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Benign Non-Odontogenic and Odontogenic Jaw Tumors in Children and Adolescents: Distribution, Clinico-Pathological Features and Surgical Management

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Abstract

Introduction: Non-odontogenic and odontogenic tumors are not common in children and adolescents. This study aimed to investigate the distribution clinical and pathological features and surgical management of intraosseous benign JT in pediatric patients.

Patients and Methods: This prospective study included children and adolescents who presented with non-odontogenic and odontogenic tumors that were surgically managed. Distribution, clinico-pathological features, management and outcome were statistically analyzed.

Results: The study included 122 patients (54 boys and 68 girls) with 65.57% non-odontogenic and 34.43% odontogenic tumors.The most common non-odontogenic tumors were central giant cell granulomas (31.14%) while the most common odontogenic tumors were odontomas (8.19%). Treatment included conservative surgery (51.64%) and radical resection (48.36%). Mandible was reconstructed by costochondral graft (29.51%) and fibula flap (4.92%) while maxilla was reconstructed by temporalis flap (9.83%), obturator (2.46%), and fibula flap (1.64%). Recurrence was detected in one patient (0.82%). Accepted functional and esthetic results were obtained in all cases.

Conclusion: Pediatric jaw tumors were more common in girls. The mandible was more affected and non-odontogenic tumors were more common than odontogenic tumors. Posterior jaw lesions were more frequent than anterior lesions. Central giant cell granulomas were the most common non-odontogenic tumors. Odontomas were the most common odontogenic tumors. The treatment included conservative surgery and radical resection, depending on tumor aggressiveness. Costochondral grafts are valuable for mandibular reconstruction while temporalis muscle flap and obturator are satisfactory for maxillary reconstruction. Microsurgical reconstruction has high success rates. Esthetics, and functional outcomes were satisfactory when appropriate management was performed.

Keywords: Pediatric Jaw Tumors; Non-Odontogenic Tumors; Odontogenic Tumors; Radical Resection; Mandibular Reconstruction; Maxillary Reconstruction

Introduction

Intraosseous Jaw Tumors (JT) are not common in the pediatric population where they are commonly benign with only 3% of cases are malignant [1]. They are divided into Non-Odontogenic Tumors (N-OT) and Odontogenic Tumors (OT) or with N-OT represent the vast majority [2, 3]. They more commonly affect the mandible than maxilla leading to obvious facial disfigurement, which may be the reason for presentation. The patients most commonly present with either a palpable jaw mass or evidence of a mass on routine imaging [4]. An incisional biopsy is important to guide further management. Although the tumors are benign, they still require surgical intervention to eradicate the disease. Surgery extends from the most conservative measures including curettage and simple excision to extensive procedures such as en-bloc resection and reconstruction [5]. Reconstruction of the mandible and maxilla must take into account the growth and developmental

changes in bone and soft tissue both at the donor site and in the recipient mandibulo-maxillary complex [6].

Autogenous bone is considered the standard for bony reconstruction and is still widely used despite its unpredictable resorption. The most common donor sites of non-vascularized bone graft are ribs and iliac bone [7, 8], Microsurgical reconstruction of the mandible and maxilla in children has proven successful although it presents challenges compared with adults. Temporalis muscle flap and obturators are simple and satisfactory options for pediatric maxillary reconstruction [9].

The aim of the present study was to investigate the distribution clinical and pathological features and surgical management of intraosseous benign JT in pediatric patients.

Materials and Methods

This was a prospective study conducted in General Surgery Department, Sohag Faculty of Medicine, Egypt. The case notes of patients under 18 years of age who presented with JT and tumor-like lesions between January 2011 and December 2020 were reviewed and examined. All patients who were histologically diagnosed with an intraosseous JT were included in the study. The inclusion criterion was any lesion with radiographic changes in the jawbone, for which there was a definitive and conclusive biopsy report. The exclusion criteria were soft tissue tumors with bone erosion, cysts or cyst-like lesions, and malignant JT. The study was conducted in accordance with the principles of Helsinki and approved by the Institutional Review Board and the Ethics Committee of Sohag Faculty of Medicine, Egypt. Informed consent was signed by the parents or guardians of the patients.

In this study, conservative modalities included 'curettage' which means scrapping of tumor tissue and 'simple excision' which meant the removal of the entire tumor along the tumor margin. Radical resection meant the removal of a tumor in normal bone tissue, 5-10 mm outside the boundary.

Data including Distribution, clinico-pathological features, surgical management and outcome of the JT in pediatric patients were collected and analyzed in IBM SPSS statistics for Windows version 22.0 (IBM Corp., Armonk, N.Y., USA). Absolute numbers and simple percentages were used to describe categorical variables. Quantitative variables were described by (means with standard deviation). Results were grouped into different categories for logical conclusions.

Results

The study comprised 122 patients, over a 10 years-period (2011-2020). The age of the patients ranged from 1 months to 18 years with a mean age of 9.45 ± 2.1 years. The most commonly affected age group was 6-12 years (51.64%) followed by age group 12-18 years (29.51%) while the least affected group was 0-8 years (18.85%). There were 54 boys (44.27%) and 68 girls (55.73%) (Table 1).

Eighty-four cases (68.85%) occurred in mandible while 38 cases (31.15%) affected maxilla. The frequency of occurrence was higher in mandible than maxilla (mandible: maxilla 84:38, *i.e.*, 2.2:1). There was 80 N-OT (65.57%) compared to 42 OT (34.43%) with N-OT predominating (2:1). Anterior lesions were 22 (18.03%); 13 in mandible and 9 in maxilla. Posterior lesions were 100 (81.97%); 60 in mandible and 40 in maxilla (Table 2, Figure 1 and 2).

The 80 N-OT found in our study were 38 central giant cell granulomas (CGCG) (31.14%), 30 ossifying fibromas (24.59%) and 12 giant cell tumors (9.83%). There were 56 cases in mandible and 24 cases in maxilla. In the mandible, boys to girls ratio was 4:9 for CGCG, 1:1 for ossifying fibromas and 2:3 for giant cell tumors. In the maxilla, the ratio between boys and girls was 2:1 for CGCG and 2:3 for ossifying fibromas. Giant cell tumors in maxilla were observed only in girls.

Table 1: Age and sex distribution of study population.

Age group	Sex		Total
	Boys	Girls	
0 - 6	10 (8.2%)	13 (10.65 %)	23 (18.85%)
6 - 12	29 (23.77%)	34 (27.87%)	63 (51.64%)
12 -18	15 (12.3%)	21 (17.21%)	36 (29.51 %)
Total	54 (44.27%)	68 (55.73 %)	122 (100 %)

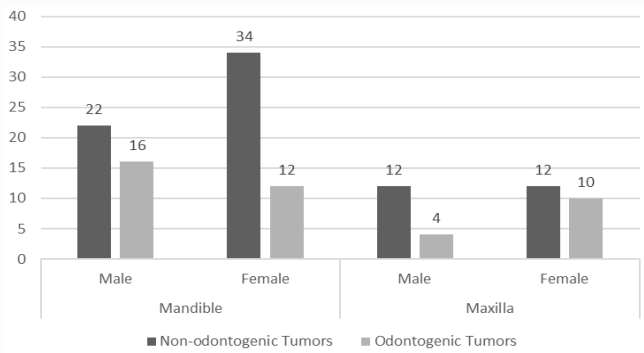


Figure 1: Distribution of the tumours according to sex and site.

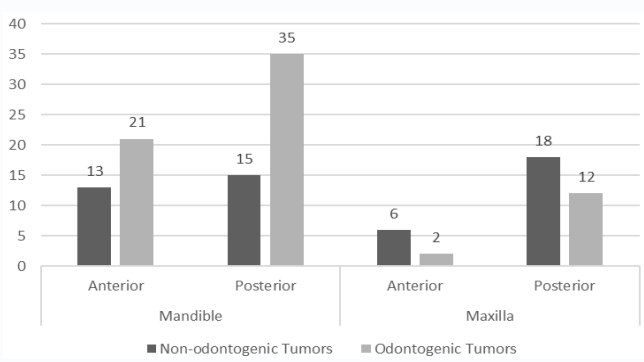


Figure 2: Distribution of the tumours according to location.

Among N-OT, posterior mandible was the most common site with 35 cases (28.68%) in our study, of which 15 were boys and 20 were girls. It was followed by anterior mandible with 21 cases (17.21%), out of which 7 were boys and 14 were girlss. The posterior maxilla had 18 cases (14.75%), of which 10 were in girls and 8 were in boys. Anterior maxilla was least common with only 6 cases (4.91%), of which 4 were in boys and 2 in girls.

Of the 42 OT that occurred in our study, 10 were odontomas (8.19%), 8 were adenomatoid OT (6.55%), 8 were ameloblastic fibro-odontomas (6.55%), 8 were ameloblastomas (6.55%), 4 were odontogenic fibromas (3.27%), and 4 were cementifying fibromas (3.27%), with odontomas being the most common odontogenic tumors. There were 28 cases in mandible and 14 cases in maxilla. In mandible, boys to girls ratio was 1:1 for odontogenic fibromas,

Table 2: Distribution of the tumors in relation to sex of the patients and location.

Type of the tumor		Mandible				Maxilla			
		Boys		girls		Boys		girls	
		Ant.	Post.	Ant.	Post.	Ant.	Post.	Ant.	Post.
Non-Odontogenic Tumors	Central Giant Cell Granuloma	3	5	10	8	4	4	2	2
	Ossifying Fibroma	2	8	4	6	0	4	0	6
	Giant Cell Tumor	2	2	0	6	0	0	0	2
Odontogenic Tumors	Odontogenic Fibroma	0	2	0	2	0	0	0	0
	Adenomatoid Odontogenic Tumor	2	0	1	1	0	2	0	2
	Ameloblastic fibro-odontoma	0	2	2	2	0	0	0	2
	Cementifying fibroma	0	2	0	0	0	0	0	2
	Ameloblastoma	2	0	0	2	2	0	0	2
	Odontoma	4	2	2	0	0	0	0	2

adenomatoid OT and ameloblastomas. It was 1:2 for ameloblastic fibro-odontomas and 3:1 for odontomas (8.19%). The cementifying fibromas were observed only in boys.

In OT, posterior mandible was the most common site with 15 cases (12.29%) in our study, out of which 8 were males and 7 were girls. This was followed by the anterior mandible with 13 cases (10.65%), out of which 8 were boys and 5 were girls. The posterior maxilla had 12 cases (9.83%), out of which 10 were in girls and only 2 were in boys. Anterior maxilla was the least common site with only 2 cases (0.01%) and both were boys. No OT was reported in girls in our study.

Treatment methods ranged from conservative surgery to radical resection, depending on the type, extent, location and aggressiveness of the tumor (Table 3). The most common method of treatment was conservative surgery which was performed in 63 cases (51.64%) in the form of curettage in 37 cases (30.33%) and simple excision in 26 cases (21.31%). Radical resection was performed in 59 cases (48.36%). Segmental mandibulectomy and hemi-mandibulectomy were performed in 21 cases (17.21%) each. Partial maxillectomy was the option in 12 cases (9.84%), while subtotal maxillectomy was performed in 5 cases (4.1%) (Table 4).

Reconstruction of post ablation defects was performed in 59 cases (48.36%), including 42 mandibular defects (34.43%) and 17 maxillary defects (13.93%). Mandibular defects were reconstructed by costochondral or rib graft and free fibula osteo-cutaneous flap. Maxillary defects were reconstructed by temporalis muscle flap, obturator, and free fibula flap (Table 4).

The intraoperative complications were mild haemorrhage, costochondral cartilage cap detachment and pleural. Postoperative complications were mild wound infection, severe infection and resorption of the rib, ankylosis of the costochondral graft on the skull, Facial asymmetry due to undergrowth of the bone graft. Temporal hollowness was observed in all patients reconstructed with temporalis muscle flap. Other complications included transient paresis of frontal nerve, injury to marginal mandibular nerve and hypertrophic submandibular scar. Recurrence was noted in one case of CGCG that was treated by curettage (Table 5).

Follow-up ranged from 2 to 8 years with a mean of 4 ± 1.43 years. All cases reported satisfactory esthetic and functional results.

Discussion

Clinico-pathological features

The present study included 122 patients with age range from 1 months to 18 years and a mean age of 9.45 ± 2.1 years. The most commonly affected age group was 6-12 years followed by the age group 12-18 years while the least affected group was 0-8 years. Tanaka *et al.,* [2] reported that pediatric jaw tumors were most common in the 6-11 years age group (43.8%), followed by the 12-15-year age group (31.4%). Some other researchers reported a higher incidence of tumors in the age group of 11-15 age [3, 10, 11]. In this study, the incidence rate for boys (44.27%) was less than that for girls (55.73%). Tanrikulu *et al.,* [3] reported similar rates, while Others reported that the incidence rate for girls and boys were approximately equal [2, 10].

In the present study, more than two-thirds of JT occurred in the mandible, while the remaining third occurred in the maxilla. Posterior jaw lesions were more common than anterior jaw lesions. Many studies, reported that mandible was most frequently affected compared to maxilla [2, 3, 10, 12]. They also found that tumors affecting the posterior region of the jaw were more common in both children and adults than those affecting the anterior region, in both the maxilla and the mandible [12].

Our study revealed that of all JT, 65.57% were N-OT and 34.43% were OT. Similarly, other authors [1, 3, 13-15] reported that N-OT were more common than OT in the pediatric population.

Our study also showed that CGCG was the most common N-OT in the pediatric population (31.14%). Similar results were shown by Tanrikulu *et al.,* [3] however, Lin *et al.,* [16] concluded that CGCG was a relatively rare benign bone lesion that accounts for approximately 7% of all benign JT. In this study, ossifying fibroma showed a predominance in girls, which is consistent with most studies in the literature that also indicates that ossifying fibroma has a predilection for females, ignoring age. However, Liu *et al.,* [17] and MacDonald [18] have shown a predilection for males. The giant cell tumors in our study showed predilection for girls, with much higher mandibular involvement. Giri *et al.,* [19] reported a mandibular case in a 12-year-old girl.

In our study, OT accounted for 42 (34.4%) cases, which is quite a significant number. Our study was in line with Adebayo *et al.,* [20] Sato *et al.,* [21] Tanaka *et al.,* [2] and Guerrisi *et al.,* [22] who found a high percentage of OT in their respective patients series. OT

Table 3: Detailed treatment of non-odontogenic and odontogenic tumors.

Tumor		Treatment modality		Frequency
Non-odontogenic tumors	Central giant cell granuloma [38]	Conservative surgery [22]	Curettage of mandibular lesion	14
			Curettage of maxillary lesion	8
		Radical Resection [16]	Segmental mandibulectomy	7
			Partial maxillectomy	3
			Hemi-mandibulectomy	5
			Subtotal maxillectomy	1
	Ossifying fibroma [30]	Conservative surgery [11]	Curettage of mandibular lesion	6
			Curettage of maxillary lesion	5
		Radical resection [19]	Segmental mandibulectomy	5
			Partial maxillectomy	3
			Hemi-mandibulectomy	9
			Subtotal maxillectomy	2
	Giant cell tumor [12]	Conservative surgery [4]	Curettage of mandibular lesion	3
			Curettage of maxillary lesion	1
		Radical resection [8]	Segmental mandibulectomy	5
			Partial maxillectomy	1
			Hemi-mandibulectomy	2
Odontogenic tumors [42]	Odontogenic Fibroma [4]	Conservative surgery	Simple excision of mandibular lesion	4
	Adenomatoid Odontogenic Tumor [9]	Conservative surgery	Simple excision of mandibular lesion	2
			Simple excision of maxillary lesion	2
		Radical Resection	Segmental mandibulectomy	1
			Partial maxillectomy	1
			Hemi-mandibulectomy	1
			Subtotal maxillectomy	1
	Ameloblastic fibro-odontoma [8]	Conservative surgery	Simple excision of mandibular lesion	3
			Simple excision of maxillary lesion	1
		Radical Resection	Segmental mandibulectomy	2
			Partial maxillectomy	1
			Hemi-mandibulectomy	1
	Cementifying fibroma [4]	Conservative surgery	Simple excision of mandibular lesion	2
			Simple excision of maxillary lesion	2
	Ameloblastoma [8]	Radical Resection	Segmental mandibulectomy	1
			Partial maxillectomy	3
			Hemi-mandibulectomy	3
			Subtotal maxillectomy	1
	Odontoma [10]	Conservative surgery	Simple excision of mandibular lesion	8
			Simple excision of maxillary lesion	2

showed a slight predilection for girls in the present study, which was in agreement with Jones and Franklin [23] who also showed a female predilection. However, it was in contrast to the study by Urs *et al.,* [24] which showed a male predilection.

In our study, Among OT, odontomas were the most common tumor, accounting for 8.19 % of cases, which is in agreement with Jones *et al.,* [23], Tanrikulu *et al.,* [3] and Ulmansky *et al.,* [13] who observed a higher incidence of odontomas. Servato *et al.,* [25] showed that among pediatric JT, odontoma was the most common type (41.4%), followed by keratocystic odontogenic tumors (25.5%) and ameloblastomas (14.6%). However, a study by Andrade *et al.,* [15] showed that ameloblastoma was the most common OT in children (44.65%). In other studies [2, 20, 22, 24], the frequency of ameloblastoma within the total cases of OT ranged from 24% to 53.8%. Compared to adults, ameloblastomas are rare in children [24]. In our study, ameloblastomas showed male predominance and most commonly involve the posterior maxillary region. This is in agreement with the findings of Urs *et al.,* [24] and Fernandes *et al.,* [26].

Amelobalstomas, adenomatoid OT and ameloblastic fibromas

Table 4: Surgical treatment of tumors and reconstruction of the defects.

Item	Details		Frequency
Treatment modality	Conservative surgery: 63 (51.64%)	Curettage	37 (30.33%)
		Simple excision	26 (21.31%)
	Radical resection: 59 (48.36%)	Segmental mandibulectomy	21 (17.21%)
		Hemi-mandibulectomy	21 (17.21%)
		Partial maxillectomy	12 (9.84%)
		Subtotal maxillectomy	5 (4.1%)
Reconstruction: 59 (48.36%)	Mandibular: 42 (34.43%)	Costochondral / rib graft	36 (29.51%)
		Free fibula flap	6 (4.92%)
	Maxillary: 17 (13.93%)	Temporalis muscle flap	12 (9.83%)
		Obturator	3 (2.46%)
		Free fibula flap	2 (1.64%),

Table 5: Complications of surgical treatment of jaw tumors and their management.

Complications	Frequency	Management
Mild intraoperative hemorrhage	7	Blood transfusion
Costochondral cartilage cap detachment	4	Cap was secured the graft using non-resorbable sutures
Pleural tears	5	Inserting a catheter into the tear and a and suturing the opening with a purse string suture. While the anesthesiologist providing positive pressure ventilation, the catheter was withdrawn and the suture was tied off. If this procedure was unsuccessful, a chest tube under water seal was placed.
Mild post operative wound infection	6	Wound care and antibiotics
Severe infection and rib graft resorption	1	Antibotics accprding to culture and sensitivity, sequestrectomy.
Ankylosis of the costochondral graft to skull	1	Gap arthroplasty
Facial asymmetry due to under growth of the bone graft	3	Distraction osteogenesis
Temporal hollowness	12	Camouflaged by hair
Transient frontal nerve paresis	1	Physiotherapy
Hypertrophic submandibular scar	3	Local creams
Permanent marginal mandibular nerve paralysis	2	Contralateral Botulinum toxin injection
Recurrence in one case.	1	Radical resection and reconstruction with fibula free flap

were the second most common OT in our study, with 8 cases (6.55%), which is in agreement with Asamoa *et al.,* [27]. However, Guerrisi *et al.,* [22] stated that adenomatoid OT is a rare tumor and accounted for 5.2% of odontogenic tumors. It shows a female predilection with a tendency towards the anterior maxilla [28]. However, our study showed an even sex distribution of adenomatoid OT, and the maxillary tumors were located in the 1st and 2nd premolar region.

Treatment

In our study, treatment ranged from curettage to radical resection, depending on the type, size, and aggressiveness of the tumor. Conservative modalities included curettage and simple excision. The most common treatment was the conservative surgery which was performed in 51.64% of cases in the form of curettage (30.33%) and excision (21.31%). Radical resection was the treatment in 48.36% of cases.

Our surgical approach for pediatric JT was consistent with that reported in the literature (Table 6). Conservative treatment was the choice when the tumor was not aggressive, while radical resection was mandatory when the tumor was aggressive and had invaded far into the jaw or when previous conservative treatment had failed. The current standard of care for aggressive jaw tumors is radical resection to prevent recurrence [2] (Table 6).

Defect reconstruction

In our study, the post-ablative defects underwent primary reconstruction. Reconstruction at the time of resection is generally preferred to attain a favorable cosmetic and functional outcome in a single operation [55].

In this study, reconstruction of mandibular defects was performed in most cases with costochondral rib graft while in few cases with free fibula flap. In agreement with the literature, we found that the costochondral graft was a proper option for reconstruction of the mandible [56], because of it possesses the ability to grow due to the costochondral cartilage, although its growth is unpredictable [57]. Also, it is simple to harvest, has low donor site morbidity, provides a plenty amount of bone, and is constant with slight or no evidence of resorption. In addition, it preserves other bone donor sites intact in case a vascularized bone flap is needed in the future [58].

In this study, fibula flap was used in 5 cases for reconstruction of mandibular defects. In agreement with Upton and Guo [59] we noticed that the success rates of free tissue transfer in children are similar to or even better than those in adults because of fewer comorbidities, healthy vessels, no smoking-related vascular damage,

Table 6: Mini-review of literature for surgical treatment of benign non-odontogenic and odontogenic tumors.

Tumor		Scholar	Treatment modality
Non-odontogenic tumors	Central giant cell granuloma	de Lange *et al.,* [29], Ramesh V [30] Chrcanovic *et al.,* [31]	Medical treatment, Curettage, enucleation, radical resection
		Wang *et al.,* [32], Bataineh *et al.,* [33]	Radical resection
	Ossifying fibroma	Mohanty *et al.,* [34]	Curettage, enucleation or radical resection
		Lee *et al.,* [35]	Radical resection
		Liu *et al.,* [17]	Curettage, local resection, and radical resection.
	Giant cell tumor	Kerdoud *et al.,* [36], Guerrissi JO [37]	Radical resection
		Rastogi *et al.,* [38]	Extended curettage, wide excision
Odontogenic tumors	Odontogenic Fibroma	Eversole LR [39]	Enucleation and curettage
		Chhabra and Chhabra [40], Santaro *et al.,* [41]	Enucleation
	Adenomatoid Odontogenic Tumor	Bhaskaran *et al.,* [42]	Excision / Enucleation
		Khot K *et al.,* [43]	Enucleation and simple curettage.
		Abdulla E *et al.,* [44]	Enucleation and curettage
		Ashlier M *et al.,* [45]	Excision
	Cementifying fibroma	Mohan RP *et al.,* [46], Sheikhi M *et al.,* [47]	Excision / enucleation
	Ameloblastoma	Nakamura *et al.,* [48]	Marsupialization followed by enucleation and curettage/ Enucleation plus curettage
		Becelli *et al.,* [49]	Marginal resection (radical)/Segmental resection
		Al Khateeb *et al.,* [50]	Enucleation plus peripheral ostectomy and resection
		Park JC *et al.,* [51]	Excision
	Odontoma	Poli P *et al.,* [52], Uma E [53], de Oliveira BH *et al.,* [54]	Excision

and better healing ability [59]. We agree with Weizman *et al.,* [60] that free flap reconstruction in children is an efficient and relatively safe option with acceptable functional and esthetic results [60]. It has been reported that valgus deformity of the ankle may occur after harvesting fibula flap in growing children [61, 62] in no ne of our cases did this deformity occurred because we harvested the fibular shaft which did not affect limb growth [56].

Reconstructive techniques for the maxilla include obturators, local and regional flaps, and free tissue transfer [63]. In our study, the majority of maxillary defects were reconstructed using a temporalis muscle flap. The temporalis muscle flap is a valid, reliable, and versatile reconstructive tool that has accepted cosmetic and functional outcomes, and minimal morbidity. It provides separation between the mouth and nasal cavity and can allow for another bone graft for osseo-integrated implants [64, 65].

In this study, three cases with maxillary defects were reconstructed with the obturator. The obturator allowed simple management of the defect and immediate functional and esthetic rehabilitation. In agreement with Dattani *et al.,* [66] we found that the obturator preserved phonation, prevented nasal discharge of food and facilitated swallowing [66]. Although we have found that reconstruction with an obturator appears to be satisfactory, Spilimbergo *et al.,* [65] reported that the quality of life of a patient with a surgically reconstructed palate is far superior to living with a bulky obturator that is not suitable for chewing on the affected side [65].

In the present study, the free fibula flap was used twice to reconstruct the maxillary defects. It can provide oro-nasal separation as well as bone for an implant-supported prosthesis [66, 67]. The use of microvascular free tissue transfer has gained popularity in adults, but in the pediatric patients with maxillary tumors, the use of a prosthetic obturator is more commonly reported [68], presumably because the obturator can achieve good results and postpone additional complex procedure to a later date [66].

Complications, follow-up, and outcome

In our study we reported some complications which were managed appropriately to achieve the best results (Table 5). Fernandes *et al.,* [26] reported that the most common intraoperative complications of rib graft are separation of cartilage cap and pleural tears.

In the present study, we successfully followed up our patients for a prolonged period of 2 to 8 years with a mean of 4 ± 1.43 years to detect recurrence and evaluate the outcome. Only one case with mandibular CGCG recurred and it was retreated by segmental resection and reconstruction with free fibula flap. The cause of recurrence might be the choice of inappropriate surgical treatment as the case was treated by curettage. Wang *et al.,* [32] preferred enucleation and curettage as they preserve the mandibular cortex and inferior alveolar nerve but these procedures were associated with a recurrence rate of 30-70% in aggressive CGCG [32]. According to Bataineh *et al.,* [33] segmental resection had the lowest recurrence rate.

Tahiri *et al.,* [57] reported that complications of rib graft include resorption and ankylosis of the temporomandibular complex [57]. Ankylosis is thought to result when the graft is not harvested with the cartilaginous cap or due cartilage fracture or ossification [69]. The risk of developing ankylosis may be related to the duration of postoperative mandibulo-maxillary fixation which was required in some cases to allow healing of the graft at the distal mandibular segment [70]. Fernandes *et al.,* [26] found that delayed complications were related to the cosmetic defects [26]. In our study, facial growth was not markedly affected and the esthetic and functional outcomes were acceptable to most patients and their families.

Conclusions

Pediatric N-OT and OT were more common in females. The mandible was more commonly affected than the maxilla and N-OT were more common than OT. Posterior jaw lesions were more frequent than anterior jaw lesions. CGCG and ossifying fibromas were the most common N-OT. Odontomas were the most common OT. Treatment ranged from curettage to radical resection, depending on the type, size, .and aggressiveness of the tumor. Costochondral rib grafts remain a valuable option for reconstruction of pediatric mandible. The temporalis muscle flap and obturator are simple and satisfactory reconstructive tools for maxillary defects in children. Although microsurgical reconstruction of the jaw is challenging in pediatric population, it is safe and has high success rates. Facial growth, esthetics, and functional outcomes were satisfactory when appropriate reconstruction was performed.

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