One-stage combined surgery with or without preoperative traction for developmental dislocation of the hip in older children

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ABSTRACT

Purpose. To compare one-stage combined surgery with and without preoperative traction, in older children with developmental dislocation of the hip (DDH).

Methods. Records of 9 children who underwent combined surgery for DDH with preoperative traction in 12 hips (group 1) and 12 undergoing the same procedure without preoperative traction in 16 hips (group 2) were retrospectively reviewed. The surgery consisted of open reduction, Salter’s innominate osteotomy and femoral shortening with derotation varus osteotomy. The mean age of the patients at the time of operation was 5.8 years. The mean follow-up period was 5.9 years.

Results. At final follow-up, clinical outcome in group 1 was worse than that in group 2, though radiographic assessment demonstrated no significant difference between the groups.

Conclusion. One-stage combined surgery without preoperative traction is effective in the treatment of DDH in older children, and has a lower complication rate, but radiographically the groups did not differ.

Key words: hip dislocation, congenital; surgical procedures, operative

INTRODUCTION

The treatment goal of developmental dislocation of the hip (DDH) is to maintain the concentric reduction so as to provide an optimal environment for the development of the femoral head and acetabulum. The success rate of conservative treatment such as the Pavlik harness or other abduction devices may improve if the diagnosis is made in the early period of life. The normal development of the hip joint (femoral head and acetabulum) is jeopardised whenever the diagnosis is delayed.

The treatment of DDH in older children is a challenge because they have high displacement of the hip, contracted soft tissues, insufficiency of the acetabulum and increased anteversion of the femoral head. In such patients it is difficult to reduce the
Table 1
Demographic and clinical data pertaining to individual patients

| Patient No.* | Sex | Age at operation (years) | Follow-up duration (years) | Traction duration (days) | Sharp acetabular angle\(^{19}\) | Final centre edge angle\(^{20}\) |
|--------------|-----|--------------------------|---------------------------|--------------------------|-----------------------------|---------------------------------|
|              |     |                          |                           |                          | Preoperation                 | Final                           |
| Group 1      |     |                          |                           |                          |                             |                                 |
| 1            | M   | 5.3                      | 9.0                       | 13                       | 32°                         | 10°                             |
| (2)          | M   | 6.1                      | 8.2                       | 19                       | 38°                         | 10°                             |
| 3            | F   | 7.7                      | 4.0                       | 7                        | 50°                         | 45°                             |
| (5)          | F   | 3.3                      | 5.2                       | 19                       | 38°                         | 20°                             |
| 6            | F   | 8.0                      | 9.0                       | 20                       | 38°                         | 30°                             |
| 7            | F   | 4.2                      | 7.4                       | 17                       | 41°                         | 18°                             |
| 8            | F   | 4.3                      | 5.5                       | 9                        | 43°                         | 12°                             |
| (9)          | F   | 5.0                      | 4.7                       | 15                       | 41°                         | 12°                             |
| 10           | F   | 6.3                      | 9.9                       | 17                       | 36°                         | 22°                             |
| 11           | F   | 6.7                      | 5.3                       | 19                       | 48°                         | 28°                             |
| 12           | F   | 5.9                      | 7.2                       | 18                       | 32°                         | 14°                             |
| Group 2      |     |                          |                           |                          |                             |                                 |
| 13           | F   | 4.3                      | 8.3                       |                          | 35°                         | 18°                             |
| 14           | F   | 4.9                      | 4.0                       |                          | 38°                         | 15°                             |
| 15           | F   | 8.0                      | 3.6                       |                          | 40°                         | 20°                             |
| (16)         | F   | 8.9                      | 2.9                       |                          | 38°                         | 20°                             |
| 17           | F   | 3.5                      | 3.8                       |                          | 50°                         | 35°                             |
| (18)         | F   | 4.5                      | 2.8                       |                          | 50°                         | 35°                             |
| 19           | F   | 8.4                      | 3.8                       |                          | 42°                         | 25°                             |
| 20           | F   | 5.6                      | 8.4                       |                          | 40°                         | 15°                             |
| 21           | M   | 6.0                      | 2.7                       |                          | 38°                         | 14°                             |
| 22           | F   | 3.7                      | 9.0                       |                          | 42°                         | 18°                             |
| (23)         | F   | 4.9                      | 7.8                       |                          | 38°                         | 10°                             |
| 24           | M   | 8.5                      | 4.8                       |                          | 48°                         | 12°                             |
| 25           | F   | 5.9                      | 6.6                       |                          | 36°                         | 14°                             |
| 26           | F   | 5.5                      | 5.6                       |                          | 32°                         | 18°                             |
| (27)         | F   | 8.5                      | 2.6                       |                          | 42°                         | 12°                             |
| 28           | F   | 6.0                      | 9.0                       |                          | 42°                         | 15°                             |

* In patients with bilateral dislocation, the second operation is in parentheses

femoral head into the acetabulum, maintain the concentric reduction and obtain a satisfactory functional hip joint.\(^8\)

The treatment of choice for DDH in older children is open reduction of the hip in conjunction with femoral shortening, and iliac osteotomy or acetabuloplasty.\(^6\)–\(^16\) Nonetheless, complications such as avascular necrosis, redislocation, subluxation and stiffness of the hip may compromise the outcome.

The present study aimed to compare one-stage combined surgery with and without preoperative traction.

METHODS

Between 1995 and 2002 inclusive, one-stage combined surgery with or without preoperative traction was performed in 41 patients (56 hips) in the Cumhuriyet University in Turkey. Children with neuromuscular disease, not available for follow-up, or not fulfilling entry criteria (e.g. not having Salter’s osteotomy or ≥9 years old) were excluded. Records of 21 children (28 hips) were retrospectively reviewed and classified into 2 groups: group 1 included 12 hips of 9 patients who underwent one-stage combined surgery with preoperative traction; group 2 included 16 hips of 12 patients who underwent one-stage combined surgery without preoperative traction (Table 1). All but 3 patients were male. The mean age of the patients at the time of surgery was 5.8 (range, 3.3–8.9) years. The mean follow-up duration was 5.9 (range, 2.6–9.9) years.

Group 1 had preoperative traction for 7 to 20 days (mean, 15.9 days), depending on the degree of contracture. The traction weight was one eighth of the body weight, as per a previous recommendation.\(^9\) Group 2 did not have preoperative traction. Both
### Table 1
Demographic and clinical data pertaining to individual patients

| Patient No.* | Sex | Age at Follow-up | Traction duration | Radiographic outcome per Severin criteria²¹ | Complications |
|--------------|-----|------------------|-------------------|---------------------------------------------|---------------|
|              |     | (years)          | (days)            |     |                                      |               |
| Group 1      |     |                  |                   |     |                                      |               |
| 1 (11)       | M   | 5.3              | 13                | II (good)                                   |               |
| 1 (2)        | M   | 6.1              | 19                | II (good)                                   | Coxa vara, leg length discrepancy, avascular necrosis |
| 13 (F)       | F   | 7.7              | 17                | 50° | Poor                                  | Redislocation, leg length discrepancy, avascular necrosis |
| 14 (F)       | F   | 3.3              | 19                | 38° | Good                                  | -             |
| 1 (5)        | F   | 4.3              | 20                | 38° | Fair                                  | Femur length discrepancy, avascular necrosis |
| 16 (F)       | F   | 8.0              | 18                | 50° | Good                                  | Coxa vara, leg length discrepancy, avascular necrosis |
| 17 (F)       | F   | 4.2              | 17                | 41° | Good                                  | -             |
| 18 (F)       | F   | 4.3              | 19                | 43° | Excellent                             | -             |
| 19 (F)       | F   | 8.4              | 17                | 42° | Good                                  | -             |
| 20 (F)       | F   | 5.6              | 17                | 40° | Good                                  | -             |
| 21 (M)       | M   | 6.0              | 19                | 38° | Excellent                             | -             |
| 22 (F)       | F   | 3.7              | 18                | 42° | Good                                  | -             |
| 23          | M   | 4.9              | 7.8               | 38° | Excellent                             | -             |
| 24 (M)       | M   | 8.5              | 4.8               | 48° | Good                                  | -             |
| 25 (F)       | F   | 5.9              | 6.6               | 36° | Excellent                             | -             |
| 26 (F)       | F   | 5.5              | 5.6               | 32° | Good                                  | -             |
| 27          | F   | 8.5              | 2.6               | 42° | Excellent                             | -             |
| 28 (F)       | F   | 6.0              | 9.0               | 42° | Excellent                             | Avascular necrosis |

* In patients with bilateral dislocation, the second operation is in parentheses.

**Postoperatively,** a spica cast was applied with the hip flexed 30°, abducted 30°, and rotated neutrally. The cast was removed 6 weeks later, and an abduction brace or cast was used for a further 6 weeks.

Clinical assessment was performed using McKay criteria¹⁷ with the modification by Barrett et al.¹⁸ It evaluated pain symptoms, gait pattern, status of the Trandelenburg sign, and the range of motion of the hip joint (Table 2). Radiographs were taken at presentation, immediately postoperation, and at final follow-up to measure the Sharp acetabular angle¹⁹ and the centre-edge (CE) angle²⁰ and were evaluated using the Severin criteria²¹ (Table 3). Presence of avascular necrosis of the femoral head was graded by the criteria by Kalamchi and MacEwen²²: grade I changes affecting the ossific nucleus, grade II lateral physeal damage, grade III central physeal damage, and grade IV total damage to the femoral head and physis.

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groups had various degrees of contracture. The use of traction did not indicate the severity of the disease; some surgeons used the traction regularly for a continuous period and then discontinued the practice.

Surgery was performed using a Klisic approach (n=24 hips) or a lateral femoral proximal approach (n=4 hips). All patients underwent psoas tendon release, open reduction, femoral varus derotation osteotomy with shortening followed by innominate osteotomy in the standard manner. The amount of correction of femoral varus derotation and shortening was determined intra-operatively. The mean derotation angle was 29° (range, 10°–60°) and the range of shortening was 1 to 3 cm. A mean 15° of varus angulation was added to the subtrochanteric osteotomy. The osteotomy site was fixed with a paediatric blade plate or a small dynamic compression plate. Capsular repair was performed in all patients as described by Wenger et al.¹⁵
Table 3
Severin criteria for radiographic evaluation21

| Grade | Criteria |
|-------|----------|
| Excellent (IA) | CE angle >19°, age 6–13 years; CE angle >25°, age >14 years |
| Good | IB | CE angle 15°–19°, age 6–13 years; CE angle 20°–25°, age >14 years |
| Fair (III) | Dysplastic hip, no subluxation; CE angle <15°, age 6–13 years; CE angle <20°, age >14 years |
| Poor | IV | Subluxation |
| | V | Femoral head in false acetabulum |
| | VI | Redislocation |

* CE denotes centre-edge

RESULTS

Table 1 shows the demographic data and clinical details and outcomes of individual patients and individual hips. There was no significant difference between the 2 groups regarding the age and duration of follow-up. According to the McKay criteria, in group 1 clinical outcome was excellent in one (8%) of the hips, good in 4 (33%), fair in 5 (42%), and poor in 2 (17%). In group 2, clinical outcome was excellent in 5 (31%) hips, good in 8 (50%), fair in 2 (13%) and poor in one (6%). Thus, 5 (42%) of the hips in group 1 and 13 (81%) in group 2 had satisfactory results, whereas 7 (58%) of the hips in group 1 and 3 (19%) in group 2 had unsatisfactory results. This difference was statistically significant (p=0.049, unpaired t test).

According to the Severin criteria, in group 1, radiographic outcome was excellent in 6 (50%) hips (Fig.), good in 5 (42%) and poor in one (8%). In group 2, radiographic outcome was excellent in 14 (88%) hips, and good in 2 (13%). Thus, radiographically, 11 (92%) of the hips in group 1 and 16 (100%) in group 2 had satisfactory results, whereas one (8%) in group 1, and none (0%) in group 2 were unsatisfactory. This difference was not statistically significant (p=0.428, Fisher’s exact test). The mean Sharp acetabular angle of all patients was 41° (range, 32°–50°) before surgery and 19° (range, 10°–45°) at final follow-up. The mean CE angle at final follow-up was 37° (range, 15°–53°). All patients had improved Sharp acetabular angle and CE angle. There was no significant difference between the preoperative and corresponding final follow-up Sharp acetabular and CE angles; the preoperative status and severity of DDH in the 2 groups was similar.

In one patient (case 3), the hip redislocated and required further surgeries. She had hip joint ankylosis in the false acetabulum. Leg length discrepancy was noted in 4 patients (cases 2, 3, 5, and 6; mean discrepancy, 4.5 cm). Avascular necrosis was detected in the hips of 5 patients (cases 2, 3, 5, 6, and 20): one in Kalamchi and MacEwen grade IV, and 4 in grade III. Only one patient (case 3) with avascular necrosis received further surgery. The use of different surgical approaches did not correlate with outcome. No patient developed an infection or graft displacement.

DISCUSSION

Combined surgery is the treatment of choice for DDH in older children.6–16 It consists of open reduction, pelvic osteotomy or acetabuloplasty, and femoral shortening with derotation osteotomy, and whenever necessary a varus osteotomy.

Ombredanne23 reported open reduction and femoral shortening for treatment of DDH in 1932. Open reduction combined with femoral shortening, iliac osteotomy, reorientation of the femoral head and neck, and medial transposition of the iliopsoas muscle has been used since 1963.9 Combined surgery is recommended for DDH in children aged 7 years to puberty. In younger children, open reduction and femoral shortening is combined with either a Salter
osteotomy of the innominate bone or a Pemberton acetabuloplasty; in older children, it is combined with the Chiari osteotomy. Open reduction of the hip and femoral shortening combined with acetabuloplasty is reported to decrease pressure on the femoral head and is indicated for unreduced dislocations in patients aged 6 to 13 years.

There have been many comparative studies directed at preoperative traction and femoral shortening. Some reported favourable outcomes following femoral shortening with preoperative traction. Others advocated open reduction and femoral shortening without preoperative traction. Satisfactory outcomes were reported in DDH patients aged ≥2 years who underwent femoral shortening without preoperative traction. Preoperative traction decreases technical difficulties during the operation and helps to diminish the length of the excised femoral segment. Nonetheless, Morel recommended progressive heavy traction in patients aged one to 8 years. Open reduction with femoral shortening without preoperative traction was preferred in patients ≥3 years, and was associated with lower incidence of avascular necrosis. Schoenecker and Strecker reported a 54% incidence of avascular necrosis and a 31% incidence of redislocation after the use of skeletal traction in patients older than 3 years.

Shih and Shih found no difference in outcome in patients treated with or without traction. In the present study, complications were fewer in patients who underwent open reduction and femoral shortening without preoperative traction.

The Salter osteotomy was performed in all of our patients. It is recommended for individuals with DDH aged 18 months to 6 years. Its use has been widely reported in older children up to 9 years of age. However, some surgeons prefer other types of acetabuloplasty, such as shelf procedures, the Pemberton, the Chiari, or the Albee, and others used all of those variably.

CONCLUSION

One-stage combined surgery without preoperative traction is clinically more effective in the treatment of DDH in older children, by virtue of a lower complication rate. Radiographic outcomes were not significantly different. Since this study was retrospective and patients were not randomly allocated, a prospective randomised trial recruiting a larger series of patients is needed to verify our findings. In addition, longer follow-up is needed to determine whether degenerative osteoarthritis will develop.

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