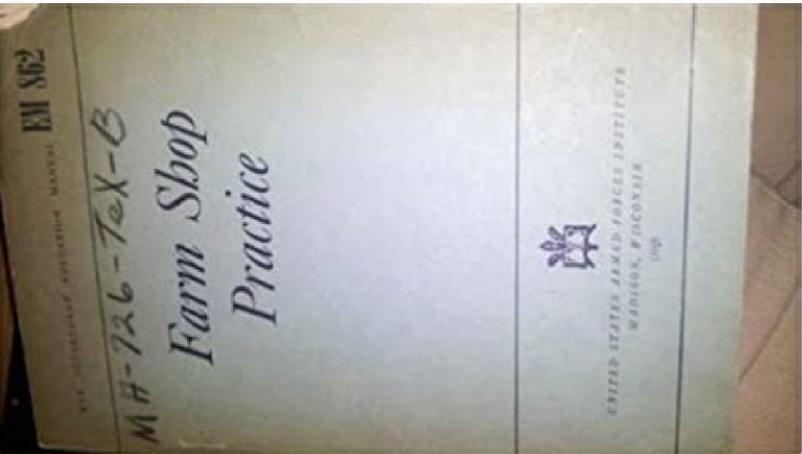
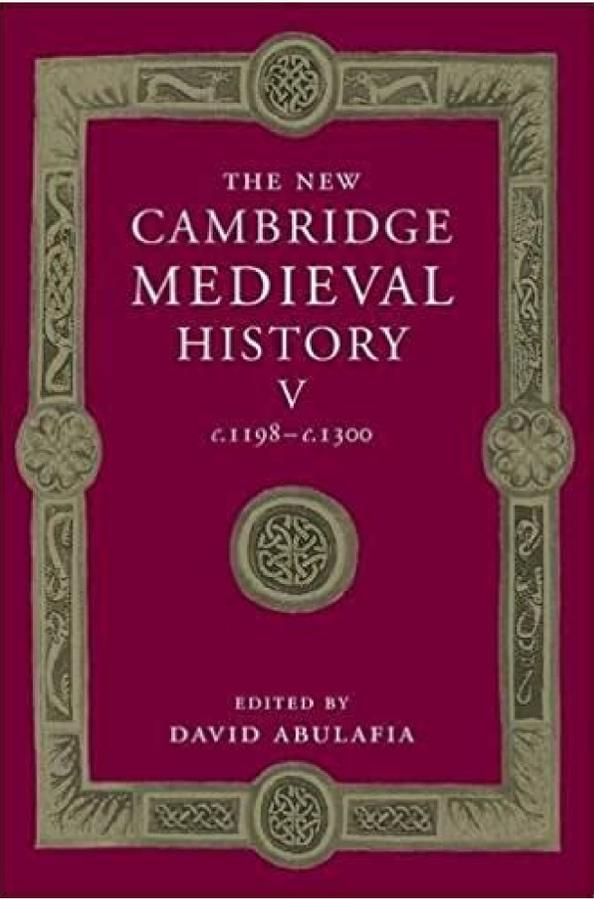


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Gadolinium contrast is not used routinely but would be indicated in cases where infection, inflammatory arthropathy, or neoplasm is suspected. Cine gradient echo (GRE) images depict disc movement and can be used to evaluate condylar translation. [Google Scholar][Ruparelia, P.B.; Shah, D.S.; Ruparelia, K.; Sutaria, S.P.; Pathak, D. 2014, 124, 1067-1083. In addition, T2WI is useful for detecting degenerative periaricular changes and the presence of a joint effusion. 2020, 132, 109291. [Google Scholar][CrossRef][Okeson, J.P. The Classification of Orofacial Pains. Imaging of Chondrocalcinosis: Calcium Pyrophosphate Dihydrate (CPPD) Crystal Deposition Disease—Imaging of Common Sites of Involvement. 2012, 30, 118–125. Radiographics 2000, 20, 1407–1434. Axial (A) CT in bone windows and reformatted coronal (B) image demonstrates a prominent bony mass arising along the medial aspect of the mandibular condyle (star), with a well-corticated appearance and no aggressive features. N. Condylar fracture accounts for 25–50% of mandibular fractures and is classified as the condylar head (intra- or extra-articular) or neck fracture [23]. In patients with a condylar fracture, the unopposed force of the lateral pterygoid muscle usually causes inferior and anteromedial dislocation of the condylar head and the lateral displacement and telescoping of the ramus (Figure 8). When small, it is challenging to differentiate osteochondroma from an osteophyte. TMJ metastases can present with a soft tissue mass with adjacent bone erosion. Figure 5. Soc. Figure 8. Subsequently, it translates anteriorly in the upper compartment [6]. 2021, 25, 441–453. Can. [Google Scholar][CrossRef][PubMed][Chen, M.-J.; Yang, C.; Qiu, Y.-T.; Zhou, Q.; Huang, D.; Shi, H.-M. ID peaks in the second to the fourth decade of life with a female-to-male ratio of 3:1 and most commonly presents with jaw pain, clicking, or locking [9,10]. Clinical diagnosis is complicated because the patient may be asymptomatic until a relatively late stage of the disease [30]. Contrast-enhanced MRI is the preferred imaging modality and shows both the acute findings and secondary degenerative arthritis. The lateral pterygoid muscle fibers and tendons attach the anterior band of the disc to this complex. Korean Assoc. 2014, 25, 1703–1706. Am. 2018, 30, 239–249. The CT depicts a soft tissue mass arising from the joint with areas of hyper attenuation which enhances after contrast injection. The articular disc (straight arrow) demonstrates the normal inverted C-shaped morphology and hypoechogenicity, situated just superior to the condylar cortex. The sonographer should perform a high-resolution ultrasound (12–20 MHz high-frequency linear transducer) by placing the probe perpendicular to the zygomatic arch and parallel to the mandibular condyle. [Open Access Rheumatol. [Google Scholar][CrossRef][Youssef Mohamed, M.M.; Dahaba, M.M.; Farid, M.M.; Ali Elsayed, A.M. Radiographic Changes in TMJ in Relation to Serology and Disease Activity in RA Patients. While internal derangement is the most common TMJ pathology, radiologists should not overlook other less common pathologies such as inflammatory arthritis, infection, trauma, and neoplasm. We aim to review normal TMJ anatomy and function, most common TMDs, and their imaging presentations. Interpreting TMJ imaging requires an understanding of the normal anatomy of the joint. Given the high MRI contrast resolution of the soft tissues, it is currently the gold standard for diagnosing disc disorders. [Google Scholar][CrossRef][Naqvi, A.H.; Abraham, J.L.; Kellman, R.M.; Khurana, K.K. Calcium Pyrophosphate Dihydrate Deposition Disease (CPPD)/Pseudogout of the Temporomandibular Joint—FNA Findings and Microanalysis. Magn. [Google Scholar][CrossRef][Morales, H.; Cornelius, R. Temporomandibular joint radiographs. Figure 10. Oral Rehabil. © 2022 by the authors. Radiologists need to be familiar with the normal anatomy and function of the TMJ and MR imaging of the internal derangement and other less common pathologies of the TMJ. [Google Scholar][CrossRef][Larheim, T.A.; Hol, C.; Ottersen, M.K.; Mork-Knutson, B.B.; Arvidsson, L.Z. The Role of Imaging in the Diagnosis of Temporomandibular Joint Pathology. Studies have shown a correlation between the severity and pattern of condylar fractures on CT and risk of soft tissue injuries. Am. 2012, 20, 397–412. On CT, the condyle of the mandible is deformed with significant subchondral sclerosis. 1997, 83, 393–399. Figure 4. However, MRI is the modality of choice to evaluate retrodisical tissue injury and disc dislocation [42,43]. Osteochondroma is a benign bone lesion that can arise from the mandibular condyle or glenoid fossa. On the other hand, secondary OA can be seen in younger patients with ID, prior trauma, or other TMJ arthropathies [18]. Temporomandibular Dislocation Caused by Pancreatic Cancer Metastasis: A Case Report. Monit. Most condylar fractures will show functionally favorable outcomes after closed reduction. [Google Scholar][CrossRef][Uchiyama, Y.; Matsumoto, K.; Murakami, S.; Kanasaki, T.; Matsumoto, A.; Kishino, M.; Furukawa, S. [Google Scholar][CrossRef][Nomura, F.; Kishimoto, S. [Google Scholar][CrossRef][Sodhi, A.; Naik, S.; Pai, A.; Anuradha, A. Cross-sectional imaging is usually indicated in cases where malocclusion or intra-articular abnormalities are suspected. With its ability to evaluate the bones, CT is the mainstay imaging modality in the setting of trauma. 1990, 154, 319–322. Endod. Other findings, such as pain with mastication, obstruction of the external auditory canal, hearing loss, and limited jaw opening are commonly seen with all TMDs. On CT, chondrosarcoma appears as a soft tissue mass with flocculent calcifications in the joint with or without bone erosion. The intermediate zone should be located between the condyle and the temporal bone. Characteristics of the Maxillofacial Morphology in Patients with Idiopathic Mandibular Condylar Resorption. Med. Coronal (A) and axial (B) CT shows multiple calcified loose bodies in the right TMJ consistent with synovial chondromatosis. [Google Scholar][CrossRef][Leighty, S.M.; Spach, D.H.; Myall, R.W.; Burns, J.L. Septic Arthritis of the Temporomandibular Joint: Review of the Literature and Report of Two Cases in Children. [Google Scholar][CrossRef][Chang, V.K.O.; Thambar, S. [Google Scholar][CrossRef][Dreizin, D.; Nam, A.J.; Tirada, N.; Levin, M.D.; Stein, D.M.; Bodanapally, U.K.; Mirvis, S.E.; Munera, F. Cases 2020, 6, 100180. Based on the growth pattern on CT, Chen et al. Emerg. TMD is the second most common musculoskeletal condition after back pain to cause pain and disability with an annual cost of \$4 billion in the United States [3]. The adjacent bone might demonstrate erosions and sclerosis. 2014, 43, 20130280. Department of Radiology, West Hospital, VCU School of Medicine, Virginia Commonwealth University, 1200 East Broad Street, North Wing, Box 980470, Richmond, VA 23298-0470, USA Authors to whom correspondence should be addressed. The lateral aspect of the disc connects with the joint capsule and inserts into the condylar neck. It shows heterogeneous enhancement on post-contrast images [47,48]. Osteosarcoma is a malignant bone tumor arising from the osteogenic mesenchymal matrix and producing osteoid, fibrous, cartilaginous, and osseous tissue. This aggressive form of degenerative disease of the TMJ has been attributed to an exaggerated response to minor traumatic injury induced by excess estrogen receptors [9,21,22]. Malignant PVNS is extremely rare but has been reported in the TMJ [46]. Multidetector CT is the modality of choice for evaluating facial and mandibular fractures in the acute setting. Rheumatoid Arthritis Affecting Temporomandibular Joint. Radiol. Continuity with the parent bone without cortical interruption is an essential characteristic feature. Classified osteochondromas into two main types: type 1, which protrudes from the condyle and involves less than two-thirds of the surface of the condyle, and type 2, which is causing global expansion of the condyle [44]. MRI shows a predominantly low T1 signal exophytic mass with a T2-hyperintense cartilage cap. However, traumatic dislocation of the disc or injury to the retrodisical soft tissue can lead to joint ankylosis, a devastating complication. Tophaceous Calcium Pyrophosphate Dihydrate Deposition Disease of the Temporomandibular Joint. Cases 2020, 6, 100145. Metastatic lesions in the TMJ most commonly originate from the breast, lung, prostate, kidney, and thyroid [50,51]. In patients with long-standing RA, disc displacement occurs more often due to the lack of bony support by the underlying osseous structures, not morphologic changes of the disc itself [30]. While no definite radiologic classification has been established to evaluate the severity of RA in the TMJ, Mohamed et al. High-Resolution Ultrasound Imaging Compared to Magnetic Resonance Imaging for Temporomandibular Joint Disorders: An In Vivo Study. Figure 1. The operator should acquire transverse and longitudinal images in closed-mouth and open-mouth positions. Figure 6. Due to higher signal-to-noise ratios, 3 T MRI magnets have the advantage of depicting improved anatomic and pathologic details of the TMJ compared with 1.5 T. Ultrasound can be considered a non-invasive, readily available, and less expensive technique for the evaluation of the TMJ. [Google Scholar][CrossRef][PubMed][Kellenberger, C.J.; Junhasavadsikul, T.; Tolend, M.; Doria, A.S. Temporomandibular Joint Atlas for Detection and Grading of Juvenile Idiopathic Arthritis Involvement by Magnetic Resonance Imaging. The size of the cartilage cap is directly related to the risk of malignant transformation to or harboring chondrosarcoma [45]. Pigmented Villonodular Synovitis (PVNS) is a benign synovial proliferation process of uncertain origin, most commonly involving larger joints and uncommonly affecting the TMJ. The incidence of TMD peaks in the second to the fourth decade of life with a higher prevalence among women [4,5]. 2018, 56, 249–255. Post-contrast T1Wfat-saturated sagittal (B) and coronal (C) images demonstrate extensive surrounding synovial enhancement (black arrows) and soft tissue enhancement (star). Figure 7. Diagnostic Imaging of the Temporomandibular Joint: Recommendations for Use of the Various Techniques. Gender Difference in Prevalence of Signs and Symptoms of Temporomandibular Joint Disorders: A Retrospective Study on 243 Consecutive Patients. Proton density sagittal image of the TMJ in closed mouth (A) position shows anterior displacement of the articular disc with otherwise normal low-tie appearance (straight arrow). Also noted is enhancement along the dura of the right temporal lobe (curved arrow), indicating the intracranial extension of infection. Surg. Unlike PVNS, which never calcifies, the loose bodies in SC are typically calcified. The disc is anteriorly displaced if the posterior band lies more than 30 degrees anterior to the vertical line through the condylar head, at around 10 to 11 o'clock [12]. Cytological evaluation is limited when evaluating deeper structures and/or any osseous abnormalities. Synovial Chondromatosis. It is considered to be the most common benign tumor of the TMJ [19]. Cancer 2011, 48, 252–253. CPPD of the TMJ is rare overall, and only a few case reports have been published in the literature [36,37,38]. The definitive diagnosis of CPPD is made by joint aspiration and fluid analysis showing the presence of calcium pyrophosphate crystals, but the radiologic evaluation is critical for evaluating the extent of underlying osseous destruction, secondary osteoarthritis, the presence of joint fluid, and to exclude other etiologies. CT is the best imaging modality for this disease and generally shows a calcified mass in the joint with secondary destructive and degenerative changes [35]. Dentomaxillofac. The most common organism cultured is Staphylococcus aureus, which infects the joint either from direct inoculation or hematogenous spread [41]. Imaging findings of TMJ septic arthritis are similar to those of infections in other joints, namely synovial enhancement, joint effusion, surrounding soft tissue, and bone marrow edema. However, TMJ involvement is not a classic finding of RA [24]. MRI is the modality of choice for the diagnosis of PVNS, showing an intra-articular mass with areas of hemosiderin deposition depicted as low signal intensity on T1WI and T2WI and blooming artifact on GRE sequences [3]. Synovial chondromatosis (SC) is a rare, benign synovial proliferative disease characterized by the growth of cartilaginous nodules in the synovium that eventually calcify and detach from the joint. The prevalence of chronic TMJ pain ranges from 5 to 31%, and the incidence of first-time pain is 4% per year [1,2]. 2017, 14, 6053–6058. MRI is the modality of choice for evaluation of the TMJ. Swiss Dent. A Case Report of Chondrocalcinosis of the Temporomandibular Joint: Surgical Management and Literature Review. Oral Maxillofac. This allows for a greater range of motion with respect to the joint's size. On MRI, osteosarcoma resembles chondrosarcoma, presenting as a heterogeneously enhancing, intermediate T1 and high T2 signal mass (Figure 11). In the closed-mouth position, the posterior band should lie near the 12 o'clock position on the sagittal projection. [Google Scholar][CrossRef][Yoon, H.-J.; Cho, Y.-A.; Lee, J.-I.; Hong, S.-P.; Hong, S.-D. Case Rep. Indian J. Anteriorly, the attachments of the disc are variable and called the “disc-capsular complex”. Imaging Clin. Oral Invest. 2013, 45, 674–678. World J. [Google Scholar][CrossRef][PubMed][Nortje, C.J.; van Rensburg, L.J.; Thompson, I.O. Case Report. A normal disc does not move in the coronal plane during mouth opening (Figure 1 and Figure 2). TMJ radiographic examinations include transcranial (oblique lateral view), trans maxillary (modified AP view), trans pharyngeal (oblique lateral view), and submental vertex radiographs. 2014, 2014, 262430. Proton density sagittal image of the TMJ (A) demonstrates a large joint effusion expanding the space between the articular disc and articular tubercle (straight white arrow). [Google Scholar][CrossRef][Manfredini, D.; Guarda-Nardini, L. [Google Scholar][CrossRef][Slade, G.D.; Fillingim, R.B.; Sanders, A.E.; Bair, E.; Greenspan, J.D.; Ohrbach, R.; Dubner, R.; Datchenko, L.; Smith, S.B.; Knott, C.; et al. Magnetic Resonance Imaging Evaluation of Temporomandibular Joint and Associated Soft Tissue Changes Following Acute Condylar Injury. The position of the disc is evaluated by the location of the posterior band and intermediate zone in relation to the mandibular condyle. Comput. 2014, 6, 39–47. Head Neck Pathol. 2020, 49, 20190186. A few cases with erosion of the glenoid fossa and intracranial invasion have been reported. [Google Scholar][CrossRef][Scolozzi, P.; Becker, M.; Lombardi, T. Axial lateral MRI views in the closed mouth (A) and open mouth (B) positions demonstrate the normal location of the mandibular condyle within the mandibular fossa (black arrow) and normal condylar rotation and anterior translation (white arrow), respectively. The key imaging finding on MR is disc displacement with or without recapture. Condylar Osteochondroma. Synovial Sarcoma of the Temporomandibular Joint and Infratemporal Fossa. [Google Scholar][CrossRef][Aiken, A.; Bouloux, G.; Hudgins, G.; Choi, J.J.; Kransdorf, M.J.; Flemming, D.J.; Gannon, F.H. Imaging of Osteochondroma: Variants and Complications with Radiologic-Pathologic Correlation. In the initial phase of mouth opening, the condyle rotates in the lower joint compartment. Imaging Approach to Temporomandibular Joint Disorders. Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations. 2009, 107, 844–860. Multidetector CT of Mandibular Fractures, Reductions, and Complications: A Clinically Relevant Primer for the Radiologist. Am. 2016, 60, 105–124. The central anatomic structure of the TMJ is the articular disc or meniscus. 2015, 6, 124–127. [Google Scholar][CrossRef][PubMed][Wilkes, C.H. Internal Derangements of the Temporomandibular Joint. Malignant Pigmented Villonodular Synovitis of the Temporomandibular Joint with Lung Metastasis: A Case Report and Review of the Literature. More severe involvement can lead to trismus, facial deformity, and chronic loss of function [26]. Contrast-enhanced MRI and CT are commonly used for the evaluation of inflammatory arthritis such as RA in the TMJ. In the intermediate stage, the disc still has a normal morphology, is displaced in a closed-mouth position, and does not recapture with mouth opening. TMJ symptoms are seen in approximately 50% of patients with RA. Craniofac. [Google Scholar][CrossRef][Baigis, B.; Ayaz, E.A.; Turgut, S.; Durkan, R.; Özcan, M. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (© 2012, 70, 2829–2834. Osteochondroma of the Mandibular Condyle: A Classification System Based on Computed Tomographic Appearances. [Google Scholar][CrossRef][Klatkiewicz, T.; Gawriolek, K.; Pobudek Radzikowska, M.; Czajka-Jakubowska, A. Temporomandibular Joint Chondrosarcoma: A Case Report and Literature Review. The signs and symptoms of TMJ metastatic disease are nonspecific and similar to other TMDs, including pain, restricted motion, clicking, trismus, and malocclusion [54,55,56]. On CT, TMJ metastases present as lytic and destructive bone lesions, but sclerotic or mixed lesions can also be seen with lesions from prostate, lung, and breast origin [57]. 2009, 107, e34–e38. Oral Med. Calcium Pyrophosphate Crystal Deposition Disease: Diagnosis and Treatment. [Google Scholar][CrossRef][Aiken, A.; Bouloux, G.; Hudgins, G. Larger lesions can cause condylar displacement with associated pain or malocclusion [14,44]. Bilateral TMJ Involvement in Rheumatoid Arthritis. Temporomandibular Joint Imaging. Differentiation of septic arthritis from other inflammatory diseases is predominately based on the clinical presentation and the acuity of the symptoms. Summary of Findings from the OPPEERA Prospective Cohort Study of Incidence of First-Onset Temporomandibular Disorder: Implications and Future Directions. Oral Surg. Chondrosarcoma can be primary—without pre-existent benign lesion—or secondary—arising from pre-existent benign lesions such as enchondroma or osteochondroma. Post-contrast T1W fat-saturated sagittal (A) and coronal (B) images of the TMJ demonstrate flattening and irregularity of the condyle with erosions (long tail arrows), resulting in an irregular foreshortened appearance from chronic inflammation. The lateral pterygoid muscle contributes to jaw opening, and the medial pterygoid, masseter, and temporalis muscles facilitate jaw closure. Otolaryngol. Images are acquired perpendicular or parallel to the long axis of the mandibular condyle to optimize the visualization of the disc and the osseous structures. Proton density sagittal image of the TMJ in closed mouth (A) position shows normal location and bow-tie appearance of the articular disc with anterior (straight arrow) and posterior bands (curved arrow). The most common cause of ID is the displacement of the articular disc. MRI is the standard imaging modality for assessing ID in TMJ [11]. Pathological Variations. MRI in a Case of Osteosarcoma in the Temporomandibular Joint. [Google Scholar][CrossRef][Helms, C.A.; Kaplan, P. [Google Scholar][CrossRef][PubMed][Tamimi, D.; Jalali, E.; Hatcher, D. Head Neck Surg. [Google Scholar][CrossRef][Suenaga, S.; Ogura, T.; Matsuda, T.; Noikura, T. 2014, 14, 6–15. [Google Scholar][CrossRef][Kretapiprom, K.; Okochi, K.; Nakamura, S.; Tetsumura, A.; Ohbayashi, N.; Yoshino, N.; Kurabayashi, T. Temporomandibular Joint Osteoarthritis: Diagnosis and Long-Term Conservative Management: A Topic Review. 2009, 38, 1229–1236. The medial and lateral corners of the disc align with the condylar borders and do not bulge medially or laterally [6]. TMJ has two compartments that function as two small joints within a same capsule. 2010, 110, e21–e28. The superior compartment separates the glenoid fossa of the temporal bone from the disc, while the inferior compartment separates the disc from the mandibular condyle. Eur. Reson. Several key features should be evaluated while interpreting the MRI of TMJ derangement, including the position and morphology of the disc, the morphology and signal of the mandibular condyle, the presence of joint effusion, and condylar translation with dynamic imaging. In a closed mouth position on an oblique sagittal plane, the posterior band of the disc should lie superior to the condylar head at the 12 o'clock position. J. 2006, 33, 551–559. CT is also particularly valuable in assessing surgical reconstruction, detecting calcified loose bodies, and in some cases of inflammatory, infectious, and neoplastic disease. Br. J. The disc is an oval-shaped fibrocartilaginous structure composed of anterior and posterior articular bands and a thinner center, called the intermediate zone. Arthritis Care Res. For most patients, the diagnosis of RA is made before the development of TMJ symptoms. 2014, 203, 1047–1058. [Google Scholar][CrossRef][PubMed][Tamimi, D.; Kocasarac, H.D.; Mardini, S. Septic arthritis. Idiopathic Condylar Resorption. Joint effusion is noted with surrounding synovial enhancement (short tail arrows), consistent with an acute JIA flare. Licensee MDPPI, Basel, Switzerland. Axial (E) and sagittal (F) CT images show a soft tissue mass with mineralized matrix and aggressive periosteal reaction (small arrows) at the TMJ. On MRI, T2 hyperintense and enhancing lesions with adjacent marrow edema may be seen. Other malignant processes such as lymphoma, multiple myeloma, and malignant synovial sarcoma of the TMJ have been reported [58]. Internal derangement is the most common TMJ pathology which can be best evaluated by MRI. Am. 2018, 56, 157–175. 2018, 24, 812–817. Therefore, MRI is rarely used as the initial imaging modality if CPPD is suspected. Ultrasonography in the Diagnosis of Temporomandibular Disorders: A Meta-Analysis. Normal Temporomandibular Joint MRI. [Google Scholar][CrossRef][Patricia, A.; Kaba, S.P.; Trievierler, M.M.; Shinohara, E.H. Osteoblastic Metastasis from Breast Affecting the Condyle Misinterpreted as Temporomandibular Joint Disorder. Oral Pathol. Newer dynamic techniques, such as a half-Fourier acquired single-shot turbo spin-echo (HASTE) or balanced steady-state free precession sequence (SSFP), can contribute to the evaluation of the disc movement. It usually involves the long metatarsals but rarely involves the jaw and is called gnathic osteosarcoma. [Google Scholar][CrossRef][Mitsimponas, K.; Mehmet, S.; Kennedy, R.; Shakk, K. [Google Scholar][PubMed][Menezes, A.V.; Lima, M.P.; Mendonca, J.E.d.F.; Haiter-Neto, F.; Kurita, L.M. Breast Adenocarcinoma Mimicking Temporomandibular Disorders: A Case Report. Exp. [Google Scholar][Reynolds, J.L.; Matthew, I.R.; Chalmers, A. 2008, 9, 100–106. Synovial proliferation, joint space narrowing, articular erosion, flattening of the condyle, disc deformity, shorter condylar height, and abnormal condylar motion are common imaging findings that are seen with RA [23,27,28,29]. Unlike OA, in RA articular disc

Occurs later in the course of disease and the disc can remain in a normal position despite substantial changes to the underlying condylar disc [30]. The recapture of the articular disc, which is now in the normal position (curved arrow). [Google Scholar]Kruse, A.L.D.; Luehbers, H.-T.; Obwegeser, J.A.; Edelmann, L.; Graetz, K.W. Temporomandibular Disorders Associated with Metastases to the Temporomandibular Joint: A Review of the Literature and 3 Additional Cases. Figure 2. Adjusting and tilting the probe during the exam will help to optimize the visualization of the disc, condylar changes, and joint effusion [7,8]. Sagittal (A) and coronal (B) images through the TMJ in bone windows demonstrate extensive loss of the mandibular condyle and additional erosive changes of the underlying mandibular fossa and articular eminence. Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) Axis I Diagnoses in an Italian Patient Population. [Google Scholar]Gayle, E.A.; Young, S.M.; McKenna, S.J.; McNaughton, C.D. Septic Arthritis of the Temporomandibular Joint: Case Reports and Review of the Literature. Normal ultrasound of the articular disc. showed that in patients with moderate to severe disease activity, the condyle has a smaller AP dimension. Rare causes for temporomandibular disorders. [Google Scholar] [CrossRef]Rammelsberg, P.; Pospiech, P.R.; Jäger, L.; Pho Duc, J.M.; Böhm, A.O.; Gernet, W. They also showed that disease activity had a statistically significant direct correlation with all osteoarthritic changes except for the glenoid and condylar erosions [29].Juvenile idiopathic arthritis (JIA) is the most common rheumatologic disease of childhood and adolescents. It can be seen in the context of different etiologies such as trauma, sickle cell anemia, or systemic lupus erythematosus. On CT, it often appears as a pedunculated osseous mass, usually arising from the anterior surface of the condyle and at the insertion of the lateral pterygoid muscle (Figure 9). Res. The early diagnosis and management of TMJ involvement in JIA patients are essential because a delay in diagnosis can damage the mandibular growth plate and compromise normal facial growth. The most common cause of TMD is internal derangement. Most secondary to articular disc displacement. Pediatr. Other important but less frequent TMJ pathologies are osteoarthritis, idiopathic condylar resorption, inflammatory arthropathies, trauma-related conditions, and tumor and tumor-like lesions. 2011, 111, e30–e36. [Google Scholar] [CrossRef]Faro, T.F.; Martins-de-Barros, A.V.; Lima, G.T.W.F.; Raposo, A.P.; Borges, M.d.A.; Araújo, F.A.d.C.; Carvalho, M.d.V.; Nogueira, E.F.d.C.; Laureano Filho, J.R. Chondrosarcoma of the Temporomandibular Joint: Systematic Review and Survival Analysis of Cases Reported to Date. Assist. Figure 6. Imaging of the Temporomandibular Joint. Notable MRI features are periaricular T2 hypointense signals with heterogeneous enhancement, which can mimic more concerning diseases such as chondrosarcoma [35]. Figure 8. 2019, 54, 282–301. [Google Scholar] [CrossRef]Ahmad, M.; Hollender, L.; Anderson, Q.; Kartha, K.; Ohrbach, R.; Truelove, E.L.; John, M.T.; Schiffman, E.L. Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD): Development of Image Analysis Criteria and Examiner Reliability for Image Analysis. The temporomandibular joint (TMJ) plays a crucial role in mastication, jaw mobility, verbal, and emotional expression. In addition, there is a male predilection, with the male-to-female ratio of 2:1 [14,49]. Trauma. Imaging features of degenerative joint disease such as flattening of the condyle, osteophytes, joint effusion, or the abnormal T1 and T2 signal of the condyle can also be seen in more advanced stages [9,13,14,15]. Condylar chondroblastic osteosarcoma. 2018, 48, 411–426. Mandibular Condylar Metastasis Mimicking Acute Internal Derangement of the Temporomandibular Joint. Therefore, a CT can help differentiate the two entities [3,9].Chondrosarcoma is a malignant tumor that arises from embryogenic cartilaginous cells and is characterized by the production of a cartilaginous matrix. 2012, 9, 539–544. 2020, 19, 291–295. Arch. Oncol. Figure 3. The most common symptoms are pain, joint swelling, and limited jaw motion [25]. 2000, 24, 461–465. Severity of Synovium and Bone Marrow Abnormalities of the Temporomandibular Joint in Early Rheumatoid Arthritis: Role of Gadolinium-Enhanced Fat-Suppressed T1-Weighted Spin Echo MRI. 2016, 42, 288–294. [Google Scholar] [CrossRef]Vaid, Y.N.; Dunnivant, F.D.; Royal, S.A.; Beukelman, T.; Stoll, M.L.; Cron, R.Q. Imaging of the Temporomandibular Joint in Juvenile Idiopathic Arthritis. [Google Scholar] [CrossRef] [PubMed]Brontoladi, S.; Sembroio, S.; Tel, A.; Lazzarotto, A.; Robiony, M. Figure 2. Semin. Jaw osteosarcoma is not as aggressive as osteosarcoma in the long bones, with the mean age of patients being 35 years–10 years younger than long bone osteosarcoma. Contemp. Pain 2013, 14, 1116–1124. [Google Scholar] [CrossRef]Manevska, N.; Makazieva, T.; Stojanovski, S.; Vela, I.; Komina, S. Mild sclerosis around the fracture lines suggests a component of interval healing. The posterior band is usually thicker than the anterior band, and both bands are wider in the transverse dimension. 2013, 42, 3162–3170. 2022, 11, 952. The commonly seen imaging findings on CT or MRI are flattening of the condyles, osteophytes, bone erosions, joint space narrowing, subchondral sclerosis, and marrow signal abnormality [19]. Dent. The retrodisical tissue or bilaminar zone is a rich neurovascular tissue that serves as a posterior disc attachment, blending the disc with the joint capsule and temporal bone. Sci. Anterior disc displacement with recapture. Imaging demonstrates loss of condylar bone mass and flattening of the anterior or superior aspect of the condyle (Figure 5).Rheumatoid arthritis (RA) is the most common inflammatory arthritis in adults that can affect the TMJ [23]. The condyle and disc both translate anteriorly as the mouth opens, and the disc stays between the articular eminence and mandibular condyle.In the earliest stage of internal derangement, the disc has a normal biconcave morphology but is anteriorly displaced in the closed mouth position (Figure 4). On ultrasound, the normal articular disc appears as a hypoechoic, inverted c-shape structure, situated superior to the hyperechoic condylar cortex (Figure 3).The most common TMD is internal derangement (ID), which implies a mechanical interference of the smooth joint movement. [Google Scholar] [CrossRef]Tanimoto, K.; Awada, T.; Onishi, A.; Kubo, N.; Asakawa, Y.; Kunimatsu, R.; Hirose, N. 2014, 66, 47–54. As the condyle translates anteriorly, the disc should move between the condyle and the articular eminence. Academic Editor: Majid Chalian Diagnostics 2022, 12(4), 1006; Received: 28 February 2022 / Revised: 1 April 2022 / Accepted: 16 April 2022 / Published: 16 April 2022 (This article belongs to the Special Issue Skeletal Radiology) Temporomandibular disorder (TMD) is a common musculoskeletal condition that causes pain and disability for patients and imposes a high financial burden on the healthcare system. Figure 3. Figure 9. As a result, SC usually presents with joint effusion and multiple loose bodies (Figure 10). The primary symptom of TMJ chondrosarcoma is preauricular swelling, followed by preauricular pain and trismus. Figure 1. 1. The intermediate zone gives the disc a biconcave appearance on the sagittal view. Longer disease duration, early age at onset, polyarticular or systemic course, and lack of HLA-B27 are risk factors for TMJ involvement [20]. Two primary forms of CPPD have been described, common and tumoral, with the tumoral type affecting the TMJ [35]. MRI Characteristics of Rheumatoid Arthritis in the Temporomandibular Joint. Periaricular Chondrocalcinosis of the Left Temporomandibular Joint: A Case Report. [Google Scholar] [CrossRef]Cannizzaro, E.; Schroeder, S.; Müller, L.M.; Kellenberger, C.J.; Saurenmann, R.K. Temporomandibular Joint Involvement in Children with Juvenile Idiopathic Arthritis. [Google Scholar] [CrossRef]Matsuda, S.; Yoshimura, H.; Kondo, S.; Sano, K. Figure 10. Figure 9. Treatment ranges from medical management to surgical debriement of the joint with or without possible resection of the involved condyle [37,39].TMJ septic arthritis is rare but is associated with high morbidity and significant long-term disability [40]. However, the disc returns to the normal anatomical position or recaptures as the condyle translates anteriorly during mouth opening. [Google Scholar] [CrossRef]Lee, K.; Kim, S.H.; Kim, S.-M.; Myoung, H. Writing—original draft preparation, S.M.G., Y.Q., A.F. and J.V.; writing—review and editing, S.M.G., Y.Q., A.F. and J.V.; supervision, S.M.G., Y.Q. and J.V. All authors have read and agreed to the published version of the manuscript.This research received no external funding.The authors declare that they have no conflict of interest.Valesan, L.F.; Da-Cas, C.D.; Réus, J.C.; Denardin, A.C.S.; Garanhani, R.R.; Bonotto, D.; Januzzi, E.; de Souza, B.D.M. Prevalence of Temporomandibular Joint Disorders: A Systematic Review and Meta-Analysis. The standard MR imaging protocol consists of oblique sagittal and coronal proton density-weighted (PDWI) sequences in closed- and open-mouth positions. [Google Scholar] [CrossRef]Ahmad, M.; Schiffman, E.L. Temporomandibular Joint Disorders and Orofacial Pain. The rate of TMJ involvement in JIA differs based on the subtypes, ranging from 40% to 70% [13,31]. In septic arthritis, severe pain often occurs suddenly, with extreme tenderness on palpation, and is usually accompanied by other general symptoms such as malaise, fevers, or nausea/vomiting [41].Trauma to the jaw can cause a condylar fracture, glenoid fossa fracture, or TMJ dislocation. Clin. However, on CT or radiographs, osteosarcoma usually does not show typical ring-and-arc or whorl shape calcifications.Most metastases involve the mandibular body and not the condyle; therefore, metastatic disease to TMJ is rare [12]. AJR Am. J. Endodontol. On MR, the marrow is dark on T1WI and shows a mixed signal on T2WI [20].Idiopathic condylar resorption or “cheerleader syndrome” is a poorly understood disease that is most commonly occurs in adolescents and young women. [Google Scholar] [CrossRef]Pretzl, C.; Lübbbers, H.-T.; Grätz, K.W.; Kruse, A.L. Metastases in the temporomandibular joint: A review from 1954 to 2013. Signs and symptoms of OA in TMJ are pain, movement limitations, and crepitus.Avascular necrosis is the result of impaired blood flow to the condyle. Chondrosarcoma of the TMJ is extremely rare, with only 50 cases reported in the literature. Metastases with different origins, such as melanoma, pancreatic, hepatocellular, and rectal cancer, have been reported in the literature [52,53,54]. The mean age of patients is 45.5 years with a female predominance (F:M = 1.4:1) [47]. Idiopathic condylar resorption. [Google Scholar] [CrossRef]Kalladka, M.; Quek, S.; Heir, G.; Eliav, E.; Mupparapu, M.; Viswanath, A. [Google Scholar] [CrossRef]Fu, K.-Y.; Li, Y.-W.; Zhang, Z.-K.; Ma, X.-C. Nucl. Roentgenol. A commonly used classification of TMJ disc displacement using clinical and imaging findings was described by Wilkes [16].Ultrasound can be used as an alternative modality for evaluating ID, particularly for disc displacement and joint effusion. Biopsy confirmed chondroblastic osteosarcoma. The bow-tie appearance of the articular disc is preserved. [Google Scholar] [CrossRef]Magarelli, N.; Amelia, R.; Melillo, N.; Nasuto, M.; Cantatore, F.; Guglielmi, G. However, MRI is still often performed since common symptoms of TMJ CPPD disease such as pain, joint swelling, and limited range of motion are also symptoms in other TMD, for which MRI is indicated as standard practice. Sagittal CT image of the TMJ demonstrates comminuted fracture of the condylar neck with a displacement of the fracture fragments. Ultrasonography of the Temporomandibular Joint: A Literature Review. Axial pre-contrast (A) and post-contrast T1W (B), sagittal pre-contrast T1W (C), and axial T2W (D) images demonstrate a heterogeneously enhancing and T2-hyperintense right condylar mass in a nine-year-old patient. Indian Prosthodont. 1989, 115, 469–477. Temporomandibular disorder (TMD) is a term used to describe several pathologies that involve the TMJ and surrounding bone and soft tissues. Solitary Metastatic Deposit in the Mandible from Follicular Thyroid Carcinoma. [Google Scholar] [CrossRef]Petscavage-Thomas, J.M.; Walker, E.A. Unlocking the Jaw: Advanced Imaging of the Temporomandibular Joint. [Google Scholar] [CrossRef]Talmaceanu, D.; Lenghel, L.M.; Bolog, N.; Buduru, S.; Leucuta, D.; Rotar, H. [Google Scholar] [CrossRef]Manfredini, D.; Chiappe, G.; Bosco, M. The tip of the mandibular condyle (arrow) is displaced antero-inferiorly. On open mouth images (B), normal condylar rotation and anterior translation are noted. 1996, 25, 292–297. As inflammation and joint destruction continue, chronic secondary arthritic changes such as pannus formation, bone erosions, and disc destruction become more prevalent, eventually leading to condylar flattening and deformity (Figure 6) [32].Several scoring systems have been proposed for radiological grading of inflammation and damage of the temporomandibular joint in JIA patients based on the presence or degree of MRI findings such as bone marrow edema and enhancement, joint effusion, synovial thickening or enhancement, condylar flattening or erosion, and abnormal disc morphology [32,33].Calcium pyrophosphate deposition disease (CPPD) is a noninfectious inflammatory arthropathy characterized by crystal deposits in the articular and periarticular soft tissues [34]. [Google Scholar] [CrossRef]Garip, M.; Verhelst, P.-J.; Van der Cruyssen, F.; Sciot, R.; Luyten, F.P.; Bila, M.; Coropciuc, R.; Politis, C. Magnetic Resonance Features of Metastatic Melanoma of the Temporomandibular Joint and Mandible. Rheumatol. However, this modality is considered less useful in detecting bone abnormalities in condyle [8,17].Osteoarthritis (OA) is related to the breakdown of joint cartilage and underlying subchondral bone. Radiographically, osteosarcoma can have a lytic, sclerotic, or mixed appearance with malignant periosteal reaction. 2011, 38, 510–515. Variability of Disk Position in Asymptomatic Volunteers and Patients with Internal Derangements of the TMJ. On MRI, chondrosarcoma appears as an intermediate-to-low T1 and high T2 signal mass with foci of low T1 and T2 signal due to calcification. Figure 4. [Google Scholar] [CrossRef] Figure 1. Am. 2008, 20, 133–144. Multiple other pathologies such as inflammatory arthritis, infection, and neoplasm can mimic internal derangement. The mandibular condyle is situated in an anatomic location within the mandibular fossa. [Google Scholar] [CrossRef]Rosales-Alexander, J.L.; Balsalobre Aznar, J.; Magro-Checa, C. Lett. The mandibular condyle (star) is in an anatomic location within the mandibular fossa. Tomogr. Synovial enhancement, joint effusion, and synovial thickening are the most common findings early in the disease process. 2012, 78, e77. Pract. Cone-beam computed tomography (CBCT) has shown comparable osseous detail to CT, with the advantage of decreased radiation dose.MRI is the best modality for the evaluation of intra-articular processes. Juvenile idiopathic arthritis. 2016, 26, 5–22. Figure 5. MR Imaging of the Temporomandibular Joint. TMJ is a synovial joint between the glenoid fossa of the temporal bone and the mandibular condyle. 2021, 14, e241601. Primary OA is more common in older patients. [Google Scholar] [CrossRef]Dwivedi, A.N.D.; Tripathi, R.; Gupta, P.K.; Tripathi, S.; Garg, S. Figure 7. 2021, 15, 923–934. Oral Radiol. 1993, 22, 292–297. Auris Nasus Larynx 2014, 41, 572–575. These findings are best visualized on MRI (Figure 7). [Google Scholar] [CrossRef]Som, P.M.; Curtin, H.D. Head and Neck Imaging—2 Volume Set; Expert Consult—Online and Print; Mosby Elsevier: Maryland Heights, MO, USA, 2011; ISBN 9780323053556. 2008, 35, 717–721. Assoc. Osteonecrosis of the Mandibular Condyle as a Precursor to Osteoarthritis: A Case Report. In the later stages, the disc is chronically displaced and has an abnormal morphology, e.g., it is perforated or the posterior attachment to the bilaminar zone is disrupted. Figure 11. Radiographics 2016, 36, 1539–1564. Sonographic images of the TMJ with the probe longitudinal to the articular disc on closed mouth views demonstrate the normal hypoechoic appearance of the mandibular condyle (star), with a rim of the hyperechoic cortex. Neuroradiol. TMJ Pain as a Presentation of Metastatic Breast Cancer to the Right Mandibular Condyle. BMJ Case Rep.

Un libro è un insieme di fogli, stampati oppure manoscritti, delle stesse dimensioni, rilegati insieme in un certo ordine e racchiusi da una copertina.. Il libro è il veicolo più diffuso del sapere. L'insieme delle opere stampate, inclusi i libri, è detto letteratura.I libri sono pertanto opere letterarie.Nella biblioteconomia e scienza dell'informazione un libro è detto monografia, per ... Interstate 196 (I-196) is an auxiliary interstate highway that runs for 80.6 miles (129.7 km) in the US state of Michigan.It is a state trunkline highway that links Benton Harbor, South Haven, Holland, and Grand Rapids.I-196 is known as the Gerald R. Ford Freeway in Kent, Ottawa, and Allegan counties, after the 38th president of the United States, who was raised in Grand Rapids ... Lesser Cypyleft derivative works must be licensed under specified terms, with at least the same conditions as the original work: combinations with the work may be licensed under different terms Health providers say they are seeing more patients than ever with pain and joint ailments in their hands, necks, shoulders and upper backs — and that mobile phones are most likely playing a part. Browse our listings to find jobs in Germany for expats, including jobs for English speakers or those in your native language. Quickly translate words and phrases between English and over 100 languages.

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