

Hip Arthroplasty : Long Term Follow-up Colonna : Quo Vadis ?

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Abstract Introduction : The authors present their experience with the long-term results of hip arthroplasty according to Colonna. Review of the literature did not reveal a study similar in length of follow-up and in number of examined patients.

Patients : Twenty-four of 106 patients operated on between 1955 and 1973 were still under continuous observation at the same orthopaedic hospital at the time of this study ; another 15 were re-examined for the purpose of this study.

Results : Of 39 patients (49 hips) followed-up after 34 years (range, 26~44 years), all except three hips (in three patients) had had unfavorable results, and 11 patients (14 hips) had undergone total hip arthroplasty on the operated side before the age of 50. Four hips operated on both sides were considered as fair and sixteen as poor.

Conclusions : Deterioration of hips which underwent acetabuloplasty according to Colonna was found to be unavoidable. In agreement with some reports in the literature, our experience proved that the 'breaking point' of deterioration occurs 20~25 years after surgery. This raises the questions of whether the 'good' years are the result of surgery or are part of the natural history of DDH, and is the surgery worthwhile.

Introduction

The late diagnosis of developmental dysplasia of the hip (DDH), i. e., after the child begins to walk, is extremely rare nowadays. However, some 50+ years ago, the situation was not the same. Different surgical procedures were required to save the dislocated pediatric hip. The operation originally described by Codivilla in 1901 gained great popularity after Colonna published his first enthusiastic report

on the success of this procedure which today bears his name¹⁾. Colonna himself performed the first capsular arthroplasty in 1929.

According to a review of the literature published by Tonnis in 1987, short term results for this procedure were not successful in 3~40% of cases, while excellent-to-good results were achieved in 20~70%²⁾. It must be mentioned that it is very difficult to compare the results of different authors because of the many modifications made to the original method, additional

procedures, such as shortening osteotomies, changing indications for the operation, including subluxated hips and other conditions, e. g., septic arthritis sequelae and not developmental dislocation only, and the varied criteria and methods used for evaluating the results. The short follow-up period (2~20 years) and the low number of patient, between 20~100 (except for Dega's report on 510 patients) in Tonnis' review²⁾, contributed to the relative 'success' of the operation. In report of middle and longer term results, and still for relatively small numbers of patients, the statistics become less favorable, with the 'breaking point' for deterioration of hips at 20~25 years after the acetabuloplasty^{3)~6)}.

In 1987, Steno et al⁷⁾ published the results of their experience with Colonna's arthroplasty on 294 hips, with 3~19 years of follow-up. In 1991, Horsky et al⁸⁾ evaluated the same patients with 221 hips 12~25 years after the surgery. Although fair and poor results were achieved in 31.5% in the first report, this number had doubled to 73% in the second report!

The aim of the present study was to verify the further history of the hips of these patients after more than 25 years and to determine the difficulty and the problems of finding patients for long-term follow-up.

Patients and Methods

With surprising ease and in numerical order in the clinic's register, we found the ambulatory charts of 106 patients operated on for DDH by Colonna's method between 1955 and 1973. These patients belonged to the cohort of patients examined by Steno et al and Horsky et al⁷⁾⁸⁾. Excluding eight charts with incomplete notes or patients with neuromuscular disorders such as

cerebral palsy, we were able to review 98 patients, 24 of whom who had undergone Colonna arthroplasty on 33 hip joints, 26~44 years earlier and who were under continuous observation up to the time of this study. To this number, we added 15 patients (16 hips) who responded to an invitation to present themselves for evaluation. Thus, we achieved a 39.8% response rate for the follow-up evaluation. Missing patient identification numbers, changes of address and married names of women made it impossible to identify other patients, and some patients had left the country in the meantime.

In the charts we found the age and sex of the patient at the time of surgery, year surgery performed, and mode of previous treatment. The charts also included detailed descriptions of the pre-operative treatment and follow-up, details of the surgery, including detailed descriptions of the shape and relationship of the femoral head to the acetabulum, along with details of the clinical and radiological findings at the follow-up visits, and age and clinical-radiological findings at the last visit to this clinic, for patients followed continuously for more than 26 years. The acetabular depth was part of the description also. This enabled us to divide the type of surgery into five categories :

- 1 : Colonna arthroplasty with traction
- 2 : Colonna arthroplasty without traction
- 3 : Colonna arthroplasty after previous varus derotational osteotomy
- 4 : One-stage Colonna arthroplasty combined with varus derotational osteotomy
- 5 : Colonna arthroplasty with concomitant femoral shortening and varus derotational osteotomy

All patients were examined clinically and

Table 1. Summary of data of 39 patients(49 hips)followed for 34 years(range, 26~44 years)

Side	Right	Left	Bilateral
Female			
No. of patients	9	16	10
Age at surgery(years) (range)	6.9(3~15)	6.8(2~13)	7.0(4~10)
Age at last examination(years) (range)	41(29~50)	37.8(32~52)	38.5(33~43)
Length of follow-up(years) (range)	34.2(26~39)	37.8(29~44)	31.5(26~36)
Male			
No. of patients	1	3	0
Age at surgery(years)	6	10.3(4~15)	0
Age at last examination(years)	39	46(36~52)	0
Length of follow-up(years)	33	35.7(32~40)	0

Table 2. Detailed patient data

No.	ID	Sex	Side	Age at surgery	Age at last exam.	Length of follow-up	*Type of surgery	Age at HR	Subjective	Limp	Movement	X-ray	Overall result**	Comment
1.	KA	F	L	2 y	33 y	31 y	2		post-effort pain	+	flex. contr. abd. 20, rot. 0	sclerosis; narrow joint space	4	
2.	CHS	F	R	3 y	29 y	26 y	2		no pain	+	flex. 50, abd. 20, rot. 0	ankylosis	4	
3.	SZ	F	L	3 y	32 y	29 y	4		permanent pain	+	abd. 30, rot. 1/3	coxa magna; arthrosis	3	
4.	SJ	F	L	3 y	35 y	32 y	2		permanent pain	+	limited	heavy coxarthrosis	4	
5.	BL	M	L	4 y	36 y	32 y	1		permanent pain	+	flex. 50, abd. 0, rot. 0	coxarthrosis	4	
6.	SK	F	R	4 y	41 y	37 y	3	41 y	night pain	+	flex. 60, abd. 20, rot. 0	subluxation	4	
7.	DL	F	R	4 y	41 y	37 y	3		permanent pain	+	flex. 45, rot. 0	head & acetabulum deformity	4	
8.	JA	F	L/R	4/6 y	40/40 y	36/34 y	4/5		occasional pain	+	flex. 60, abd. 15, rot. 0	head deformity; arthrosis	4/4	
9.	PM	F	L/R	4/5 y	40/40 y	36/35 y	2/2		permanent pain	+	flex. 70, abd. 35, rot. 1/3	arthrosis	4/4	
10.	NV	F	L	4 y	43 y	39 y	2		permanent pain	+	ankylosis	ankylosis	4	
11.	SV	F	L	5 y	32 y	27 y	2		permanent pain	+	abd. 25, rot. 1/3	head deformity; narrow joint space	4	
12.	BZ	F	L/R	5/5 y	34/34 y	29/29 y	4/4		post-effort pain	+	limited in all directions	arthrosis	3/3	
13.	KV	F	R/L	5/5 y	37/37 y	32/32 y	1/1		permanent bilateral pain	+	flex. R:55,L:35; abd. 10, bilateral; rot. 1/3 normal	bilateral coxarthrosis	4/4	
14.	MH	F	R	5 y	40 y	35 y	1		permanent pain	+	flex. 90, abd. 40, rot. 0	narrow joint space; head & acetabulum deformity	3	
15.	VA	F	R	5 y	41 y	36 y	1		no pain	-	full ROM	minimal changes	1	
16.	BJ	F	L	5 y	43 y	38 y	2		permanent pain	+	abd. 35, rot. 0	narrow joint space; sclerosis	1	
17.	SD	F	L/R	6/6 y	33 y	27/27 y	5/5		permanent pain	+	flex. 70, abd. 30, rot. 1/3	arthrosis	4/4	
18.	SD	F	L	6 y	38 y	32 y	3		occasional pain	+	flex. 90, abd. 30	narrow space, slightly deformed head	2	
19.	MD	M	R	6 y	39 y	33 y	2		permanent pain	+	rot. 1/2 limited	valgosity of neck; subchondral sclerosis	4	
20.	KJ	F	L	6 y	43 y	37 y	1		no pain	-	flex. 60, abd. 30, rot. 0	narrow space; head deformity	3	
21.	FM	F	L/R	7/7 y	33/33 y	26/26 y	5/5	33/33 y	permanent pain	+	ankylosis	-	4/4	

22.	TM	F	R	7 y	39 y	32 y	1		post-effort pain	+	flex. 90, abd. 40, rot. 10	slight deformity	2	
23.	OI	F	L	7 y	40 y	33 y	1	36 y	permanent pain	+	flex. 45, abd. 30, rot. 0	coxarthrosis	4	
24.	NG	F	R	8 y	40 y	32 y	2		permanent pain	+	flex. 30, abcl. 10, rot. 0	severe coxarthrosis	4	
25.	NL	F	L	8 y	35 y	27 y	2	37 y	post-effort pain	+	abd. contracture	-	4	
26.	VR	F	L	8 y	37 y	29 y	5	34 y	post-effort pain	+	ankylosis	ankylosis	4	
27.	BD	F	L/R	8/8 y	40 y	32/32 y	4/5		post-effort pain	+	flex. 90, abd. 30, rot. 1/2	L coxa magna; R coxarthrosis	3/3	
28.	HV	F	L	8 y	52 y	44 y	4	31 y	post-effort pain	+	flex. 30, rot. 0	narrow joint space; dysplasia	4	THR-R side
29.	KA	F	L/R	10/10 y	42/42 y	32/32 y	3/3		permanent pain	+	flex. 30, rot. 0	arthrosis	4/4	
30.	RL	F	L	10 y	44 y	33 y	3		post-effort pain	+	flex. 60, abcl. 30, rot. 0	ankylosis	4	
31.	SH	F	L/R	10/9 y	43/43 y	33/34 y	5/5	43/41 y	occasional pain	+	ankylosis	ankylosis	4/4	
32.	CZ	F	L/R	9/10 y	43/43 y	34/33 y	5/5	39/41 y	occasional pain	++	ankylosis	ankylosis	4/4	
33.	ME	F	L	10 y	46 y	36 y	2	33 y	permanent pain	+	ankylosis	ankylosis	4	
34.	FA	F	L	10 y	47 y	37 y	2	40 y	permanent pain	+	ankylosis	ankylosis	4	
35.	JB	F	R	11 y	50 y	39 y	4	47 y	permanent pain	+	ankylosis	ankylosis	4	
36.	DK	F	L	13 y	48 y	35 y	2	46 y	permanent pain	+	ankylosis	ankylosis	4	
37.	PD	M	L	12 y	52 y	40 y	1		post-effort pain	-	flex. 90, abd. 60	acetabular protrusion	3	
38.	RH	F	R	15 y	49 y	34 y	3		post-effort pain	+	flex. 40, abd. +, rot. 0	head deformity	3	
39.	BJ	M	L	15 y	50 y	35 y	3	41 y	post-effort pain	+	ankylosis	ankylosis	4/4	THR-R side

***Type of Surgery**

- 1 : Colonna arthroplasty with traction
 2 : Colonna arthroplasty without traction
 3 : Colonna arthroplasty after earlier varus derotational osteotomy
 4 : Colonna arthroplasty varus derotational osteotomy
 5 : Colonna arthroplasty+ femoral shortening and varus derotational osteotomy

In patients who underwent THR, the clinical and radiological findings were recorded prior to THR-

Abbreviations

THR : total hip replacement, Abd : abduction, Rot : rotation, Flex : flexion

****Result**

- 1 : excellent
 2 : good
 3 : fair
 4 : poor

radiologically. Using the Shephard and Gade criteria⁹⁾ enabled the unique comparison of the results of surgery at the same institution, although not necessarily on exactly the same patients as previously reported⁷⁾⁸⁾. The criteria are simple :

1. Excellent results : Subjectively : no complaints ; no limping ; Trendelenburg sign nega-

tive ; terminally limited range of movement in the hip joint. On x-ray : well formed acetabulum ; spherical femoral head, well centered.

2. Good results : Subjectively : occasional pain in the hip joint ; Trendelenburg sign positive+ ; flexion in the hip joint possible to 80°, abduction 70° ; minimal flexion contracture ;



a|b

Fig. 1.

X-ray of right hip of patient considered as having an excellent result (a)-the opposite side has a normal appearance (b)

limited rotation in the hip joint. On x-ray : mild enlargement of the acetabulum ; femoral head mildly deformed ; broken Shenton arch.

3. Fair result : Subjectively : post-effort pain in the hip joint region ; . limping ; Trendelenburg sign positive++ ; limited movement in the hip joint. On x-ray : narrowing of the joint space, deformity of the femoral head, sclerosis of the acetabulum.

4. Poor result : Subjectively : permanent pain and/or working disability ; limping ; Trendelenburg sign positive+++ ; markedly limited range of movement ; flexion contracture in the hip joint ; hyperlordosis of the lumbar spine. On x-ray : deformed acetabulum, narrowing or absence of the joint space (i. e., ankylosis) with osteophytes ; deformed femoral head and femoral neck shortening. Note that patients who underwent total hip replacement (THR) were included here.

Results

With no effort, we were able to use the records of 24 patients (33 hip joints) with a follow-up of 26~44 years, who had undergone acetabuloplasty according to Colonna⁹⁾¹⁰⁾. Another 15 responded to our invitation and came in for follow-up (some 32~40 years after their surgery). Thus, a total of 39 patients (40%

response rate) were seen for the average long term of 34 years (range, 26~44 years) of follow-up. Sex, operated side, age at time of surgery and length of follow-up for all patients is summarized in Table 1. Detailed information on patients is given in Table 2.

One hip (2%) was considered as excellent (full range of movement, minimal arthrotic changes on x-ray (Fig. 1) and two as good (4%), while nine hips (19%) were classified as having fair results and 37 (75%) as poor results. Of the last group, 16 hips were after THR and three after revisional surgery. In other words, all except for three hips followed over 25 years had an unfavorable outcome. A total of 12/19 patients (15 hips) operated on over the age of 6 by Colonna arthroplasty underwent total hip replacement between the ages of 33 to 47 years. One patient, a female who had arthroplasty at the age of 4 years, underwent total hip replacement at the age of 41 years. Total hip replacement in 12 patients (15 hips) was performed at the age of 39.5 years (range, 33~47 years). In two patients, the THR was performed on the opposite hip, and not the side of the Colonna arthroplasty.

Of 10 patients operated on both hips, 16 hips were considered as having poor results (six of these had total hip replacement) and four as fair

results. Two patients (BJ and HV) who underwent Colonna acetabuloplasty were evaluated as fair and poor, respectively, but, as noted previously, the opposite hip was worse, i.e., after THR.

One patient with excellent results was a five year old female at the time of surgery and the operation was performed after two weeks of traction and strictly following Colonna rules. Of two female patients operated at the ages of 6 and 7 years of age, respectively, one underwent Colonna arthroplasty after varus derotation osteotomy and one strictly following Colonna rules after two weeks of traction. However, three other hips operated strictly according to Colonna had a fair outcome and four had a poor outcome.

Discussion

Unfavorable results of surgical treatment for dislocated hips in children over the age of 2 led Colonna to use a procedure which, today, bears his name. The idea was to bring the dislocated femoral head opposite to the acetabular socket by preliminary skeletal traction, followed by open reduction. Subsequent deepening of the acetabulum was achieved by the removal of all articular cartilage and then placing the femoral head, covered by the capsule, in this socket. Colonna assumed that the transplanted capsule would become firmly adherent to the floor of the acetabulum and the synovial cells would undergo metaplasia, transforming them into cartilage-like cells. He advised early mobilization, 4~5 weeks after surgery¹⁾ (6 weeks in our patients).

Even short to middle term results reported by various authors and summarized by Tonnis²⁾ were not always very encouraging. To these

should be added the reports of longer experience, adding a new aspect to the understanding of the natural history of the hips treated by Colonna's arthroplasty as described by Stans and Coleman³⁾ and by Chung et al⁴⁾, reporting on patients operated on by Colonna himself, and by Pozo et al⁵⁾. In all, they followed 142 hips (in 127 patients) for 16, 17 and 20 years, respectively, for a total of 22 patients followed over 20 years.

Of 21 hips followed by Stans and Coleman³⁾ for 16 years (range, 6~32 years), seven hips (of 6 patients) followed for 20 years or more had unfavorable results [three underwent THR]. In this group, deterioration began even earlier: "As in the long-term study by Chung et al, symptoms of degenerative hip disease tended to develop approximately 15 years after the Colonna arthroplasty. The seven hips (32%) that had an unsatisfactory result had been followed for a mean of 20 years; this reflects the natural history of hips after a Colonna arthroplasty"³⁾.

Chung suggests the following reasons for the unfavorable results:

1. forceful reduction of the femoral head in the acetabulum because of inadequate first stage traction
2. preoperative distortion of the femoral head
3. surgery at a late age
4. excessive immobilization following surgery
5. previous open surgery prior to capsular arthroplasty
6. presence of associated joint diseases, especially bilateral hip diseases or knee dysfunction
7. excessive physical activity

8. avascular necrosis, whatever the cause

However, the strongest factor influencing the results seems to be the amount of time which has passed since the surgery and bilaterality of surgery. In the report by Chung et al⁴⁾, 9/56 patients were seen 25 years or more after surgery. These patients began to have gradual and progressive degenerative disease with pain on motion of the operated hip. One had a spontaneous fusion, another cup arthroplasty, and four had clinical scores of 56-69.

Pozo et al⁵⁾ reported only one of seven hips followed over 26 years had a favorable result, 18% of the hips were evaluated as unsatisfactory less than 20 years after surgery and 55% hips were evaluated as unsatisfactory at more than 20 years after surgery.

The only long term(40 years after Colonna arthroplasty) follow-up report we were able to find in the literature was that of Boardman and Moseley¹¹⁾; its disadvantage is that the group was relatively small-17 patients(21 hips). In this study, only 4/16 patients questioned had not undergone THR. In the present study, only three(three hips)of all 39 patients observed at more than 25 years after the surgery were found to have favorable results.

Unanimously poor results are reported in the literature for patients who had bilateral procedures independent of a particular age at the time of surgery and of the length of follow-up²⁾⁻⁵⁾; this was our experience also: all eight patients(16 hips)followed by us for 26~36 years, operated on both hips at ages 4~10 years, had results considered as poor. Another two(4 hips), operated on at ages 5 and 8, respectively, and followed up at 29 and 32 years, respectively, were considered as fair. THR was performed on eight hips(50%) in this group

when the patients were 33~43 years of age. We agree with Pozo et al⁵⁾ that unfavorable results "may reflect the observation that a stiff painless hip often presents little handicap, whereas two stiff hips area serious impediment to normal function".

The continuously deteriorating results in our experience do not prove Colonna's assumption. If, in the first work at the institution where the study was performed, the fair and poor results represented 31.1% of patients(similar to the 46% reported by Glass and Dunningham¹²⁾), the results worsened to 73% in the second report. In the present study, one-third of the hips needed THR at the very young age of 33~47 years, i. e., under the age of 50, and 94% of patients had unfavorable results. In the study by Steno et al⁷⁾, 22.4% of patients were reported with excellent results; Horsky et al⁸⁾ reported only 3% classified thus, and we were able to find only one excellent result.

As described in the literature, even by Chung et al⁴⁾ who collected patients operated on by Colonna himself, we also learned that almost none of our patients was operated on strictly following Colonna's rules. The age of the patient at the time of operation was younger on one occasion, and older than that proposed by Colonna on 11 occasions. Only nine hips(of 8 patients)had traction prior to the Colonna acetabuloplasty. Even the modification of an additional shortening osteotomy which was meant to decrease the pressure on the femoral head, and which was carried out on 11 occasions, did not influence the poor outcome. Surprisingly, seven of these patients underwent THR(one with bilateral THR was operated on at the age of 7 and one at the age of 8 years). It is questionable if the 15~20 years of good func-

tion after the arthroplasty as claimed by some authors³⁾⁻⁵⁾ are enough of a reason for the revival of this procedure, or if it is better to avoid it by early detection and simple treatment.

The positive surprise in our study was that we were able to find, without effort, the records of the 106 patients who underwent arthroplasty between the years 1955~1973. Among these, about 25% were under continuous follow-up, and another 15% were easily reached for further follow-up. This is contrary to the report by Boardman and Moseley¹¹⁾ who made sophisticated and time-consuming efforts to identify and find their patients. However, we confirm their observations that Colonna's arthroplasty has very unfavorable results even for a relatively short period, deteriorating sharply with time. This has reinforced our belief that screening today is better than the best operation tomorrow.

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