Diagnosis: silicone synovitis. Figure 1 shows increased density of the lunate from avascular necrosis. Figure 2 shows the lunate prosthesis in place, following resection of the native lunate. The joint spaces are intact. Figure 3 is the same wrist 8 years after surgery. The lunate prosthesis has changed shape, and there is destruction and resorption of the carpal bones. There is regional soft tissue swelling and osteoporosis. The prosthesis was removed and a total wrist arthroplasty was done (Fig 4).

**BACKGROUND**

Silicone elastomer prostheses were used for replacement of bones and joints from the 1960s until the late 1980s. Silicone prostheses were most frequently used to replace small joints and bones damaged by arthritis. They were most often used in the hand and wrist to replace metacarpophalangeal and proximal interphalangeal joints, the thumb carpometacarpal articulation, and the radiocarpal joint. The distal ulna and various carpal bones were also resected and replaced with silicone implants. Although less common, these implants were also used in temporomandibular joints and metatarsophalangeal joints. The implant provided stability of the joint, improved range of motion, and relieved pain.

Complications of silicone prostheses include fracture, infection, dislocation, collapse, and silicone synovitis. The synovitis associated with these prostheses has a characteristic pathologic, clinical, and radiographic course.

**PATHOGENESIS**

Silicone synovitis is thought to be a chronic, non-specific, inflammatory reaction. This foreign body reaction is induced by microparticles and affects the soft tissue and adjacent bone. The reaction can travel to regional lymph nodes. Shedding of microparticles (particles smaller than 100 μm) from the silicone prosthesis is caused by compressive and shear forces which fragment the prosthesis. There is evidence that synovitis is dependent on particle size, length of exposure, and rate of production of particles rather than the composition of the particles. Thus, small particle disease is a more accurate term than silicone synovitis.

Silicone small particle synovitis is most commonly associated with carpal prostheses, where the compressive forces are high, and less commonly with the small joint prostheses of the hand, where the compressive forces are fewer. There is an especially high incidence of silicone synovitis following scaphoid and lunate replacement, and therefore studies suggest not using silicone to replace these bones. The metatarsophalangeal joint also has a high incidence of silicone synovitis due to the significant load during weight bearing.

**PATHOLOGY**

Grossly the implant that is removed due to silicone synovitis is discolored with a pitted surface and has usually lost its shape. Adjacent bone structures may have cystic and erosive changes, and there is adjacent soft tissue swelling. Local adenopathy is also a common finding.

Histologic findings include hyperplastic synovitis with foreign body granulomas. There is villous hypertrophy of the synovium which is infiltrated with inflammatory cells, and sometimes there is focal fibrosis. The silicone particles are more obvious when seen under polarized light and are found in the extracellular fluid as well as intracellular in histiocytes and giant cells. The articular cartilage is eroded by this pannus, and synovial invasion of structures adjacent to the prosthesis leads to bone destruction.

Particles of silicone have been found in soft tissue, subchondral bone cysts and erosions, and in the regional lymph nodes. Silicone has also been found in the bone marrow and in lymphatic channels which accounts for distant lymphadenopathy and distant bone involvement.

**CLINICAL SIGNS AND SYMPTOMS**

The onset of synovitis after implantation of the silicone prosthesis is delayed, varying from 1 year to 9 years after surgery. The majority of cases have occurred following carpal bone...
lymphadenopathy, and occasionally low grade fevers.\textsuperscript{6,7} Local lymph node involvement usually does not occur before 3 years after the implantation.\textsuperscript{2} Lymphadenopathy may be mistaken for a malignant tumor or infection. It has been suggested that spread of silicone particles through lymphatics has caused lymphoma.\textsuperscript{7}

**IMAGING**

Some patients with symptomatic silicone synovitis do not have any radiologic changes. More frequently patients do have radiological abnormalities but do not have symptoms.\textsuperscript{8}

The radiographic evidence of silicone synovitis is quite impressive. The silicone prostheses are normally seen on radiographs because they are denser than soft tissue and, in addition, sclerosis develops around the implant which aids in visualization (Fig 2). If synovitis develops, deformity or fracture of the prosthesis and neighboring bones is sometimes apparent.

Subchondral lucent defects or cysts, marginal erosions, and endosteal scalloping are also seen (Figs 5-7). The cartilage space may be preserved. There is soft tissue swelling. Occasionally the implant is collapsed and there is regional disorganization and osteopenia.\textsuperscript{2,3} (Fig 3).

Radiographic differential diagnosis includes amyloidosis, pigmented villonodular synovitis, tuberculous arthritis, and fungal arthritis. Amyloid tends to be symmetrical, whereas silicone synovitis is unilateral. Pigmented villonodular synovitis usually affects large joints with maintenance of normal bone density. Tuberculous arthritis and fungal arthritis should be considered if there is clinical evidence of infection.\textsuperscript{6}

Studies have demonstrated no correlation between radiographic change in silicone synovitis and time after implantation. However, if serial radiographs are available, they should be compared to check for changes in position of the prosthesis or alteration in carpal bone alignment.\textsuperscript{8}

**TREATMENT AND PROGNOSIS**

A diagnosis of silicone synovitis can usually be made after clinical, radiologic, and histologic evaluation. It has been recommended that patients who show histologic or radiologic evidence of disease, but have no clinical symptoms, should be followed. Surgery is reserved for patients who become symptomatic.\textsuperscript{3}

Once the patient is symptomatic, the affected joint or bone is explored. Removal of the implant is usually necessary. Prosthesis fragments, bone cysts, and affected synovium are either curetted or aspirated. After removal, the prosthesis can be replaced with an alternative prosthetic device (Fig 4). Titanium grommets have been used to protect the bone and implant interface. Non-implant salvage procedures, such as interposition of neighboring muscle, fascia, or tendon, have also been used,\textsuperscript{3} as well as joint arthrodesis.

Most patients improve after surgery with relief of symptoms and decrease of swelling. Neighboring bone and tissue destruction does not progress once the implant is removed.\textsuperscript{3}

**USE OF SILICONE**

There is ongoing controversy over silicone breast implants and their potential role in disease. Is there any similarity to silicone bone and joint prostheses and silicone synovitis? Polydimethylsiloxane polymers are used in silicone gels, liquids, and solid elastomer (Silastic), and Silastic has been used in the casing of mammary implants and also for orthopedic prostheses. Silicone-mediated inflammatory responses are associated with both breast implants and joint prostheses and are thought to be induced by a foreign body reaction.\textsuperscript{7} A recent study shows that there is histologic similarity between hyperplasia associated with silicone synovitis and hyperplasia around breast implants. This suggests that the pathophysiologic process could be similar in both cases.\textsuperscript{9}

(continued on page 280)
(Radiologic Case Study continued)

Silicone breast implants and the association of connective tissue disease have received much recent publicity due to their medical and legal significance. There are studies that support and even more studies that refute the association. Immunologic activity and the development of autoantibodies have been postulated to have a role in the pathogenesis of silicone breast disease. This, too, is highly controversial.10,11

Currently there is no evidence that silicone orthopedic prostheses cause connective tissue disease or any immunologic activity, although little research data are available. In addition, there is evidence that the small particles of certain size cause synovitis regardless of their composition.

REFERENCES


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Fig 6: Axial (A) and coronal (B) CT images of the temporomandibular joints show a malformed prosthetic implant (curved arrow) on the right, as well as extensive bony erosions (black arrows) of the adjacent temporal bone.

Fig 7: Coronal T1-weighted (A) and T2-weighted (B) spin echo magnetic resonance Images of the wrist show signal void from the scaphoid silicone prosthesis (*). There is abnormal fluid in the midcarpal joint space with discrete erosions of multiple carpal bones (white arrows).
This patient had avascular necrosis of the lunate (Fig 1). Treatment consisted of lunate resection and placement of a silicone prosthesis (Fig 2). Eight years after her surgery, the patient reports increasing wrist pain and swelling of 1 year’s duration (Fig 3). Your diagnosis is?

(See page 277 for answer.)