IJMA

International Journal of Medical Arts

Volume 7, Issue 3 (March 2025)

http://ijma.journals.ekb.eg/

P-ISSN: 2636-4174

E-ISSN: 2682-3780

Available online at Journal Website
https://ijma.journals.ekb.eg/
Main Subject [Orthopedic Surgery]

Original Article

Periacetabular Ganz Osteotomy in the Treatment of Adolescent Acetabular Dysplasia

Mahmoud Abdelaliem Elsayyad *; Salah Eldeen Abd-Elhamed Youssef; Osman Abd-Ellah Mohamed

Department of Orthopedic Surgery, Damietta Faculty of medicine, Al-Azhar University, Damietta, Egypt.

Article information

Received: 28-11-2023

Accepted: 15-02-2025

DOI: 10.21608/ijma.2025.251730.1879

*****Corresponding author

Email: dr.mahmoudelsayyad@gmail.com

Citation: Elsayyad MA, Youssef SEA, Mohamed OA. Periacetabular Ganz Osteotomy in the Treatment of Adolescent Acetabular Dysplasia. IJMA 2025 Mar; 7 [3]: 5525-5529. DOI: 10.21608/ijma.2025.251730.1879.

ABSTRACT

Background: Hip dysplasia is a hereditary, dynamic, mechanical condition that can harm the hip's structure. Abnormal hip anatomy leads to abnormal hip mechanical characteristics, which leads to more anatomical defects.

Aim of the work: This study aims to assess the clinical, functional and radiological results of periacetabular Ganz osteotomy in treatment of adolescent acetabular dysplasia.

Patients and methods: This prospective interventional single arm study included 20 patients suffered from acetabular dysplasia and submitted for periacetabular osteotomy at Al-Azhar university hospital in Damietta. The patients were evaluated radiologically and by using the Harris hip score [HHS] before and after operation.

Results: A statistically significant improvement was observed in acetabular index [AI], and Harris Hip Score [HHS] postoperatively [P < 0.001]. Complications were encountered in seven cases [35.0%]. Posterior column fracture occurred in two patients [10.0%], Lateral cutaneous nerve of the thigh dysesthesia was encountered in two patients early after surgery [10.0%], and Superficial wound infection occurred in one patient [5.0%].

Conclusion: The study found Ganz periacetabular osteotomy safe and effective for treating adolescent acetabular dysplasia, resulting in significant improvement in radiographic and functional results.

Keywords: Periacetabular Ganz Osteotomy; Adolescent Acetabular Dysplasia.

INTRODUCTION

Acetabular dysplasia is a chronic illness that results in pain, physical limitations, and secondary osteoarthritis. Acetabular deformity can hasten hip deterioration if it is not treated. It can also cause structural weakening, elevated joint reactive pressures, and mechanical overloading of the acetabular lip [1].

Regrettably, a delayed diagnosis was also frequent; it took an average of 61.5 months from the time symptoms appeared until acetabular dysplasia was formally diagnosed. A crucial part of the clinical assessment for young adult patients with acetabular dysplasia is accurate radiographic analysis [2]. The most popular method for assessing the severity of a hip subluxation is probably plain X-ray radiography [3]. Physical testing typically showed deficiencies of hip abduction, which were known to be the most vulnerable measure as contractures started to appear when laxity and tension continued to evolve [4].

Non-surgical options for treating acetabular dysplasia include physical therapy, weight loss, and activity restriction. However, if the surgery is needed to treat the hip dysplasia, the periacetabular osteotomy [PAO] offers a clear surgical benefits over previous surgical procedure treatment options [5].

The aim of this study is to assess the clinical, functional and radiological results of periacetabular Ganz osteotomy in treatment of adolescent acetabular dysplasia

PATIENT AND METHODS

This prospective interventional single arm study included 20 patients suffered from acetabular dysplasia and submitted for periacetabular osteotomy at Al-Azhar university hospital in Damietta. Our study followed the Helsinki declaration principals. Ethical approval was obtained from our institution. Informed written consent was obtained from every patient or from his parents before the recruitment. Children presenting with symptoms related to a hip problem, with no history of trauma or infection, were subjected to a plain neutral anteroposterior x-ray view. Those who fulfilled the inclusion and exclusion criteria were included in this study:

The Inclusion criteria were symptomatic severe acetabular dysplasia [Grade IV or V according to the Severin classification], minimal or no secondary osteoarthritis, young [less than thirty years], adequate congruency of the hip joint, adequate hip flexion [≥ 100°] and abduction [≥ 30°].

The Exclusion criteria were moderate to advanced secondary osteoarthritis, older age, major hip joint incongruity, obesity, major restriction of hip motion [hip flexion of < 100° or abduction of < 30°, unless a proximal femoral procedure is planned to address femoro-acetabular impingement], and major medical comorbidities or Patient noncompliance

Data collection:

A detailed pre-operative sheet was completed with special attention to age, height, and weight. General examination and local pelvic and lower limb examinations were done with a special attention to the presence of apparent limb length discrepancy, abnormal pelvic tilt, knee or foot deformities, abnormal proximal position of greater trochanter, and abnormal contour of the iliac crest.

Hip ROM was assessed and compared to the other side. Radiological examination was done including; Plain radiological assessment including AP, False profile view of the hip. CT with 3D reconstruction of the hip and pelvis, with distal femoral cut to measure proximal femoral version angle. MRI to exclude labral pathology. The degree of hip dysplasia was classified according to Severin classification [1].

Routine preoperative investigations were done including complete blood picture, prothrombin time and activity, International normalized Ratio [INR], renal and liver function tests, blood grouping and virology tests.

Surgical technique:

Pre-operative planning of the osteotomy was done based on the pre-operative measurements of the lateral and anterior CEA and the AI, to estimate the degree of fragment correction needed. CT evaluation was essential for better understanding and of the bony anatomy, the configuration, and the direction of the desired osteotomy cuts. Under general or spinal anesthesia, patients lie supine on a radiolucent operating table, permitting an intraoperative radiograph of the entire pelvis. The entire buttock and the proximal half of the thigh were sterilized and draped.

Modified Smith Petersen approach, as described by **Ganz *et al.*** [6], the first part of the dissection was done with the hip in extension; the incision, 15-20 cm in length, started at the iliac crest, towards the anterosuperior iliac spine and then continued longitudinally along the lateral aspect of the proximal thigh. Superficial dissection was carried out, care to avoid injury of the main branch of the lateral cutaneous nerve of the thigh, as it lies in this fatty tissue, within the sheath of the sartorius muscle. Then, the fascia of the tensor fascia lata was split.

The muscle belly of the tensor muscle was pulled laterally while the sartorius muscle was dissected and retracted medially. The anterior superior iliac spine was detached using a saw from lateral over l.5 cm and a depth of l cm. The origin of the sartorius and the inguinal ligament were reflected medially together with split ASIS. The origin of the tensor fascia lata muscle together with the origin of the external oblique muscle were lifted subperiosteally from the iliac crest. The dissection of the inner table of the iliac wing was continued strictly subperiosteal, down to the Linea terminalis.

Careful retraction of the structures medially was necessary to avoid lateral femoral cutaneous nerve injury. Flexion of the hip during this step helped to relax the anterior structures thus facilitating the medial retraction of the anterior structures. The outer and the anterior aspects of the pelvis, especially the supra-acetabular area, were exposed properly, the reflected head of the rectus was divided transversely close to the anterior inferior iliac spine and the direct head detached from the anterior inferior iliac spine. A well-developed iliocapsularis muscle [capsular part of the iliac muscle], was seen over the anterior joint capsule in some cases.

The dissection was completed distally in the interval between the iliocapsularis muscle and the capsule. This muscle was retracted medially to expose the anteroinferior part of the capsule. Then a large, curved pair of scissors with rounded ends was pushed along the anteroinferior capsule in a posterior direction directly in contact with the capsule until they reach the ischial ramus. The scissors tip slide to feel the medial and lateral edges of the ischial tuberosity. Care was taken to avoid injury of the obturator vessels medially by keeping the closed scissor tip in direct contact with the bone. The tendinous origins of the muscles at the lateral border of the ischial tuberosity offered a soft resistance to the palpating instrument, thus protecting it from sliding which may have caused injury to the sciatic nerve.

The periacetabular osteotomy was divided into five steps; The first step is the ischial cut. The second step is the Pubic ramus osteotomy. The third step is the supra-acetabular osteotomy. The fourth step is the retro-acetabular osteotomy. The fifth step is the fragment manipulation and fixation. **Postoperatively**, analgesics and broad-spectrum antibiotics for 28-72 hours were started, early passive range of motion within the first few days, and Partial weight bearing [toe touch with crutches] as tolerated for the first 4-6 weeks were done. Active abduction exercises after 4 weeks, and active flexion exercises after six weeks were also done. Full weight bearing and full active range of motion were started when radiographic evidence of healing appeared [usually after 8 -12 weeks].

Follow up x-rays were taken immediate postoperative then after 2 weeks, at 6 weeks, every 3 months in the first two years, then yearly, to measure and document the CEA and acetabular index. Clinical evaluation of the patient, especially hip ROM, was done routinely every follow-up visit. HHS questionnaire and the additive hip score were obtained and recorded at the 6-month follow-up visit. The patients were evaluated radiologically and by using the Harris hip score [HHS].

Statistical analysis: The collected data will be coded, processed and analyzed using SPSS program [Version 24] for windows. The results were represented in tabular and diagrammatic forms. Frequency and percentage were used for qualitative variables description and chi-square test was used for testing its association. Mean and standard deviation were used for quantitative variables description appropriate T tests will be used testing its association when normality is present. The differences were considered statistically significant when P. value was ≤ 0.05.

RESULTS

A total of 20 patients, presenting with acetabular dysplasia undergoing Ganz periacetabular osteotomy, were enrolled in our study.

Table [1] summarizes the basic demographic data of the entire cohort, including age, gender, body mass index [BMI], affected side, and Severin classification.

As regards the acetabular Index, the mean preoperative AI was 39.1 ± 3.79 degrees, ranging from 33 to 47 degrees. Postoperatively, the mean AI decreased to 9.2 ± 3.61 degrees, ranging from 3 to 14 degrees, which is considered a significant improvement [P < 0.001]. In addition, the Anterior Centre Edge Angle showed that, the mean preoperative ACEA was 11.7 ± 6.54 degrees, ranging from 4 to 23 degrees. Postoperatively, the mean ACEA increased to 32.5 ± 4.43 degrees, ranging from 25 to 40 degrees [P = 0.001]. In terms of Lateral Centre Edge Angle, the mean preoperative LCEA was 11.2 ± 2.29 degrees, ranging from 7 to 15 degrees. Postoperatively, the mean LCEA increased to 32.2 ± 4.10 degrees, ranging from 25 to 39 degrees [P = 0.001] **[Table 2].**

As regards the Harris Hip Score, the mean preoperative HHS was 52.9 ± 8.84, ranging from 41 to 68. Postoperatively, the mean HHS increased to 80.8 ± 6.23, ranging from 70 to 91. All patients had poor hip function preoperatively. Postoperatively, two [10.0%] patients had excellent hip function, 11 [55.0%] patients had good hip function, and seven [35.0%] patients had fair hip function. None reported poor hip function postoperatively **[Table 2]**.

PAO is a major complex procedure. Potential complications are numerous and have been well documented. In this study, complications were encountered in seven cases [35.0%]. Posterior column fracture occurred in two patients [10.0%], both occurred intraoperatively due to incidental extension of the ischial cut to the posterior column. No intra-operative steps were taken to manage this complication; however, weight bearing was strictly delayed until bony union was evident in these cases. This occurred after an average of eight weeks. This complication had no significant effect on the functional outcome. Lateral cutaneous nerve of the thigh dysesthesia was encountered in two patients early after surgery [10.0%]. Although it caused significant discomfort to the affected patients during the early follow-up period, it did not affect the final functional evaluation, as the condition subsided spontaneously within two months. Superficial wound infection occurred in one patient [5.0%], It was managed by daily dressings and broad-spectrum antibiotic and deep infection in one patient [5.0%] manifested by hotness, redness of the wound edges, and wound discharge, four days after surgery. The infection resolved within five days with no later sequalae.

Table [1]: Baseline Patient Data [N = 20]

Variables		Statistics [n=20]
Age [years	Mean±SD	14.9±2.2
	Min. – Max.	11- 19
Age grade [n,%]	Less than 14	5[25.0%]
	14-16	10[50.0%]
	More than 16	5[25.0%]
Gender [n,%]	Male	8[40.0%]
	Female	12 [60.0%]
BMI [kg/m^2**]**	Mean±SD	30.8±6.1
	Min. – Max.	22-40
BMI grade [n,%]	Average weight	3[15.0%]
	Overweight	6 [30.0%]
	Obese	11 [55.0%]
Affected side [n,%]	Right	7[35.0%]
	Left	13 [65.0%]
Severin Classification [n,%]	Class I	2[10.0%]
	Class II	8[40.0%]
	Class III	8[40.0%]
	Class IV	2[10.0%]

Table [2]: Comparison between pre- and post-operative values of Acetabular Index [AI], Anterior Centre Edge Angle [ACEA], Lateral Centre Edge Angle [LCEA] and Harris Hip Score [HHS] [N = 20]

		Preoperative	Postoperative	P value
AI degrees	Mean±SD	39.1±3.79	9.2±3.61	<0.001*
	Min. – Max.	33- 47	3-14	
ACEA, degrees	Mean±SD	11.7±6.54	32.5±4.43	<0.001*
	Min. – Max.	4-23	25-40	
LCEA, degrees	Mean±SD	11.2±2.29	32.2±4.10	<0.001*
	Min. – Max.	7-15	25-39	
HHS	Mean±SD	52.9±8.84	80.8±6.23	<0.001*
	Min. – Max.	41-68	70-91	

.

DISCUSSION

Regarding the demographic data of the studied patients, the current study showed that mean age of enrolled patients was 14.9 ± 2.2 years, ranging from 11 to 19 years. 50.0% have ages ranged from 14 to 16 years. Eight [40.0%] patients were males, while 12 [60.0%] were females. The male to female ratio in our study group was 1:1.5. On the other hand, the mean age is higher in most of other studies on PAO.

Ganz *et al*. [6], who published the first study on PAO in 1988, included 75 patients with a minimum of one-year follow-up. The mean age of the patients was 29 years, ranging from 12 to 56 years

The mean BMI of enrolled patients was 30.8 ± 6.1 kg/m2, ranging from 22 to 40 kg/m2. 55.0% were obese. The right hip was affected in seven [35.0%] patients, while the left hip was affected in 13 [65.0%] patients. Furthermore, Baseline Severin Classification revealed that two [10.0%] patients were classified as Severin class I, eight [40.0%] patients were classified as Severin class II, another eight [40.0%] patients were classified as Severin class III, and two [10.0%] were classified as Severin class IV.

Comparing our result with other studies published in the literature about the PAO, **Ganz *et al*.** [6], **Trousdale *et al*.** [7], **Trumble *et al*.** [8] reported a gross match, and there was a satisfactory correlation between it and our results.

It was noted that the functional results were better in younger age groups in the present study, however this was statistically insignificant. This might be related to the short-term follow-up and the fact that only patients younger than 18 years were included. The relatively better results in the younger age group in the present work may be related to multiple factors. Firstly, the faster wound healing and bony union after surgery. Secondly, performing the osteotomy and fragment manipulation is easier during the surgery. Nonetheless, the degree of preoperative secondary hip changes due to dysplasia is expected to be less in younger age group.

Regarding outcome, our results are comparable to the study of **Ganz *et al*.** [6], who reported that, the corrections were 31° for the vertical center edge angle of Wiberg and 26° for the corresponding angle of Lequesne.

Also, **Trousdale *et al*.** [7] demonstrated that there was an average improvement of 28° in the lateral center-edge angle of Wiberg, an average improvement of 26° in the anterior center-edge angle of Lequesne and an average improvement of 20° in acetabular roof obliquity.

In the study carried out by **Trumble *et al*.** [8], there was an average improvement of 23° in the lateral center-edge angle of Wiberg, an average improvement of 25° in the anterior center-edge angle of Lequesne and an average improvement of 17° in acetabular roof obliquity.

Clohisy *et al*. [9] showed that, there was an average improvement of 44.6° in the lateral center-edge angle of Wiberg, an average improvement of 51° in the anterior center-edge angle of Lequesne and an average improvement of 25.9° in acetabular roof obliquity.

In addition, **Park *et al*.** [10], reported that, the mean acetabular angle improved from 47.9° to 26.4°. The mean center-edge angle increased from 14.2° to 41°. The acetabular depth increased from 176 to 242.7. The mean femoral head coverage increased from 63.3 to 95.4%.

Furthermore, **Chen *et al*.** [11] reported that, the radiographic parameters postoperatively improved into the normal range, with an average improvement of 29.1° in the lateral center-edge angle of Wiberg and an average improvement of 27.4° in the anterior center-edge angle of Lequesne, whereas no progression was found from preoperative Tonnis osteoarthritis score.

Finally, **Sierra *et al*.** [12] reported that there was an average improvement of 31° in MHD [moderate hip dysplasia], 23° in SHD [severe hip dysplasia]in the lateral center-edge angle of Wiberg, an average improvement of 42° in MHD, 28° in SHD in the anterior center-edge angle of Lequesne and an average improvement of 5° in MHD, and an improvement of 12° in SHD in acetabular roof obliquity

Regarding Harris Hip Score [HHS], the mean preoperative HHS was 52.9 ± 8.84, ranging from 41 to 68. Postoperatively, the mean HHS increased to 80.8 ± 6.23, ranging from 70 to 91. There was a statistically significant improvement in HHS postoperatively [Paired sample t test, P < 0.001]. All patients had poor hip function preoperatively. Postoperatively, two [10.0%] patients had excellent hip function, 11 [55.0%] patients had good hip function, and seven [35.0%] patients had fair hip function. None reported poor hip function postoperatively. No major complications occurred.

Trousdale *et al*. [7] reported that the HHS improved from an average of 62 points [range: 33–95 points] preoperatively to an average of 86 points [range: 29–100 points] postoperatively to 89 points at the latest follow-up.

Clohisy *et al*. [9] showed that the average HHS improved from 73.4 points preoperatively to 91.3 points at the time of the latest follow-up, while **Park *et al*.** [10] reported that the mean HHS improved from 59.6 to 96.4 points.

In addition, **Chen *et al*.** [11] showed that, one hip had total hip replacement [THR] at the last follow-up, while **Sierra *et al*.** [12], reported that, the HHS improved significantly in both groups [mild hip dysplasia [MHD]: 52–92 and severe hip dysplasia [SHD]: [66–89].

As regards the incidence of complications, it was low in our study; we

reported 2 patients who had injury of lateral cutaneous nerve of the thigh, two patients had intraarticular osteotomy or post column involvement, heterotophic bone formation in one patient, one had superficial wound infection treated by antibiotics, and one had deep wound infection and wound debridement was done intraoperative.

Ganz *et al*. [6] showed that the complications included two intra-articular osteotomies, a femoral nerve palsy that resolved, one nonunion, and ectopic bone formation in four patients before the prophylactic use of indomethacin. Thirteen patients required screw removal, while **Trousdale *et al*.** [7], reported that complications reported were two DVTs, one symptomatic heterotopic ossification, one LFCN dysesthesias [requiring neurolysis], nine symptomatic hardware, 13 asymptomatic heterotopic ossifications, and two pubic nonunions [no surgery].

In the study by **Trumble *et al*.** [8], there were three arterial thromboses, two DVTs, two wound infections [required surgery], one loss of fixation after proximal femoral osteotomy [PFO], one pubic nonunion and intermittent entrapment of iliopsoas muscle, one impending iliac nonunion [bone grafting], five hematomas, one femoral vein laceration, one heterotopic ossification [excised], 31 symptomatic hardware, and 20 heterotopic ossifications [Brooker I–II, not excised]. However, **Clohisy *et al*.** [9], demonstrated that there was one loss of fixation [required open reduction internal fixation [ORIF]], one asymptomatic ischial nonunion, and two pubic nonunions.

In the study by **Park *et al*.** [10], there was a hematoma in two cases, temporary lateral femoral cutaneous nerve palsy in three cases, and superficial wound infection in one case.

In the study by **Chen *et al*.** [11], there was one hip that had THR at the last follow-up. In the study by **Sierra *et al*.** [12], two hips in the MHD group and 15 hips in the SHD group underwent future total hip arthroplasty [THA].

In our study we used the same parameters of other institutions performing the PAO for evaluation of the results of our patients postoperatively [LCEA, acetabular index and HHS]. Hence, we can easily compare our results on mid-term and long-term follow-up with them. The author acknowledge that this study does have several limitations. Firstly, the short-term follow-up of the included cases is one of the main limitations. Longer follow-up is substantial to monitor the effect of PAO regarding the development of femoro-acetabular impingement and hip arthrosis. Moreover, gait changes were not evaluated separately in this study, as such changes would be more evident on the long term.

The radiographic assessment of the coverage after PAO using AI and LCEA only may not be enough for accurate evaluation, a post-operative CT can provide better understanding and evaluation of the osteotomy coverage and the joint congruency. Harris hip score, which was used for functional evaluation in this study, is mainly subjective score, and can be influenced by many personal factors, such as the psychic status, activity levels before surgery and pain tolerance level. Thus, a satisfactory functional outcome does not necessarily reflect a similar objective outcome. Consequently, the radiological assessment was added to the evaluation tools. This additive score was considered necessary in the present study owing to the short term follow up and the small number of the studied cases, however, the additive score lacks validation.

In contrast, this study has some limitations, like any single-cohort study; there was a lack of comparison or control group in this case series' study. Without a truly randomized long-term study about the results of PAO in hip dysplasia, it would be difficult to compare outcomes of this technique with other various surgical techniques such as triple osteotomy [steel] or a rotational osteotomy.

Conclusion: In conclusion; the current study showed that Ganz periacetabular osteotomy was safe and effective procedure in the treatment of Adolescent Acetabular Dysplasia. Ganz periacetabular osteotomy resulted in significant improvement in all radiographic and functional results.

Financial and non-financial activities and relationships of interest: None.

References

1. Ali M, Malviya A. Complications and outcome after periacetabular osteotomy - influence of surgical approach. HIP Int. 2020; 30 [1]: 4-15. doi:10.1177/1120700019883244.

2. Kraeutler MJ, Ashwell ZR, Garabekyan T, Goodrich JA, Welton KL, Flug JA, et al. The Iliofemoral Line: A Radiographic Sign of Acetabular Dysplasia in the Adult Hip. Am J Sports Med. 2017; 45[11]:2493-500. doi:10.1177/0363546517714472.

3. Li C, Zhang X, Meng X, Pu L, Chen H, Su Y, et al. Treatment of symptomatic hip dysplasia by posterolateral small incision assisted Bernese periacetabular osteotomy. BMC Surg. 2022;22 [1]: 217. doi:10.1186/s12893-022-01670-4.

4. Nandhagopal T, De Cicco FL. Developmental Dysplasia of the Hip. StatPearls. 2023. PMID: 32809556.

5. Venkatadass K, Durga Prasad V, Al Ahmadi NMM, Rajasekaran S. Pelvic osteotomies in hip dysplasia: why, when and how? EFORT Open Rev. 2022;7[2]:153-63. doi:10.1530/EOR-21-0112.

6. Ganz R, Leunig M, Leunig-Ganz K, Harris WH. The Etiology of Osteoarthritis of the Hip. Clin Orthop Relat Res. 2008;466[2]: 264-72. doi:10.1007/s11999-007-0060-z.

7. Trousdale RT, Ekkernkamp A, Ganz R, Wallrichs SL. Periacetabular and intertrochanteric osteotomy for the treatment of osteoarthrosis in dysplastic hips. J Bone Joint Surg Am. 1995;77[1]:73-85. doi: 10.2106/00004623-199501000-00010..

8. Trumble SJ, Mayo KA, Mast JW. The periacetabular osteotomy. Minimum 2 year follow-up in more than 100 hips. Clin Orthop Relat Res. 1999; [363]:54-63. PMID: 10379308.

9. Clohisy JC, Barrett SE, Gordon JE, Delgado ED, Schoenecker PL. Periacetabular Osteotomy for the Treatment of Severe Acetabular Dysplasia. J Bone Joint Surg Am. 2005; 87[2]:254-9. doi:10.2106/JBJS.D.02093.

10. Park YS, Moon YW, Lim SJ, Park JC, Son MS. Short-Term Follow-up Results of Periacetabular Osteotomy for Hip Dysplasia. J Korean Hip Soc. 2009;21[2]:156. doi:10.5371/jkhs.2009.21.2.156.

11. Chen C, Wang T-M, Kuo KN. Pelvic Osteotomies for Developmental Dysplasia of the Hip. In: Developmental Diseases of the Hip - Diagnosis and Management. InTech; 2017. doi:10.5772/67161.

12. Sierra RJ, Potter GD, Novais EN, Trousdale RT. Successful outcomes at midterm follow-up of periacetabular osteotomy done for mild hip dysplasia. J Hip Surg. 2017; 1:167-172. doi: 1055/s-0038-1635102.

IJMA

International Journal of Medical Arts

Volume 7, Issue 3 (March 2025)

http://ijma.journals.ekb.eg/

P-ISSN: 2636-4174

E-ISSN: 2682-3780