Acta Orthopaedica et Traumatologica Turcica xxx (2017) 1–5

Contents lists available at ScienceDirect

Acta Orthopaedica et Traumatologica Turcica

journal homepage: https://www.elsevier.com/locate/aott

The effect of hip reconstruction on gross motor function levels in children with cerebral palsy

Mutlu Cobanoglu [a, *], Emre Cullu [a], Imran Omurlu [b]

[a] Adnan Menderes University, Faculty of Medicine, Department of Orthopedics and Traumatology, Aydın, Turkey
[b] Adnan Menderes University, Faculty of Medicine, Department of Biostatistics, Aydın, Turkey

ARTICLE INFO

Article history:
Received 8 December 2016
Received in revised form
17 June 2017
Accepted 6 November 2017
Available online xxx

Keywords:
Cerebral palsy
Hip reconstruction
Gross motor function
Classification system

ABSTRACT

Objective: The aim of this study was to determine whether the hip reconstruction has an effect on gross motor function classification system (GMFCS) levels in patients with hip instability in cerebral palsy (CP).
Methods: A total of 45 hips of 30 patients (mean age: 8.7 (4–17) years) with CP operated due to hip instability with a minimum of 2 years of follow-up were included into the study. Migration index was used for classification of the severity of hip instability. Clinical evaluation included sitting and walking ability, existence of pressure sores, difficulty in perineal care, and hip pain. The functional gains from the surgery were evaluated with changes in GMFCS levels. Wilcoxon *T* test, chi-square test and Spearman correlation test were used.
Results: Mean follow-up time was 57 (24–132) months. The distribution of preoperative GMFCS was level I in 1 patient, level II in 4 patients, level III in 5 patients, level IV in 9 patients and level V in 11 patients. The complaints resolved in 25 patients, and persisted in 5 postoperatively. There was no correlation between the changes in GMFCS levels and the postoperative complaints ($p = 0.504$). The GMFCS levels did not change in 20 patients, improved in 8, and worsened in 2. There were no significant differences between the preoperative and postoperative GMFCS levels ($p = 0.052$). Positive correlations were found between the preoperative GMFCS-MI, the type of CP-MI respectively ($p = 0.001$, $p = 0.015$).
Conclusion: There was an improvement in preoperative complaints. GMFCS levels remained stable after surgery. Relief in symptoms was not consistent with the changes in GMFCS in children with cerebral palsy after hip reconstruction.
Level of evidence: Level IV, Therapeutic study.

Introduction

Hip displacement is one of the most common orthopedic problems in cerebral palsy (CP), and constitutes a management challenge for both orthopedic surgeons and the patients' caretakers. Hip displacement ranges from a silent subluxation to a painful hip dislocation, and when left untreated it negatively affects the quality of life and leads to problems in sitting, standing, and walking.[1,2] Therefore prompt diagnosis, close follow up, and preventive conservative and surgical management are necessary. Hip displacement is not affected by sex, and its rates may be as high as 75% depending on the level of neurologic involvement and walking ability. The incidence of hip instability in non-ambulatory patients is higher compared to ambulatory patients.[3]

Gross motor function in children with cerebral palsy is assessed using Gross Motor Function Classification System (GMFCS). In this system, level I shows the highest function, and level V shows the lowest.[4] The risk of hip displacement in patients at Level V on GMFCS is 2.5–3 times greater than those patients who are at Levels III–IV. Thus, the risk of hip dislocation increases as motor capacity decreases.[5,6] It is reported that while GMFCS remains constant during childhood, it may change by interventional methods.[7,8] On the other hand, when displacement increases in a child who is ambulatory or who can sit without support, a vicious cycle may occur when an increase in hip displacement leads to a decrease in functional capacity. Breaking this cycle may provide a change in the functional capacity. This condition brings to mind how the motor ability will be affected after surgery in patients suffering from the frequently encountered hip displacement. The aim of the study was

* *Corresponding author.* Adnan Menderes University, Faculty of Medicine, Department of Orthopedics and Traumatology, Kepez Mevkii 09100, Aydın, Turkey. Fax: +90 2562197163.
E-mail address: drmutlu79@hotmail.com (M. Cobanoglu).
Peer review under responsibility of Turkish Association of Orthopaedics and Traumatology.

https://doi.org/10.1016/j.aott.2017.11.001

Please cite this article in press as: Cobanoglu M, et al., The effect of hip reconstruction on gross motor function levels in children with cerebral palsy, Acta Orthop Traumatol Turc (2017), https://doi.org/10.1016/j.aott.2017.11.001

to investigate how the GMFCS would be affected by surgical procedures in patients with CP related hip displacement.

Materials and methods

A retrospective chart review of patients operated between 2003 and 2012 due to CP related hip dislocation or subluxation, was performed. The data were recorded by the same author. The follow-up time was at least 2 years per patient. The patients who continued to the clinical follow had long-term follow-up period. But the last follow-up time of the patients who did not apply for routine examination was accepted as the last visit time.

The patients were evaluated before the operation for sitting and walking ability, pressure sores, difficulty in perineal care, and the presence of hip pain. The pain was evaluated by talking to caretakers or patients having talking ability. The level of pain was assessed with presence of pain or no pain. The improvements in these symptoms after the operation were also assessed. Improvements in seating and walking were evaluated according to whether any walking assistance or wheelchair modifications were needed. Subluxation was defined as the lateral and superior displacement of the femoral head, and dislocation was defined as the lack of relationship between the acetabulum and femoral head. The displacement rate of the hip was assessed with Reimer's migration index (MI).[9] Hip subluxation was graded according to the magnitude of the migration index in the anteroposterior hip X ray, an index under 24% was accepted as hip under risk, between 25 and 39% as mildly subluxated hip, 40–59% as moderately subluxated hip, more than 60% as severely subluxated hip, and 100% as dislocated hip.[10]

Hip surgery consisted of proximal femoral varisation and derotation osteotomy (with or without open reduction), and combined surgery (open reduction proximal femoral osteotomy, Dega osteotomy, and combination of adductor–iliopsoas tenotomies (if required)). If only femoral osteotomies were indicated bilaterally, the osteotomies were performed simultaneously by two surgeons but if combined pelvic and femoral osteotomies were indicated bilaterally, there was at least 3 weeks between surgeries of both sides. A short leg cast with antirotational bar was applied for two weeks after the operation in patients who underwent proximal femoral osteotomy, while a hip spica cast was applied for six weeks in patients who underwent combined surgery. The surgical procedures other than the hip operations were also evaluated. Soft tissue operations, applied simultaneously with hip surgery or afterwards, consisted of soft tissue operations outside the hip (hamstring release, achilloplasty, vulpius).

Functional gains obtained from surgery were assessed by using GMFCS 6–12 years, before and after the operation[4] (Table 1). Postoperative GMFCS level and complaint status were assessed by a researcher who was identified as an independent observer and not part of the surgical team.

Statistics

Comparison of preoperative and postoperative GMFCS levels was performed with the Wilcoxon *T* test. Comparison of qualitative data was performed with the chi-square test. The relationships between MI versus preoperative GMFCS and type of CP were evaluated with the Spearman correlation test. Complementary statistics were reported as mean (standard deviation), minimum–maximum values and frequency. A p value below 0.05 as considered statistically significant.

Ethics

This retrospective clinical study was approved by the institutional review board (Number: 2015/668).

Results

There were 31 patients who were operated due to CP related hip dislocation or subluxation, one of these patients was excluded due to the death of the patient from an unknown cause. Thirty patients (45 hips) fulfilled the study criteria. There were 16 males and 14 females; mean age was 8.7 (5–18) years. Mean follow up was 57 (24–132) months. Based on the type of CP, 13 patients were children with diplegia, 2 were children with hemiplegia, and 15 were children with quadriplegia. Based on the severity of hip displacement, 7 hips were risky, 13 had mildly severe subluxation, 7 had moderately severe subluxation, 7 had severe subluxation, and 11 hips were dislocated. The demographic data of the patients are shown in Table 2.

Pelvic and femoral osteotomies were performed in 7 of the dislocated hips. In the remaining 4 hips the acetabular coverage was considered adequate and a proximal femoral osteotomy was applied. In subluxated hips, femoral osteotomies alone were performed in 19, pelvic and femoral osteotomies were applied together in 8. In 7 risky hips, only femoral osteotomies were performed. During the early postoperative period, superficial infection developed in four of the operated hips, and they were treated with tissue debridement and antibiotic therapy. During the late period one hip in one patient was reoperated for femoral nonunion, and recurrent dislocation developed in one hip of the another patient who refused to undergo another operation.

The distribution of the patients according to preoperative GMFCS are one patient level I (hemiplegia), four patients (one of hemiplegia, three of diplegia) level II, five patients (diplegia) level III, nine patients level IV (five diplegia, four quadriplegia), 11 patients (quadriplegia) level V.

There was a positive correlation between the preoperative GMFCS and MI ($p = 0.001$, $r = 0.596$). There was also a positive correlation between the type of CP and MI ($p = 0.015$, $r = 0.440$). The GMFCS levels remained constant in 20 of the patients, improved in 8, and deteriorated in 2. The difference between the preoperative and postoperative GMFCS levels was not statistically significant ($p = 0.052$).

Assessment of the relationship between the type of CP and the change in gross motor function levels showed improvement in 1 of the 2 patients with hemiplegia, 4 of the 13 patients with diplegia, and 3 of the 15 patients with quadriplegia. The levels remained constant in 11 of the patients with quadriplegia and 8 of the patients with diplegia. One patient with hemiplegia was at level 1 both before and after the operation.

Table 1
Gross motor function classification system.

Level I	Walks independently. Limitations in advanced gross motor abilities.
Level II	Walks without assistive devices. Experiences limitations when walking in public. Experiences difficulties when walking on uneven surfaces and in the crowd, and is unable to run or jump.
Level III	Walks with an assistive device (orthosis, walker, crutch). Limitations when walking in the crowd. Able to sit without support.
Level IV	Very limited ability to move independently, often carried by another in the public. Able to sit independently.
Level V	Have no means of independent mobility. Often unable to sit without support.

Please cite this article in press as: Cobanoglu M, et al., The effect of hip reconstruction on gross motor function levels in children with cerebral palsy, Acta Orthop Traumatol Turc (2017), https://doi.org/10.1016/j.aott.2017.11.001