RADIOGRAPHIC ANALYSIS OF PROGNOSTIC FACTORS IN DDH TREATMENT AFTER WALKING AGE

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ABSTRACT

Objective: To evaluate the results of surgical treatment of Developmental Dysplasia of the Hip (DDH) treated in the walking age. Methods: We evaluated 33 hips in 30 patients operated between November of 1992 and September of 1997. The mean age was 4 years and 5 months at surgical period and the mean age at the last evaluation was 11 years and 7 months. The mean follow up time was 10 years and 2 months. We performed femoral shortening, open reduction and pelvic osteotomy (Salter or Chiari). Radiographic assessment considered: acetabular index; acetabular angle; Shenton's line; Hilgenreiner's line; the c/b, c/h, acetabulum-center and acetabulum-head ratios; the width of the triradiate cartilage; the trochanter and femoral head relationship; femoral head sphericity; Wiberg angle; avascular necrosis and leg length discrepancy. These parameters were measured and compared in pre-operative, early and late post-operative period. Results: After statistical analysis we observed a significant decrease in these parameters from pre-operative period to immediate post-operative period (p=0.0001) and those have not changed between the immediate post-operative period and late post-operative period (p=0.5958). Conclusion: By the classification used we observed 23 (69.70%) good, 5 (15.15%) regular and 5 (15.15%) poor results. None of these radiographic parameters were relevant to predicting final results.

Keywords: Hip dislocation, congenital. Osteotomy. Surgery. Radiography. Follow-up studies.

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INTRODUCTION

There is no doubt about the need for therapy in patients with Developmental Dysplasia of the Hip (DDH). However, there is still controversy regarding the best treatment methodology among the various existing protocols, both surgical and non-surgical.[1-6]

Those that support closed methods base their opinion on the occurrence of remodeling of the articular surfaces of the dislocated hip after the performance of reduction.[7,8] However, there are those that advocate the use of surgical treatment, as these allege that the anatomical alterations already established, especially in children over 18 months of age, could not determine satisfactory future results.

Among the advocates of surgical methods, we find authors that perform femoral surgeries with the intention of minimizing rates of necrosis of proximal femoral epiphysis, demonstrating good results with the use of this resource.[9-11]

Iliac osteotomies provide additional stabilization to open reduction, thus preventing re-dislocation and promoting adequate development of the hip.[12]

Therefore, we conducted this study in order to radiographically evaluate the hips of patients with Developmental Dysplasia of the Hip that underwent surgical treatment at our institution.

MATERIAL AND METHODS

Initially, the project of this survey was submitted to the evaluation of the Committee of Medical Ethics in Research of Universidade Federal de São Paulo under registration number 186/09 and approved for execution. Our study is comprised of 33 hips of 30 patients with inveterate congenital dislocations that underwent surgical treatment, between November 1992 and September 1997. In relation to gender, 29 of the patients were female and one male. As regards ethnic group, 23 were white and 7 not white. Of the 33 hips operated, 14 presented impairment of the right side and 19 of the left. Age ranged from 1 year and 8 months to 12 years and 4 months (mean age 4 years and 5 months) at the time of surgery. (Table 1)

Age in the performance of the radiographic assessment for the execution of this study ranged from 4 years to 24 years (mean age 11 years and 7 months). The follow-up time ranged from 2 years and 3 months to 18 years (mean time 10 years and 2 months).

All the authors declare that there is no potential conflict of interest referring to this article.

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Table 1 – *Data for the 33 hips according to the serial number, gender, color, age at the time of surgery, degree of dislocation, impairment and side treated.*

Number	Gender	Color	Age	Degree of dislocation	Side	Femoral shortening (mm)	Procedures
1	F	NW	5 to 3 m	III	L	30	FS + OR + MS
2	M	WH	2 to 9 m	II	L	30	FS + OR + MS
3	F	WH	4 to 5 m	II	L	40	FS + OR + MS
4	F	WH	2 to 4 m	II	L	30	FS + OR + MS
5	F	WH	2 to 4 m	III	L	39	FS + OR + S
6	F	WH	4 to 7 m	III	L	50	FS + OR + MS
7	F	WH	9 to 5 m	III	R	80	FS + OR + MS
8	F	WH	12 to 4 m	I	R	70	FS + OR + C
9	F	WH	4 to 10 m	III	L	40	FS + OR + MS
10	F	NW	1 to 8 m	III	R	30	FS + OR + S
11	F	WH	10 to 7 m	I	L	40	FS + OR + C
12	F	NW	2 to 6 m	III	R	55	FS + OR + S
13	F	NW	2 years	III	L	40	FS + OR + MS
14	F	NW	1 to 11 m	III	L	30	FS + OR + MS
15	F	WH	5 years	III	L	60	FS + OR + MS
16	F	NW	2 to 1 m	I	L	36	FS + OR + S
17	F	WH	2 to 10 m	III	R	40	FS + OR + MS
18	F	WH	7 to 2 m	III	R	76	FS + OR + MS
19	F	WH	8 years	III	L	70	FS + OR + MS
20	F	WH	2 to 1 m	I	R	30	FS + OR + S
21	F	WH	2 to 2m	III	R	30	FS + OR + S
22	F	NW	3 to 8 m	III	R	30	FS + OR + MS
23	F	WH	4 years	III	R	42	FS + OR + MS
24	F	WH	3 years	III	L	48	FS + OR + S
25	F	WH	3 to 10 m	III	R	55	FS + OR + MS
26	F	WH	8 to 6 m	I	R	65	FS + OR + C
27	F	WH	5 to 11m	III	L	60	FS + OR + S
28	F	WH	7 to 3 m	III	R	60	FS + OR + MS
29	F	NW	2 to 4 m	II	L	30	FS + OR + S
30	F	WH	3 to 2 m	III	L	43	FS + OR + S
31	F	NW	2 to 11 m	III	L	50	FS + OR + S
32	F	WH	2 to 3 m	III	L	30	FS + OR + MS
33	F	WH	2 to 4 m	II	R	30	FS + OR + MS

F = female, M = male, WH = white, NW = not white, L = left, R = right, FS = femoral shortening, OR = open reduction, S = Salter's osteotomy, MS = modified Salter osteotomy, C = Chiari surgery

SURGICAL METHODOLOGY

We started the surgery with femoral head ostectomy where the diaphyseal bone segment removed was 45.12mm on average (ranging from 30mm to 80mm) without the association of anti-rotation or femoral varization. We carried out osteosynthesis with a small fragment plate (with four or six holes) and cortical screws. After the open reduction of the dislocated hips, we performed the iliac osteotomy. We used Salter's osteotomy on 11 hips; performed modified Salter surgery[10] on 19; and Chiari surgery on 3. The pelvipodalic plaster cast was removed between six and eight weeks, on average, and the rehabilitation of the operated hip could be initiated under the supervision of physiotherapists. The threaded Kirschner wires employed for the fixation of the pelvic osteotomies were removed after radiographic observation of complete integration of the graft employed with the adjacent bone tissue. Walking with support was henceforth allowed.

Methodology for radiographic assessment

We took anteroposterior and Lauenstein radiographs of the pelvis at the following times:

- Preoperative period.
- Immediate postoperative period or upon removal of the pelvipodalic plaster cast.
- Late postoperative period, when the last evaluation was performed.

For the evaluation of results we used a classification developed at this institution that considers the parameters avascular necrosis, discrepancy of length between lower limbs, Wiberg angle and femoral head sphericity.

For qualification of the type of postsurgical necroses in the hips of the operated patients, we applied the classification described by Kalamchi and MacEwen[13] who divide the changes into four groups: group I – changes affecting the ossific nucleus; group II - lateral physeal damage; group III - central physeal damage; group IV - total damage to the head and the physis.

The total measurement of the lower limbs determining their length was performed by scanometry measuring the distance between the upper point of the femoral head and the medial malleolus on each one of the sides and leg length discrepancy was evaluated when present.

The measurements of the Wiberg angle were obtained by applying the author's original methodology, combining Mose's concentric circles with the technique. We then used the normal measurements of this variable, found by him, to compare them with the measurements obtained of the unaffected hips of the patients of this study. Values below 20° would not be considered normal, values between 20° and 25° would be considered borderline and above 25° normal.

The sphericity of proximal femoral epiphysis was evaluated with the aid of a ruler created for this purpose, with concentric circles, and variation between its radii of one millimeter, according to the principles of Mose.

We consider the radiographic result good when all the variables are within satisfactory limits, regular when satisfaction is not attained in a requisite, and unsatisfactory when at least two variables are altered. (Chart 1)

Chart 1 *– Radiographic classification of results according to the evaluation of the rates of avascular necrosis; the measurement, in degrees, of the Wiberg angle; sphericity verified by the application of Mose's concentric circles; and discrepancy between lower limbs, gauged in millimeters.*

Classification	Radiographic parameters			
	Necrosis	Wiberg Angle	Mose's Circles	Discrepancy
GOOD	0 – I	> 25°	0mm	< 20mm
REGULAR	II – III	Between 20° and 25°	0mm to 2mm	20mm – 30mm
POOR	III – IV	< 20°	> 2mm	> 30mm

We then evaluated the degree of dislocation by the classification of Zionts and McEwen:

- Degree I – the ossification nucleus of the femoral head or medial portion of the proximal femoral metaphysis meet sidelong, below the level of the superolateral edge of the true acetabulum.

- Degree II – the ossification nucleus of the femoral head or medial portion of the proximal femoral metaphysis are at the superolateral level of the edge of the true acetabulum.
- Degree III – the ossification nucleus of the femoral head or medial portion of the proximal femoral metaphysis meet above the superolateral edge of the true acetabulum.

Accordingly we obtained five (15.15%) first-degree, five (15.15%) second-degree and 23 (69.70%) third-degree dislocations.
We also evaluated:
a. Acetabular Index, introduced by Kleinberg and Lieberman.
b. Sharp's Acetabular Angle.
c. Shenton's line; we used the sign (+) when we observed that the femoral portion showed a loss of continuity above; the sign (0) when the line was intact; and the sign (-) for loss of continuity of this line in the caudal direction.
d. Hilgenheiner's line: we used the sign (+) when the center of the epiphysis meets this line above, (0) when it is at the same level e (-) when positioned underneath.
e. c/b and h/b ratios:[14] we performed the measurements of distance between the central median line of the body and the medial portion of the metaphysis, called distance "c" and the measurements of distance between the median line and the Perkin's line, called "b". c/b is obtained by the ratio been the measurements referred to here. We used the measurements of distance between the central median line of the body and the medial portion of the metaphysis, called "c" and measurements of the epiphysis height, called "b". c/h is obtained by the ratio between these measurements.
f. acetabulum-center ratio;
g. acetabulum-head ratio;
h. width of the triradiate cartilage;
i. trochanter and femoral head relationship - we use the sign (+) when the trochanter is below the level of the femoral head, (0) when they are leveled and (-) when the trochanteric height superimposes that of the femoral head.

Statistical method

Statistical tests (Mann-Whitney's test and Fisher's exact test) were used for analysis of results, taking into consideration the nature of the distributions and of the variables studied. The rejection level for the nullity hypothesis was set at 0.05 or 5% in all the tests, marking significant values with an asterisk.

RESULTS

Table 2 presents the distribution of the 33 hips according to: serial number, acetabulum-center ratio; width of the triradiate cartilage; trochanter and femoral head relationship; c/b ratio; h/b ratio, Sharp's angle, in degrees; acetabular index (in degrees); Hilgenreiner's angle, in degrees; relationship between proximal femoral epiphysis and Shenton's line; size of the proximal femoral epiphysis; acetabulum-head ratio; Mose's concentric circles; Wiberg angle, in degrees; and the caption.
Table 3 presents the results according to the serial number, age (in months), postoperative follow-up time (in months), acetabulum-center ratio, width of the triradiate cartilage, trochanter and femoral head relationship, c/b ratio, h/b ratio, Sharp's angle (in degrees), acetabular index (in degrees), relationship between femoral epiphysis and Hilgenreiner's line (in degrees), relationship between proximal femoral epiphysis and Shenton's line, size of the proximal femoral epiphysis, acetabulum-head ratio and caption.

Table 2 – *Distribution of the 33 hips according to: serial number, acetabulum-center ratio; width of the triradiate cartilage; trochanter and femoral head relationship; c/b ratio; h/b ratio, Sharp's angle in degrees; acetabular index (in degrees); Hilgenreiner's angle, in degrees; relationship between proximal femoral epiphysis and Shenton's line; size of the proximal femoral epiphysis; acetabulum-head ratio; Mose's concentric circles; Wiberg angle, in degrees; and the caption.*

N	AcR	WTC	RTF	c/b ratio	h/b ratio	SHA	AI	PFE HIL	PFE ShL	PFE	AhR	MC	WA
1	0.93	10	+	0.59	0.23	40	15	0	-	NL	0.94	Good	22
2	0.87	10	+	0.70	0.12	40	10	-	-	<	0.84	Good	35
3	1.00	13	+	0.66	0.21	40	13	-	-	<	0.77	Good	34
4	0.83	13	+	0.74	0.13	47	25	0	-	<	0.94	Good	18
5	0.93	11	+	0.68	0.19	46	20	-	-	<	0.94	Good	20
6	0.93	11	+	0.75	0.17	47	12	0	-	<	0.87	Good	45
7	1.04	5	+	0.74	0.19	42	8	-	-	<	0.87	Good	18
8	0.94	22	+	0.65	0.21	40	18	+	+	>	0.82	Regular	41
9	1.00	17	+	0.74	0.16	39	12	-	-	<	0.83	Good	37
10	2.50	12	+	0.71	0.21	41	18	-	-	<	0.88	Good	25
11	0.86	15	-	0.68	0.22	41	26	+	+	<	0.92	Regular	20
12	1.00	13	+	0.73	0.22	28	10	-	-	<	0.88	Good	44
13	1.00	10	+	0.69	0.69	28	12	-	-	NL	0.88	Good	40
14	0.83	12	+	0.72	0.17	44	20	+	+	<	0.93	Good	13
15	0.96	16	+	0.63	0.23	38	8	0	-	<	0.78	Good	34
16	0.91	13	+	0.76	0.16	45	20	-	-	<	0.90	Good	30
17	0.83	12	+	0.76	0.14	33	5	0	-	<	0.92	Good	28
18	1.00	16	+	0.64	0.15	40	15	-	-	NL	0.77	Good	34
19	1.27	16	+	0.73	0.16	30	10	-	-	<	0.84	Good	43
20	1.33	8	+	0.63	0.18	35	6	-	-	<	0.85	Good	40
21	0.95	11	+	0.66	0.13	44	10	+	-	<	0.84	Good	25
22	1.38	15	+	0.69	0.17	47	25	-	-	<	0.92	Good	23
23	0.87	12	+	0.73	0.14	30	6	-	-	NL	0.88	Good	34
24	1.00	12	+	0.70	0.16	32	6	-	-	<	0.79	Good	42
25	1.63	11	+	0.78	0.14	37	20	-	-	<	0.80	Good	25
26	1.00	15	+	0.68	0.23	18	0	-	-	<	0.66	Good	48
27	1.10	11	+	0.61	0.21	41	18	-	-	<	0.83	Good	24
28	1.06	15	+	0.63	0.19	32	10	-	-	<	0.78	Good	34
29	1.00	10	+	0.76	0.19	44	18	-	-	<	0.87	Good	26
30	1.22	15	+	0.69	0.15	40	17	-	-	<	0.87	Good	28
31	1.08	12	+	0.70	0.19	35	18	-	-	<	0.74	Good	40
32	0.93	7	+	0.81	0.11	50	28	0	-	<	0.89	Good	22
33	1.00	13	+	0.70	0.13	46	17	-	-	<	0.90	Good	25

SHA – Sharp's Angle, WA – Wiberg Angle, AhR – Acetabulum-head ratio, AcR – Acetabulum-center ratio, MC – Mose's Circles, PFE – Proximal femoral epiphysis, PFE HIL – Relation between proximal femoral epiphysis - Hilgenreiner's line, PFE ShL – Relationship between proximal femoral epiphysis -Shenton's line, AI – Acetabular index, WTC – Width of triradiate cartilage, NL – Normal, RTF – Relationship between trochanter and femoral head

The distribution of the 33 hips according to the type of necrosis avascular; measurement of Wiberg angle, in degrees; sphericity analysis, by Mose's circles; measurement of femoral discrepancy, in millimeters; and result of the radiographic assessment are shown in Table 4.
The result of the radiographic assessment, absolute frequency, relative frequency (in percentage) and the sample total are shown in Table 5. Where we observe 23 (69.70%) good, 5 (15.15%) regular and 5 (15.15%) poor results.
Table 6 demonstrates: mean absolute frequency, standard deviation, median, minimum and maximum, considering age, Wiberg angle, measurement of femoral shortening and discrepancy between lower limb length (in millimeters) and the product of the statistical analysis.

Table 3 – *Distribution of the 33 hips according to: serial number, age (in months), postoperative follow-up time (in months), acetabulum-center ratio, width of the triradiate cartilage, trochanter and femoral head relationship, c/b ratio, h/b ratio, Sharp's angle (in degrees), acetabular index (in degrees), relationship between femoral epiphysis and Hilgenreiner's line (in degrees), relationship between proximal femoral epiphysis and Shenton's line, size of the proximal femoral epiphysis, acetabulum-head ratio and the caption.*

N	Age	TS	Side	AcR	WTC	RTF	c/b ratio	h/b ratio	SHA	AI	PFE SL	PFE HIL	PFE	AhR
1	133	70	L	1.00	14	+	0.60	0.27	40	15	0	+	NL	0.87
2	99	66	L	1.00	15	+	0.67	0.12	45	12	-	0	<	0.92
3	135	82	L	1.14	14	+	0.58	0.26	40	7	0	0	NL	0.66
4	98	70	L	0.96	15	+	0.68	0.18	50	23	+	+	NL	0.93
5	105	77	L	1.30	15	-	0.68	0.28	62	13	0	-	NL	0.91
6	106	51	L	0.96	21	+	0.65	0.22	41	10	0	-	NL	0.88
7	149	36	R	0.97	7	-	0.68	0.22	40	11	0	+	>	0.86
8	183	35	R	1.00	24	+	0.64	0.20	44	16	+	+	NL	0.75
9	100	42	L	0.96	15	+	0.62	0.21	36	13	0	+	>	0.82
10	47	27	R	1.29	16	+	0.71	0.22	42	16	-	-	<	0.78
11	211	84	L	0.88	SM	+	0.69	0.21	42	SM	+	+	<	0.94
12	120	90	R	1.00	15	+	0.75	0.21	30	10	-	+	NL	0.88
13	120	96	L	1.00	13	+	0.67	0.13	30	19	-	+	NL	0.86
14	119	96	L	0.88	17	+	0.67	0.17	48	20	+	+	NL	0.95
15	118	58	L	0.86	20	+	0.63	0.23	38	12	0	+	<	0.84
16	70	45	L	0.95	16	+	0.71	0.17	45	20	0	+	>	0.91
17	83	49	R	0.93	20	+	0.59	0.22	41	13	0	+	<	0.87
18	159	73	R	1.00	14	+	0.58	0.24	25	5	0	+	NL	0.77
19	158	62	L	1.15	15	-	0.65	0.17	36	18	0	+	<	0.83
20	68	43	R	1.36	9	+	0.63	0.18	35	6	-	-	<	0.85
21	82	56	R	0.93	11	+	0.62	0.13	45	11	+	-	>	0.83
22	138	94	R	1.00	14	+	0.60	0.22	48	23	0	+	NL	0.88
23	121	73	R	1.19	17	-	0.59	0.29	32	5	-	+	NL	0.88
24	121	85	L	1.07	17	+	0.57	0.28	32	0	0	+	>	0.78
25	92	46	R	1.14	17	+	0.62	0.19	30	0	-	-	<	0.80
26	141	39	R	1.04	18	+	0.59	0.24	20	10	-	-	NL	0.67
27	102	31	L	1.05	14	+	0.62	0.21	45	18	-	0	NL	0.87
28	163	76	R	1.00	15	+	0.65	0.20	38	10	-	-	NL	0.80
29	55	27	L	0.96	12	+	0.82	0.19	43	17	-	+	NL	0.86
30	110	72	L	1.20	17	+	0.65	0.23	42	10	0	-	>	0.87
31	101	66	L	1.12	16	+	0.60	0.24	35	10	0	-	NL	0.82
32	87	60	L	0.94	9	+	0.83	0.13	43	25	-	-	NL	0.84
33	102	74	R	1.00	16	+	0.55	0.25	47	6	-	+	>	0.81

SHA – Sharp's Angle, AhR – Acetabulum-head ratio, AcR – Acetabulum-center ratio, PFE – Proximal femoral epiphysis, PFE SL – Relationship between proximal femoral epiphysis – Shenton's line, PFE HIL – Relationship between proximal femoral epiphysis – Hilgenreiner, AI – Acetabular index, AE – Age at least evaluation, WTC – Width of triradiate cartilage, SM – Skeletal maturity, NL – Normal, RTF – Relationship between trochanter and femoral head

Table 7 presents the distribution of absolute and relative frequency (in percentage) of the 33 hips according to the results of the radiographic assessment with the degree of dislocation and the result of Fischer's exact test (p=1,000).

Table 8 considers the result of the radiographic assessment and Mose's concentric circles, according to its absolute and relative frequency (in percentage), the total and the result of the statistical study. Fisher's exact test < 0.001

In Table 9 we point out the results of the evaluation of the preoperative period, in the immediate postoperative (or intraoperative) period and in the late postoperative period, considering the acetabulum-head ratio, its absolute distribution, the mean, the standard deviation, the minimum and maximum values and the result of the statistical test.

Table 10 shows the results of the evaluation of the preoperative period, immediate postoperative (or intraoperative) period and late postoperative period, considering the Wiberg angle, its absolute distribution, the mean, the standard deviation, the minimum and maximum values and the result of the statistical test.

Table 4 – *Distribution of the 33 hips according to: serial number; type of avascular necrosis; measurement of Wiberg angle, in degrees; sphericity analysis, by Mose's circles; measurement of femoral discrepancy, in millimeters; and result of radiographic assessment.*

N	Avascular necrosis	Wiberg Angle	Mose's Circles	Femoral discrepancy	Radiographic result
1	0	23	Good	20	Good
2	0	34	Good	10	Good
3	0	47	Regular	15	Regular
4	0	20	Good	5	Good
5	0	15	Good	25	Poor
6	0	26	Good	20	Good
7	0	26	Good	60	Regular
8	0	38	Good	20	Good
9	0	42	Good	20	Good
10	0	28	Good	15	Good
11	0	20	Good	0	Regular
12	0	40	Good	0	Good
13	0	37	Good	0	Good
14	0	16	Good	0	Regular
15	0	32	Poor	35	Poor
16	I	26	Good	0	Good
17	0	29	Good	0	Good
18	0	47	Good	0	Good
19	IV	45	Poor	15	Poor
20	0	35	Good	10	Good
21	I	27	Good	10	Good
22	0	27	Good	0	Good
23	IV	20	Regular	35	Poor
24	III	40	Good	0	Regular
25	0	42	Good	10	Good
26	III	52	Good	35	Poor
27	0	24	Good	20	Good
28	0	34	Good	20	Good
29	0	30	Good	10	Good
30	0	23	Good	0	Good
31	0	40	Good	20	Good
32	0	27	Good	5	Good
33	I	34	Good	0	Good

Table 5 – *Distribution of the 33 hips according to the result of the radiographic assessment, absolute frequency, relative frequency (in percentage) and sample total.*

Radiographic Result	Num	%
Good	23	69.70
Regular	5	15.15
Poor	5	15.15
Total	**33**	**100.00**

Table 6 – *Distribution of the 33 hips according to: mean absolute frequency, standard deviation, median, minimum and maximum, considering age, Wiberg angle, measurement of femoral shortening and discrepancy of length between the lower limbs (in millimeters) and product of the statistical analysis.*

Variable	Radiographic Assessment	Num	Mean	Standard deviation	Median	Minimum	Maximum	P
Age	G	23	105.10	33.59	101.00	47.00	183.00	0.0226*
	B	5	128.60	20.89	121.00	105.00	158.00	
	R	5	147.00	37.76	135.00	119.00	211.00	
Wiberg	G	23	31.74	7.57	30.00	17.00	47.00	0.8579
	B	5	32.80	15.80	32.00	15.00	52.00	
	R	5	29.80	13.24	26.00	16.00	47.00	
Femoral Discrepancy	G	23	9.78	9.23	10.00	0.00	30.00	0.0154*
	B	5	29.00	8.94	35.00	15.00	35.00	
	R	5	15.00	25.98	0.00	0.00	60.00	
Femoral Shortening	G	23	42.39	14.36	40.00	30.00	76.00	0.1819
	B	5	55.20	13.92	60.00	39.00	70.00	
	R	5	47.60	19.20	40.00	30.00	80.00	

There is a significant difference between the groups in relation to age and to femoral discrepancy

Table 7 – *Distribution of the absolute and relative frequency (in percentage) of the 33 hips according to the results of the radiographic assessment with the degree of dislocation and the result of Fisher's exact test.*

Radiographic Assessment	Degree of Dislocation						Total
	I		II		III		
	Num	%	Num	%	Num	%	
Good	3	13.04	4	17.39	16	69.57	23
Regular	1	20.00	1	20.00	3	60.00	5
Poor	1	20.00	0	0.00	4	80.00	5
Total	5		5		23		33

Fisher's exact test 1,000
There is no significant difference between absolute and relative frequencies in relation to the degree of dislocation

Table 8 – *Distribution of the 33 hips considering the result of the radiographic assessment and Mose's concentric circles, according to their absolute and relative frequency (in percentage), the total and the result of the statistical study.*

Radiographic Result	Mose						Total
	Good		Poor		Regular		
	Num	%	Num	%	Num	%	
Good	23	100.00	0	0.00	0	0.00	23
Regular	0	0.00	0	0.00	5	15.15	5
Poor	0	0.00	5	15.15	0	0.00	5
Total	23		5		5		33

Fisher's exact test < 0.001*
There is a significant difference between the percentages of the groups in relation to the degree types of Mose classification

DISCUSSION

Today the treatment of congenital dislocation of the hip that was diagnosed in a late phase still divides the opinion of authors, who have consequently been defending diametrally opposite theories.[15]

Table 9 – *Evaluation of the preoperative period, in the immediate postoperative (or intraoperative) period and in the late postoperative period, considering the acetabulum-head ratio, its absolute distribution, the mean, the standard deviation, the minimum value, the maximum and the result of the statistical test.*

Num	Variable	Num	Mean	Standard deviation	Minimum	Maximum
33	Pre	33	1.167	0.180	0.683	1.439
	Intra	33	0.852	0.065	0.661	0.940
	Post	33	0.842	0.067	0.661	0.952

There is a significant decrease from the preoperative period to the immediate postoperative period (p=0.0001) and no significant variation from the immediate postoperative period to the late postoperative period (p=0.5958)

Table 10 – *Evaluation of the preoperative, immediate postoperative (or intraoperative) and late postoperative periods, considering the Wiberg angle, its absolute distribution, the mean, the standard deviation, the minimum value, the maximum and the result of the statistical test.*

Num	Period	Mean	Standard deviation	Minimum	Maximum
33	Intraoperative	30.82	9.23	13.00	48.00
	Preoperative	31.61	9.66	15.00	52.00

There is no significant difference between the immediate and late postoperative periods (p=0.5227)

It is not easy to perform reduction of femoral epiphysis in an acetabular cavity both previously deformed and filled by the hypertrophied fatty pad and femoral head ligament, particularly after the start of gait. The excessive pressure exercised on the articular surfaces may bring on necrosis of the proximal epiphysis of the femur, which would be exacerbated by the considerable tension of the muscles adjacent to the hip joint. Thus we believe that all the structures that present contractures should be released in order to achieve concentricity.

In our institution, as from 1990, the patients treated were no longer submitted to preoperative traction of the lower limbs upon admission and we adopted the idea that treatment could be performed through a single procedure, optimizing hospitalization time.

Proximal femoral epiphysis of a congenitally dislocated hip is considered susceptible to complications during the first 18 months of life, yet in the first six months of life, when the femoral epiphysis is completely cartilaginous, we observe that the risks of ischemia are much more appreciable.

The discovery of avascular necrosis is frequently considered one of the main reasons for the poor functional and radiographic results and is referred to as a disastrous complication in the treatment of DDH.

The unsatisfactory results were observed by Colonna who attributed his findings to necrosis, probably due to excess pressure by the acetabulum on the femoral head. This was also held to blame by other authors when these used open reduction, iliac osteotomy and the femoral supracondylar derotational osteotomy and when traction was applied to the lower limbs in the preoperative period. There was also the recognition of a succession of technical errors that would correspond to approximately 42% of the operations.[3] Avascular necrosis could also be related to the patients' age at the beginning of the treatment.[10]

There are authors who affirm that they could anticipate the prognosis after the establishment of therapy by the analysis of specific radiographic parameters. The possibility of valorizing a radiographic parameter capable of predicting the future result intrigued us, thus we sought to verify its existence in our study.

In evaluating our results, we sought to assess whether one of the radiographic parameters analyzed could anticipate the prognosis as indicated by other authors.[16-18]

By the evaluation of radiographs we verified 23 hips (69.70%) with good results, five (15.15%) regular and five (15.15%) poor. The poor results were considered for hips number 5, 15, 19, 23 and 26. In hips number 5 and 15 we detected problems when the Salter acetabuloplasty was performed, as the graft used did not keep the osteotomized surfaces of the ilium separate on account of its reduced size. In hip 19 the surgery was performed at an advanced age (96 months) and Salter's osteotomy was probably not appropriate for redirecting the acetabulum and providing suitable coverage. In hip 23 we verified a discrepancy of 35.00 mm besides necrosis. For hip number 26 of this series we verified a necrosis of group III that caused leg length discrepancy of 35.00 mm. The femoral resection of 65.00 mm, where the operation was also performed at a late stage (8 years and 6 months), contributed to this, in addition to the fact that two surgeries had been performed previously for treatment.

The comparison of the radiographic elements used in this study demonstrated that there was significant alteration of their values between the pre- and immediate postoperative periods. These did not undergo changes in the late phase. Such fact should be interpreted as follows: the altered anatomical elements present in DDH at gait age determine immediate correction of the radiographic parameters. The potential good results would be altered by avascular necrosis that is only recognized over the course of the follow-up and depending on the degree determines poor prognosis.

The advantages of Salter's osteotomy, based on acetabular redirection, were verified by numerous authors and demonstrated by the clinical and biomechanical findings. [6] Redirection, from the biomechanical point of view, is a positive factor for the coxofemoral articulation, promoting adequate development of femoral epiphysis and of the acetabulum.[19] However, there are reports that this surgical procedure could theoretically contribute toward necrosis of the proximal femur due to lowering of the acetabular roof, increasing pressure on the hyaline cartilage of the femoral head. This was applied in 30 hips in our casuistry.

We used Chiari's capsular arthroplasty in three patients as we realized that it would be impossible to achieve satisfactory acetabular coverage with Salter's osteotomy, due to the major inclination of the cotyloid cup. We routinely use a bone graft from the ilium to promote adequate anterior coverage on the femoral head.

We did not observe correlation between the unfavorable results and: Wiberg angle, ostectomy, leg length discrepancy, degree of dislocation, sphericity by Mose's concentric circles, acetabulum-head ratio.

When we attempted to verify whether the result observed in the late postoperative period is related with the patients' age at the time of surgical treatment, we did not observe correlation by the statistical analysis.

But for the final evaluation of the patients, we agree with the opinion of various researchers that only a long-term follow-up and the performance of further research could reveal the veracity of these opinions.[20]

CONCLUSIONS

Going by the classification used we observed 23 (69.70%) good, 5 (15.15%) regular and 5 (15.15%) poor results.

The radiographic parameters underwent significant changes between the preoperative period and immediate postoperative period and did not change in the late postoperative period, when the evaluations were performed.

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