traditional predictors of treatment failure for head and neck sarcomas (Potter and Sturgis, 2003). Among them the most common cause of treatment failure is local recurrence. Local

recurrence is also considered to be the most common risk of systemic metastases that appeared to correlate with biological grade (Habib et al., 2022). Depth of invasion and presence of metastases at presentation may also predict overall survival (Swallow and Catton, 2007). As expected, age is also identified as a factor predicting overall survival. In addition to this, the presence of perineural invasion affected recurrence free survival (RFS) and positive lymph node status affected overall survival (OS) (Tajudeen et al., 2014). Regarding sarcomagenesis smoking, genetic predisposition, toxins and chronic inflammation trigger the development of sarcoma (von Mehren et al., 2022), while chemotherapy, radiotherapy and negative margins of resection decrease the risk of recurrence (Weskamp et al., 2022).

4.6. Radiation-induced sarcoma

Radiation-induced sarcomas of the head and neck (RISHNs) appear in irradiated tissues of the head and neck without any anatomical subsite predilection. The median latency after radiotherapy (RT) is reported to be 10–12 years (Coca-Pelaz et al., 2021). RISHN is a long-term RT treatment complication, while surgery remains the preferred treatment modality in case RISHN is considered resectable (Patel et al., 1999; Coca-Pelaz et al., 2021). The overall prognosis is still poor with a 5-year overall survival rate varying between 24.2% and 38.2% (Coca-Pelaz et al., 2021). In this study there was a male patient, who has received radiotherapy for oral squamous cell cancer. After two decades, he developed mandible osteosarcoma (RISHN), which has been treated with LC mandibulectomy, followed by reconstruction with a vascularized fibula free flap. Due to the radicality of the operation this patient has achieved a 10-year disease free survival. Although surgical management of RISHN is challenging because of the close proximity of the tumor to important regional structures and the technical difficulties of operating in an irradiated area, complete surgical excision appears to offer the best means for palliation and the only realistic chance for long-term survival (Patel et al., 1999). However, radiation-induced sarcoma represents a significant prognostic factor with a worse survival (Yanzon et al., 2021).

Another issue is the use of new RT techniques with associated long-term risks. Intensity modulated radiation therapy (IMRT) and volumetric modulated arc therapy (VMAT) are nowadays the most common RT methods used to treat head and neck tumors. These techniques ensure less acute toxicity than traditional RT; however, the low-dose irradiation fields become wider. Therefore, it cannot be ruled out that the potentially damaging consequences of the larger low-dose component surrounding the target in IMRT/VMAT are balanced by the higher cancerogenic effects observed in a smaller area receiving an intermediate-dose in 3D-CRT (Giannini et al., 2018).

Also, intensity modulated proton therapy (IMPT) as well as carbon ion radiotherapy are now promising approaches under investigation. However, before seeing a substantial change in RISHN epidemiology, probably some decades from now will be needed (Giannini et al., 2018).

5. Conclusion

Head and neck sarcoma is a rare aggressive tumor, constituting a very heterogeneous group. Prognosis is poor in terms of local recurrence and overall survival. The treatment plan should aim at resection with negative margins and take account of the functional and aesthetic sequelae, which are often heavy due to the anatomy of the head and neck region. The development of reconstruction surgery with free tissue transfer included, by making more aggressive surgical resection of these tumors possible, enhances treatment potential and local control.

The results of this study have confirmed that surgical treatment of head and neck sarcomas may have satisfactory results when performed by experienced and specialized surgeons in tertiary centers. Wide surgical resection along with the appropriate microvascular reconstruction of the head and neck region can offer patients an acceptable quality of life and prolong the survival rates.

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Ethical approval

All procedures were performed in compliance with relevant laws and institutional guidelines and have been approved by the appropriate institutional committee (reference number of ethical approval: 28/448,361).

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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