CHAPTER II

LITERATURES REVIEW

The shoulder implants system that designs mimicked the normal anatomy would provide the best function and durability. However, the original Neer prosthesis was only available in a limited range of sizes, first generation shoulder prosthesis. Fluoroscopic studies showed that the ability to reproduce the normal kinematics of the glenohumeral joint with such an implant was limited.[6] In the early 1990s modular, or second generation prostheses were developed (Biomet, Cofield, Global) to try to match the wide variation observed in the dimensions of the head and the diameter of the medullary canal. Unfortunately, their concept and design did not achieve to mimicking the normal anatomy and two major problems were encountered. First, the prosthetic head was often malpositioned in both the vertical and the horizontal planes. This was because of their relatively fixed geometry. Most were uncemented and because they were press-fit, the position of the stem dictated that of the head, leading in some instances to displacement of the center of rotation outside its normal position. Secondly, the head was frequently oversized. Heads usually came in differing depths but of the same diameter, leading the surgeon to implant excessively large prostheses. Studies[2,7] have shown that there was a linear relationship between depth and diameter, such that only one depth went with one diameter, except for heads larger than 50 mm. in diameter. Another reason for oversizing was the gap between the osteotomy and the prosthetic head. Pearl and Kurutz,[8] in a three-dimensional analysis, noted that even when this gap was eliminated and optimal prosthetic version was achieved, there was still a displacement of the center of rotation greater than 5 mm. despite their modularity, second-generation prostheses did not allow replication of the proximal humeral anatomy and even created new problems not seen with the Neer prosthesis. Too large a head changed the biomechanics by over-tensioning the joint, thereby limiting mobility and possibly increasing wear of the glenoid cartilage with a hemiarthroplasty or wear of the polyethylene if the glenoid was resurfaced. The associated excessive tension in the rotator cuff may lead either to early rupture of the repair of subscapularis and possible anterior instability, or later stretching or tearing of supraspinatus, causing pain and loss of active elevation. Inaccurate reproduction of the geometry of the proximal humerus may induce abnormal function of the abductor muscles and change the lever arms around the glenohumeral joint. Nyffeler et al.[1] have shown that if the centre of the head lies too superiorly subscapularis and infraspinatus are converted from abductors into adductors, substantially increasing the load on supraspinatus in elevation and abduction. Alteration of the bony anatomy by changing humeral retroversion may lead to eccentric loading at the periphery of the glenoid, which may increase glenoid wear with subsequent loosening.[1] This may explain the rapid deterioration of the clinical results in some patients with second-generation arthroplasties[9]. Boileau and Walch [2] , and others[3], have shown that the shape of the proximal humerus is more complex than has been described previously . Roberts et al.[5] and Wallace et al.[10]observed that the articular surface of the head was offset posteriorly compared with the proximal medullary axis. If a prosthesis is to reproduce normal anatomy, its head must also be offset. We found that the articular surface was also medially offset in relation to the proximal medullary axis and that the head was variably orientated in the vertical and horizontal planes.[2] Therefore, it must be possible to offset the head posteriorly and medially and to vary its inclination and retroversion These findings led to modifications in the design of the prosthesis in the surgical technique. Identifying the true anatomical neck became the critical step. This was achieved by careful removal of the crown of osteophytes around the head. The anatomical neck could be visualized even in the presence of severe erosion of the head. Better understanding of the anatomical relationships within the normal glenohumeral joint has resulted in improvements in design of unconstrained prostheses so that the three-dimensional geometry of the proximal humerus can be recreated, third generation prostheses. The principle of correct positioning of the prosthetic head to mimic an individual's anatomy is described as 'adaptability', and clinical results using this implant have been published to validate this view[11,12]. Subsequent research with other third-generation implants, both modular and adaptable, has confirmed the importance of recreating the unique of each patient's anatomy[1,4,8,13,14,15]. Part of the principle of design in the third generation implants is matching the depth of the head to its diameter. We now know that displacement of the joint surface leads to altered kinematics and decreases glenohumeral movement, causing translation of the head of the humerus[14,15,16] . Selecting the appropriate size of head is important since biomechanical experiments have shown that a change in the centre of rotation of 5 mm. to 10 mm. results in significant reduction of the lever arms of the deltoid and rotator-cuff muscles during abduction. Harryman et al have shown that an increase in the depth of the head by only 5 mm. decreases the range of glenohumeral movement by 20 degree to 30 degree. Decreasing the depth by 5 mm. reduces the glenohumeral excursion by 24 degree[13].Using an oversized head component results in a substantial reduction of joint laxity and severe limitation of flexion, abduction and external and internal rotation. Other aspects of the anatomy of the proximal humerus need to be considered in trying to design an anatomical prosthesis. If the individual neck-shaft angle is not respected, the length of the abductor muscles may be altered resulting in abnormal function. Therefore, the implant must offer this option in order to restore the lever arms of the deltoid and supraspinatus. Boileau et al[2]. study has noted that the provision of four stem-neck angles (125 degree, 130 degree, 135 degree and 140 degree) encompasses more than 95 percent of patients. By resecting the humeral head at the anatomical neck and using an implant which can be constructed to match the retroversion, inclination and medial and posterior offset with an identical depth of head, the individual lever arms of the rotator cuff muscles are restored. This ‘anatomical reconstruction’ of the joint results in normal kinematics and kinetics. Third-generation systems can recreate structure and geometry which matches the normal anatomy to a greater extent than those of the second-generation[8,18].