Total Hip Arthroplasty in Adolescents – Literature review and own clinical experience

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Abstract - Background: Total hip arthroplasty in adolescent patients is still researched surgical procedure in terms of indications, outcomes and long-term survivorship. The purpose of this report is to assess the results from THA in teenagers from the literature and to add data from our own clinical practice in order to provide insights for clinical decision-making in this specific and unique age group.

Material and Results: A systematic literature review was performed including studies reporting clinical, radiological, functional outcomes and survivorship of THA in adolescent patients for any cause, with a minimum follow-up of one year. We added data from our clinical experience of 4 cases with hip endoprostheses in teenagers. Overall results showed significant increase of Harris Hip Score (HHS) with more than 53 points postoperatively, reaching values over 90 points (93±2) which is considered a very good and excellent result. Ten years survival rate has been reported in more than 85% of cases, with aseptic loosening mainly of the acetabular component. Revision rate has been 14,4%, as the leading cause – acetabular loosening in 64% of the cases. Complications have been found to be 3,4%.

Conclusion: Total hip arthroplasty is a highly effective option for adolescents with severe destruction of the hip joint. It has demonstrated very good survivorship, low complication rate and acceptable functional results. However, altered hip anatomy, an increased revision rate and the long term implant survival must be considered before performing THA in teenagers.

1. Introduction

Primary total hip arthroplasty (THA) is the most effective intervention to treat end-stage hip arthritis in the elderly population. For young patients and adolescents, data regarding indications, outcomes and survivorship is still limited[1]. It is a rare procedure as arthroplasty registries currently report that THA performed in patients under 21 years old is less than 0.01% of all hip replacements[2], nonetheless this proportion is expected to increase in recent years[3].

Adolescents with end-stage hip osteoarthritis (OA) might benefit from THA, especially when considering the satisfactory results in very young adults (< 35 years) and advancements in bearing surfaces[1,4]. However, similarly to tumor endoprostheses[5], joint replacement in adolescents presents unique challenges. Altered proximal femoral

anatomy, dysplastic acetabulum, growing skeleton[6,7], multiple previous procedures, and smaller implant sizes ultimately increase the risk of complications[8]. Alternatives to THA in this age group include arthrodesis, resection arthroplasty, and salvage procedures such as pelvic support osteotomy. Nevertheless, these procedures are not as predictable for relieving pain and restoring function[9]. Furthermore, understanding the psychosocial context of adolescents, actively shaping their identity and exposed to emotional and social influences, is crucial for the comprehensive care of these patients. Another concern with hip reconstruction surgery in adolescents is the longevity of the implant survival and the likelihood of revision surgery. Younger patients typically have higher activity levels, different expectations regarding and longer life expectancy. Therefore, a ten year revision risk has different implications in young patients and might result in higher revision rates[8]. It is hypothesized that adolescents undergoing THA would demonstrate significant functional improvement and acceptable rates of implant survivorship. When facing a case of severe hip destruction in adolescents, it is important for patients, their parents, and the surgeon to make informed decisions, considering the existing high-quality data regarding outcomes of THA in this specific age group. The purpose of this report is to conduct a systematic review, adding analysis of our own clinical experience with such patients in order to assess the current surgical indications, implants used, functional outcomes, complications and define mid- and long-term survivorship of primary THA in teenage patients.

2. Material and Results

A systematic search was performed in PubMed® database. The following Medical Subject Headings (MeSH) and free terms were used: “Arthroplasty, “Hip Replacement”, and ‘‘adolescents/teenagers ”, “outcomes”, “complications”, “implant survival”. We analyzed studies, reporting clinical, radiological, and functional outcomes of THA in adolescent patients, for any cause, with a minimum follow-up of one year.

Our clinical experience includes 4 cases of THA in teenage patients – 2 males and 1 female – bilateral. In every case the indication for total hip arthroplasty has been severe deformity of the femoral head due to AVN - posttraumatic (1 case), drug induced (corticosteroids) (2 cases) and postoperative after correction of severe chronic femoral head slip (1 case). Average patient`s age at time of operation has been 16,72 ± 0,89 years. All hips are classified as Stulberg V. The modified Oxford Hip Score (OHS) for skeletal maturity has been over 19 point and Risser stage 5 for all patients. Leg shortening, impaired gait and hip pain have been main patient`s complains. The Harris Hip Score (HHS) was 39 ± 9,55 preoperatively. Two of our patients has had previous surgeries for treatment of the primary hip deformity. All components of the endoprostheses were uncemented, with ceramic head on highly cross-linked polyethylene (HXLPE) acetabular insert. In average follow-up period of 24 ± 5,35month, our patients showed significant clinical improvement of Harris Hip Score (HHS) with values over 90 points (93±2) and radiographs showing retained position of the implants with no signs of component mobilization and wearing of the bearing surfaces [Fig.1].

3. Discussion

Total hip arthroplasty in adolescents with end-stage hip deformity is a specific and unique scenario in which different factors impact both short- and long-term results[1,5]. These young patients are usually expected to outlive the prostheses. Ten years survival

rate of THA in teenage patients is identified in 85%, with aseptic loosening as the leading cause for revision in 64% of the cases[1]. Mobilization predominantly of the acetabular component is considered to be due to the presence of the growing triradiate cartilage at the time of the arthroplasty[6]. In a recent study a very good survivorship of the implant is observed – 100% for 5 years follow-up, 97% for 10 years and 90% for 15 years[10,11].



Fig. 1 14-year-old male with posttraumatic AVN of left femoral head. **A, B, C:** preoperative radiographs: shortening of left lower extremity with 25mm, collapse and deformity of left femoral head, leading to aspherical hip incongruency (Stulberg V). **D:** postoperative – restoration of limb length discrepancy (LLD) and Shenton-Menard`s line. **E:** at 4 years follow-up – no signs of component loosening, neither HXLPE wearing.

In earlier reports, juvenile idiopathic arthritis (JIA) was the most common indication for THA[12,13]. However, prompt diagnosis and initiation of targeted therapy, including non-steroidal anti-inflammatory drugs (NSAIDs), systemic and intraarticular glucocorticoids, and non-biologic or biologic disease-modifying antirheumatic drugs (DMARDs), allow better disease control and prevents permanent damage to the hip[14]. In recent publications the predominant cause for THA in adolescents becomes avascular necrosis oh the femoral head (AVN), accounting for 36% of THA in teenagers, leaving JIA second - 24%[1,15,16]. Femoral head necrosis might be posttraumatic, drug induced or complication after surgical treatment of adolescent epiphysiolysis (SCFE)[17]. In all our cases AVN has been the reason for THA. Other described reasons for early arthroplasty are deformities due to avascular necrosis of the femoral head - Kalamchi IV, which lead to asphericity of the head, thence incongruency of the hip joint[18]. Such cases are not indicated for hip preserving surgery[19] and total hip arthroplasty remains the only option for increase of teenager`s life quality. Severe deformities following natural history of SCFE and Morbus Perthes leading to joint incongruency and severe early hip OA are less common reason for THA in adolescents – around 9% for each[1]. In recent years, both early screening and better treatment of DDH reduce the early onset of end-stage OA and make it a rare indication for THA in this teenage group – less then10% [1,20,21].

Significant proportion of adolescents for THA had undergone previous surgical interventions for various indications, including salvage procedures aimed at postponing arthroplasty. Pelvic and femoral osteotomies may alter native anatomy and biomechanics of the hip, making THA in adolescent technically challenging[22]. Numerous studies have demonstrated that surgical interventions prior THA are associated with prolonged operative times and increased blood loss[23]. Although the effect of previous osteotomies on implant survival is still debatable, several studies have reported a lower grade of consistency in acetabular cup positioning in this group of patients[24]. This along with the abovementioned presence of triradiate cartilage, might be related to increased revision rate of the acetabular component.

Regarding the surgical approaches that are used for THA in teenagers, the most commonly used is postero-lateral 58%, then lateral – 37% and last comes direct anterior approach – 5%[1], which however gains greater popularity lately with its main advantage of muscle spearing. Postero-lateral and lateral approaches allow better visibility. This is extremely important for proper implant positioning in situations with altered regional anatomy and biomechanics, which are most of the adolescent THA cases. In our patients we used the lateral approach twice and postero-lateral also two times, benefiting their advantages.

Acetabular aseptic loosening and osteolysis/polyethylene wear are found to be the most common reasons for revision and reoperations after adolescent THAs. The revision rate is found to be 14,4%, which is higher than in adults[1]. In the past, revisions have been reported higher due to the predominant use of conventional polyethylene until the early 2000s, which was the bearing surface of choice earlier[11]. With the introduction of highly cross-linked polyethylene (HXLPE), the median linear and volumetric wear rates decreased significantly. In a study by Stambough, Clohisi et al. no revisions due to osteolysis were documented at a ten-year follow-up[25]. Recent evidence shows that HXLPE dramatically reduced wear-related complications[26]. However, different bearing surfaces have been studied in younger patients with the goal of improving longevity of the prosthesis. Third generation ceramic-on-ceramic and ceramic-on-polyethylene bearing surfaces demonstrated favourable results in young patients[16,27,28].

Other complications that have been reported after THA in adolescent are periprosthetic fractures-1.4%, instability/dislocation-0.8%, nerve damage-0.7%, superficial wound infection-0.3% and deep periprosthetic infection 0.2% [1]. These altogether–3,4%, are considerably lower than the complication rates reported in adults[29].

For the assessment of functional results of adolescents undergoing THA, the Harris Hip Score (HHS) has been the most frequently used instrument. In most of the studies HHS is reported to be over 90 points, with more than 53 points increase postoperatively. These results are considered good and excellent and they are consistently observed in numerous studies[30-34]. We also report HHS over 90 points, which confirms these favorable results [Fig.2].

The initial observation from our limited clinical experience, completely supports data from the abovementioned authors regarding indications, time for THA, surgical techniques and high satisfaction rates of these teenage patients and their parents.



Fig. 2 Clinical result 4 years post operative. **A:** Trendelenburg (+++) pos. on the left side; **B:** Trendelenburg (-) neg. on the left side.

4. Conclusion

Total hip arthroplasty is a highly effective surgical solution for adolescents with end-stage destruction of the hip joint that are not candidates to joint preservation procedures. THA in this age group has shown very good survivorship and low complication rate. It has demonstrated adequate results in patient satisfaction and leg function. However, altered hip anatomy, an increased revision rate and the long term implant survival must be considered when surgeons encounter an adolescent requiring THA. In recent years continuous improvement of results is obtained with modern operative techniques, bearing surfaces and implant designs. Future studies are needed for further enhancement of THA outcomes in teenagers.

5. References

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