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sebaceous contents; and procedure for chemical ablation of the cyst wall and lining cells. Following successful development of these three procedures at Nationwide Children's Hospital, dermoid cysts have been successfully treated without surgery in patients ranging from 2 to 57 years of age. All phases of the treatment procedure are performed with continuous sonographic and/or fluoroscopic guidance. Specimens are obtained to provide cytologic confirmation of the diagnosis. Given the intervention in critical areas such as the orbit, the procedure is carried out by a practitioner with a detailed understanding of the involved anatomy and expertise in techniques of sonographically guided microintervention.

Results observed to date in our patients have been excellent. All treated patients reported no postoperative pain or evidence of significant localized inflammatory response. Visual disturbances and globe displacement/mass effect resolved following treatment. Cosmetic results were excellent and there has been no evidence of recurrence in the neck and orbital dermoids that underwent the complete treatment regimen.

Cervical Ranula

Cervical ranula is a common mass in the floor of the mouth and neck of children and young adults. The term ranula finds origin from the common bullfrog, *Ranus ranus*, with the bulbous vocal sac in the floor of the mouth and neck. The cervical ranula is a cystic mass arising from one of the major salivary glands, most commonly the sublingual gland and less commonly the submandibular gland. Cervical ranulae present as two types: Simple and plunging (diving). The simple ranula is a cystic mass that bulges into the oral cavity anteriorly under the tongue. The natural history of the simple ranula is enlargement of the unilateral cyst with intraoral cyst rupture, drainage, and recurrence. They can be complicated by feeding and speech disorders, infection, pain and progression to a plunging ranula

dissecting in the deep soft tissues of the neck. The less common plunging ranula typically presents as a swelling in the neck, with pain and occasionally infection with abscess formation. Plunging ranulas are often mistaken for neck abscess or lymphatic malformations. The salivary gland ranula is believed to arise as a result of prior inflammation with resultant salivary gland small ductular obstruction in the parenchyma of the salivary gland. The plunging ranula results from rupture of the salivary gland capsule with leakage of the saliva and mucus into the soft tissues of the neck. Diagnosis is initially suggested by physical examination, CT, or MRI and confirmed with detailed neck sonography. Sonography demonstrates the salivary gland of origin and defines any accompanying cystic parenchymal disease or calculi in the affected salivary gland.

Otolaryngologists have shown that the recurrence rate of the plunging ranula was 70% after incision and drainage of the cyst, 53% after marsupialization, 85% after excision of the cyst in the neck, and 2% after excision of the sublingual or submandibular gland. Surgical treatment of plunging ranulas involves a large field neck dissection and excision of the affected salivary gland.

Prior to advancements at Nationwide Children's Hospital, there was no successful interventional radiological therapy for simple or plunging cervical ranulas. Cervical ranulas, both simple and plunging have been successfully treated without surgery in patients ranging from 5 to 54 years of age. With minor differences, both simple and plunging ranulas are treated with cyst catheter drainage, treatment of infection, and regional or total ablation of the affected salivary gland. Ablation is performed with meticulous ethanol ablation of the salivary gland of origin, maintaining the ethanol in an intracapsular, intraparenchymal location, always avoiding intravenous injection of ethanol with the associated potential complications. The combination drainage and ablation treatment of cervical ranulas has been successful in 100% of treated patients, most often following a single treatment session.

Cystic head and neck masses, whether congenital or acquired, traditionally presented unique challenges to surgeons. New treatment procedures and protocols at Nationwide Children's Hospital provide excellent likelihood for cure and the alternative of minimally invasive and microinvasive technology for treatment of cystic masses in critical areas of risk, injury, and morbidity.

Because sclerotherapy is a unique minimally invasive procedure used to treat lymphatic malformations that affect people at any age, Nationwide Children's Radiology Department patient population has grown to include adults as well as children. If you have questions about this procedure or would like references, contact Dr. William Shiels by e-mail at William.Shiels@NationwideChildrens.org or by calling radiology at (614) 722-2363. For more general information about Nationwide Children's radiology and new procedures visit the Nationwide Children's web site www.NationwideChildrens.org/Radiology.

William E. Shiels II, DO, MS, is the Chief of the Department of Radiology at Nationwide Children's Hospital and President of the Children's Radiological Institute. Dr. Shiels is a Clinical Professor of Radiology and Pediatrics and Category M on the graduate faculty in Biomedical Engineering at The Ohio State University College of Medicine. He is also an Adjunct Professor of Radiology at the School of Medicine at the University of Toledo Medical Center and a visiting scientist at the Armed Forces Institute of Pathology in Washington, D.C.

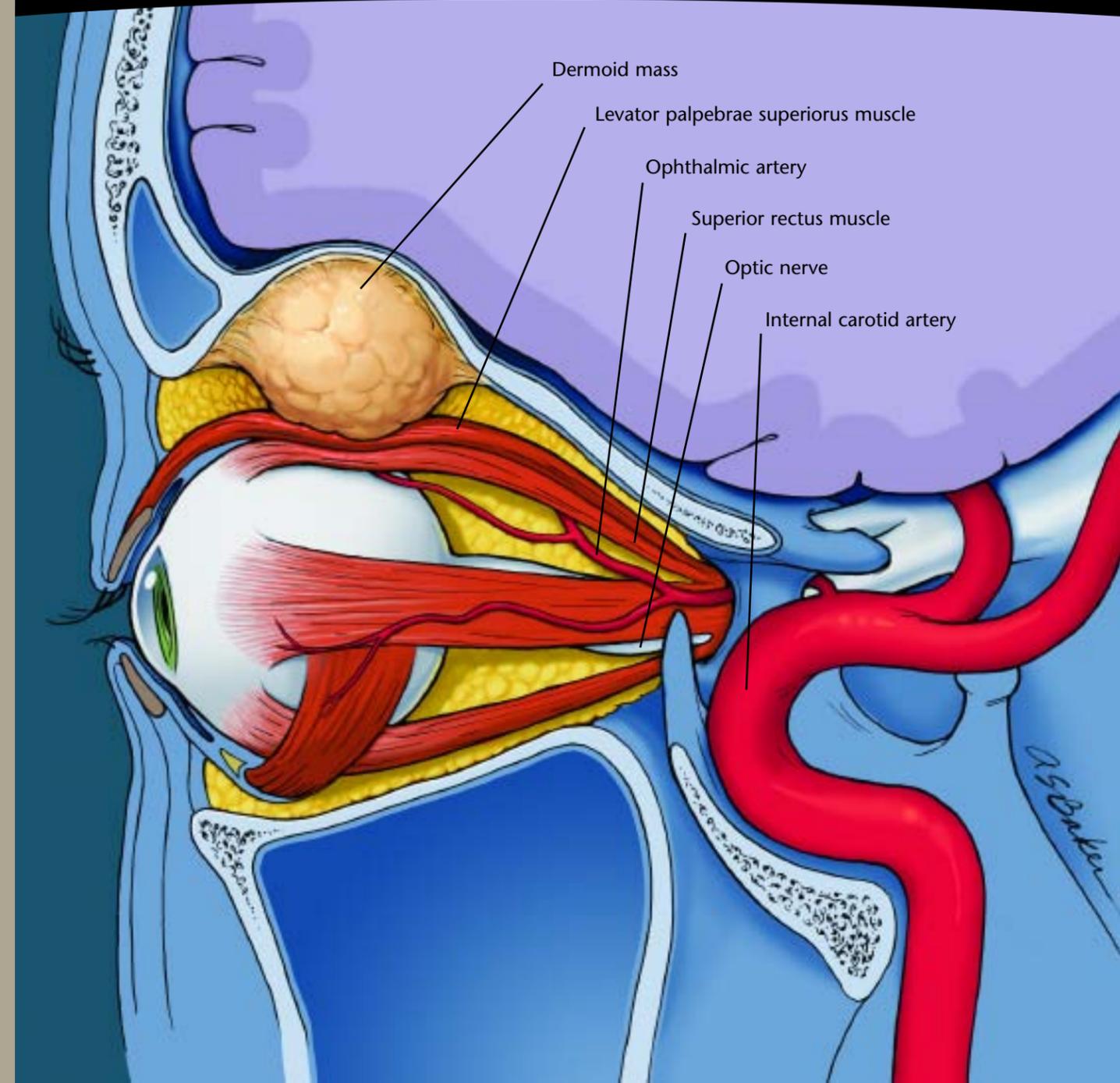
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Figure 3: 51 y/o male undergoing drainage and ablation of a multilocular lymphatic malformation in the neck. The LM responded to a single treatment with no evidence of recurrence or scarring at two years follow-up ultrasound.

Head and Neck Cystic Masses: New Minimally and Micro-invasive Treatment Solutions

William E. Shiels II, DO; Chairman, Department of Radiology, Nationwide Children's Hospital



Anthony Baker Medical Illustration

There are new interventional radiology treatments that have been developed at Nationwide Children's Hospital for children and adults with congenital and acquired cystic masses in the head and neck. This article will focus on a new treatment being used at Nationwide Children's Hospital for head and neck lymphatic malformations (previously termed lymphangioma), dermoid cysts, and cervical ranulas. Ophthalmologists, oculoplastic surgeons, otolaryngologists, pediatric surgeons, neurosurgeons, and other surgeons now offer their patients these minimally invasive treatments as alternatives to more extensive and potentially deforming surgical procedures. The following two case studies illustrate the dramatic impact that this treatment can make in a patient's life.

Case #1

The Christmas lights glowed and presents were scattered throughout the living room. A festive time for the family was suddenly sobered with a new discovery: Their 4-year-old daughter, Jessica's right eye was suddenly bulging and painful. Two days after Christmas, Jessica was rushed to Nationwide Children's Hospital, where surgeons and radiologists found a cystic mass behind the eyeball filled with hemorrhage. After five attempts at surgical drainage of the mass, the oculoplastic surgeon could only offer Jessica a 50% chance of resection (with removal of the boney lateral orbital wall and risk of optic nerve damage) and 50% or greater chance of recurrence. Four years after treatment with sclerotherapy, the new orbital interventional radiological technique developed at Nationwide Children's Hospital, Jessica's vision is better than prior to treatment with full cure of the lymphatic malformation (lymphangioma).

Case #2

Mrs. Doyle was a pleasant 57-year-old woman with a 15 year history of daily severe headaches and photophobia in the mornings from her left eye. Now, headaches and visual problems

were overshadowed as she discovered a lump under her left eyeball. The oculoplastic surgeon and radiologists concluded that Mrs. Doyle had a large orbital dermoid cyst filling 50% of her left orbit, including extension out of the orbit into the lateral temporal tissues of her skull. As the alternative to extensive skull and orbital surgery, Dr. Cahill offered Mrs. Doyle interventional radiological sclerotherapy. The day of treatment was the last day Mrs. Doyle experienced her headaches, and she wakes in the morning with no aversion to light. Following treatment, orbital sonography shows no evidence of the intraorbital mass, with normal visual and extraocular muscle function.

Lymphatic Malformations

Lymphatic malformations (LM) present at all ages, from fetus through adulthood. The typical LM is often a combination of large macrocysts with small foci of accompanying smaller cysts (microcystic disease). Less commonly, LM presents solely as a small number of large macrocysts. LM is most frequently diagnosed in the head and neck, but can present in numerous locations to include the orbit, mediastinum, retroperitoneum, abdomen, extremities, scrotum, and penis. A LM that is diagnosed at birth usually presents as a soft, spongy, non-tender mass. In older children and adults, a LM may present with rapid development of a soft or firm non-tender mass, this occurring as a result of hemorrhage into previously undiagnosed LM locules. Less frequently, LM presents with infection of the mass or pain.

The pathology of LM is central to understanding imaging findings with various modalities, as well as designing effective therapeutic interventional techniques. Pathologically, LM is a complex of multiple cysts lined with lymphatic vascular endothelium. The supporting matrix of the LM is a combination of fibrous tissue and smooth muscle with small feeding vessels and aggregates of lymphocytes in the interweaving septations. The cystic spaces may or may not communicate and contain serous or hemorrhagic

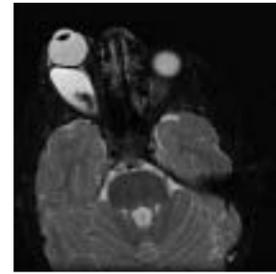


Figure 1A: MRI of 4 y/o female with proptosis due to the right retrobulbar lymphatic malformation

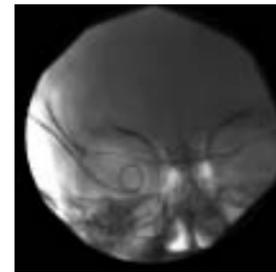


Figure 1B: SF drainage catheter in position for drainage and ablation

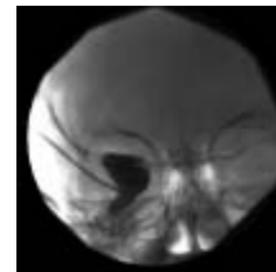


Figure 1C: Contrast cystogram defining the orbital cystic mass prior to ablation

fluid. When macrocystic disease predominates, pathologists refer to these as cavernous lesions, or the typical "Cystic Hygroma."

Diagnostic imaging is best performed with a combination of MRI and sonography. MR is the imaging modality of choice for global assessment of the extent of a LM. Sonography may be the sole diagnostic imaging modality if the lesion is well localized in a superficial location. Sonography during a preoperative consultation facilitates pre-procedural mapping, as well as effective parent/patient education.

Prior to sclerotherapy, intracystic contrast injection demonstrates the well-defined macrocysts, often communicating with small adjacent cysts; the large cysts most frequently do not communicate. In some areas such as the tongue, microcysts may communicate with areas of lymphangiectatic vessels.

Traditionally, LM is treated with surgical resection, followed by interventional radiological sclerotherapy for recurrent or unresectable lesions. Surgical resection may be difficult, and when foci of microcystic disease are left in the operative bed, recurrence can be expected. Due to a high recurrence rate following surgery (up to 50%) and the development of effective sclerotherapy techniques, surgeons increasingly request that sclerotherapy be performed as the initial treatment choice.

Procedures such as sclerotherapy have been further developed and refined in the Department of Radiology at Nationwide Children's Hospital and they have proven to be highly successful alternatives to multiple surgeries for treatment of LM. The

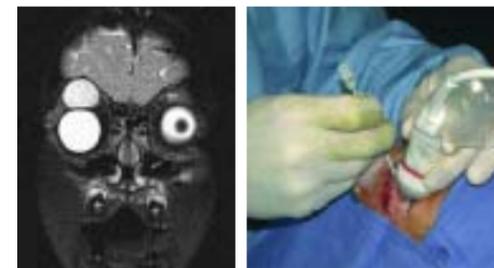


Figure 2A: MRI of 4y/o female with large supra-orbital dermoid cyst eroding and elevating the orbital roof

Figure 2B: SF drainage catheter placed through the superior eyelid for drainage and treatment of the orbital dermoid



Figure 2C: Photograph of the evacuated dermoid contents demonstrating the sebaceous nature of the material as well as eyelashes (cilia) contained within.

age of patients treated at Nationwide Children's Radiology for LM ranges from birth to 51 years of age.

Macrocystic disease is also treated with the new catheter based treatment with a 98% success rate after one session of treatment of specific locules of the LM. Prior to treatment, cytology specimens are collected to confirm the diagnosis of LM. Sclerotherapy of macrocystic LM is performed with indwelling catheter placement and time-limited dual-drug (sodium tetradecyl sulfate followed by ethanol) sclerosant contact followed by suction drainage. Following aspiration of the ethanol, the catheter is connected to a Jackson-Pratt suction bulb system, maintained for three days.

In the natural history of LM, microscopic cysts that are not detectable by sonography or the naked eye at surgery mature to a point where they are larger than 1mm and detectable with surveillance sonography. In prior years, minimally invasive therapy for LM was limited to macrocystic disease. Foci of residual or maturing microcystic disease can now be successfully treated with targeted interventional radiological therapy, avoiding complications of infection, sepsis, and hemorrhage. A new microcystic sclerotherapy technique developed at Nationwide Children's Hospital provides precisely targeted high concentration Doxycycline that allows 50 or more cysts to be treated in a single setting. In this microcystic treatment technique, cysts as small as 2mm are drained and ablated with intracystic Doxycycline sclerotherapy.

Ultrasound examination performed one month following sclerotherapy will demonstrate complete ablation of the treated cysts in greater than 95% of cases. Massive LMs have been successfully treated in the abdomen and mesentery without complications. In the treatment of large cysts there is a 5% incidence of repeat hemorrhage in cysts following sclerotherapy. Following repeat hemorrhage, a second treatment has been effective for ablation in 100% of cases. In our patients, no cases of neuropathy,

unexpected skin necrosis, or myoglobinuria have been encountered with sclerotherapy. In LM that involves the cutaneous epidermis, sclerotherapy targets the LM and involved skin to provide a clean tissue bed for successful skin grafting.

Dermoid Cysts

Dermoid cysts (See illustration on title page.) are the most common orbital/periorbital tumors found in the pediatric population and also commonly found in the neck of children and adults. They are categorized as developmental choristomas that develop as a result of sequestration of surface ectodermal elements typically found along suture lines of the orbital bones and the upper neck. They are slow growing, cystic masses that may cause pain, visual impairment, diplopia, ptosis, globe displacement, motility disturbances, and chronic inflammation. Various surgical techniques have been described, depending on specific location of the dermoid, and may frequently involve osteotomy or neck dissection. However, the relatively extensive nature of such surgical interventions may pose serious risks to both vision and cosmesis.

Confirmation of diagnosis and cyst location by CT, MRI, or ultrasound is an important consideration in case selection. Dermoid cysts have characteristic features on each of these radiological modalities, and when used in conjunction with one another, diagnosis is precise. Assessment of tumor location is important in order to determine whether the cyst is safely accessible without undue risk to adjacent structures such as the globe, lacrimal gland, extraocular muscles, optic nerve, or facial nerve. Since the interventional radiological procedure is performed under direct, real-time ultrasound guidance, special care is taken to avoid damaging such structures.

The treatment of dermoid cysts required development of three new procedures: A procedure for catheter access in small cysts; procedure for emulsification and drainage of the

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