Purpose:

The purpose of this educational exhibit is to provide a comprehensive review of multimodality imaging findings, typical locations, diagnostic pitfalls, and treatment complications of chondrosarcoma of the head and neck (H&N).

Description:

In this IRB-approved, HIPAA-compliant study, we reviewed our institution's imaging database for illustrative cases of histopathologically-proven chondrosarcoma of the H&N and present a selection of lesions with characteristic multimodality imaging findings. Additionally, a review of the current medical literature was performed.

Chondrosarcomas are a heterogeneous group of malignant tumors containing chondroid matrix, accounting for less than 5% of all sarcomas [1]. Approximately 10% or less of chondrosarcomas occur in the H&N, which may arise from any site containing a cartilaginous rest, such as the skull base (particularly sutures or synchondroses), laryngeal cartilages, sinonasal region, mandible, trachea, and orbit [1]. Although malignant, H&N chondrosarcomas often behave less aggressively than chondrosarcomas elsewhere, more commonly present as lower grade and stage, and demonstrate greater disease-specific and overall survival [1].
CT and MRI provide complimentary information about suspected chondrosarcomas of the H&N. CT better delineates the degree of osseous involvement, detects associated matrix mineralization, and identifies associated airway compromise [2, 3]. Matrix mineralization is variable, reported in 44-100% of cases [3, 5-7]. MRI offers superior tissue contrast resolution, more precisely delineating the extent of tumor spread for treatment planning [4, 6]. Chondrosarcomas show characteristic signal iso-to-hypointensity on T1-weighted images and hyperintensity on T2-weighted images, particularly if matrix mineralization is minimal. Enhancement is typically avid and often heterogeneous. Based upon the imaging appearance of individual lesions, the primary differential considerations include chordoma, osteosarcoma, metastases, myeloma/plasmacytoma, Langerhans cell histiocytosis, and non-hodgkin lymphoma, which are detailed in this exhibit. We also detail potential treatment complications of radiation necrosis of the brain and osteoradionecrosis of bone.

Summary:

Chondrosarcoma of the H&N is an uncommon, but critical diagnosis that must be recognized by imagers. The diagnosis must be suspected if a mass shows bright T2 signal intensity, matrix mineralization, or is found in typical locations of chondroid rests.

References:

1. Ellis MA, Gerry DR, Byrd JK. Head and neck chondrosarcomas: analysis of the surveillance, epidemiology, and end results database. Head Neck 2016; Epub APR 2016 DOI: 10.1002/hed.24434


(HP_02) The Hypoglossal Canal: What Lies Within?

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Abstract Details
Purpose: The hypoglossal canal is a structure that often is overlooked secondary to its size and the complexity of the skull base. At our institution, a variety of pathologies involving the hypoglossal canal have been imaged. The purpose of this exhibit is to provide a pictorial review of select abnormalities that can affect the hypoglossal canal, with a discussion of the relevant imaging findings.

Approach/Methods: A retrospective review of patients with processes involving the hypoglossal canal at our institution was performed. Relevant MR and CT images as well as surgical and pathological correlations in select cases were collected.

Findings/Discussion: The hypoglossal canal contains the hypoglossal nerve and vascular structures. We shall discuss various pathologies ranging from congenital vascular variants such as the persistent hypoglossal artery, to acquired conditions such as schwannomas of the hypoglossal nerve, skull base metastasis affecting the canal, among others. In addition, secondary effects of hypoglossal nerve injury such as imaging findings of paralysis of the tongue will be presented. High resolution imaging will be used to outline the course of the hypoglossal nerve.
Summary/Conclusion: This review will provide the practicing neuroradiologist and in training physician with a working knowledge of the spectrum of pathologies that can affect the hypoglossal canal, thereby facilitating early detection. Potentially missing a lesion within the hypoglossal canal may lead to later problems involving speech and swallowing.
Abstract Details
Cranial nerve thickening can be encountered in various pathologies. Etiologies are protean; classifying the presentation as diffuse or focal can help narrow the differential. Furthermore, pertinent history and clinical information is very important to offer a proper differential diagnosis. We propose a review of common etiologies of focal and diffuse cranial nerve thickening, as well as a helpful algorithmic approach to help radiologists offer the most appropriate diagnostic avenues. Congenital and acquired causes of cranial nerve thickening are discussed, as well as common pathways of perineural spread from cutaneous and head & neck malignancies.
(HP_04) Pictoral Review of Perineural spread of Head and Neck Cancer with Correlation Using a 3D Printed Model.

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Abstract Details
Purpose: To provide a comprehensive review of perineural spread of head and neck malignancies with correlation using a 3D printed model.
Description: Perineural spread of head and neck malignancies can be subtle especially in cases of remote history of prior head and neck cancer. With the prevalence of CT scans being obtained, this can often be overlooked. A comprehensive review will be provided along with the common pathways of perineural spread. This will establish the framework to allow detection of even these subtle cases of tumor spread. To do this I am going to utilize a 3D printer to build several models of the head which exemplifies the cranial nerves and their individual courses. The nerve courses are the highways for perineural tumor spread, and a 3D model will allow greater understanding of the anatomy of the cranial nerves. A pictoral review of imaging findings with correlation using the 3D printed model will clearly demonstrate these common pathways of perineural spread. Finally, subtle cases of perineural spread will be presented that will reinforce the imaging findings necessary to make the diagnosis.
Summary: By providing a 3D printed model of the cranial nerves of the head and their courses. The nerve courses are the highways for perineural tumor spread. By utilizing a 3D model, the common "highways of perineural tumor spread" will be reinforced. Then a comprehensive review of perineural tumor spread along with the pertinent imaging findings will be provided.
Abstract Details

Background:
Dehiscence of the superior semicircular canal (SSC) wall is associated with unusual audiologic symptoms. The patient with a bone defect may have sound or pressure induced vertigo, autophony (one’s own voice is uncomfortably loud) or dizziness and unsteadiness. While up to 10% of individuals may have dehiscence, the defect may be asymptomatic (1, 2).

The initial imaging work-up for neurotologic signs and symptoms in the adult is an MRI with CSF bright (constructive interference in steady state, FIESTA, CISS) contiguous axial images and T2 coronal fast spin echo sequences through the posterior fossa, mastoid and middle ear complex, and membranous labyrinth. A hypointense layer between the high signal intensity fluid in the SSC and CSF in the floor of the middle cranial fossa has been shown to prove the canal is intact superiorly (3, 4). However, a temporal bone CT may be requested to supplement the MRI, with special attention to the SSC roof.
The goal of this project was to confirm our anecdotal observation that an additional anatomic finding, a supra-labyrinthine air cell, infers that the SSC roof is intact, and a temporal bone CT is not necessary to confirm.

Methods and Materials

For this retrospective IRB approved study, cases were pulled from our database with search terms “hearing loss” or “sinusitis.” CT was performed on 64-row multidetector scanners (0.625 mm axial acquisition, with coronal/oblique reformations). The anatomic study included 94 CT examinations (65 CT angiograms, 29 temporal bone or sinus CTs) and 188 temporal bones were included. Coronal CT reformations were reviewed and a supralabyrinthine cell was recorded as present or absent. SSC roof was recorded as intact or dehiscent.

Results

Our population included 71/94 female, 23/94 male and mean age 47.2 yrs (range 21 – 79 yrs). 31/188 temporal bones had supralabyrinthine cells, and none of these had SSC dehiscence. There were 15 labyrinths with SSC dehiscence, and none of these had a supralabyrinthine air cell.

Discussion

Only 16.5% of temporal bones had a supralabyrinthine air cell, and all had intact SSC roofs. The presence of an air cell was not necessary for an intact SSC roof, as most had intact bone without an extensively pneumatized skull base. This preliminary anatomic study supports our observation that an air cell above the labyrinth is secondary evidence of an intact canal roof, and is an additional finding that may obviate a temporal bone CT (4). A supralabyrinthine air cell is usually obvious on coronal T2 or CSF-bright MR sequences, and when present a second imaging study, a temporal bone CT, is not necessary to determine that the SSC is intact superiorly.

Our future goal will be to review cases where both temporal bone CT and MR were performed, to test our observation. If proven, we plan to amend our sensorineural hearing loss MR template to include a statement reflecting an intact SSC roof.
Using 3D printing technology to demonstrate frontal sinus outflow variants

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Abstract Details
Purpose: The purpose of this exploratory project is to describe the utility of 3D printing in demonstrating anatomic variants of the frontal sinus outflow tract including agger nasi as well as Type I-III frontal cells.

Description: Understanding the 3-dimensional anatomy of frontal sinus outflow pathway variants is challenging to conceptualize based on two-dimensional CT sagittal and coronal reformats for both the radiologist and treating surgeon. The purpose of this exploratory project is to describe the utility of 3D printing in demonstrating anatomic variants of the frontal sinus outflow tract including agger nasi as well as Type I-III frontal cells. This exhibit will provide step-by-step methods as well as challenges and solutions as other radiologists incorporate this technology into their practices.

Summary: 3D printing technology can be leveraged to better demonstrate complex head and neck anatomy for surgical planning.
Abstract Details
PURPOSE

To establish objective age-related normal size values of the optic pathway structures - orbital optic nerves (ON), prechiasmatic optic nerves (PON), optic tracts (OT) and optic chiasm (OC) in the paediatric population using MRI, and to correlate these finding with age.

METHODS
We retrospectively reviewed all cranial MR studies of paediatric patients referred for reasons unrelated to ophthalmic or orbital pathology and whose results were interpreted as normal by a certified neuroradiologist. All examinations were performed on a 1.5-T or 3-T Siemens MR system using routine imaging protocols. Exclusion criteria included studies degraded by patient motion artefacts or technical factors preventing adequate visualisation of ON/PON/OT/OC, and any invasive cranial procedures. All measurements were performed manually using hand-held digital caliper.

For statistical analysis purposes the patients were stratified into five age groups: (I) 0-1.5 years, (II) 1.5-3 years, (III) 3-6 years, (IV) 6–12 years, (V) 12-18 years).

RESULTS

The final study population included 137 studies (72 male, 65 female, average age = 7.7 SD 5.3 ). The mean diameter of aforementioned structures for each age group was established. A strong positive correlation between age and mean diameter of ON/PON/OT was noted (p < 0.001). A significant difference in mean diameters was found in age groups I-III (0-6 y.o) followed by a plateau. ON/OT ratio used to study simultaneous growth of different structures showed the same mean value for all age groups and no correlation with age.

CONCLUSIONS

Size of optic pathways is function of age. Most prominent increase in size of ON/PON/OT occurs under age of 6 years and different structures show equal growth rate.
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Abstract Details
Biting off more than you can chew - A review of common and uncommon dental pathology.

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Topic: Dental pathology

Purpose: Review of dental anatomy and common and uncommon dental pathology.

Materials and methods: A retrospective review of patients imaged at our institution was performed for CT and MRI findings of uncommon and common dental pathology.

Description:
With the increasing frequency of urgent and routine CT and MRI examinations from both the Emergency department and outpatient clinics, pathology involving teeth and their underlying foundation is not
infrequently seen. The ability to recognize, describe, and accurately diagnose pathology in this area can be crucial for appropriate patient care and management. Through a case based approach, we will review basic anatomy of the dentition, maxilla and mandible, as well as common and uncommon pathology that arises in these locations that every radiologist should know.

Summary:
This educational exhibit will provide basic review of anatomy of the teeth and their adjacent foundation, as well as common and uncommon pathology involving dental pathology.
Estimation of the proton density fat fraction of the salivary gland

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Abstract Details
Purpose
The first purpose was to assess the value of a six-echo variant of the modified Dixon Quant (mDixon) for salivary gland fat fraction (FF) quantification against multi-echo T2 corrected MR spectroscopy which was used as the reference standard. The second goal was to apply mDixon to estimate the FFs and to compare them among the control group, Sjogren’s syndrome (SS) group and IgG4 related disease (IgG4-RD) group.

Materials and Methods
To conduct this study, 10 healthy volunteers were enrolled and 20 parotid glands (PGs) were evaluated. Quantitative MRI was performed using the mDixon sequence in addition to single-voxel MRS to compare the mDixon-FF with MRS-FF. On the FF image obtained by the mDixon method, we measured the FF of the region of interest (ROI). For the MRS, five unsuppressed 1H spectra were acquired by the Stimulated Echo Acquisition Mode with different echo delays (TE=13-53ms). Time-domain quantification was performed using the AMARES algorithm from the MRUI software package. Relaxation times T2 of water and the four main different triacylglycerol components (5.3, 2.1, 1.3, and 0.9 ppm) were determined.

For the second purpose, we applied the mDixon sequence to 64 cases. Eleven patients were thus assigned to the SS group, 4 patients to the IgG4-RD group, and the remaining 49 patients to the control group with any abnormality of the salivary gland. The outlines of both the PGs and submandibular glands (SMGs) were traced to set the ROIs to estimate the FF. In the control group, we evaluated any...
correlations among the FF, height, weight, body mass index (BMI), cholesterol level, and serum triglyceride level. We also compared the FF among the three groups.

Results
The FF (mDixon) correlated closely with the FF (MRS) according to the following equation
FF(mDixon) = 1.06 × FF(MRS) - 2.6 with R² of 0.99. Therefore, the FF (mDixon) was considered to be potentially appropriate for clinical use.

The PG-FF of the control group positively correlated with the weight and BMI (ρ = 0.32, P = 0.024 and ρ = 0.59, P < 0.001, respectively). The SMG-FF also correlated with the weight, BMI and serum triglyceride levels (ρ = 0.59, P = 0.0228, ρ = 0.38, P = 0.0067 and ρ = 0.52, 0.0004, respectively).

The SS group had a higher PG-FF (50.3 ± 1.7%) than both the control group (34.9 ± 11.1%) and IgG4-RD group (35.2 ± 21.7%) and a significant difference was found between the SS group and control group (P = 0.0113, Steel-Dwass test). This trend was remarkable in the submandibular gland. The SS group had a significantly higher SMG-FF (41.1 ± 25.9%) than both the control group (7.4 ± 4.5%) and IgG4-RD group (3.9 ± 3.2%) (P < 0.0001 and P = 0.0258, respectively, Steel-Dwass test). Therefore, the SMG-FF was lower than the PG-FF in the control group (P < 0.001, paired t test), however fat may accumulate rapidly in SMG patients due to the progression of SS.

Conclusions
Estimating the FF of the salivary gland using mDixon was thus found to be highly accurate in comparison to the MRS method. Therefore, this modality is considered to be potentially appropriate for clinical application. The FF obtained by mDixon quantitatively revealed the characteristic fat accumulation (especially SMGs) in the SS group.
Abstract Details
Purpose:
To determine interventions that may decrease non-diagnostic rates in ultrasound guided fine needle aspiration (FNA) for head and neck lymph node masses.
Materials & Methods:
Ultrasound guided FNA was performed on 69 head and neck lymph node masses by a single surgeon over a 5-year period. The study analyzed the relationship between non-diagnostic rates and age, gender, size of mass, needle gauge (23 vs 25), and biopsy technique (capillary action vs aspiration), as well as year in practice and year of technique. FNA diagnosis and final pathology, where applicable, were recorded for each sample. Data was analyzed using chi-square or Fisher's exact test.
Results:
The overall non-diagnostic rate was 7.2%. Capillary action, with a 23-gauge needle, yielded an overall lower non-diagnostic rate (0%) compared to aspiration technique (7.2%). Non-diagnostic rates decreased
with increasing physician experience (0% in the final year of the study). However, small sample size hindered statistical significance. The sensitivity, specificity, PPV, NPV, and accuracy for detecting benign vs. malignant lesions was 64%, 100%, 100%, 88%, and 90%, respectively.

Conclusion:
Our data indicates that ultrasound guided FNA of head and neck lymph node masses is accurate and exhibits a short learning curve. Moreover, capillary action may yield lower overall non-diagnostic rates than the aspiration technique. We recommend novice physicians use a 23-gauge needle with the capillary action technique to perform this procedure. However, given the small sample size, we also recommend a follow up study with a larger sample size.
(HP_12) Are radiologists aware of their boundaries? A study to evaluate whether radiological imaging is over-reporting gross ECS in head and neck cancer and to learn from any mistakes.

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Abstract Details
Are radiologists aware of their boundaries?

Dr. M. Spurr

Objective
To evaluate whether radiological imaging is over-reporting gross ECS in head and neck cancer and to learn from any mistakes.

Methods
All primary neck dissections at The Royal Glamorgan Hospital were analysed retrospectively between February 2011 and November 2015. The radiology department used a combination of US and CT to assess nodes; MRI was occasionally used if needed. Radiological findings were compared with nodal histology from neck dissection. The incorrectly reported scans were analysed to learn from mistakes.

Results
119 patients were included in the study. There were 3 cases where radiology predicted ECS but pathology proved this wrong. Sensitivity and specificity were 100% and 97.20% respectively. The positive predictive value was 80% and the negative predicted value 100%. Over-reporting occurred as suspicious lymph node boarders, seen on CT and MRI, could not be compared properly with the limited USS images saved from the initial scan.

Conclusion
Although ECS is not included in TNM staging, it is recognised to be associated with increased rates of regional and distant metastases and a significant fall in 5 year survival (Puri et al. 2003). Additionally ECS status will affect treatment decisions. If predicted and treated correctly, outcomes are improved (Mendenhall et al. 2006). Our data suggests clinicians should be reassured that a positive radiological ECS status is highly unlikely to be pathologically negative.
In future, commenting on ECS status whilst performing US may lead to a reduction in over-reporting.