Abstract. This chapter describes the anatomy, pathology and hip replacements developed to treat pathological hip conditions. The history of four generations of hip replacement designs, their evaluation in light of the material in Chapters I and 2 and the clinical performance of these designs is presented. The first and second generations met with partial success and led the way to the development of improved designs. The third generations of designs work well. Current designs have added modularity to further improve the flexibility in the use of hip replacements. Also presented is the design of a fourth generation hip system using the principles of the first three chapters. The design process of Chapter 3 was used for the development of an improved version of the B-P hip system. The system includes conventional, modular and surface replacement elements. Ceramic coated titanium alloy is used for its metallic components. Except for the effects of UHMWPe wear clinical results are quite good. Wear is a problem common to all hip replacement systems using UHMWPe bearings. Use of highly cross-linked UHMWPe, fortunately, shows considerable potential for solving this problem. Ceramic on ceramic articulating devices show excellent long term performance. Metal on metal, although initially promising, has essentially been abandoned due to the adverse effects of metal ions released by wear.

5.1 Anatomy

The complex known as the hip joint consists of the femoral head and the acetabulum (Fig. 5.1), articulating to accommodate extension, flexion and rotational movements, similar to a “ball and socket” joint.
5.1.1 **Ligamentous Structures**

The ligamentous structures are integrated with the capsule to provide stability at the extremes of rotational motion. A transverse acetabular ligament maintains inferior acetabular stability of the anterior and posterior cotyledons of the “horseshoe-shaped” acetabular articular surface. A peripheral fibro-cartilaginous labrum provides added joint stability and helps to seal the synovial fluid film around the hip joint.

Additional stability is provided by the deep spherical acetabular socket that entraps the femoral head throughout its range of motion.