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OSTEONECROSIS OF FEMUR HEAD: METHODS OF TECHNOLOGY FOR DIAGNOSIS, RADIONUCLIDE DIAGNOSIS: INDICATIONS AND MAIN PRINCIPLES FOR OBTAINING PICTURE

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Osteonecrosis of the femoral head (ONFH), also known as avascular necrosis, is a debilitating clinical condition characterized by the death of bone components due to an interruption of blood supply. From a pathological standpoint, this ischemia leads to the death of osteocytes and bone marrow cells, followed by a failed repair process that often results in subchondral fractures and the eventual collapse of the articular surface. Statistically, the disease predominantly affects young and middle-aged adults, typically between 30 and 50 years old, with a high incidence of bilateral involvement (40–70%). Without early intervention, approximately 80% of cases progress to advanced secondary osteoarthritis, making it a leading cause for total hip arthroplasty in the younger population.

The technological landscape for diagnosing ONFH has shifted toward multi-modal imaging to capture both structural and functional changes. While digital radiography remains the initial screening tool, it lacks sensitivity in early (pre-collapse) stages. Magnetic Resonance Imaging (MRI) is currently the "gold standard" for diagnosis, boasting sensitivity and specificity rates above 95%. MRI can detect the characteristic "double-line sign" and bone marrow edema months before structural changes appear on X-rays. Additionally, Computed Tomography (CT) is utilized to precisely map the extent of subchondral fractures and the geometry of the femoral head, providing critical data for surgical planning and determining the risk of collapse.

Radionuclide diagnosis, specifically bone scintigraphy and SPECT/CT, plays a vital role in assessing the metabolic activity and vascularity of the bone. By using radiopharmaceuticals like ^{99m}Tc-MDP, clinicians can visualize the "cold spot" (photopenia) indicating early-stage ischemia where blood flow is absent. As the body attempts to repair the necrotic area, a "donut sign" may appear, showing a rim of increased uptake around the dead bone. Modern SPECT/CT (Single Photon Emission Computed Tomography) combines these metabolic insights with high-resolution anatomical data, allowing for a more accurate 3D localization of the lesion compared to traditional 2D scans.

The main principles and indications for obtaining these images are centered on early detection to prevent joint replacement. Indications include persistent groin pain in patients with risk factors– such as long-term corticosteroid use, excessive alcohol consumption, or prior hip trauma–even if initial X-rays are normal. The diagnostic algorithm follows a hierarchy where MRI is the preferred next step after X-ray; however, radionuclide imaging is indicated when MRI is contraindicated (e.g., due to metal implants or pacemakers) or when there is a need to evaluate the viability of the bone after regenerative procedures.

In summary, the integration of anatomical and functional imaging is essential for managing osteonecrosis. By combining the structural detail of CT/MRI with the physiological data from radionuclide studies, radiologists can provide a comprehensive assessment of the femoral head's integrity. This multi-layered approach ensures that patients receive timely, organ-preserving treatments such as core decompression or bone grafting before irreversible collapse occurs.