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Comparative study between lateral shelf acetabuloplasty and combined procedure of lateral shelf acetabuloplasty with trochanteric epiphysiodesis in cases of Legg-Calves-Perthes disease — a retrospective study

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Legg-Calves-Perthes disease (LCPD) has a poor outcome leading to disability and early onset of osteoarthritis. Patient aged less than 8 years have usually good prognosis and are usually managed conservatively. The primary goal is to achieve spherical and congruent femoral head to reduce the chance of further subluxation of femoral head and secondary arthritis of the hip. Methods. The study aimed to analyze the radiological and functional outcomes of group-A (LSA) and group-B (LSA and trochanteric epiphysiodesis) in cases of LCPD. Our study retrospectively analyzed 80 patients (45 in Group-A and 35 in Group-B) between 2008 and 2018, 63 patients were boys and 17 patients were girls. Patients who did not respond to the conservative treatment over the course of 6 months and patients with Caterall type-II and III were taken into the study. Radiological parameters like Center edge angle, sharp angle, medial joint space distance, epiphysis height ratio, acetabular coverage, neck-shaft angle, articulo-trochanteric distance was noted for comparing radiological outcome. Results. Most of the patients in both the groups were Catterall-III — 66.25 % and Catterall-II — 33.75 %. According to Stulberg classification, excellent outcome was seen in 22.2 % of group A patients & 37.1 % of group B patients. Similarly, 15.5 % patients in Group A and 5.7 % patients in Group-B had bad outcome. Radiological and functional assessments were evaluated preoperatively and postoperatively till skeletal maturity which showed significant improvement in Group-B. 4 (8.8 %) patients in group-A and 3 (8.5 %) patients in group-B developed non-union & graft resorption was seen. Conclusions. Lateral shelf acetabuloplasty along with trochanteric epiphysiodesis helps in improving the neck shaft angle, gait, containment of subluxated head and maintains its congruity along with physiological remodeling. We recommend this combined procedure in cases of LCPD to counter the complications of early-onset arthritis and femoral head subluxation.

Важливим під час лікування хвороби Легга-Кальве-Пертеса (ХЛКП) є раннє виявлення захворювання, що дозволить зменшити ймовірність ускладнень. Пацієнти віком до 8 років зазвичай мають сприятливий прогноз і лікуються консервативно. Основною метою є досягнення сферичної та конгруентної головки стегнової кістки, щоб зменшити ймовірність подальшого її підвивиху та вторинного артриту стегна. Мета. Проаналізувати рентгенологічні та функціональні результати лікування дітей у разі ХЛКП. Методи. Проаналізовано 80 осіб (45 у групі А та 35 у В) у період з 2008 по 2018 р., 63 — хлопчики та 17 — дівчата. У дослідження ввійшли хворі, яким не допомогло консервативне лікування протягом 6 міс., а також із типом Caterall II і III. Визначено такі рентгенологічні параметри: центральний крайовий кут, гострий кут, відстань між суглобовою щілиною, співвідношення висоти епіфіза, кульшової западини, суглобово-кульшовий проміжок. Результати. Здебільшого в пацієнтів обох груп діагностовано Catterall-III — 66,25 % та Catterall-II — 33,75 %. Відповідно до класифікації Stulberg, відмінний результат після лікування спостерігався в 22,2 % випадків групи А та 37,1 % групи В. Рентгенологічні та функціональні оцінки порівнювалися до операції та після неї до досягнення зрілості скелета, що показало значуще покращення в групі В. У 4 (8,8 %) осіб у групі А та у 3 (8,5 %) у групі В розвинулося незрощення та резорбція трансплантата. Висновки. Ацетабулопластика латеральної зони разом із епіфізіодезом вертлюга допомагає покращити ходу, уникнути підвивиху головки стегнової кістки та балансує конгруентність разом із фізіологічним ремоделюванням. Ми рекомендуємо цю комбіновану процедуру у випадках ХЛКП для протидії ускладненням раннього артриту та підвивиху головки стегнової кістки. Ключові слова. Хвороба Легга-Кальве-Пертеса, ацетабулопластика бічної зони, епіфізіодез вертела.

Keywords. Legg-Calves-Perthes disease, lateral shelf acetabuloplasty, trochanteric epiphysiodesis

Introduction

Legg–Calve–Perthes disease (LCPD) is a deforming disease of early childhood. LCPD is idiopathic a vascular necrosis of the capital femoral epiphysis which acts as a precursor to early osteoarthritis of the hip. The annual incidence of LCPD that has been reported in India varies between 0.45 and 21 cases per 1,00,000 children. The incidence of involvement of both the hips ranges from 8 % to 24 % [1, 2]. Children less than 15 years of age are usually affected with a peak onset between 5 and 8 years [3]. It is more prevalent in boys as compared to girls [3]. In LCPD the physeal arrest of subcapital femoral physis results in a shorter femoral neck and the patients often exhibit trochanteric overgrowth. These two factors biomechanically cause Trendelenburg gait and limping [4].

Growth of the greater trochanter is not impaired as compared to physeal arrest due to the intact vascularisation by the metaphyseal vessels which is not affected by ischemia [5]. James McCarthy et al., in their study, specifically discussed the need to intervene to prevent trochanteric overgrowth before 8 years of agewhich is more efficacious as compared to more than 8 years of age [6].

The foremost goal in the treatment of LCPD, whether it is conservative or surgical is to obtain a spherical femoral head with acceptable congruency which reduces the risk of femoral head subluxation and onset of early osteoarthritis after skeletal maturity. Patients aged less than 8 years and with early detection of symptoms are usually treated by non-operative treatment such as bed rest, immobilization, non-weight bearing, traction, spica casting, and bracing [3]. Caterall reported poor outcomes in more than 50 % of cases aged > 8 years who were managed conservatively [7].

Patients, where the conservative management fails and present with the delayed onset of symptoms are managed by a surgical procedures like LSA, pelvic osteotomy (Salter's innominate osteotomy, Chiari's osteotomy), femoral Varus osteotomy, and combined osteotomy [7]. Recent studies have shown promising functional and radiological results with triple osteotomy [31].

Mild or moderate deformities of the femoral head are usually managed by redirection osteotomies of the pelvis. The concept of Varus osteotomy of the femur with or without derotation is to decrease the pressure over the femoral head and to increase the blood flow to the capital femoral epiphysis [8]. LSA and Chiari's Osteotomy are usually indicated where redirection osteotomy is insufficient to produce optimal coverage of the extruded femoral head [8]. Studies have shown that following Chiari Osteotomy, patients develop abductor muscle weakness and mechanical advantage of the hip is lost due to proximal and medial migration of the hip following osteotomy. Also, the rate of graft resorption is very high in cases of LCPD undergoing Chiari Osteotomy as reported by Karami et al.

LSA has shown promising results in the previous studies that were reported in terms of reduction in pain, limping, improvement in the containment area of the femoral head, reduced subluxation, and delay in the onset of early osteoarthritis [3, 7–9]. Recently, Muhammad Mobushir et al. in their study concluded that LSA has better results than non-operative treatment and other operative procedures in patients over 8 years of age at onset of he disease [32].

Studies related to trochantericepiphysiodesis conducted in the past reported that the procedure should be done in children aged less than 8 years [4, 6]. Von Tongel et al. also concluded that the epiphysiodesis procedure will be maximum effective if the child's age is less than 8 years. After 8 years of age, epiphysiodesis can no longer reduce the overgrowth [4].

There has been only one study documenting the combination of LSA and epiphysiodesis for the treatment of the LCPD simultaneously and in a different sitting [4]. This study aimed to interpret the radiological and functional outcome and compare with LSA group with LSA and the trochanteric epiphysiodesis group in the cases of LCPD.

Material and methods

From 2008 to 2018, a total of 80 patients aged between 7 years to 12 years who were diagnosed with LCPD in SVNIRTAR were taken into the study after retrospective analysis. Patients were divided into two groups — A and B. Group A consisted of participants undergoing LSA and Group B consisted of participants undergoing both LSA and Trochanteric epiphysiodesis simultaneously. Participants were randomized into both groups after meeting the inclusion criteria. Out of these 80 patients, 63 were boys and 17 were girls. In these 80 patients, 42 participants had involvement of the right hip, 33 patients of the left hip, and 5 had bilateral hip involvement.

After obtaining informed consent from parents or guardians, patients were admitted withinclusion criteria of:

– I — patients who didn't respond to conservative treatment over 6 months with Waldenstrom stages of 2 and 3;

– II — caterall type-II,and III;

– III — herring type-B and type-C;

– IV — having Trendelenburg gait and limping.

Patients who were previously treated surgically, age less than 7 years, Caterall type-I and IV, Herring type-Awerenot includedin the study. The age at the onset of signs, the patient's sex, side of involvement, and the age at the time of surgery was documented. Pre-operative anteroposterior radiographs were used for the staging of the disease using Herringand Caterall classifications [15].

Radiographic assessment (Both preoperative and postoperative radiographs) was done with the help of the following parameters:

– CE (center edge) angle;
– sharp angle;
– medial joint space distance (M2/M1);
– epiphysis height ratio of the operated hip to non-operated hip (R1/R2);
– percentage of acetabular coverage;
– neck-shaft angle;
– articulo-trochanteric distance.

Functional assessment was done based on:

– active and Passive range of motion;
– presence of pain and limp;
– presence of Trendelenburg gait;
– limb length discrepancy;
– stulberg outcome grading at skeletal maturity [15].

Surgical technique

Lateral shelf acetabuloplasty

The patient was placed in a supine position with a sandbag placed beneaththe ipsilateralbuttocks. A bikini curve incision was given below the iliac crest, around 1.5 cm below the ASIS. Adductor tenotomy was performed in all our cases as the first surgical procedure. The reflected tendon of the rectus femoris was divided fromthe direct portion in the joint capsule and dissected posteriorly. Fractional lengthening of Iliopsoas at pelvic brim was done. The glutei were stripped from theouter table of the ilium.

The curvilinear slot was made above the subchondral bone of the anterolateral aspect of the acetabulum in an ascending direction from lateral to medial and from distal to proximal measuring about 3.5–4 cm in length, 3–4 mm in height, and 1.5–2 cm in depth. Thin strips of cortico-cancellous bone grafts harvested from the lateral aspect of the ilium were placed in the slot extending over the capsule with extrusion of 1.5–2 cms. The remaining cancellous grafts were packed above the previous grafts.

The reflected head of the rectus femoris was sutured back to the direct head and put on harvested graft, keeping 5–6 mm of the lateral most aspect exposed. The periosteum and glutei were closed to maintain the grafts in place.

Trochanteric epiphysiodesis

Epiphysiodesis of the greater trochanter was performed percutaneously by drilling five to six holes in the greater trochanteric epiphysisand then one or two cannulated cancellous screws were placed under the image intensifier.

All patients were in the hospital for 10 days until the suture removal was done asthe patients were mostly tribal people who had come from far off places with limited medical care. To give proper medical care till suture removal and good rehabilitation, patients were made to stay till 10 days.

Following this, a Boot and bar castwas worn for 6 weeks. Non-weight bearing mobilization with the help of crutches was promoted after 6 weeks and full weight-bearing was allowed after 12 weeks. Patients were followed up at 6 weeks, 3 months, 6 months, 12 months, and yearly there after till skeletal maturity was attained. Radiographic and functional data were documented and analyzed between both the groupsfor statistical significance using a computer program- statistical package for social sciences (IBM SPSS for WINDOWS VERSION 20.0- CHICAGO, SPSS Inc.) and Microsoft excel 2008 edition. The p-value was evaluated usingthe student's t-test and p-values between preoperative and postoperative values were analyzed by Wilcoxon signed-rank t-test. A value < 0.05 was considered significant.

Results

In our study, the mean age of onset of disease and symptoms was around (7.6 ± 1) year, and the mean age at which the surgery was done around (9.4 ± 2.4) years.

In the case of Group-A, we had 23 (51.1 %) Herring grade-B and 22 (48.9 %) Herring grade-C patients whereas, in Group-B, we had 20 (57.1 %) Herring Grade-B and 15 (42.9 %) Herring grade-C patients. Both group A and B patients were further classified in Caterall classification wherein, Group-A, we had 22 (48.9 %) patients in Caterall-II and 23 (51.1 %) patients in Caterall-III. In the case of Group-B, we had 21 (60 %) patients in Caterall-II and 14 (40 %) patients in Caterall-III.

Non-weight-bearing was started in nearly 6 weeks and full weight-bearing was started after a mean period of 11.7 weeks in the majority of the cases. Squatting and Sitting cross-legged maneuvers were started in the meantime period of 12.7 weeks. Radiological parameters were statistically significant indicating an improvement in the spherical remodeling of the femoral head.

Patients were then subsequently reviewed for the follow-up at 6 weeks, 3 months, 6 months, 1 year, and yearly thereafter till attainment of skeletal maturity. The mean time of radiological Union of the shelf was (12.9 ± 1.1) months. In 4 (8.8 %) cases in group-A and 3 (8.5 %) cases in group-B there was non-union & graft resorption was seen. At the time of the final follow-up, the patients had an improved range of motion clinically (Fig. 3, 5). The functional outcome of Group-A has been depicted in table-1 and Group-B in Table-2.

There was a significant improvement in the radiological parameters of Group A and B which has been depicted in Table 3 and 4.

In our study at the end of follow-up which was when the child attained skeletal maturity, we had 10 (22.2 %) Stulberg class-I, 15 (33.3 %) Stulberg class- II, 13 (28.8 %) Stulberg class-III, and 7 (15.5 %) Stulberg class-IV in Group-A whereas in Group-B we had 13 (37.1 %) Stulberg class-I, 12 (34.2 %) Stulberg class-II, 8 (22.8 %) Stulberg class-III, and 2 (5.7 %) Stulberg class-IV as the functional outcome.

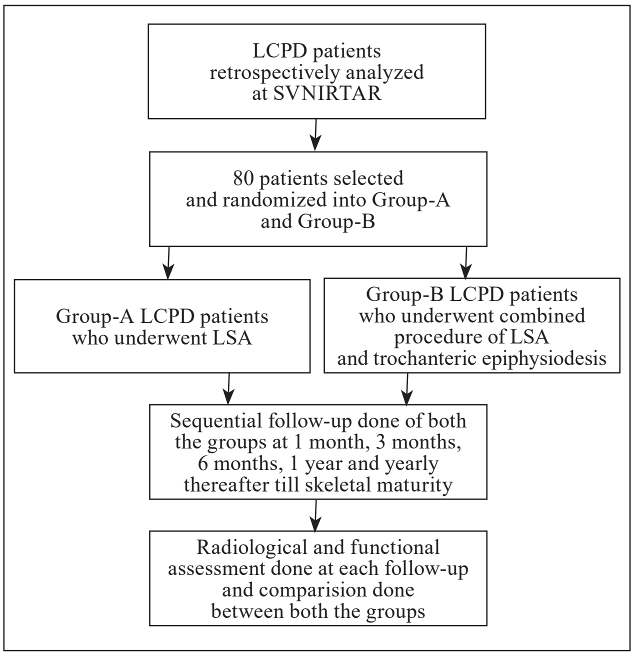

Fig. 1. Flowchart depicting the treatment algorithm and management protocol undertaken for the study

Table 1

Depicting the functional assessment of the Group-A before and after surgery

Functional assessment	Preoperative	Postoperative follow-up at 6 months	Follow-up at 1 year	Follow-up at 2 years	Final follow-up at skeletal maturity
Flexion (passive-in degrees)	66.8 (50–75)	68.3 (60–85)	70.2 (65–85)	71.1 (65–90)	82.7 (70–90)
Extension(passive-in degrees)	13.5 (5–20)	15.4 (10–20)	15.5 (10–20)	16.4 (10–20)	18.0 (10–20)
Abduction (passive-in degrees)	20.1 (10–25)	28.4 (15–30)	30.1 (15–35)	32.2 (15–35)	38.1 (15–40)
Adduction (passive-in degrees)	21.4 (15–25)	19.7 (10–30)	20.1 (15–30)	20.7 (15–30)	22.7 (15–35)
Internal rotation (passive-in degrees)	11.0 (8–15)	12.1 (10–20)	16.8 (10–20)	17.4 (10–25)	18.8 (15–25)
External rotation (passive-in degrees)	21.4 (20–35)	25.8 (25–30)	27.3 (20–35)	28 (25–35)	28.3 (25–35)
Limp (present)	45	8	8	6	5
VAS (0–10)	6.9 (6–8)	6.5 (3–8)	5.7 (3–9)	5.4 (2–9)	5.3 (2–8)
Trendelenburg gait (present)	50	7	5	4	4
Limb length discrepancy (in cms)	3.3 (2–4)	0.9 (0–2)	0.9 (0–2)	0.9 (0–2)	0.9 (0–2)

Table 2

Depicting the functional assessment of Group-B patients before and after surgery

Functional assessment	Preoperative	Postoperative follow-up at 6 months	Follow-up at 1 year	Follow-up at 2 years	Final follow-up at skeletal maturity
Flexion (passive-in degrees)	62.8 (50–75)	67.3 (55–85)	70.8 (60–85)	75.0 (60–90)	82.7 (70–95)
Extension(passive-in degrees)	10.5 (5–20)	13.4 (10–20)	15.5 (10–25)	17.2 (10–25)	18.0 (15–25)
Abduction (passive-in degrees)	18.4 (10–20)	27.4 (15–35)	30.0 (15–35)	32.3 (15–35)	38.4 (15–40)
Adduction (passive-in degrees)	18.4 (10–20)	19.2 (10–30)	20.2 (15–30)	21.0 (15–30)	22.8 (15–35)
Internal rotation (passive-in degrees)	11.8 (5–15)	12.5 (10–20)	16.4 (10–20)	18.4 (10–25)	22.8 (15–25)
External rotation (passive-in degrees)	20.4 (10–35)	23.8 (20–30)	26.3 (20–30)	28.0 (25–35)	29.3 (25–35)
Limp (present)	38	6	4	4	3
VAS (0–10)	7.4 (6–8)	6.0 (3–8)	5.4 (3–9)	5.0 (2–9)	4.9 (2–9)
Trendelenburg gait (present)	48	6	5	3	2
Limb length discrepancy (in cms)	3.4 (2–4)	1.0 (0–2)	1.0 (0–2)	0.8 (0–2)	0.5 (0–2)

Table 3

Depicting the radiological assessment of the Group-A before and after the surgery

Radiological parameter	Preoperative	Postoperative follow-up at 6 months	Follow-up at 1 year	Follow-up at 2 years	Final follow-up at skeletal maturity
CE angle (in degrees)	18.0 (15–30)	22.4 (20–36)	28.6 (22–38)	32.4 (24–40)	33.3 (25–40)
Sharp angle (in degrees)	48.8 (33–54)	47.2 (34–56)	46.0 (42–56)	43.1 (39–48)	35.7 (39–42)
Medial joint space ratio	160.2 (128–175)	143.4 (115–168)	138.4 (113–158)	127.9 (106–136)	118.5 (102–128)
Epiphysis height ratio	62.9 (54–76)	78.9 (68–90)	80.2 (68–90)	81.4 (68–90)	82.3 (79–95)
Acetabular coverage (% / age)	74.4 / (63–96)	116.1 / (90–120)	114.6 / (90–124)	115.2 / (90–126)	118.4 / (101–127)
Neck-shaft angle (in degrees)	120.3 (113–123)	122.3 (116–128)	122.8 (116–130)	123.1 (116–131)	126.2 (123–140)
Articulo-trochanteric distance (in mm)	16.8 (13–20)	17.1 (13–20)	17.0 (12–20)	17.8 (13–19)	17.9 (16–19)

Table 4

Depicting the radiological assessment of Group B before and after the surgery

Radiological parameter	Preoperative	Postoperative follow-up at 6 months	Follow-up at 1 year	Follow-up at 2 years	Final follow-up at skeletal maturity
CE angle (in degrees)	19.4 (16–30)	20.3 (19–25)	25.5 (19–26)	33.9 (20–35)	36.2 (26–38)
Sharp angle (in degrees)	42.3 (36–54)	41.9 (33–57)	40.3 (33–56)	39.3 (33–48)	35.3 (33–38)
Medial joint space ratio	164.3 (125–175)	149 (120–162)	136.8 (115–158)	123.8 (105–146)	113.2 (104–130)
Epiphysis height ratio	61.4 (54–76)	81.0 (75–87)	84.1 (76–91)	87.0 (79–95)	87.5 (80–95)
Acetabular coverage (% / age)	74.1 / (63–96)	110.6 / (101–125)	111.9 / (103–126)	115.9 / (103–128)	113.6 / (104–130)
Neck-shaft angle (in degrees)	120.5 (118–123)	125.4 (122–128)	128.0 (123–136)	130.2 (123–139)	130.3 (125–140)
Articulo-trochanteric distance (in mm)	17.9 (15–22)	20.0 (16–23)	21.5 (16–28)	19.2 (16–29)	19.6 (16–30)

Table 5

Depicting the final follow-up results of the radiological assessment between Group-A and Group-B

Radiological parameter	Final follow-up at skeletal maturity (Group-A) n=45	Final follow-up at skeletal maturity (Group-B) n=35
CE angle (in degrees)	33.3	36.2
Sharp angle (in degrees)	35.7	35.3
Medial joint space ratio	118.5	113.2
Epiphysis height ratio	82.3	87.5
Acetabular coverage (%)	118.4	113.6
Neck-shaft angle (in degrees)	126.2	130.3
Articulo-trochanteric distance (in mm)	17.9	19.6

Discussion

Our study has focused on the comparison between cases of Legg–Calve–Perthes disease which were treated by LSA in one group and in another group that was treated with both LSA and trochanteric epiphysiodesis simultaneously.

Studies that were performed in the past had already stated that LCPD patients of Caterall type-II and III if not managed at the appropriate time can lead to poor prognosis and disastrous outcome in terms of femoral head subluxation and early-onset osteoarthritis [10]. Stulberg et al documented that unless properly treated, 100 % of children older than 9 years developed poor outcomes, but Herring et al lowered that age to 8 years and Joseph to 7 years [11]. Our study included 7–12 years of age children.

In our study, we had significant improvement in the radiological and functional outcome which corroborated with similar studies.Acetabular coverage in our study significantly increased from (74.1 ± 6.8) % to (115.9 ± 6.3) % at the end of a two-year follow-up and (113.6 ± 6.5) % at the end of skeletal maturity in the Group-B; which was similar to other studies [7, 9, 12]. In case of Group-A, change in the acetabular coverage wasn't that much evident with preoperative values of (74.4 ± 2.9) % and at the end of final follow-up, the values were (118.4 ± 3.2) %.

We had a significantimprovement in the CE angle and a decrease in the Sharp angle along with a decrease in medial joint space ratio which all corroborated with the previous studies in both the groups [7, 9, 13, 14], while there was an improvement in both the groups, Group-B patients, showed better results in terms of radiological assessment and clinical assessment. In our study, patients started full weight-bearing, sitting cross-legged and squatting by a mean period of 11.7, 12.7, and 12.7 weeks respectively which corroborated with the previous study [7]. In our study the outcome was categorized according to Stulberg classification wherein class-1 was an excellent outcome, class-2 was a good outcome and class-3 was a fair outcome. Class-4 and 5 were regarded as a poor outcome [15].

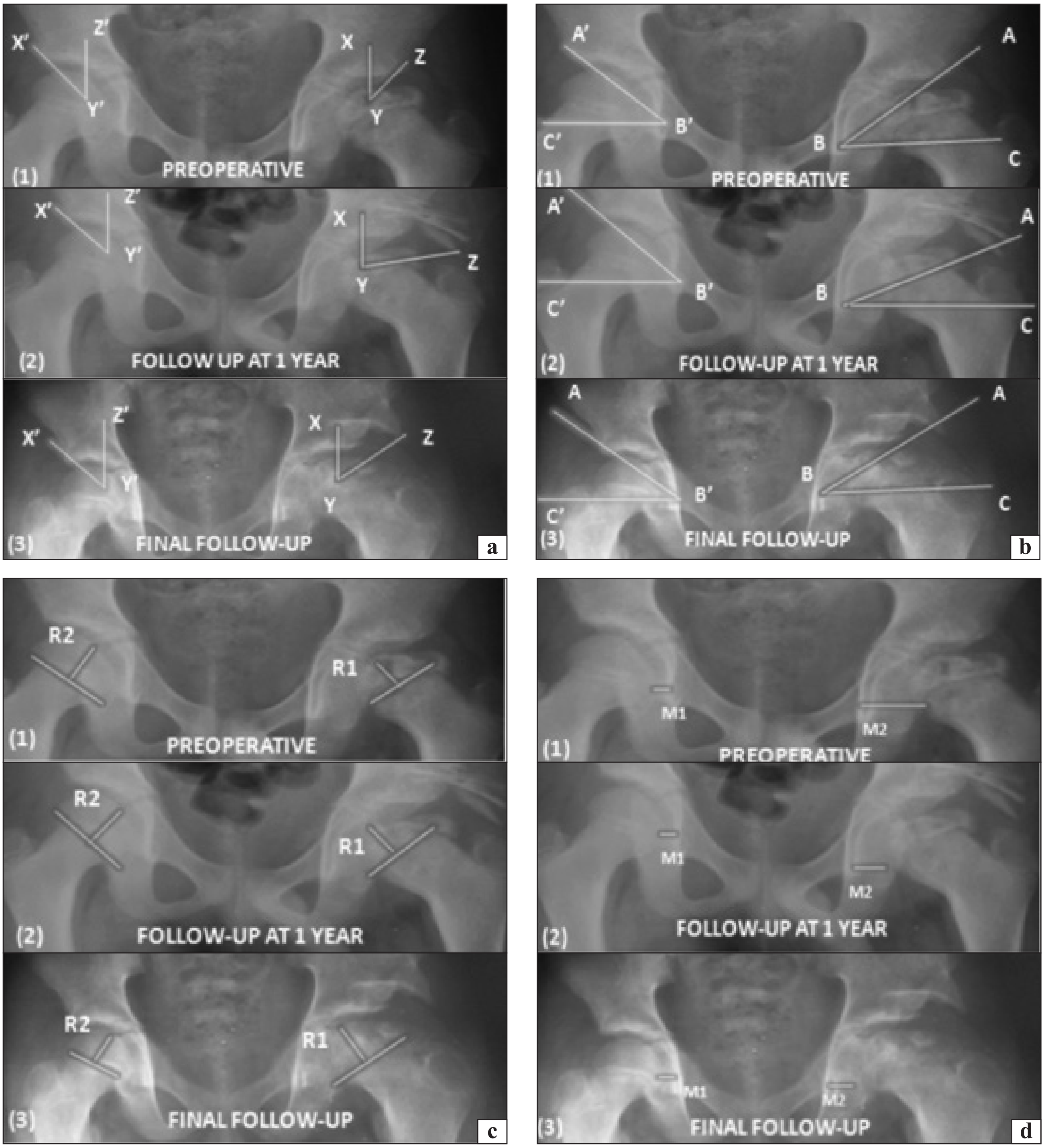

Fig. 2. Depicting the initial radiological assessment of the Group-A along with sequential follow-up: a) (I) CE angle — XYZ; b) (II) sharp angle — ABC; c) epiphysis height ratio; d) medial joint space ratio

Fig. 3. Depicts the squatting and sitting cross-legged position of the patient from Group-A at the final follow-up

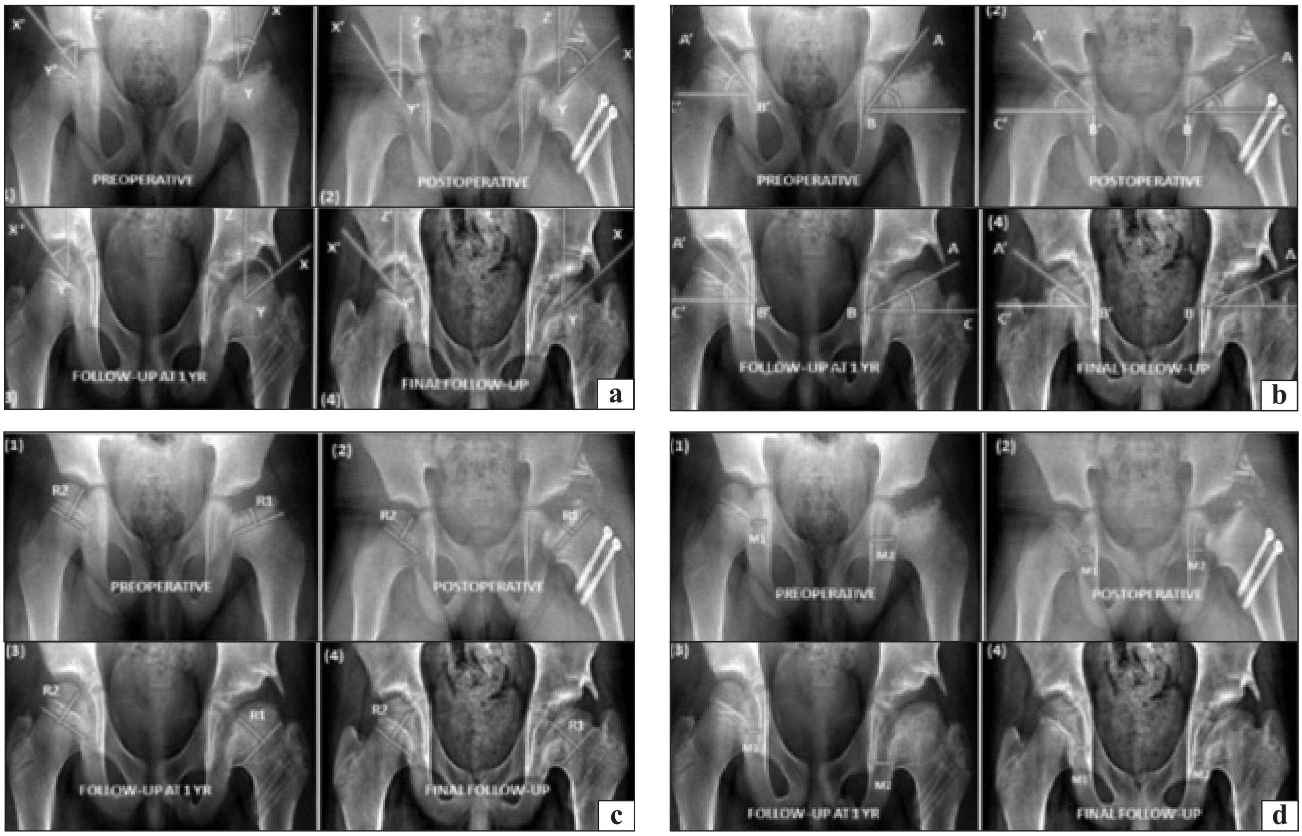

Fig. 4. Shows the preoperative and postoperative radiographical analysis of the Group-B: a) (I) CE angle — XYZ; b) (II) sharp angle — ABC; c) (III) epiphysis height ratio (R1/R2); d) (IV) medial joint space ratio (M2/M1)

Group-A showed excellent outcomes in 22.2 % of patients while Group-B showed excellent outcomes in 37.1 % of patients. In terms of a bad outcome, Group-A had 15.5 % patients and Group-B had 5.7 % patients according to Stulberg charting. In our study, we had 4 (8.8 %) cases in Group-A and 3 (8.5 %) cases in Group-B with graft resorption which was seen after 18 months of follow-up [3, 7, 8].

The presence of epiphyseal extrusion in the course of Perthes is an ominous sign and one of the contributing factors for that is Iliopsoas [16]. We had released Iliopsoas during the containment procedure which helped in improving the post-operative range of motion and reducing the hip irritability as mentioned in the Muratli et al. series [17]. We had done adductor releases in all our cases to overcome restricted abduction [8, 18, 19].

A study by Stulberg et al. reported that children over ten years of age had the worst outcome developing 'a square peg in a round hole' because of the failure of the acetabulum to remodel to the flattened femoral head [20]. But our study showed that there was a stimulation of lateral acetabular epiphysis contributing to the containment of the deformed femoral head which was similar to the previous study [12, 19, 21]. In our study, we found better femoral head sphericity and remodeling in younger children as compared with children older than 9 years which was similar to the study by Aksoy et al. [22].

Fig. 5. Depicts sitting cross-legged and squatting position of the patient from Group-B at the final follow-up

Though the results would not have been similar if the child wouldn't have undergone salvage surgery irrespective of age. Similar results were reported for femoral Varus osteotomy in older children by Friedlander et al. and Terjesen et al. [23, 24]. But femoral Varus osteotomy has its disadvantages like persisting coxa vara and shortening [25, 26].

Greater trochanter epiphysiodesis can arrest the growth of Greater trochanter (GT) by around 50 % as the growth of GT is divided equally between the superior portion of GT and metaphysis as was reported by McCarthy et al. [6].

To prevent the articulo-trochanteric distance from becoming negative, the procedure of the trochanteric epiphysiodesis is undertaken so that the trochanteric overgrowth doesn't result. The preferable age for epiphysiodesis is before 8 years as has been discussed by von Tongel et al. [4]. After the child has attained 8 years the trochanteric epiphysiodesis has its role only in cases of negative articulo-trochanteric distance. In our study, we had an effective stabilization of the articulo-trochanteric distance in children aged less than 8 years and more than 8 years. There was no evidence of progressive loss of ATD in Group-B [27].

Our study had used a modified Phemister technique that is multiple drill holes and screw fixation which is in corroboration to the previous study [28]. There have been very few studies documenting the combination of LSA and epiphysiodesis simultaneously. Von Tongel et al. had one such study which included the groups with simultaneous surgeries and groups with different timings of surgeries [4]. Compere et al. discussed the combination of trochanteric epiphysiodesis and other containment procedures like Femoral Varus osteotomy in cases of LCPD [28, 29].

Trochanteric epiphysiodesis as a single procedure improves neck-shaft angle and articulo-trochanteric distance but when both LSA and trochanteric epiphysiodesis are done simultaneously, it improves acetabular coverage of femoral head along with improved neck-shaft angle and articulo-trochanteric distance which in turn reduces limb length discrepancy and limping which might result if only LSA is done as a single procedure; which was observed in our study.

In our study, there wasn't much difference in neck-shaft angle and articulo-trochanteric distance change in children less than 8 years and those more than 8 years which was similar to the study by McCarthy et al. [6].

According to Matan et al.'s study, he has clinically and radiographically demonstrated that the effect of the epiphysiodesis is better in older children due to increased rate of inhibition probably due to increased growth during this time. So, technically doing trochanteric epiphysiodesis will be easier in older children which also corroborated with our study [30].

According to Pecquery et al.'s study, they started with early weight bearing in 19 children following shelf acetabuloplasty which resulted in good outcomes. In our cases too, we had achieved good clinical outcomes by early mobilization [34].

In our study, we have specifically looked out for complications such as graft resorption, proximal migration of the shelf, head deformation, and found that these complications can be reduced with proper surgical technique and timely follow-up [3, 8, 36, 37, 38].

Use of triple pelvic osteotomy is also a good choice of treatment in neglected and severe stages of perthes disease. Patients undergoing triple pelvic osteotomy have average hospital stay of 3.2 months which has been described by Vukasinovic et al. But patients who underwent Lateral shelf acetabuloplasty in our study stayed for maximum 2 weeks [35]. Seven domains comprising of Anger, Anxiety, Mobility, Pain, Fatigue, Depression, Interference, and Peer Relationships were used for Patient-related outcome measurement (PROMS) which gave quite satisfactory results in Group-B as compared to Group-A.

Major reported complications of LSA include graft resorption, proximal migration or growth disturbance of the lateral aspect of the acetabulum8. In our series,in 4 (8.8 %) patients in group-A and 3

(8.5 %) patients in Group-B there was non-union & graft resorption was seen. Other possible risks include intraoperative nerve and vessel injury, graft displacement, deep infection, hip joint stiffness. Simillarly, overcorrection & limb length discrepancy are the possible risks of trochanteric epiphysiodesis [33]. However, we need longer period of follow up & more extensive study to analyse these complications.

Our study had considered all the parameters of the radiological outcome, functional assessment, and Stulberg charting which showed that most of the hips following shelf surgery with epiphysiodesis in the age group of 7–12 years improved clinically and radiologically. They could have complicated further which would have been the result if they wouldn't have undergone surgeryand would have resulted in early arthritis of the hip. Our combined procedure acted as a containment procedure in cases where a phase of fragmentation was seen and as a salvage procedure where a phase of healing and re-ossification was seen. Epiphysiodesis as an added procedure helped in dealing witharticulo-trochanteric distance and limb length discrepancy.

Conclusion

LSA with trochanteric epiphysiodesis if done simultaneouslyin Caterall group II and III LCPD patients older than 7 years helps inimproving femoral head containment andallowing its biological remodeling, reducing the chance of subluxationalong with the improved neck-shaft angle, gait, and pain. The combined procedure of LSA with Trochanteric epiphysiodesis if done simultaneously can avoid the need for secondary surgery, the hospital stay is reduced, morbidity is decreased, and is cost-effective with comparable functional outcomes.

Ethics Approval. The study has been approve by IEC with the ethical letter no. Ref. № IMS SH /IEC/2008 /158.

Conflict of interest. The authors declare no conflict of interest.

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COMPARATIVE STUDY BETWEEN LATERAL SHELF ACETABULOPLASTY AND COMBINED PROCEDURE OF LATERAL SHELF ACETABULOPLASTY WITH TROCHANTERIC EPIPHYSIODESIS IN CASES OF LEGG-CALVES-PERTHES DISEASE — A RETROSPECTIVE STUDY

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