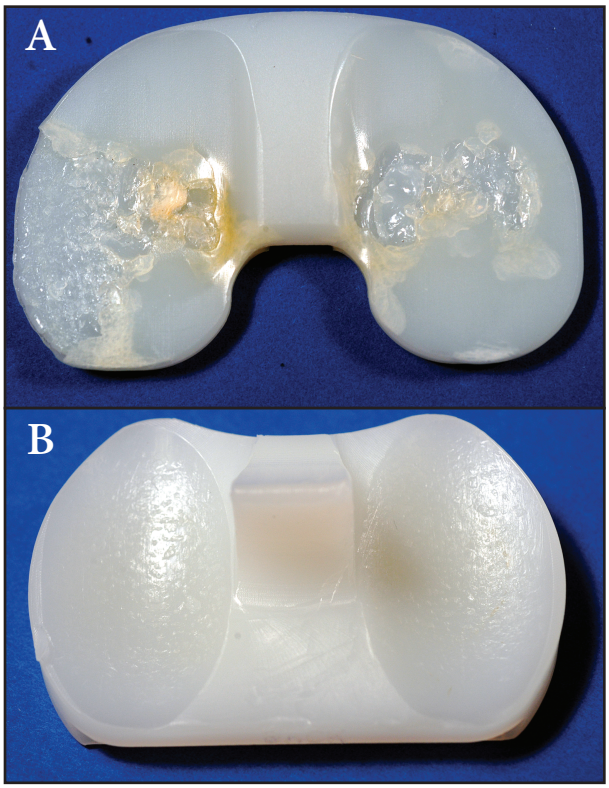

Figure 13-3. (A) Severe delamination and (B) pitting modes of damage.

Wear particles may be generated at the articulating surface between the femoral component and polyethylene tibial insert. Surface damage on polyethylene components may arise from 7 different modes of damage, which have been observed in retrieved total knee prostheses.[33] These include pitting, embedded debris, scratching, delamination, surface deformation, burnishing, and abrasion. Pitting is a mode of fatigue wear that is characterized by the formation of millimeter-sized craters and is considered to be a more benign wear mechanism that does not provoke an osteolytic response due to its large particle sizes (Figure 13-3). Embedded debris may arise from bone cement, bone chip, or metallic bead fragments becoming embedded in the polyethylene component, possibly leading to third body wear, as well as scratching of the surfaces of the metallic counterface. Scratching is a mode of abrasive wear that is characterized by linear features that are produced by plowing of microscopic asperities. Delamination is a severe form of fatigue wear, involving the removal of sheets of polyethylene and can result in catastrophic wear (see Figure 13-3). Surface deformation, which corresponds to permanent changes in the surface geometry or "creep" or "cold flow," does not result in material removal and therefore does not strictly correspond to wear. Burnishing is a mode of adhesive/abrasive wear that produces wear debris from a polishing effect, of particle sizes that can elicit an osteolytic response. Abrasion is characterized as a shredding of the polyethylene surface and is classified as a mode of abrasive wear. The surface damage to components seen with in vivo oxidation of the gamma-air sterilized polyethylene of the late 20th century should be a concern of the past with modern polymer processing methods.

While wear at the articulating surface between the femoral component and polyethylene tibial insert have been the primary focus of attention by researchers, backside wear between the inferior surface of the tibial insert and the metal tray is also a potential source of wear particles.[18,34,35] Backside wear is typically characterized by burnishing or scratching of the polyethylene component, sometimes removing the machining marks from the surface. Polyethylene may also extrude