Soft Tissue Pseudotumors of the Pelvis and Hip

MAJ Weston T. Winkler, DO, Dillon C. Chen, MD, and COL (Ret) Liem T. Bui-Mansfield, MD

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Please note that in addition to the SA-CME credits, subscribers completing the activity will receive the usual ACCME credits.

After participating in this educational activity, the radiologist should be better able to diagnose the common soft tissue pseudotumors of the pelvis and hip on different imaging modalities.

Category: General Radiology
Subcategory: Musculoskeletal
Modality: Multiple

Key Words: Soft Tissue Pseudotumor, Myositis Ossificans, Crystal Deposition Disease, Morel-Lavallee Lesion, Tumoral Calcinosis, Pseudoaneurysm

Pelvic pseudotumors are a frequent finding discovered on routine and emergent imaging examinations that often can provide a diagnostic conundrum for general radiologists. This article provides imaging characteristics of various soft tissue pelvic and hip pseudotumors through a case-based review.

In 2006, 20 million pelvis and hip radiographs were performed in the United States, comprising 7.2% of the total number of radiographic procedures that year.1 With its complex osseous and soft tissue anatomy, the pelvis provides a challenge for the radiologist to accurately evaluate, especially in the setting of unexpected findings, such as “tumors.”

In North America and Europe, the annual incidence of soft tissue sarcomas is approximately 30 cases per million people.2 In comparison, the prevalence of benign pseudotumors is significantly higher. For example, acetabular paralabral cysts are seen on MRI in 13% to 26% of asymptomatic patients.3 Femoral arteriovenous fistulas after femoral access occur in 1% of patients undergoing cardiac catheterization.4 In 6,061 unselected asymptomatic persons subjected to fluoroscopic examination of both shoulders, 165 (2.7%) were found to have calcium deposits in one or both shoulders.5 Because of these dramatic differences in frequency, the radiologist is much more likely to encounter the pelvic tumor-like disease (pseudotumor) than a true tumor in his or her daily practice.

Soft Tissue Pelvic Pseudotumors

The tumor mimickers include both intra- and extra-articular soft tissue masses, some of which radiologists will likely encounter on a daily basis. A complete discussion of all soft tissue pseudotumors is beyond the scope of this article. For the purpose of illustration, we limit our review to the following entities: bursitis, paralabral cysts, myositis ossificans,
crystal deposition disease, vascular lesions, Morel-Lavallée lesions, tendon rupture, radiation myositis, and tumoral calcinosis.

Bursitis
Several normal bursae occur in the pelvis, including iliopsoas, obturator externus, trochanteric, and ischial tuberosity. When inflamed or enlarged, these bursae can mimic pathology other than bursitis. Distention of the bursa usually is caused by overproduction of synovial fluid in the arthritic hip, which leads to increased intra-articular pressure and extension of the fluid into the potential space of the bursa. Given the increasing use of cross-sectional imaging, the prevalence of incidental radiologic discovery of bursal enlargement also has increased (Figure 1). Of note, enlarged bursae also can be an indicator of underlying pathology such as septic arthritis, failure of hip arthroplasty, synovial neoplasm, and arthritides such as rheumatoid arthritis, and should, therefore, be investigated fully.

Paralabral Cyst
Paralabral cysts are very common and have been described in patients with developmental dysplasia of the hip, femoroacetabular impingement, osteoarthritis of the hip, and remote trauma. These cysts often are associated with labral tears. Labral tears result in a loss of congruity between the femoral head and acetabulum causing increased intra-articular pressure and subsequent cyst formation. A paralabral cyst can be mistaken for soft tissue sarcoma. However, unlike sarcomas, paralabral cysts should demonstrate characteristic thin walls, without significant thick septal or nodular internal enhancement. The presence of a paralabral cyst on imaging should prompt a thorough search for underlying pathology. Paralabral cysts are often asymptomatic; occasionally, however, they may cause symptoms related to adjacent nerve impingement, such as sciatica.

Myositis Ossificans
Myositis ossificans is a benign, solitary, self-limiting ossifying mass typically occurring within skeletal muscle. It generally is seen in younger patients as the sequel of prior trauma. The initial imaging appearance of myositis ossificans is soft tissue swelling with or without peristosis. About 1 month after the traumatic insult, sometimes sooner, amorphous, hazy, soft tissue calcifications develop. Over time, the amorphous calcification matures into dense bone. During the maturation process, the imaging appearance can appear rather concerning, especially on MRI. The key to correct diagnosis is to follow the maturation of the calcification temporally on radiographs (Figure 2). Over the course of the maturation process, the lesion should develop dense bony cortex at the periphery of the lesion with a more radiolucent central area. In contradistinction, neoplasms such as extraskelatal

Figure 1. A 93-year-old woman presented with right hip pain. Initial radiographs (not shown) revealed bilateral total hip arthroplasties with evidence of right-sided polyethylene wear and medial displacement of the right obturator internus fat plane. A: Review of a prior CT scan of the pelvis reveals a slightly hyperdense, teardrop-shaped, cystic mass (arrow) coursing along the right iliopsoas muscle and arising near the arthroplasty. B: Corresponding, previously obtained lumbar spine MR examination of the same patient helped to confirm the diagnosis of right iliopsoas bursitis secondary to polyethylene wear. A well-circumscribed, cystic mass with internal debris and a low T2 signal peripheral rim (arrow) lies just superior to the metallic implant.
A 53-year-old man presented to the orthopedic clinic with right thigh pain. MR short T1 inversion recovery image (not shown) showed a heterogeneous mass within the vastus intermedius muscle. A: Axial, T1-weighted, fat-saturated, postcontrast MR image shows irregular peripheral rim enhancement (arrow). Without any additional history, MR findings are indeterminate. B: After discussion with an orthopedic oncologist, a history of trauma to the right thigh was elicited, and a diagnosis of myositis ossificans was established. Repeat radiographs 4 months later revealed calcification within the muscle of the anterior thigh consistent with hematoma evolution (arrow).

Crystal Deposition Disease
Crystal deposition disease, including hydroxyapatite deposition disease (HADD), calcium pyrophosphate deposition disease (CPPD), and gout, is a common disorder that can be mistaken by radiologists for other conditions. The imaging findings of CPPD and gouty arthritis can be quite dramatic, given the amount of joint destruction, which may be mistaken for something more sinister.

After the shoulder, the hip is the second most common joint affected in HADD. Common locations include sites of tendon attachment such as the greater and lesser trochanters and

A 60-year-old man with atraumatic right upper thigh pain. Initial radiographs (not shown) revealed a 1-cm lytic lesion in the subtrochanteric region of the right femur with a narrow zone of transition. MR examination revealed a low-signal lesion on a sagittal, T1-weighted image (not shown). A: This sagittal, T2-weighted, fat-saturated, MR image reveals a lesion measuring 4 × 8 mm at the linea aspera and high T2 signal within the hamstring musculature (arrow). B: Subsequent review of an axial CT scan of the pelvis, performed 2 months earlier, revealed disruption of the gluteus maximus tendinous insertion and adjacent calcific deposit (arrow) corresponding to the lytic lesion seen on hip radiograph (not shown). The diagnosis is rupture of hydroxyapatite deposition.

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the linea aspera. Although frequently asymptomatic, HADD can result in extensive soft tissue inflammation and pain when the calcific deposits are ruptured into the adjacent muscle, bursa, or bone. Calcium hydroxyapatite deposits appear homogeneous and amorphous on radiographs. In some cases, HADD can cause adjacent bone erosion, mimicking an aggressive process such as neoplasm (Figure 3). The key to the correct diagnosis is to recognize the presence of HADD calcification on radiography or CT and to identify the tendon attachment as the epicenter of the pathology.

CPPD and gout are less common than HADD around the hip. Calcium pyrophosphate tends to deposit in the hyaline cartilage and fibrocartilage, which can lead to joint destruction, productive arthropathy, and joint space widening. In the pelvis, pseudogout is seen most commonly in the symphysis pubis, followed by the hip joint. The common imaging features of gout include periarticular dense tophi and juxta-articular erosions. The key to diagnosis is recognition of the calcification pattern of CPPD and gout on radiographs.

If the diagnosis remains problematic and correct diagnosis is needed to determine proper therapy, dual-energy CT can be helpful to avoid aspiration of the calcified deposits for crystal analysis. Because of the differences in the atomic number of calcium and urate crystals, dual-energy CT can distinguish HADD or CPPD from gouty tophus. On dual-energy CT, HADD or CPPD appears blue, whereas gouty tophus appears green.

Vascular Lesions
Several vascular lesions can occur around the pelvis and mimic tumors. These vascular lesions include venous malformations, arteriovenous malformations (AVMs), arteriovenous fistulas, and pseudoaneurysms. In general, appropriate clinical history can be extremely helpful for correct diagnosis. Venous malformations, previously known as soft tissue hemangiomas, are slow-flow lesions that often contain internal phleboliths. On ultrasound, venous malformations demonstrate internal slow-moving debris with no arterial flow. Often, the mass is pliable and compressible. AVMs are high-flow lesions, often tangled without an associated soft tissue mass. AVMs and venous malformations can have bone involvement, resembling a destructive mass. MRI often is diagnostic, demonstrating the tangle of abnormal vessels with flow voids in the AVM. Venous malformations usually have fat signal intensity within the lesion on MRI because of fatty atrophy of the affected muscle. Arteriovenous fistulas usually are the sequela of peripheral vascular access, which transgresses both the arterial and venous systems. On Doppler ultrasound, turbulent, high-flow shunting is demonstrated. On IV contrast examinations, there is pathognomonic simultaneous venous and arterial filling. Pseudoaneurysms are vascular outpouching defects involving
Femoral pseudoaneurysms are due most commonly to cardiac catheterization, with prevalence up to 8%. On ultrasound, the “Yin-Yang” sign on color Doppler with a “to and fro” pattern on pulsed Doppler is characteristic. Anatomically, a neck connecting the contained hematoma to the injured vessel sometimes can be seen on CT (Figure 4). Most femoral pseudoaneurysms require only watchful waiting; however, those with a volume greater than 6 cm³ will require intervention, because spontaneous thrombosis is unlikely. Treatment options include ultrasound-guided compression directly over the pseudoaneurysm, embolization, and covered stenting.

Morel-Lavallee Lesion

The Morel-Lavallee lesion represents a posttraumatic closed degloving injury associated with severe trauma. It was first described by the French physician Maurice Morel-Lavallee in the 19th century. The lesion represents a collection of blood products, fat, and lymphatic material between the fascial layers of the greater trochanter, buttock, and back, and it can be mistaken for neoplasm. Sonographic appearance is variable, ranging from anechoic to hyperechoic mass. CT may show a fluid–fluid level within an encapsulated mass. MRI can be pathognomonic by demonstrating fat globules within a cystic mass, with a peripherally low T1 and T2 signal intensity rim (hemosiderin lined) (Figure 5). Treatment options include compression bandage, sclerosing therapy, and incision and drainage. Aspiration of more than 50 mL of fluid from Morel-Lavallee lesions is highly predictive of recurrence and should prompt operative intervention.

Tendon Rupture

The pelvis is home to a complex network of muscles and tendons. These tendons can be classified into four quadrants on the basis of anatomic location and function: anterior—hip...
Flexors; lateral—abductors and medial rotators; medial—adductors; and posterior—extensors and external rotators. Overall, tendon tears are uncommon and generally are seen in elderly women, suggesting a hormonal influence. These tendon injuries may mimic other etiologies of hip pain. Acute complete tears may present clinically and on imaging as an anterior thigh mass (Figure 6). Chronic tendon tear may mimic a lipomatous neoplasm because of atrophy and fat infiltration of the involved muscle (Figure 7).

**Table 1. Summary of Clinical and Imaging Features of Soft Tissue Pseudotumors of the Pelvis and Hip**

<table>
<thead>
<tr>
<th>Entity</th>
<th>History</th>
<th>Location</th>
<th>Imaging Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bursitis</td>
<td>Nonspecific. May be asymptomatic</td>
<td>Typical bursal locations</td>
<td>Thin-walled cyst</td>
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<td></td>
<td></td>
<td>Iliopsoas</td>
<td>No enhancement on MRI</td>
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<td>Obturator externus</td>
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<td></td>
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<td>Trochanteric</td>
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<td></td>
<td></td>
<td>Ischial</td>
<td></td>
</tr>
<tr>
<td>Paralabral cyst</td>
<td>Nonspecific. May be asymptomatic</td>
<td>Usually near labrum</td>
<td>Thin-walled cyst</td>
</tr>
<tr>
<td>Myositis ossificans</td>
<td>Prior trauma</td>
<td>Skeletal muscle</td>
<td>Varieties depending upon stage of radiologic progression</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Early: Soft tissue swelling</td>
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<td></td>
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<td>1 mo: Flocculated calcifications</td>
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<td></td>
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<td></td>
<td>Later: Mature, dense bony cortex at periphery of lesion</td>
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<td></td>
<td></td>
<td></td>
<td>with central lucency</td>
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<tr>
<td>Crystal deposition</td>
<td>Pain. Sometimes with known systemic disease</td>
<td>Most commonly</td>
<td>HADD: Homogeneous calcific densities, usually at sites of tendons insertion</td>
</tr>
<tr>
<td>disease</td>
<td></td>
<td>periarticular or at tendinous insertions</td>
<td>CPPD: Lines hyaline and fibrocartilage, potentially leading to joint destruction</td>
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<td></td>
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<td></td>
<td>Gout: Periarticular tophi</td>
</tr>
<tr>
<td>AVF</td>
<td>Almost always associated with penetrating trauma or percutaneous catheterization</td>
<td>Anterior compartment upper thigh</td>
<td>Turbulent high-flow shunting of blood on Doppler examination</td>
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<tr>
<td></td>
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<td>Simultaneous venous and arterial filling on contrast-enhanced CT</td>
</tr>
<tr>
<td>Pseudoaneurysm</td>
<td>Usually associated with prior percutaneous catheterization</td>
<td>Anterior compartment upper thigh</td>
<td>“Yin-Yang” sign on color Doppler</td>
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<td></td>
<td></td>
<td></td>
<td>“To and fro” pattern on pulsed Doppler</td>
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<td></td>
<td></td>
<td></td>
<td>May see neck connecting to vasculature</td>
</tr>
<tr>
<td>Vascular malformation</td>
<td>Usually incidental</td>
<td>Can occur anywhere</td>
<td>Slower flow than AVFs</td>
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<tr>
<td></td>
<td></td>
<td>Transfascial</td>
<td>Central vascular nidus</td>
</tr>
<tr>
<td>Morel-Lavallee lesion</td>
<td>Trauma</td>
<td>Greater trochanter</td>
<td>Well defined</td>
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<td></td>
<td></td>
<td>Buttock</td>
<td>Internal fat globules</td>
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<td></td>
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<td>Lower back</td>
<td>Capsule with low T1 and T2 signal intensity</td>
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<tr>
<td>Tendon rupture/tear</td>
<td>Related to prior sports injury or trauma. However, may be found incidentally, especially in the setting of muscle atrophy</td>
<td>Extensor compartment</td>
<td>Common locations</td>
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<td></td>
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<td>Gluteal insertions</td>
<td>Does not cross tissue planes</td>
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<td></td>
<td>Hamstrings</td>
<td>Direct evidence of tendon tear</td>
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<td></td>
<td></td>
<td>Muscle retraction</td>
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<td></td>
<td>No discrete mass</td>
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<td></td>
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<td></td>
<td>No enhancement</td>
</tr>
<tr>
<td>Radiation myositis</td>
<td>Prior radiation</td>
<td>Confined to the radiation field</td>
<td>Preservation of normal feathery pattern of muscle signal intensity with fusiform shape</td>
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<tr>
<td></td>
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<td>Sharp margins of edema that cross fascial plane</td>
</tr>
<tr>
<td>Tumoral calcinosis</td>
<td>Usually incidental. Commonly forms in the first two decades of life</td>
<td>Extensor surfaces in a bursal distribution</td>
<td>Fluid-fluid levels from calcium sedimentation</td>
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<td></td>
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<td>MRI is variable</td>
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AVF, arteriovenous fistula; CPPD, calcium pyrophosphate deposition disease; HADD, hydroxyapatite deposition disease.

**Radiation Myositis**

Female gynecologic cancers (10%–15% of cancers in women)\(^6\) represent the most common cause for radiation to the pelvis. Radiation therapy causes vasculitis and tissue injury, which can be seen on MR images as uniform muscle edema throughout the radiation field, with characteristic straight, sharp margins that extend uninterrupted across muscle and subcutaneous fat planes (Figure 8). Other MRI clues include persistence of the normal feathery pattern of
Tumoral Calcinosis
Tumoral calcinosis is caused by hereditary metabolic dysfunction of phosphate regulation associated with massive periarticular calcinosis. These lesions typically proliferate in the first 2 decades of life and have characteristic radiographic appearance of amorphous, cystic, and multilobulated calcifications (Figure 9). The lesions typically are located in a bursal distribution. Thus, hip and shoulder are the two most common sites. The lesions also have a predilection for extensor surfaces. On CT, the lesions often demonstrate fluid–fluid levels caused by calcium layering, commonly referred to as the “sedimentation sign.” Unlike HADD, tumoral calcinosis does not cause bone erosion or osseous destruction. There may be communication with nearby bursa. MR appearance of tumoral calcinosis is variable with both high and low T2 signal patterns described. Therefore, radiography, appropriate clinical history, and laboratory workup are key to making the correct diagnosis.

Conclusion
This CME activity emphasizes that the pelvis with its complex anatomy and many neoplastic and nonneoplastic processes can present a daunting challenge for even the experienced radiologist. Unnecessary diagnostic workup for benign lesions can lead to potential patient harm, increased patient anxiety, and exorbitant medical costs. As discussed in this review, pseudotumors of the hip and pelvis are significantly more common than primary neoplasms, benign or malignant, of the soft tissue. Therefore, when presented with a soft tissue mass in the pelvis and hip on cross-sectional examinations, the interpreting radiologist must consider a pseudotumor in the differential diagnosis. By including history, prior imaging, laboratory evaluation, and additional imaging, the radiologist can play a critical role in reaching the correct diagnosis of a pelvis soft tissue mass (see Table 1).

References

CME QUIZ: VOLUME 40, NUMBER 7

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1. Which one of the following is highly predictive of recurrence of a Morel-Lavallee lesion about the pelvis and hip?  
A. Presence of a fluid-fluid level on CT  
B. Absence of fat globules within a cystic mass  
C. Aspiration of more than 50 mL of fluid from the lesion  
D. High T2 signal intensity rim about cystic mass  
See Reference No. 8 for further study

2. All of the following are potential causes of bursitis around the pelvis and hip, except  
A. failure of hip arthroplasty  
B. rheumatoid arthritis  
C. septic arthritis  
D. synovial neoplasm  
E. labral tear  
See Reference No. 2 for further study

3. Which one of the following statements concerning HADD and CPPD deposits about the pelvis and hip is false?  
A. CPPD is more common than HADD around the hip.  
B. The hip is the second most common joint affected in HADD.  
C. A common location of HADD is tendinous attachment on the hip trochanters.  
D. CPPD tends to deposit in hyaline cartilage and fibrocartilage.  
E. HADD can cause adjacent bone erosion.  
See Reference No. 7 for further study

4. Figure 10 is a Doppler ultrasound of a 58-year-old man who developed a left groin mass after femoral artery catheterization. What should be the next step in this patient's management?  
A. Consult an interventional radiologist  
B. Contrast-enhanced CT examination  
C. Contrast-enhanced MR examination  
D. Fluorodeoxyglucose positron emission tomography imaging  
E. Repeat Doppler ultrasound in 3 months  
See Reference No. 4 for further study

5. All of the following are MRI features that favor radiation myositis about the pelvis and hip, except  
A. sharp margins of muscle edema  
B. normal feathery pattern of high T2 signal intensity within muscles  
C. normal fusiform shape of muscles  
D. edema crossing muscle and fat planes without disruption  
E. tendon displacement  
See Reference No. 9 for further study

6. Phleboliths about the pelvis and hip most commonly occur in  
A. pseudoaneurysm  
B. arteriovenous fistula  
C. arteriovenous malformation  
D. venous malformation  
See Reference No. 4 for further study

7. Which one of the following is the most specific imaging feature of myositis ossifications about the pelvis and hip?  
A. Presence of periostitis on radiographs  
B. Heterogeneous hyperintensity on T2 MR images  
C. Dense bony cortex at the periphery of the lesion on radiographs over time  
D. Extensive perilesional edema on MR images  
See Reference No. 6 for further study

8. Which one of the following statements regarding femoral pseudoaneurysms about the pelvis and hip is false?  
A. They are due most commonly to cardiac catheterization.  
B. They contain all three layers of the normal artery.  
C. Watchful waiting is the usual treatment for small lesions.  
D. “To and fro” pattern on pulsed Doppler is characteristic.  
E. Those with a volume greater than 6 cm³ require treatment.  
See Reference No. 4 for further study

9. In which anatomic structure does tumoral calcinosis typically deposit about the pelvis and hip?  
A. Bursa  
B. Fascia  
C. Muscle  
D. Skin  
E. Tendon  
See Reference No. 10 for further study

10. The incidence of acetabular paralabral cysts seen on MRI in asymptomatic patients is  
A. 2%  
B. 13%  
C. 32%  
D. 45%  
E. 65%  
See Reference No. 3 for further study

Figure 10.