Objective: To evaluate the incidence, types, and treatment outcomes of pediatric parotid lesions.

Design: Retrospective case review, histological tissue review, and literature review.

Setting: Tertiary care center.

Patients: All patients aged 18 years and younger with parotid masses evaluated and treated at the Mayo Clinic, Rochester, Minn, from January 1, 1970, to December 31, 1997.

Results: Parotid masses were identified in 118 children (60 boys and 58 girls). At diagnosis, the ages of patients were from birth through 18 years, and 72 (61.0%) were aged 10 years and older. An asymptomatic mass was the most common presentation. Forty-three patients (36.4%) had infectious or inflammatory lesions, 56 (47.5%) had benign lesions, and 19 (16.1%) had malignant lesions. The most common benign lesions were pleomorphic adenoma (22.9%) and hemangioma (10.2%). The most common malignant lesions were mucoepidermoid carcinoma (6.8%) and acinic cell carcinoma (3.4%). The most common treatment was total parotidectomy (40.7%). Surgical complications included temporary facial nerve weakness in 22 (18.6%) patients, permanent facial weakness in 11 (9.3%), and permanent paralysis in 2 (1.7%). Pleomorphic adenoma recurred in 4 (14.8%) of 28 patients and mucoepidermoid carcinoma in 3 (37.5%) of 8 patients. One patient with adenoid cystic carcinoma died of the tumor.

Conclusions: Although pediatric parotid masses are unusual, they can represent a variety of pathological diagnoses, including malignancy. We advocate prompt evaluation and treatment of these masses, and suggest guidelines for their management, based on diagnosis.

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MATERIALS AND METHODS

We examined the medical records of all children (<19 years) with a parotid mass or who had surgical treatment for parotid disease at Mayo between January 1, 1970, and December 31, 1997. Of patients with infectious or inflammatory lesions, only those treated surgically were included. Medical histories were reviewed for patient age and sex, presenting signs and symptoms, location of the lesion, treatment, complications, recurrence, follow-up, and outcome. Tissue specimens were available from 106 of 118 patients identified and were examined to confirm or alter the diagnosis by a head and neck pathologist (J.E.L.). Of 12 patients for whom histological review was not performed, 2 with a diagnosis of hemangioea were followed up with only observation, and no tissue diagnosis was obtained. Five other patients had excisional biopsies performed at another institution, and no additional tumor was found during subsequent surgery. Five other patients had infectious or inflammatory lesions removed in the 1970s, and the specimens were not preserved. These 12 patients were classified according to the original diagnosis. Telephone follow-up was successful for 94 (79.7%) of 118 patients, and provided extended follow-up and information about long-term outcome.

Other long-term complications after parotid surgery included evidence of Frey syndrome in 55 patients (47.4%). This was reported most often by patients aged 10 through 18 years, and occurred equally after total (48% of patients) and superficial (47% of patients) parotidectomy. Permanent facial numbness was reported by 39 patients (33.6%); cosmetic complaints, including hypertrophic scarring (most common, 18.1%), asymmetry of the face, and abnormalities in the position of the ear after surgery, were noted by 28 patients (24.1%).

Mean follow-up of all patients was 13.4 years (range, 2.0 days to 29.3 years). Of 118 study patients, 21 (17.8%) experienced at least 1 recurrence of disease. This was most common with adenoid cystic carcinoma (1 [50%] of 2 patients), followed by first branchial cleft cysts (3 [43%] of 7 patients) and mucoepidermoid carcinoma (3 [38%] of 8 patients) (Table 1).
had permanent facial nerve injury. One patient (2%) underwent superficial parotidectomy, 3 (16%) of whom had temporary facial nerve weakness, and none (44%) underwent total parotidectomy. Nineteen patients had temporary facial nerve weakness, and 1 had permanent partial facial nerve weakness. Nineteen patients underwent excisional biopsy followed by total parotidectomy. One patient underwent incision and drainage of an M avium abscess; 1 underwent radiation therapy for a lesion thought to be a lymphoma (later diagnosed by J.E.L. as a reactive lymph node); and 1 underwent partial parotidectomy, with excision of only the portion of the gland around the lesion.

Recurrence was noted in 7 (16%) of these 43 patients. Initial treatment for recurrence included total parotidectomy in 3 patients and superficial parotidectomy in 2. Two (50%) of 4 patients treated with limited excision also had recurrence. Of 7 patients with recurrence, 5 had chronic sialadenitis (2 with abscess) and 2 had reactive lymphadenopathy. Three (43%) of 7 patients still had evidence of disease at latest follow-up. Treatment and outcomes of these patients are listed in Table 2.

### INFECTIOUS AND INFLAMMATORY LESIONS

Of 376 children with parotitis diagnosed from January 1, 1970, to December 31, 1997, 43 (11.4%) were treated surgically at Mayo for infectious or inflammatory lesions. These 43 patients included 24 boys (56%) and 19 girls (44%) with a mean age of 9.4 years (median, 7.6 years; range, <1.0-18.0 years) (Figure 1). Thirty-one patients (72%) received at least 1 trial of antibiotic drug therapy, and all had at least 3 recurrent episodes of swelling or continuous swelling for at least 1 month before surgical excision. Only 1 patient underwent fine needle aspiration preoperatively; the findings were consistent with fibrosis. Histological diagnoses in the other children in this group included chronic sialadenitis in 26 (60%), chronic sialadenitis plus abscess in 9 (21%), multiple inflammatory lymph nodes in 6 (14%), a single large inflamed node in 1 (2%), and Castleman disease in 1 (2%).

Of 35 patients with chronic sialadenitis, with or without abscess, 9 had granulomatous lesions. Cultures of specimens from 2 of these lesions were positive for Mycobacterium avium, and the specimen from another lesion stained positive for acid-fast bacilli, but no organism grew in culture. No organism was identified in the other 6 patients with granulomatous lesions. Among 26 patients with nongranulomatous chronic sialadenitis, with or without abscess, a specific organism was identified in only 1—culture-positive actinomycosis—and was treated surgically and with long-term antibiotic drugs given intravenously.

In these 43 patients, case distribution by decade showed that 24 were treated surgically in the 1970s, 11 in the 1980s, and 8 in the 1990s. Surgical treatment was total parotidectomy with preservation of the facial nerve in 20 patients (46%) (bilaterally in 3); 5 (25%) of whom had temporary facial nerve weakness, and 1 had a permanent partial facial nerve weakness. Nineteen patients (44%) underwent superficial parotidectomy, 3 (16%) of whom had temporary facial nerve weakness, and none had permanent facial nerve injury. One patient (2%) underwent excisional biopsy followed by total parotidectomy. One patient underwent incision and drainage of an M avium abscess; 1 underwent radiation therapy for a lesion thought to be a lymphoma (later diagnosed by J.E.L. as a reactive lymph node); and 1 underwent partial parotidectomy, with excision of only the portion of the gland around the lesion.

Recurrence was noted in 7 (16%) of these 43 patients. Initial treatment for recurrence included total parotidectomy in 3 patients and superficial parotidectomy in 2. Two (50%) of 4 patients treated with limited excision also had recurrence. Of 7 patients with recurrence, 5 had chronic sialadenitis (2 with abscess) and 2 had reactive lymphadenopathy. Three (43%) of 7 patients still had evidence of disease at latest follow-up. Treatment and outcomes of these patients are listed in Table 2.

### BENIGN MASSES

Fifty-six patients had benign masses of the parotid gland: 28 boys and 28 girls with a mean age of 11.0 years (median, 12.6 years; range, <1.0-18.0 years). Diagnoses included pleomorphic adenoma in 27 patients (48%), hemangiomia in 12 (6 juvenile and 6 cavernous) (21%), first branchial cleft cysts in 7 (12%), lymphangioma in 6 (11%), neurofibroma in 2 (4%), solitary fibrous tumor in 1 (2%), and a mass that histologically was normal parotid gland in 1 (2%).

Initial treatment in these patients included superficial parotidectomy in 22 (39%), total parotidectomy in 20 (36%), partial parotidectomy (all performed at another institution) in 7 (12%), excisional biopsy performed at another institution and followed within days by superficial parotidectomy at Mayo in 4 (7%), excisional biopsy performed at another institution and followed by total parotidectomy at Mayo in 1 (2%), and hemangiomas treated with observation only in 2 (4%).

Of 46 patients who had their initial surgery at Mayo, early surgical complications included temporary

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### Table 2. Diagnosis, Treatment, and Follow-up of 7 Patients With Infectious or Inflammatory Lesions Who Had Recurrence

<table>
<thead>
<tr>
<th>Age at Diagnosis, y</th>
<th>Diagnosis</th>
<th>Initial Treatment</th>
<th>Time to Recurrence</th>
<th>Treatment of Recurrence</th>
<th>Further Recurrence</th>
<th>Follow-up, y</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Chronic sialadenitis</td>
<td>Total parotidectomy</td>
<td>9 mo</td>
<td>Antibiotic drugs</td>
<td>After 14 mo of antibiotic drug therapy</td>
<td>5.7</td>
</tr>
<tr>
<td>1</td>
<td>Reactive lymphadenopathy</td>
<td>Total parotidectomy</td>
<td>Unknown*</td>
<td>Observation</td>
<td>None</td>
<td>22.7</td>
</tr>
<tr>
<td>17</td>
<td>Chronic sialadenitis</td>
<td>Excisional biopsy followed by total parotidectomy</td>
<td>3 mo</td>
<td>Excision of sinus tract</td>
<td>After 9 mo, further excision of tract</td>
<td>8.0</td>
</tr>
<tr>
<td>18</td>
<td>Reactive lymphadenopathy</td>
<td>Superficial parotidectomy</td>
<td>Unknown*</td>
<td>Observation</td>
<td>None</td>
<td>18.3</td>
</tr>
<tr>
<td>4</td>
<td>Chronic sialadenitis with abscess</td>
<td>Partial parotidectomy</td>
<td>19 mo</td>
<td>Superficial parotidectomy</td>
<td>None</td>
<td>8.8</td>
</tr>
<tr>
<td>4</td>
<td>Chronic sialadenitis</td>
<td>Superficial parotidectomy</td>
<td>6 y</td>
<td>Total parotidectomy</td>
<td>None</td>
<td>8.8</td>
</tr>
<tr>
<td>3</td>
<td>Chronic sialadenitis with abscess</td>
<td>Incision and drainage</td>
<td>5 d</td>
<td>Superficial parotidectomy</td>
<td>None</td>
<td>4.1</td>
</tr>
</tbody>
</table>

*Patient was not sure when swelling reappeared.
facial nerve weakness in 15 (33%), and postoperative infection in 1 (2%). Long-term surgical complications included Frey syndrome in 23 patients (50%), facial numbness in 18 (39%), and permanent facial nerve weakness in 1 (2%). Of 10 patients who underwent at least 1 procedure at another institution before surgery for recurrent disease at Mayo, 3 had permanent facial weakness before surgery at Mayo, and 3 had temporary weakness after additional surgery at Mayo. One patient in this group complained of permanent partial facial nerve weakness after surgery for recurrent disease.

For this group of 56 patients, mean follow-up was 11.7 years (range, 9.10 days to 28.5 years). Nine patients (16%) had at least 1 recurrence (for 7 [78%] of them, after treatment at another institution and before evaluation at Mayo). No patient had recurrence after additional treatment at Mayo; however, after initial surgical treatment at Mayo, 2 patients had recurrence: 1 had a stable lymphangioma and the other had a pleomorphic adenoma that was treated successfully with radiation. Recurrence data for this group are summarized in Table 3.

**MALIGNANT PAROTID NEOPLASMS**

Of 118 patients, 19 (16.1%) had malignant parotid neoplasms: 8 boys and 11 girls with a mean age of 13.2 years (median, 14.4 years; range, 4.0-18.0 years). Histologically, the distribution of the tumors is given in Table 1. Most malignancies were carcinomas with mucoepidermoid (8 patients), followed by acinic cell carcinoma (5 patients). All mucoepidermoid carcinomas were grade I (low grade, 7 patients) or II (intermediate grade, 1 patient). Unusual neoplasms in this population included a malignant nerve sheath tumor in 1 patient and an adenocarcinoma in another.

Management of parotid gland malignancies at Mayo involved total parotidectomy, except in the patient with a malignant nerve sheath tumor and the patient with lymphoma. Five patients received treatment at another institution before referral to Mayo, 3 of whom had subtotal parotidectomy with recurrence 3, 6, and 11 months after the initial operation. Two of these 3 patients underwent subsequent total parotidectomy at Mayo, and 1 had recurrence 3.5 years later and was treated successfully with local excision (Table 4). The other of these 3 patients had a second recurrence after further treatment at another institution and had total parotidectomy at our institution. One of the remaining 2 patients had total parotidectomy elsewhere, but disease recurred 4 years later and was treated by additional surgery and radiation therapy at our institution, and the last recurred 2 months after superficial parotidectomy elsewhere and required further surgery at Mayo.

Six patients received adjuvant therapy, which included radiation therapy in 5 (as part of initial therapy in 3 and for recurrence in 2) and chemotherapy and radiation therapy for a malignant nerve sheath tumor in 1. One patient had a limited upper-neck dissection for an acinic cell carcinoma because of palpable lymph nodes. Three patients had local recurrence after total parotidectomy. Recurrences noted during treatment, before and after referral to Mayo, are listed in Table 4. Mean follow-up in this group was 12.5 years (median, 8.6 years; range, 316.0 days to 29.3 years). Overall, of 14 patients who received their primary therapy at Mayo, only 1 had recurrence. This 18-year-old patient had advanced adenoid cystic carcinoma at presentation and died of metastatic disease 4 years 4 months after the surgical procedure. Except for patients in whom the seventh nerve was intentionally sacrificed, no patient described permanent facial weakness after surgical treatment for malignancy at Mayo. Of 3 patients who had facial nerve resection because of tumor involvement, 2 had permanent total paralysis despite cable grafting, and 2 patients initially treated at another institution had permanent facial weakness before treatment at Mayo.
Masses in parotid glands of children can result in a diagnostic and therapeutic dilemma. Of our 118 patients, 83.9% had benign lesions. However, it is difficult on examination to determine the nature of a parotid mass. Fine needle aspiration biopsy is useful in evaluating salivary gland lesions, and has been reported to have a specificity of 91% and a sensitivity of 96% when sufficient cells are present. The frequency of nondiagnostic aspirates can be a problem. In the pediatric population, patient tolerance of this procedure limits its use. Therefore, it is common for a pediatric patient to undergo surgery to establish the diagnosis of a parotid mass. We rely on frozen-section evaluation to guide intraoperative decision making. If the certainty of diagnosis on frozen section is questioned, definitive treatment may be delayed. Data reported herein indicate that parotid surgery can be performed safely in pediatric patients, with low risk. Frey syndrome can be expected to occur in approximately half of all patients, and complaints of facial numbness in approximately one third. Hypertrophic scarring can be expected in about one fifth of patients, and is always a risk with surgery in children. Furthermore, the incidence of permanent total facial weakness is unusual unless a malignant lesion invades the nerve. Permanent weakness unrelated to facial nerve sacrifice is unusual.

**INFECTIOUS AND INFLAMMATORY LESIONS**

Infectious and inflammatory diseases are the most common causes of enlargement of the parotid gland in the pediatric population. In our series, 43 (37.1%) of 116 children who underwent parotid surgery at Mayo had infectious or inflammatory lesions of the parotid gland, and this is only a small percentage of children who have swelling of the parotid gland but are treated more conservatively. Although chronic recurrent parotitis is less common than acute parotitis, it presents a treatment dilemma, especially in children. The agents responsible for the development of chronic parotitis can vary. As in adults, the likely bacterial agent in the acute phase is *Staphylococcus aureus* (most common), *Streptococcus pneumoniae*, or various gram-negative bacilli.\(^1\)

However, the cause of chronic infections is less clear. This condition is characterized by recurrent swelling of the parotid gland, usually unilateral, and is often accompanied by low-grade fever and malaise. It has been postulated that the cause of infection is ascending infectious agents via the Stensen duct, which (in combination with stasis from sialolithiasis, ductal strictures, sialodochitis, or a decrease in the production of saliva\(^1\)) results in recurrent or chronic infection. More common in children 5 to 7 years old, these swellings can occur many times yearly and may continue for several years. Short-term management involves antibiotic drug therapy and supportive care, but regardless of treatment, the episodes can continue. Exacerbations tend to subside as the child reaches puberty but in some cases, can extend into adulthood. Treatment ranges from supportive care with eventual resolution of symptoms to surgical removal of the affected gland. Often, no causative organism is ever identified. We advocate conservative management of chronic sialadenitis in children, with surgical management reserved for patients with disease that is unresponsive to medical therapy, and in whom the severity and frequency of symptoms outweigh the surgical risks. This approach explains the decrease in surgical treatment of chronic sialadenitis at our institution in recent years. When indicated, surgical treatment must be directed toward the extent of the disease and protection of the

### Table 4. Diagnosis, Treatment, and Follow-up of 6 Patients With Malignant Neoplasms Who Had Recurrence

<table>
<thead>
<tr>
<th>Age at Diagnosis, y</th>
<th>Diagnosis</th>
<th>Initial Treatment*</th>
<th>Time to Recurrence</th>
<th>Treatment of Recurrence*</th>
<th>Further Recurrence</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Mucoepidermoid carcinoma</td>
<td>Superficial parotidectomy</td>
<td>2 mo</td>
<td>Total parotidectomy (Mayo)</td>
<td>Along scar line 3 y mo later, treated with local excision</td>
<td>27 y (no further recurrence)</td>
</tr>
<tr>
<td>12</td>
<td>Mucoepidermoid carcinoma</td>
<td>Partial parotidectomy</td>
<td>3 mo</td>
<td>Total parotidectomy (Mayo)</td>
<td>None</td>
<td>21 y</td>
</tr>
<tr>
<td>16</td>
<td>Mucoepidermoid carcinoma</td>
<td>Partial parotidectomy</td>
<td>11 mo</td>
<td>Reexcision followed by radiation therapy</td>
<td>4 mo, still present, treated with total parotidectomy (Mayo)</td>
<td>26.8 y (no further recurrence)</td>
</tr>
<tr>
<td>16</td>
<td>Acinic cell carcinoma</td>
<td>Total parotidectomy</td>
<td>4 y</td>
<td>Excision of recurrent nodule and radiation therapy (Mayo)</td>
<td>None</td>
<td>16 mo (no recurrence)</td>
</tr>
<tr>
<td>14</td>
<td>Mucoepidermoid carcinoma</td>
<td>Partial parotidectomy</td>
<td>6 mo</td>
<td>Total parotidectomy (Mayo)</td>
<td>None</td>
<td>13 y 6 mo (no recurrence)</td>
</tr>
<tr>
<td>18</td>
<td>Adenoid cystic carcinoma</td>
<td>Total parotidectomy with partial mandibulectomy and scapular free flap, excision of facial nerve (Mayo)</td>
<td>16 mo, pulmonary metastases</td>
<td>None</td>
<td>Continued with disease Died of disease 4 y after surgery</td>
<td></td>
</tr>
</tbody>
</table>

* At another institution except where otherwise indicated.
facial nerve. Because continued swelling may occur, regardless of the procedure (Table 2), we advocate surgical removal of the entire affected gland to the extent that the facial nerve is not at risk. Total parotidectomy does not decrease the risk of recurrent swelling (Table 2); therefore, in children who are surgical candidates, superficial parotidectomy should be the procedure-of-choice.

Although no infectious agent was identified as the cause of recurrent inflammation in most of our patients, 9 had granulomatous lesions, which in adults, often represent a tuberculous infection. In children, more than 90% of mycobacterial infections of the head and neck are from nontuberculous mycobacterial infections, most commonly M avium-intracellulare complex and Mycobacterium scrofulaceum. Only 2 of our patients had cultures positive for Mycobacterium, but in both cases, it was M avium. Many authors5,6 have advocated surgical treatment of this disease, often without the need for antibiotic drug therapy. One of our 2 patients with cultures positive for Mycobacterium was treated initially with simple incision and drainage of an associated abscess, but quickly had recurrence and required superficial parotidectomy for definitive treatment. The other patient was treated with surgery alone. More recently, however, macrolides have been found to be effective against M avium lymphadenitis. Clarithromycin and azithromycin, initially tested in patients having acquired immunodeficiency syndrome with disseminated M avium complex infections, have been shown to be effective against M avium; however, whether this treatment will replace surgical excision of these lesions is not clear.7,8

The other 8 patients in the infectious or inflammatory group all had inflammatory lesions, most commonly reactive lymph nodes (88%). Although a multitude of inflammatory processes have been described affecting the parotid gland, such as Sjögren syndrome, sarcoidosis, and lymphocytic infiltration (often associated with human immunodeficiency virus infection), they are less likely to occur in children, and were not the cause of the lesions in any of our patients who required surgery for parotid swelling. Swelling of intraparotid lymph nodes, most often caused by viral infections in children, may mimic both benign and malignant diseases of the parotid. Because fine-needle aspiration is difficult to perform in children, parotidectomy was necessary to rule out malignancy. Of 7 patients with reactive lymphadenopathy, 2 (29%) reported recurrence in the form of additional swelling in the area, and were treated with observation only. Thus, if a diagnosis cannot be established in a child with a parotid mass, we advocate—at minimum—superficial parotidectomy (depending on the extent of the neoplasm) to confirm the absence of malignancy or neoplasm. Further swelling can then be treated conservatively.

One patient in this group had a diagnosis of Castleman disease—or unicentric angiofollicular lymph node hyperplasia, which occurs in 2 forms: the hyaline vascular type (80% to 90% of cases), which occurs at a single site as a benign lesion, and the plasma cell type. Patients with the latter type exhibit systemic symptoms and have a poor prognosis. Although Castleman disease is most common in the mediastinal region, it has been reported9 in the parotid gland (all cases have been unicentric lesions). Our patient had the hyaline vascular type and was cured after total parotidectomy, which is the recommended treatment for this rare disease.9

Also of interest is the decrease in frequency of surgical treatment of these lesions during the last 3 decades. Twenty-four patients had surgical therapy for infectious or inflammatory lesions of the parotid in the 1970s, 11 in the 1980s, and 8 between 1990 and 1997. This decrease is likely caused by the development of better antimicrobial agents, better understanding of the causes of inflammatory parotid disease and a change in management strategy.

**BENIGN LESIONS**

Benign lesions of the parotid gland in children can be subdivided into vascular and nonvascular lesions. Although vascular lesions (more specifically, hemangiomas) are thought to be the most common benign tumors in this area,10 we found a higher incidence of nonvascular tumors (primarily pleomorphic adenomas) in our series. Of the 56 children in our series who had benign lesions, 18 (32%) had vascular neoplasms (hemangioma or lymphangioma) and 27 (48%) had pleomorphic adenomas. Also, in the series by Chong et al11 from our institution, which covered the 52 years preceding our study, a higher percentage of patients had pleomorphic adenomas (30%) than vascular lesions (28%).

Most hemangiomas in our series were treated surgically (10 [83%] of 12); however, the 2 patients who were treated with only observation reported that their lesions resolved, emphasizing that these lesions can be treated conservatively with similar results. Lymphangiomas were more likely to recur or be incompletely excised, and 2 of our 6 patients with lymphangioma had recurrence (Table 3). Although recurrent or persistent disease is common with this type of tumor, this should not prevent an attempt at excision because if the tumor is left alone, it can continue to grow and involve surrounding structures. Although recent studies12,13 have investigated the use of sclerotherapy agents for the treatment of lymphangiomas, surgical excision remains the treatment-of-choice for lesions involving the parotid gland.

Pleomorphic adenoma is the most common benign lesion in the adult population. Although benign, it may undergo malignant degeneration in a small percentage of cases (as noted in adult populations). Partial parotidectomy with removal of the tumor is advocated by some authors14; however, of the 4 pleomorphic adenomas that recurred in our series, 3 (75%) were treated initially with partial parotidectomy at another institution. None of the 3 patients had further recurrence after surgery at Mayo. Of 21 patients treated initially at Mayo with superficial or total parotidectomy for pleomorphic adenoma, only 1 had recurrence. Because of this, we advocate—at minimum—superficial paroti-
ductomy for these lesions. This will permit adequate identification and preservation of the facial nerve at the initial operation, and should prevent the need for further surgery for recurrent lesions, which would put the facial nerve at further risk. In our study, 3 of 6 patients with benign lesions, in whom permanent facial weakness developed, were treated for recurrent disease. The overall recurrence rate of 14.8% for these tumors is similar to that of the earlier study by Chong et al.11

First branchial cleft cysts were uncommon benign lesions in our series. These lesions, believed to be remnants of the first branchial arch apparatus, are often intimately involved with the facial nerve,15 which often makes total removal difficult. These lesions can become repeatedly infected, and the resulting scarring and fibrosis can increase the difficulty of surgical removal. The 3 cysts that recurred in our series were all treated with partial parotidectomy (often more than once) at other institutions. This again emphasizes the need for formal parotidectomy (superficial or total, depending on the lesion) to help ensure preservation of the facial nerve and complete removal of the lesion.

Neurofibromas are unusual tumors and reportedly represent 0.6% of all pediatric salivary gland tumors.16 The tumors reported were all of the plexiform type, which is diagnostic of neurofibromatosis, even if the tumor is the only manifestation of the disease. Both children in our series with neurofibromas of the parotid gland had neurofibromatosis. Diagnosis was made after the lesion was removed in 1 of these children, and the other child was known to have the disease (neurofibromas were present elsewhere on the body). In the latter patient, the tumor was removed for cosmetic reasons (the tumor was large) and to rule out malignancy. In all cases of neurofibromas of the parotid gland, removal is usually curative.

Only 1 patient in our series had a mass consistent with a solitary fibrous tumor. These tumors most often arise from the visceral or parietal pleura of the lung, but have also been reported17 in the salivary glands. They usually are benign, but a subset is malignant. Histologically, solitary fibrous tumors may be confused with hemangiopericytoma. Solitary fibrous tumors in the parotid gland are best treated with parotidectomy. With complete excision, recurrence is unlikely.

MALIGNANT LESIONS

Malignant parotid lesions are uncommon in the pediatric population, and only 16.1% of parotid masses in our study were malignant. However, when a parotid mass is neoplastic, primary parotid malignancies are more common in children than in adults. If vascular lesions are excluded, parotid tumors were malignant in 35% of our patients. This is less than that reported in previous reviews10,18 of parotid lesions. The small number of patients with malignant lesions in our study and in most previously reported studies10,19-21 makes it difficult to draw definitive conclusions. The behavior of malignant tumors in children is related to histological type, and is similar to that of adult parotid gland malignan-

cies. Patients with low-grade mucoepidermoid carcinomas consistently have a good result after appropriate surgical treatment, as did all of our patients. Death may occur with adenocarcinomas and adenoid cystic carcinomas. The limited number of patients who received combined treatments also makes it difficult to draw definitive conclusions. However, because the biological behavior of tumors in children is probably similar to that of tumors in adults, we believe that the indications for postoperative radiation therapy are similar. Indications for radiation therapy after complete tumor resection include facial nerve invasion, highly aggressive histological features,22 perineural invasion with adenoid cystic carcinoma, cervical lymph node metastasis, and soft-tissue invasion. The potential for radiation-induced malignancies and effects on facial growth and development must be balanced with the need for improved local and regional control. Of 14 patients who received their initial treatment at Mayo, only 1 (7%) had a recurrence, and this manifested as metastatic pulmonary disease after resection of an adenoid cystic carcinoma. All these patients (except those with lymphoma or a malignant nerve sheath tumor) were treated with total parotidectomy, and except for patients in whom the facial nerve was intentionally sacrificed, no one had permanent facial weakness. Of the remaining 5 patients who had recurrence, 4 underwent a more limited procedure at another institution (Table 4), and even after further treatment, 2 of them had a second recurrence and 1 had permanent facial weakness. Our results support the idea that the best treatment for pediatric parotid malignancies is total parotidectomy. This procedure not only provides the best chance for cure, but also has a low risk of morbidity.

We conclude with the following points:

1. Parotid masses in children are uncommon and consist of various lesions.

2. Infectious and inflammatory lesions that are unresponsive to conservative therapy require surgical treatment.

3. Compared with adults, parotid neoplasms in children are less common but have a higher incidence of malignancy.

4. In the pediatric population, parotid surgery is associated with minimal morbidity.

5. Appropriate surgical therapy results in a low recurrence rate and few complications.

6. Limited procedures increase the risk of recurrence. We advocate, at minimum, superficial parotidectomy for benign disease and total parotidectomy for malignancy.

7. Frey syndrome occurs in approximately 50% of patients independent of the extent of surgery.

8. Hypertrophic scarring is the most common cosmetic complaint of children who have had parotid surgery.

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REFERENCES