Zeitschrift: Jahrbuch der Schweizerischen Naturforschenden Gesellschaft. Wissenschaftlicher und administrativer Teil = Annuaire de la Société Helvétique des Sciences Naturelles. Partie scientifique et administrative

Herausgeber: Schweizerische Naturforschende Gesellschaft

Band: 160 (1980)

Artikel: Non-hinged replacement of the knee joint

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DOI: https://doi.org/10.5169/seals-90815

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Non-Hinged Replacement of the Knee Joint

Lee H. Riley, Jr

Orthopaedic surgeons in the United States were slow to accept the operation of total replacement of the hip joint and the use of methylmetacrylate which was essential to the success of the procedure. The misfortunes associated with the use of polyurethane polymer (ostamer) (Thompson, Sezgin, 1962) were still fresh in the minds of many American orthopaedic surgeons and perhaps explains their reticence to acknowledge the tremendous advancement in hip surgery that had been proven in Europe through the pioneering work of Mr. McKee and Watson-Farrar (1966), Sir John Charnley (1970), and Professor Maurice Mueller (1970). However, by the end of the decade of the 1960's, the era of total hip arthroplasty had begun in the United States.

The success of total hip arthroplasty emphasized two observations. First, methylmetacrylate would provide a secure method of fixation of prosthetic components to bone, and the bone acrylic interface necessary for firm fixation would remain intact for many years. Secondly, high density polyethylene and metal were acceptable in an intra-articular environment for a reasonably long period of time. These two observations stimulated the rapid development of non-articulated total knee units.

A group of orthopaedic surgeons representing initially four and later five institutions joined to participate in the design and clinical testing of a non-articulated unit to replace the articular surfaces of the human knee. The design criteria felt to be important initially were:

1) that it be non-hinged;
2) that it be intrinsically stable;
3) that it permit insertion without sacrifice of the cruciate ligaments if they were present;
4) that it permit correction of fixed varus and valgus deformities;
5) that it permit retention of the patella;
6) that it be inserted by a reproducible surgical technique; and
7) that it permit knee fusion as a salvane procedure. The geome tric unit was developed to conform with these criteria and was used in many centers throughout the world in the early and middle years of the 1970's (Coventry et al. 1972).

My experience with the use of this knee unit was gratifying. A group of 44 patients with rheumatoid arthritis for whom 54 geometric total knee arthroplasties were performed was analyzed in 1978 (Riley and Hungerford 1978). The period of follow-up was from 24 to 64 months. There were no operative deaths, no post-operative infections, and no pulmonary emboli in this group. One patient died from cardiac arrest during the induction of anesthesia for manipulation of the knee two weeks following total knee arthroplasty. Autopsy of this patient revealed advanced arteriscleroticcoronary disease but no pulmonary emboli. Four patients required additional operative procedures on the knee after arthroplasty. One had patellectomy one year after knee replacement for pain in the anterior part of the knee and three years after arthroplasty had no pain. One patient required resection of tibial bone and reinsertion of the tibial component to correct a flexion contracture and the third, replacement of the tibial component because of loosening. The fourth patient required knee fusion following loosening of the femoral component associated with avascular necrosis of the femoral condyle. The relief of pain and the increase in ability to carry out activities of daily living were dramatic in these patients. Similar encouraging results were achieved when the procedure was performed for degenerative disease of the knee.

Potter et al. have reported similar results in a group of 109 geometric total knee arthroplasties performed for 97 patients between November 1972 and September 1977 at the New England Baptist Hospital in Boston, Massachusetts (Hopson et al. 1980).

The anametric knee unit represented the continued collaboration of the geometric group. The objectives of the anametric knee were to increase range of motion possible following arthroplasty, allow rotary motion to exist between the femur and the tibia, increase stability while decreasing bone cement interface stresses, preserve ligamentous stability and simplify the surgical procedure necessary for insertion. These objectives were achieved by providing for multiple radii for the medial and lateral femoral condyles, providing for divergence between the medial and lateral femoral condyles, decreasing conformity of the tibial unit while increasing stability by providing increased polyethylene in the region of the amputated tibial spines, by providing for a patellar flange and modifying tibial fixation. The initial clinical experience of the group has been favorable and indeed it appears as if the goals for which the anametric unit was designed have been achieved (Einerman et al. 1979), although experience with use of this unit is limited to four years.

The experience of the past decade suggests that results that can be anticipated following non-constrained total replacement of the knee vary with the disease for which the procedure is performed with perhaps the most gratifying being in those patients with rheumatoid arthritis in whom the deseased knee varies from normal by the lack of normal articular cartilage but with minimal bone destruction, minimal ligamentous instability and minimal malalignment. In addition, patients with rheumatoid arthritis with multiple joint involvement limit activities following total knee arthroplasty to those required for daily living. The poorest results are to be expected when marked destructive changes are present, such as with a charcot knee, while results to be expected from reconstruction of the post-traumatic and degenerative knee fall somewhere in-between.

Results of non-constrained total knee arthroplasty vary with the clinical judgement and surgical skill of the surgeon and no degree of finesse in design or fabrication of total knee units will compensate for an improperly conceived or performed procedure.

Results of non-constrained total knee replacement vary with soft tissue abnormalities about the knee, the patient's weight, and the degree to which the anatomy and physiology of the deseased knee vary from normal. There are contra-indications of the use of each type of non-articulated units based upon these variables.

The experience of the past decade suggests that there are patient related and physician related factors associated with the quality of result to be anticipated following non-hinged total knee replacement. Patient-related factors include the degree of bone lose, ligamentous instability, and fixed deformity of the knee, soft tissue abnormalities about the knee, the patient's weight, and the underlying disease. The physician-related factors include selection of the proper operation for the patient, and when that proper operation is total replacement arthroplasty, selection of the proper prosthesis. Of utmost importance is the skill of the surgeon in inserting the unit properly. I would hope that the excitement and enthusiasm that has characterized the development of total knee units during the past decade can be applied during the coming decade to the refinement of surgical technique to insure their proper insertion.

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