



Percutaneous Adductor Release in Nonambulant Children with Cerebral Palsy

Ramji Lal Sahu¹

¹SMS & RI Sharda University, Uttar Pradesh, India.

ABSTRACT

Introduction: Adductor spasticity at hips is the main barrier in functional activities and rehabilitation of spastic cerebral palsy patients. The aim of this study is to evaluate the results of percutaneous adductor release under general anaesthesia.

Methods: From July 2005 to July 2010, 64 hips in 32 patients (19 males and 13 females) were recruited from outpatient department having adductor contracture at hips in cerebral palsy children. All children were operated under general anaesthesia. All children were followed for twenty-four months. The clinical results were evaluated radiologically, including measurement of CE-angle, AC-index and femoral head coverage and in terms of activity level of children.

Results: Of the thirty-two children, twenty-eight showed marked and immediate improvement. None of our children was functionally worse at follow-up. The CE-angle and femoral head coverage did not change significantly. The AC-index improved significantly ($P = 0.01$). The results were excellent in 12.5% children, good in 50%, fair in 25% and poor in 12.5%.

Conclusions: Bilateral mini-invasive adductor release can be an effective treatment for children suffering from adductor contracture refractory to nonoperative management and early adductor release can prevent subluxation and possibly the need for future bony procedure on the proximal femur and pelvis.

Keywords: *adductor contracture; cerebral palsy; minimal invasive procedure; percutaneous.*

INTRODUCTION

Hip displacement is thought to be common in children with cerebral palsy due to spasticity.^{1, 2} It is believed that this may result from the muscle imbalance that causes anomalous hip positions in adduction, flexion and internal rotation.³ The prevalence of this condition was found to be 80% in one study and it was more frequently seen in children who were non-walkers with quadriparetic conditions.⁴ The adducted position of the hip contributes towards the development of pelvic tilting and subsequent scoliosis.^{5, 6} Soft-tissue surgery

acts to prevent subluxation and dislocation of spastic hips.^{7, 8} However, there are doubts regarding the age, indications for the surgical procedures and the muscles involved, along with the postoperative management⁹ and the durability of the result obtained. The purpose of this prospective study was to evaluate the clinical and radiographic results of adductor

Correspondence: Dr. Ramji Lal Sahu, SMS & RI Sharda University, Uttar Pradesh, India. Email: drllsahu@gmail.com, Phone: +919871120703.

releases in children with cerebral palsy.

METHODS

This prospective study was carried out at Orthopaedics department of M. M. Medical College from July 2005 to July 2010. It was approved by institutional medical ethics committee. A total of 64 hips in 32 children (19 males and 13 females) with adductor contracture at hips in cerebral palsy admitted to our institute were included in present study. Thirteen children (40.62%) were female and nineteen children (59.36%) were male. A written informed consent was obtained from all the patients (by their parents). The patients were aged between two to 14 years with the mean age of 7.76 years. All the children with adductor deformity of the hip have been treated by percutaneous bilateral adductor-longus tenotomy. Age at surgery, follow-up, the degree of involvement of cerebral palsy and functional ability preoperatively and at follow-up were recorded. All children were followed for twenty-four months. All patients were evaluated radiologically, including measurements of CE-angle, AC-index and femoral head coverage.¹⁰ The criteria used to grade the final results in this series were as follows: (1) excellent: the patient could walk without braces or support; (2) good: the patient could walk with the aid of crutches or canes and long or short braces; (3) fair: the patient could walk with the aid of crutches or canes and long ad short braces; and (4) poor: the patient could not walk and required long braces with a pelvic band.

Operative technique: The patient is placed supine on the operating table with both limbs fully abducted and externally rotated. When the limbs are in this position, the adductor longus is under tension and so can be easily identified. After the usual skin preparation and draping, an incision is made on the anteromedial aspect of the thigh, beginning at the level of the pubis and extending distally along the line of the adductor longus. The muscle is severed close to its attachment to the pubis and is drawn aside until the adductor brevis is exposed. Postoperative fixation with the limb in wide abduction may or may not be necessary. In the infant, a Frejka pillow splint may be used to maintain abduction, and in the older child, plaster-of-Paris fixation or long braces with an adjustable spreader bar attached above the knees may be utilized for at least four weeks. For patients with the more severe adduction deformities, fixation in abduction at night by the use of the pillow splint or the long brace apparatus with a spreader bar is recommended for a further period of several months. Early initiation of a vigorous exercise program for the activation and strengthening of the hip abductor muscles is urged to restore muscle balance about the hips.¹¹

RESULTS

There were 32 children in this study, 19 children were male and 13 children were females. The children were aged 2 years to 14 years. All the children had bilateral adductor contracture at hip joint. The patients were divided in four groups according to their age for simplicity. Age group between 2-4 years, in this group there were five males and one female. Age group between 4-8 years, this group included six females and seven males. Age group between 8-12 years, this group consisted of three female and four males. Age group between 12-14 years, this group consisted of 3 female and 3 males (Table 1).

Table 1. Age and sex variations in study group (n = 32).

Age	Male	Female	Total
2-4	5	1	6
4-8	7	6	13
8-12	4	3	7
12-14	3	3	6
Total	19	13	32

Clinically all 32 children were classified as spastic. Twenty-two were paraplegics, 6 were quadriplegics and 4 were triplegics. Preoperatively 4 hips were dislocated, 22 hips subluxed and 6 were radiographically normal. None of our children was functionally worse at follow-up. At follow-up four hips remained dislocated and 3 subluxed, but 25 were considered normal. The functional ability improved in 2 quadriplegic children and 4 triplegics children who became independent sitters. In 22 paraplegics children the walking ability improved. The hip abductors were graded preoperatively on the basis of Lovett's system;¹² 0: gone, no contracture can be felt; I: trace, the muscle can be felt to tighten but no movement is produced; II: poor, the muscle can produce movement if it is not operating against gravity; III: fair, the muscle can produce movement when operating against gravity; and IV: good, the muscle can produce movement when operating against resistance as well as gravity. In this study the muscle were graded as 0 in four children, as I three children, as II in 18 children, as III in six children, and as IV in only one child. All children were followed for 24 months. . None was lost to follow-up. All children were evaluated radiologically, including measurements of CE-angle, AC-index and femoral head coverage. In six children between 2-4 years aged, preoperative/postoperative CE angle were

4/12 degree, AC index were 22/20 degree and femoral head coverage 63/74 %. In 13 children between 4-8 years aged, preoperative/postoperative CE angle were 13/10 degree, AC index were 27/19 degree and femoral head coverage 78/78 %. In seven children between 8-12 years aged, preoperative/postoperative CE angle

were 11/20 degree, AC index were 29/19 degree and femoral head coverage 72/77 %. In six children between 12-14 years aged, preoperative/postoperative CE angle were 31/24 degree, AC index were 18/14 degree and femoral head coverage 100/100 % (Table 2).

Table 2. Radiographic parameter (n = 32).

No of Patient & site	Age at surgery (years)	Follow-up (years)	CE-angle * (°)	AC-index * (°)	Femoral Head coverage * (%)
6 Bilateral	2-4	2 years	4/12	22/20	63/74
13 Bilateral	4-8	2 years	13/10	27/19	78/78
7 Bilateral	8-12	2 years	11/20	29/19	72/77
6 Bilateral	12-14	2 years	31/24	18/14	100/100

Preoperatively/Follow-up

Of the 32 children in this study, 28 showed marked and immediate improvement. This improvement became more apparent as the hip abductors showed increasing strength. Now children were walking with or without crutches instead of long braces with attached pelvic bands. The four children who did not improve postoperatively were again subjected to muscle testing and it was found that in these children lateral balance could not be established because of persistent flaccidity of the hip abductors. The four children were continued in the training programme wearing long braces with attached pelvic bands. The criteria used to grade the final results in this series were as follows: (1) excellent: the patient could walk without braces or support; (2) good: the patient could walk with the aid of crutches or canes and long or short braces; (3) fair: the patient could walk with the aid of crutches or canes and long or short braces; and (4) poor: the patient could not walk and required long braces with a pelvic band. The results were excellent in 12.5% children, good in 50%, fair in 25% and poor in 12.5%. (Table 3)

Table 3. Out come of results of Adductor tenotomy (n = 32).

Out comes	No	Percentage
Excellent	4	12.5%
Good	16	50%
fair	8	25%
Poor	4	12.5%

DISCUSSION

Preoperatively four hips were dislocated, 22 hips subluxed and six were radiographically normal. At follow-up four hips remained dislocated and 3 subluxed, but 25 were considered normal. The functional ability improved in two quadriplegic children and four triplics children who became independent sitters. In 22 paraplegics children the walking ability improved. Although the CE angle is an important radiographic indicator and has an adequate level of reliability and reproducibility in some cases, it may not reflect the true lateral coverage of the femoral head. Omeruglu et al,¹³ reported that the classic CE angle had nearly 1° less intra-observer and inter-observer variation than the refined CE angle. In this study, All children were evaluated radiologically, including measurements of CE-angle, AC-index and femoral head coverage. In six children between 2-4 years aged, preoperative/postoperative CE angle were 4/12 degree, AC index were 22/20 degree and femoral head coverage 63/74 %. In thirteen children between 4-8 years aged, preoperative/postoperative CE angle were 13/10 degree, AC index were 27/19 degree and femoral head coverage 78/78 %. In seven children between 8-12 years aged, preoperative/postoperative CE angle were 11/20 degree, AC index were 29/19 degree and femoral head coverage 72/77 %. In six children between 12-14 years aged, preoperative/postoperative CE angle were 31/24 degree, AC index were 18/14 degree and femoral head coverage 100/100 %. The effectiveness of adductor tenotomy has been examined by several authors.¹³⁻¹⁶ Usually, the patients compared had different ages, different pre-operative radiological status and different walking ability and this heterogeneity had a serious effect on recorded results. Sharrard et al.¹⁶ found that 75% of adductor tenotomies made the hips stable and reported that 48% of the patients were able to walk alone. Reimers¹⁵ believed that the stability was maintained or

improved in 57% of the hips with adductor tenotomy only. However, the walking ability of the 127 patients was not noted. Banks and Green¹⁴ reported on 27 hips with subluxation prior to operation and found that following adductor tenotomy and obturator neurectomy, 70% were either improved or unchanged. In severely involved patients, adductor tenotomy and obturator neurectomy was reported as satisfactory in 75% if done to prevent dislocation but that it failed to reduce subluxation or dislocation in 87% (69 of 79 hips).¹⁷ Of the 32 children in my study, twenty-eight showed marked and immediate improvement. This improvement became more apparent as the hip abductors showed increasing strength. Now children were walking with or without crutches instead of long braces with attached pelvic bands. Several authors have examined the relationship between the patient's age and the post-operative state of the hip. Some authors believe^{15,17,18} while others do not,^{19,20,21} that age at time of adductor tenotomy influences the outcome. Harris et al.²² examined the acetabular remodelling in congenital dislocation of the hip and found that a significant potential for remodelling remained up to the age of four years. Kalen and Bleck²³ took the view that surgery should be done before the age of five years and before definite skeletal changes, primarily acetabular dysplasia occur. Their successful cases were under five years of age and their failures averaged six years of age. Onimus et al.²⁴ reported that successful results occurred in 90% of patients under age four who had a pre-operative MP under 33%. I found that our children under six years of age had a significantly higher potential to obtain a better post-operative outcome than children over the age of six years. Howard et al.²⁵ stated that there was a strong correlation between the stability of the hip and the patient's ability to walk. In patients who did not bear weight on their lower limbs, subluxation of the femoral head was more likely. Cornell et al.¹⁹ documented that the pre-operative MP was a significant predictor of the outcome of adductor tenotomy. He reported that patients who had lower pre-operative MP had a much better functional and radiological status in the fifth post-operative year than those patients who had higher MP values. Cobelji et al.²⁶ and Vidal et al.¹⁸ stated that dislocation could be predicted by annual monitoring of the MP and that this could help when selecting the best treatment. They said that if the annual increase was only 1%, dislocation was not expected. Any increase from 1% to 4% per year requires regular checks every 3-6 months. They suggested that an operation was necessary when the MP was increasing by 4% or more per year for hips that were not dislocated or where there was subluxation. Kalen and Bleck²³ thought that soft-tissue surgery alone was often too inadequate for non-walkers. In their study, 41% of the patients needed further surgery

and there was radiographic evidence of progression of subluxation in 33%. In my study, ambulatory patients had better post-operative CE angles and AC index than non-ambulatory patients. The radiological state of the hips of those patients who were not able to walk deteriorated by more than 50% in the second post-operative year. Meanwhile, the operation prevented further subluxation of the hip in 75% of ambulatory patients. A recent study of 76 PSH hips in 41 CP spastic diplegic patients undergoing only adductor tenotomy found that, at three years, over half had developed radiographic progression in hip subluxation.²⁷ It is worth continuing post-operative follow-up examinations in the non-ambulatory group for several years, as this might give a better chance of finding the unsuccessful cases. Shore et al.²⁸ recently demonstrated that the success of preventative surgery for hip displacement is directly related to a patient's GMFCS level. In their study, the overall success rate at a mean follow up of 7 years was 32%. However, the success rate was predicted by GMFCS level, with a 94% at GMFCS II decreasing to 14% at GMFCS V. The Australian Standards of Care for Hip Surveillance in Children with Cerebral Palsy is the first consensus statement published on hip surveillance.²⁹ The conclusions from this consensus statement were for referral to an orthopedic surgeon when (1) the MP is greater than 30%, or (2) if the MP is unstable (changing 10° per year), or (3) if there is associated pain in the hip and (4) if other orthopedic conditions have been identified.²⁹ Identification of progressive hip displacement has limited value unless effective intervention is available.³⁰ Early identification and orthopedic intervention has been shown to alter treatment outcomes, reduce the number of reconstructive surgeries required, and avoid the need for salvage surgery.³¹ As a result, hip surveillance has become an integral part of evidence-based care for children with CP in many developed countries based on growing evidence supporting surveillance programs and their outcomes.³¹ A potential limitation of our study was the absence of a control group treated by a different modality.

CONCLUSIONS

After the analysis of this study we conclude that the soft-tissue surgery should be performed as early as possible, independent of age, sex, walking condition, type of spasticity, radiographic analysis, among patients with cerebral palsy who clinically present hip abduction less than 30 degrees, because of the benefits relating to walking, hygiene, pain relief and prevention and treatment of subluxation.

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