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The Campbell Clinic Inc., Memphis, Tennessee, U.S.A.

FRACTURE-DISLOCATION OF THE HIP

MARCUS J. STEWART, H. RELTON MCCARROLL, JR. & JAMES S. MULHOLLAN

In 1952 at the Combined Orthopaedic Meeting in London, we reported on a study of 194 fracture-dislocations of the hip in 193 patients with a follow-up analysis of 128. These patients had been seen at the Campbell Clinic over a period of 30 years. Since that time, we have treated and studied an additional 222 hips in 220 patients and have been able to make a follow-up study of 154 of these. Our objective in reviewing these additional patients was to critically compare them with those seen in our original investigation. In the majority of patients in this second study the principles for treatment and for analysis outlined in our first study have been applied. Thus, we have attempted to determine whether or not our recommendations for management were valid and what changes we should make in our treatment in the future.

Realizing that the literature abounds with classifications of fracture-dislocations of the hip and recognizing that the one used in our original report may have shortcomings, we still elected to use it in this study because it has proven comprehensive and useful for us. There are so many possibilities for subdividing a classification of fractured hips into splinter groups that to do so could lose all continuity and statistical significance.

Our classifications as to positions of the dislocation are: posterior, anterior, obturator, and central.

As pertains to the extent of fracture they are: Grades I, II, III, and IV.

Grade I: a simple dislocation without fracture or with a chip from the acetabulum so small as to be insignificant.

Grade II: a dislocation with one or more large rim fragments, but with sufficient acetabular socket remaining to ensure stability after reduction.

Grade III: an explosive or bursting fracture with disintegration of the rim and dome of the acetabulum, producing gross instability.

Grade IV: a dislocation with a fracture of the head or neck of the femur.

Rowe & Lowell reported on 93 acetabular fractures in 90 patients. Their classification includes linear and stellate acetabular fractures: posterior acetabular fracture with small or large rim sections broken; inner wall fractures with minor, moderate, or severe intrapelvic displacement; and superior and bursting fracture of the dome of the acetabulum. They found, as we did, that the highest percentage of poor results are from the bursting or explosive fractures which involve the acetabular dome.

We cannot agree with Larson & Sinning that in hips with "displacement of both weight-bearing dome and femoral head, a good functional hip results after minimal treatment". We believe there are indications for specific treatment of each type and grade of dislocation and that the best results are obtained when these principles are meticulously applied, adequately followed, and proper rehabilitation is accomplished.

CRITERIA FOR CLASSIFICATION OF RESULTS

We have reviewed our patients clinically and roentgenographically. Again we find, as in our first reported series, that often the clinical result is superior to the final x-ray appearance of the hip. However, we have combined these findings in making our final evaluation of the patient's result.

An *excellent* result means that the hip returned to normal, with a full, free range of motion, the patient had no residual pain, weakness, or fatigue after normal work, and the roentgenograms revealed no narrowing of the joint space and no avascular necrosis or arthritic changes.

A *good* result means that the patient had no appreciable pain or limp, except after a long day of hard work and weight-bearing, and not more than a 25 % restriction of motion and this without interference of his daily activities. The roentgenograms might show minimal arthritic changes, but no evidence of avascular necrosis or narrowing of the joint space.

A *fair* result was characterized by mild to moderate pain, a slight limp, and restriction of motion by 25 to 50 %. The patient's capacity for work, although curtailed, was still adequate for a sustaining occupation. There might be moderate narrowing of the joint space, with minimal cyst formation in the head of the femur and with moderate sclerosis in the acetabulum.

Patients with *poor* results had pain, limp, moderate to marked limi-

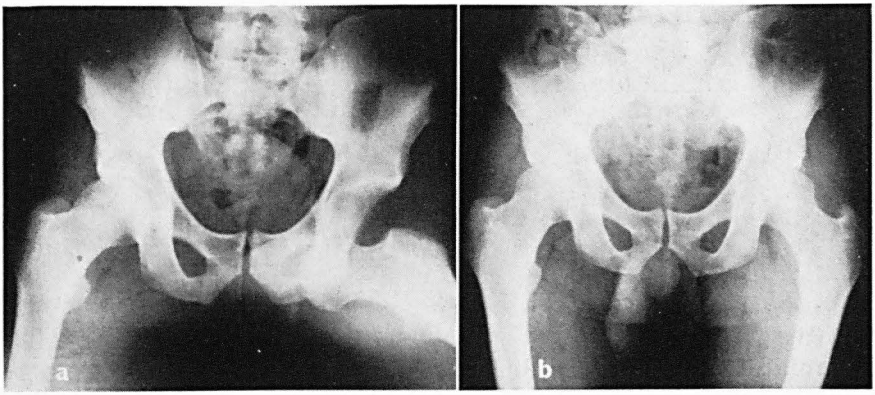

Figure 1 A. Obturator dislocation. B. Four-year follow-up.

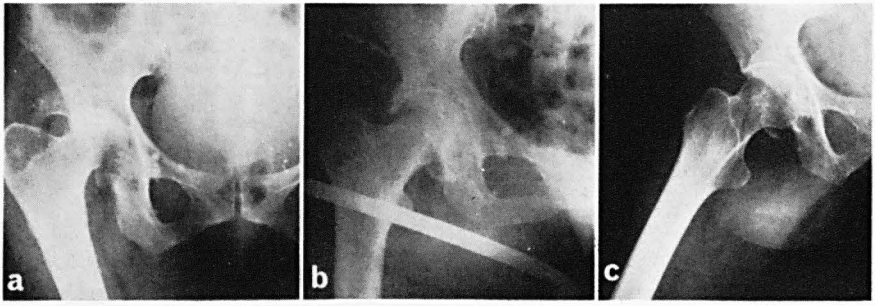

Figure 2 A. Posterior dislocation, Grade II. B. Two large rim fragments, but hip stable after reduction. C. Seventeen-year follow-up.

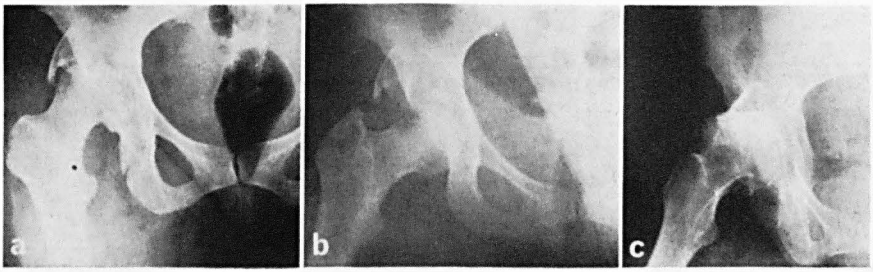

Figure 3 A. Posterior dislocation, grade III. Disruption of posterior rim. B. After menipulative reduction and limb traction. C. Seventeen-year follow-up. Narrowing of joint and arthritis. Slight pain. Patient is walking with support, and will soon need surgical reconstruction.

tation of motion, and were unable to engage in any occupation which required walking or standing. Roentgenograms revealed one or more of the following: advanced arthritis, narrowing of the joint space, marked sclerosis of the acetabulum, avascular necrosis in the head of the femur, and extensive cyst formation in the femoral head or neck.

CLINICAL REVIEW

Our current study included 222 hips in 220 patients, two being bilateral. Of these, 178 (80 %) had posterior dislocations and 36 (16 %) had central dislocations (see Table 1). The right hips were involved in 98 instances, the left in 124. This slight predominance of left hips was also present in our first study (see Table 2).

Table 1. Type of dislocation

Type	Number	%
Post.	178	80
Centr.	36	16
Ant.	2	1
Obt.	2	1
Unk.	4	2
	222	100

Table 2.

Laterality	Number	%
Right	98	44
Left	124	56
	222	100

Table 3.

Sex	Number	%
Male	155	70
Female	65	30
	222	100

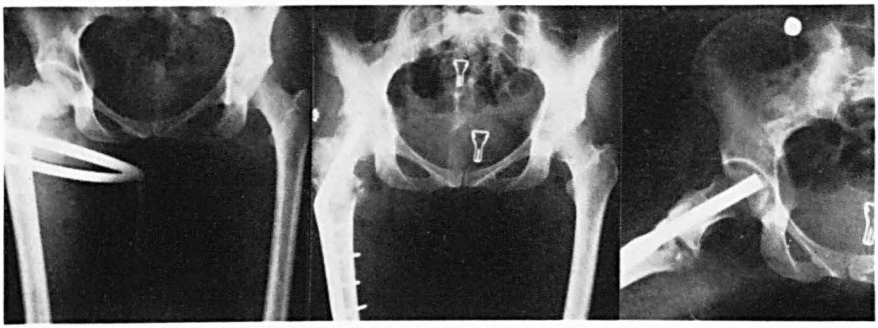

Figure 4. Posterior dislocation, grade IV. Note fracture fixed with angle nail after open reduction. Poor result (necrosis of femoral head).

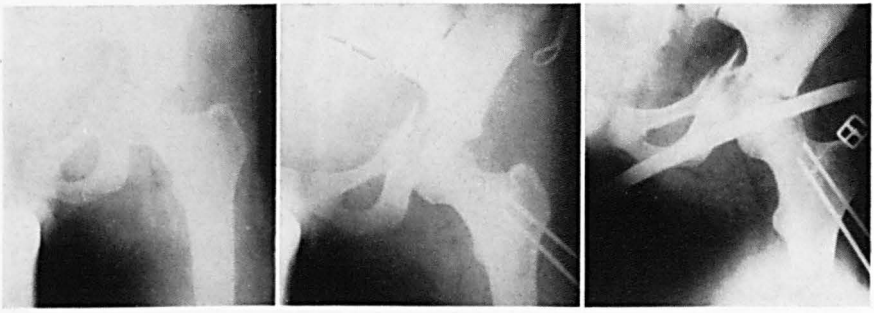

Figure 5 A. Central, grade II dislocation treated by 15 pounds longitudinal and 10 pounds lateral traction. Two additional views made at weekly intervals. Note distraction of head from acetabulum, but this never causes difficulty.

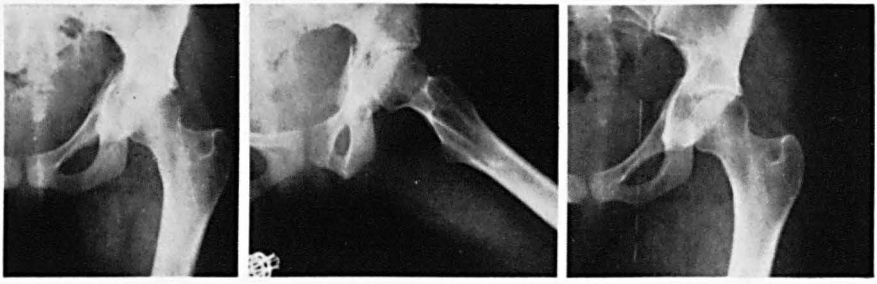

Figure 5 B. Follow-up. AP and lateral at 1 year, and AP at 3 years.

In comparing gender, there were 155 males (70 %) and 65 females (30 %). Again a striking similarity to our previous study, where there were 148 males (77 %) and 45 females (23 %) (see Table 3). Fracture dislocation of the hip is usually the result of severe and violent trauma, and males are more likely to be subjected to this type of exposure in their daily activities than are females.

CASES FOR FINAL ANALYSIS

The final analysis included only those patients who were followed for 1 year or more. Even though the results in a few patients may change after 1 year, we agree with Rowe & Lowell that the clinical and x-ray findings after 1 year offer a reliable guide to the prognosis. Patients under 10 years of age were excluded.

Again, as in our previous study, patients with closed manipulative reduction tended to show improvement or up-grading in their results as the years passed, while the reverse is true of those who had had open operations. Granting that the hips which required open operation were probably more severely injured at the time of the original accident, no doubt operative intervention further jeopardized the blood supply and enhanced deterioration, a development which has been pointed out by many authors.

Follow-up examinations were performed by the authors in 94 patients, by other members of our clinic staff in 45 cases, and by questionaires plus x-ray films in 15.

ETIOLOGY

The automobile remains the dominant culprit in all reported series. In our first investigation it was the cause in 70 % of the injuries, while in the current series 85 % of the injuries were attributable to the automobile. Falls and falling objects caused 21 % of the injuries in the first study compared to 8 % in the second. Other causes accounted for 7 % in each group. The rare causes are interesting; the first study showed that motorcycle, tractor, and railroad accidents caused three each, while in the second study, motorcycles caused four, tractors one, and railroads one. Injury by horses changed from one in the first study to four in the second, by football from zero in the first study to four in the second (Table 4).

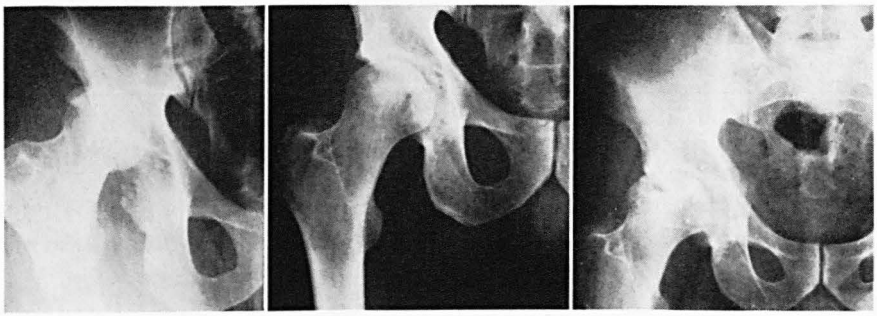

Figure 6. Posterior grade II dislocation. Reduced at 36 hours, in traction for 8 weeks. Three-year follow-up: avascular necrosis and infarct in head.

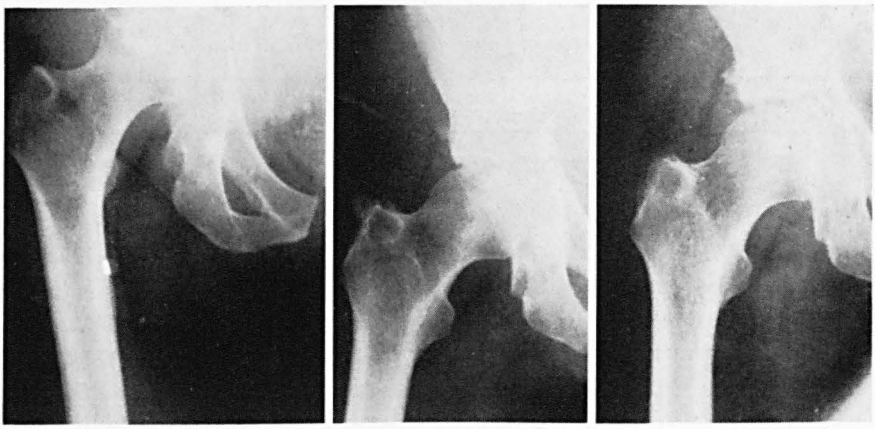

Figure 7 A. Posterior grade III dislocation with inner acetabular wall instability. Before reduction, after reduction and after 4 weeks in traction.

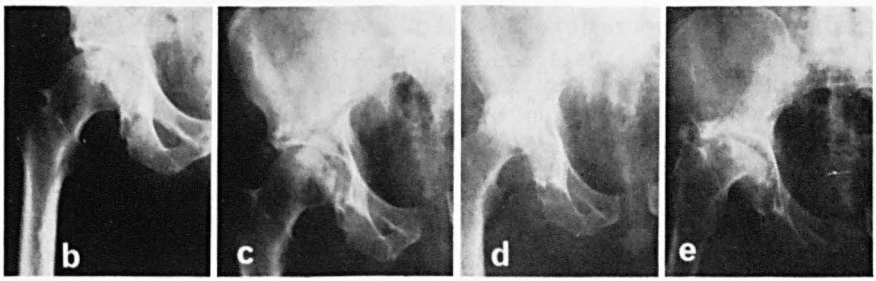

Figure 7 B. Traction was discontinued at 6 weeks. C. Gradual redislocation. D. Follow-up after 1 year and E. After 12 years.

Table 4.

Etiology		No. of hips	%
Automobile		190	85
Falls & falling objects		18	8
Others		14	7
Motorcycles	4		
Tractors	1		
Football	4		
Railroad car	1		
Horse	1		
Cows	2		
Airplane	1		
Total		222	100

Table 5. Age at time of injury—222 patients.

Age (years)	No. of patients	%
11–20	34	15
21–30	30	13
31–40	49	23
41–50	41	19
51–60	32	14
61–70	23	10
71 +	13	6
Total	222	100

AGE

The involvement acording to chronological *age* of the patients was very similar in the two groups (Table 5). Dislocations are more apt to occur during the active years of youth and middle age. Before 15 years of age, the patient will more likely have a slipped capital femoral epiphysis, while after 60 years, he is more prone to fractures. In this older age group it is interesting to note that three patients had associated fractures of the opposite hip.

COMPLICATIONS

Trauma severe enough to produce a fracture-dislocation of the hip will in most instances cause additional injury to the body. Severe injury to

the brain, spine, chest, and abdominal viscera are frequently associated with dislocation of the hip. Watson-Jones warned us of the danger of the various positions in an automobile and how the knee striking the dashboard of a car with the hip flexed or legs crossed sets the stage for dislocations. We believe that the left hip is more frequently injured in an automobile accident because the driver braces the left foot against the floor of the car while moving the right foot from the accelerator to the brake; the left leg is also placed in a position of wider abduction.

In our current study of 220 patients, 109 (50 %) sustained associated fractures in other bones at the time of the dislocation. Fifty-six (25 %) had lacerations of the face and fractures of the facial bones. Eleven (5 %) had fractures of the femur on the same side as the dislocated hip, and in one the fracture was bilateral. We believe that many of these crippling injuries can be prevented by the proper use of seat belts, and by the use of safer design principles in automobile construction.

RESULTS FOLLOWING CLOSED REDUCTION

(In The Current Study)

In 125 hips treated initially by closed manipulation, 101 were posterior dislocations, 23 were central and one was an obturator displacement. The results in the 101 posterior dislocations showed 77 excellent or good results, while 24 were fair or poor. The 23 central dislocations showed 11 excellent or good results and 12 that were fair or poor. The one with an obturator dislocation had, as expected, an excellent result. Many of the fair and poor results subsequently required reconstructive operations.

RESULTS FROM EARLY SURGICAL MANAGEMENT

(In The Current Study)

Primary treatment in 29 patients involved operative reduction or operation to correct acetabular and femoral head defects. Twenty-four of these were posterior dislocations, and five were central. The 24 hips with posterior dislocations showed 17 (70 %) excellent or good results and seven (30 %) fair or poor, while the five central dislocations showed one good and four fair or poor.

Ten patients with Grade III posterior dislocations had early manipulative reduction, but their open fixation of the acetabulum was de-

layed from 2–19 days, with an average delay of 6 days. These showed one poor, two good and seven excellent results.

In six patients with Grade I posterior dislocations the loose fragments were removed from the acetabulum. Of these, two had a good result; both were reduced and operated less than 12 hours post injury. In the other four patients the reduction and operation was delayed 48 hours, 23 days, 25 days, and 42 days respectively. All four had a final poor result. Two of these later had a successful cup arthroplasty. Again, it becomes quite obvious that early and definitive treatment is imperative. Epstein has emphasized the importance of early removal of any and all loose bony fragments from the acetabulum.

Four patients had a prosthesis primarily; they were in the older age group, the youngest being 47 years of age, and the others 63, 66, and 76 respectively. The 76-year-old had a Judet prosthesis and an unsatisfactory result; the other three had Austin Moores and good results.

One patient, age 36, with a Grade IV posterior dislocation at 9 days post injury, had an open reduction and at the same time a fixation of an intertrochanteric fracture with an angle nail, and, as you would anticipate, a poor result.

INFLUENCE OF THE TIME OF REDUCTION ON THE FINAL RESULT

Table 6 shows the results correlated with the length of time the dislocation remained unreduced. One hundred and one patients with posterior dislocations were treated initially by closed manipulation. Of the 85 patients reduced within the first 12 hours after dislocation, 79 (93 %) had an excellent or good result, and six (7 %) had a fair or poor result.

Table 6. Results correlated with the time the dislocation was reduced: Closed.

Hours		0–12		12–24		24–48		48 +		Total
Grade		E&G	F&P	E&G	F&P	E&G	F&P	E&G	F&P	
Post.	I	31	–	–	–	–	–	–	–	30
	II	32	1	–	–	–	5	–	4	41
	III	7	3	–	–	–	–	–	5	12
	IV	9	2	–	–	–	–	–	2	13
Total		79	6	–	–	–	5	–	11	101

In this group there were 31 posterior Grade I's and all of these had an excellent result. Interestingly, all 31 of these patients with Grade I injuries were allowed full weight-bearing 2–4 weeks after injury.

No reductions were done between 12 and 24 hours post injury. Five hips were reduced between 24 and 48 hours after the injury and all had an unsatisfactory result. Eleven hips reduced after 48 hours all showed an unsatisfactory result. Thus 16 patients whose hips were reduced after 24 hours all had unsatisfactory results.

As noted in our original study and in the excellent report by Thompson & Epstein, a delay in reduction of more than 24 hours invariably leads to an unsatisfactory result. In our present series it is gratifying to see that in 85 out of 101 patients with posterior dislocation, the manipulative reduction was accomplished within the first 12 hours after the injury.

The results in 23 central dislocations (Table 7) showed 12 hips reduced in the first 12 hours, and of these eight had an excellent or good result and four fair or poor. The other 11 hips were reduced after 48 hours and there were 10 fair or poor results and one good. (The one good result has been followed for only 1 year, so this may or may not be the final answer.)

Table 7. Results in central dislocations correlated with the time the dislocation was reduced.

Hours		0–12		12–24		24–48		48 +		Total
Grade		E&G	F&P	E&G	F&P	E&G	F&P	E&G	F&P	
Central	I	1	–	–	–	–	–	–	–	1
	II	5	1	–	–	–	–	–	6	11
	III	2	3	–	–	–	–	1*	4	10
	IV	–	–	–	–	–	–	–	–	–
Total		8	4	–	–	–	–	1	10	23

ANESTHESIA

General anesthesia was used in 155 patients for accomplishing reduction. Valium and/or Demoral sedation was used in 17 cases, spinal anesthesia in one, and nothing or unknown in 29 patients (Table 8). The use of a strong sedative such as Valium and Demoral is a recent innovation with us. Even though it is extremely important that the dislocation be reduced as soon as possible, it is also important that in one's

haste no further damage be done to the hip, and therefore sufficient relaxation is important.

Table 8. Anesthesia necessary for reduction.

Gen. Anes.	155
Sed. (Valium or Demoral)	17
Spinal	1
Unknown	29
Total	220

It is mandatory that adequate x-ray evaluation be obtained before and after reduction. One must properly assess the general condition of the patient, the correct position of the dislocation and the extent of the fractures. Postoperative x-ray studies should be made while the patient is still under anesthesia; the final position of the hip and that of any fragments must be accurately determined. If fragments of bone are left in the weight-bearing articular surface of the joint, this will invariably produce a rapid destruction of the cartilage, deterioration of the joint, and a poor result.

SCIATIC NERVE INJURY

In our first study sciatic nerve injury occurred in 13 % of the patients and in the second study in 19 %. The number of patients is too small to be of any statistical significance, but we might postulate from the increase in nerve involvement that modern trauma is becoming more violent and more severe. Recovery from nerve injuries varies a great deal depending upon the site and the extent of the damage. The peroneal division is more vulnerable to trauma than the anterior tibial division and its ability to recover is much inferior.

Of the 154 patients followed in this study, 30 (19 %) suffered sciatic nerve injury (see Table 9). Eighteen patients had isolated peroneal division injury, but none had isolated anterior tibial branch involvement. Both divisions were involved in eight patients and in four patients the description was indeterminate. Recovery was complete in 13 patients, while 10 had only up to 50 % recovery, two had permanent pain and little or no return of motor function, and in five follow-up information was inadequate (Table 10).

After reduction of the dislocations, if the sciatic nerve pain persists

for as much as 2 weeks or there is x-ray evidence of bone fragments in the sciatic notch area, the nerve should be explored. Nerve injury, if present, nearly always occurs in the Grades II and III posterior dislocations and is rarely seen in a Grade I or in any other type of dislocation. However, we have seen sciatic nerve involvement in a Grade I central dislocation; this undoubtedly is from direct contusion of the nerve.

Table 9. Sciatic nerve injury in 220 patients.

Peroneal div. (only)	18
Anterior div. (only)	0
Both div.	8
Inadeq. info.	4
Total	30 or 19%

Table 10. Sciatic nerve injury: Results.

Complete recovery	13
Incomplete recovery	10
Permanent	2
Lost to follow-up	5
Total	30

SECONDARY RECONSTRUCTIVE OPERATION

In comparing the results of reconstructive operations in this current series with those in our first study, we find a great deal of conflict. In the first series there were eight fusions, and three osteotomies to correct position in previously ankylosed hips, and all of these had a final good functional result. In this current study there were seven fusions and only three had a good result, while four were poor (two of these were failures of fusion).

The cup arthroplasties fared only slightly better; in the original series there were ten arthroplasties with six good and four unsatisfactory results. In this current series there were seven, with four good results and three unsatisfactory.

No prostheses were inserted prior to 1952. In our current study five prostheses were used; four had good results and one was poor. Subtrochanteric osteotomy was done in only one case and this was 9 years post injury. It produced a good result.

POSTERIOR GRADE III DISLOCATIONS

In our current series of patients who received destructive, explosive types of acetabular injury, the best results were in those who were treated surgically. Their hips were reduced promptly and held in traction; then, at an appropriate time (usually several days later), the acetabular fractures were reduced and fixed with screws. The posterior approach was used and any small, loose intraarticular fragments were discarded. Immobilization in plaster or traction was continued in all of these patients for 5–6 weeks; vigorous muscle rehabilitation for all muscles about the pelvis, back and extremity were continually and religiously carried out. However, the patients in the overall series who were treated without open operation gave a higher percentage of good results in all except the Grade III injuries.

DEATHS

There were ten deaths in this second series, but only two of these can be attributed to the dislocations. One of these died of a cardiac arrest during the general anesthetic preparatory to manipulation. Another died on the fourth postoperative day from an embolism following an open reduction. The other eight died of extensive injuries to other parts of the body, such as head, chest, abdomen, liver, and other viscera. These patients were suffering from excessive trauma and had an associated dislocation of the hip. We do not believe that the dislocated hip in these eight patients was the cause of death.

CASE REPORTS

DISCUSSION

The factors most responsible for poor results following fracture-dislocation of the hip are:

The severity of the initial trauma.
The amount of delay between dislocation and reduction.
The complications and the associated injuries.
Repeated unsuccessful attempts at reduction.
The age of the patient at the time of the dislocation.

Nicol, reporting on 144 traumatic dislocations of the hip, and Brove on 264, stated that the time from dislocation and reduction to full

weight-bearing has a definite influence on the end result. They, along with Phemister and others, also believe that this has an influence on the development of avascular necrosis, but this has not been our experience. We believe that as soon as the acetabulum is stable and its fractured components healed, the patient can begin full weight-bearing. This prolonged period of abstaining from weight-bearing will have no definite influence on the end result.

Traumatic dislocation in the child presents a different problem; the injury usually is much more benign than in the adult. Funk, reporting on 40 traumatic dislocations of the hip in children, had 14 in patients under 5 years of age. He found most of these very easy to reduce by manipulation, and no avascular necrosis or arthritic changes developed. Four of his patients between the ages of 6 and 10 were quite difficult to reduce and three required open reduction; all of these had a poor result.

In a follow-up study on 51 dislocated hips, the Pennsylvania Orthopaedic Society reported similar findings; that is, children under 6 years of age had few, if any, complications. They reported good results from early reduction; of those reduced within the first 24 hours, 41 out of 45 had normal hips. They had 18 hips in which reduction was delayed for 24 hours and results showed eight normal and ten abnormal. They observed that the severity of the initial trauma had a marked influence on the results. Reporting on those hips with less severe trauma they found that just over 14 % were abnormal, while those with more severe injury showed 60 % with poor results. Like us, Funk and the Pennsylvania Group found no correlation between the period of abstaining from weight-bearing after reduction and the final result.

Pipkin, in reviewing 55 cases of Grade IV fracture-dislocations, observed that those fractures of the femoral head that occurred below the fovea centralis showed a much better prognosis than those above this level. He also noted that prompt closed reduction followed by traction or immobilization invariably gave the best results. In those cases in which closed reduction could not be successfully accomplished, a small percentage of good results were obtained by open reduction with or without internal fixation of the head fragments. He reported two instances of fractures of the surgical neck occurring at the time of attempting closed reduction. Henry & Dayumi reported one fracture of the femoral head and 17 fractures of the femoral neck occurring during attempts at closed reduction. This points up the extreme importance of gentleness in attempting manipulative reductions.

In comparing the 222 hips studied recently and the 194 studied in 1952, the findings are quite comparable. Certainly the basic principles of treatment remain the same.

The importance of an immediate and correct diagnosis with prompt repositioning of the femoral head in the acetabulum is paramount.

Gentleness in handling these severely injured patients and atraumatic reduction of the hips are essential.

After reduction, the hip must remain stable in the acetabulum. In the Grade I dislocations this is usually no problem, but Grades II and III either posterior or central present a major challenge.

In the Grade III posterior dislocation the best results are obtained by prompt repositioning of the head, followed by open restoration with internal fixation of the acetabulum.

In the posterior Grade II's that are stable after reduction, protection by traction or body plaster for 6 weeks will usually ensure a good result.

It is imperative that any and all fragments of bone or loose cartilage remaining in the hip joint after reduction be removed within the first few days.

Those hips with Grade II or III central dislocations will respond best to adequate traction carried out over a sufficient period of time, usually 3 months.

Hips with explosive injury to the acetabular dome will produce the poorest result.

Lateral x-rays of the hips and pelvis are necessary for an accurate diagnosis.

Immediate and accurate repositioning of the head in the acetabulum, followed by internal fixation of the disrupted acetabulum when this can be accomplished simply, and fixation with two or three screws will give the best result. However, in spite of Smith's & Knight's report we hasten to discourage open operation on those badly comminuted explosive types of inner wall acetabular fractures. These can best be treated by prolonged skeletal traction applied in the longitudinal and lateral planes for a minimum of 3 months.

The most neglected phase of treatment in fracture-dislocation of the hip is proper, thorough, and prolonged muscle rehabilitation. We have found repeatedly that the patient who must use his limb extensively in his daily activities during convalescence will invariably obtain the best functional result. Also the best range of motion will be found in the plane of his maximum activity. "The *function* of any joint after it has

been anatomically restored will return in direct proportion to the *strength* of the musculature which controls that joint".

CONCLUSIONS

Dislocation and fracture-dislocation of the hip demand an accurate diagnosis and immediate reduction.

Dislocations which are unreduced for more than 24 hours will produce unsatisfactory results.

The age of the patient after the age of 15 has little or no influence upon the result.

Lateral x-rays of the hip are indicated in all dislocations and must be made whenever there is the least doubt concerning the accuracy of reduction or the position of any fragments.

Open surgery for fixation of posterior acetabular fractures may be safely delayed for 7–10 days provided the femoral head is repositioned in the acetabulum and maintained by adequate traction.

Severe inner wall fractures and explosive dome fractures of the acetabulum that are not suitable for open reduction (and very few are) can best be treated by skeletal traction. This traction should be applied in both the longitudinal and lateral planes and continued for at least 3 months.

Provided the acetabulum is stable, the period of time from reduction to weight-bearing will have little or no influence upon the final result.

Grade IV dislocations with fractures of the femoral head above the fovea should have immediate reconstructive surgery. In those patients over 50 years of age a prosthesis or total hip is recommended; in younger patients a cup arthroplasty or an arthrodesis is sufficient.

Avascular necrosis and degenerative arthritis develop in direct proportion to the severity of the trauma and the time of delay in reduction.

Adequate rehabilitation of the muscles about the hip and lower limb is imperative if a good result is to be obtained.

SUMMARY

This report reviews two groups of cases: 194 fracture dislocations of the hip reviewed in 1952, and a follow-up of 222 additional fracture dislocations of the hip seen since then. The report describes the methods of treatment used in terms of the various classifications of fracture

dislocations of the hip and analyses the results, the complications and the comparative results in these two groups of patients.

Recommendations as to the proper form of management for each type of fracture dislocation are presented.

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Correspondence to:

Marcus T. Stewart
The Campbell Clinic Inc.
Memphis, Tennessee 38104
U.S.A.