Clinical and Experimental Rheumatology 2004; 22: 270-272.

Stapling of knees with valgus deformity in children with juvenile chronic arthritis

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This study was supported by a Finnish Cultural Foundation grant.

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Received on January 5, 2004; accepted in revised form on December 31, 2004.

Key words: Juvenile chronic arthritis, valgus deformity, knee, temporary epiphyseal stapling.

ABSTRACT

Objective. *Leg length discrepancy and excessive knee valgus are potential complications of juvenile chronic arthritis of the knee. The aim of the present study was to evaluate retrospectively the safety and efficacy of temporary stapling of the knee epiphyses in management of valgus deformities of the knee in children with JCA.*

Methods. *Medical data of the patients with temporary epiphyseodesis due to knee valgus deformity (KVD) were studied. 177 knees in 112 patients were found with sufficient data for evaluation. Patient documents and radiographs of these patients were evaluated.*

Results. *Mean age at the time of operation was 8 years (range: 2 – 17) in 19 males and 93 females. The patients are predominantly affected by aggressive polyarticular disease. Preoperative mean valgus angle was 11° (IQR: 9, 14) and at staple removal 4° (IQR: 2, 5). In 120 of 177 knees (68% [95% CI: 61 – 74], $p < 0.001$) the physiological angle (3-8°) was reached. Median time of stapling was 10 months (IQR: 8, 13). Five reversible and one irreversible (3% [95% CI: 2 to 7]) major complications were documented among the 177 stapled knees.*

Conclusion. *Temporary epiphyseal stapling enables flexible correction of KVD in children with JCA. Low complication rate encourages the use of the method. Prompt follow-up is, however, important in avoing excess over-correction to varus.*

Introduction

Temporary epiphyseal arrest with staples in the management of knee malalignment was introduced in 1949 by Blount and Clarke (1). The epidemiology and pathogenesis of juvenile chronic arthritis (JCA) in relation to knee alignment disturbances have been published elsewhere (2). Patients with marked joint deformity are at high risk of developing insufficiency fractures of the lower extremity (3). A few studies on stapling in children with JCA have been published (4-9). The safety and effectiveness of temporary epiphyseal stapling in management of leg length discrepancy in patients with JCA has been shown (10).

In the present study the aim was to evaluate retrospectively the safety and efficacy of temporary stapling of knee epiphyses in managing knee valgus deformity (KVD) in children with JCA. The physiological valgus angle of the knee has been set at 5 to 7 in literature (11). In this retrospective study population the range was set to 3-8.

Materials and methods

According to a previous study 76% of Finnish children with JCA were treated at the Rheumatism Foundation Hospital (RFH) in the 1980s (2). In the earlier decennia the proportion was somewhat lower. Complete records on operative treatment at RFH were collected to identify patients who had undergone temporary epiphyseal stapling of the knee due to knee valgus deformity during 43 years after founding of RFH.

The first temporary arrest of epiphyseal growth at RFH for the management of knee valgus deformity was performed May 17th 1956, and until the end of 1999, a total of 119 children with JCA had undergone the procedure. All these patients were included in the present retrospective study and during the examination period a total of 225 knees were stapled, 38 (17%) of the procedures being re-operations due to a recurrent malalignment. The re-operations were excluded, giving 177 primary operations, altogether.

Subsequently, the medical records of the operated patients were evaluated to examine the indications of stapling; the diagnostic criteria were settled according to the proposition by European League Against Rheumatism (EULAR, 12). During the decades the indication for stapling has varied according to orthopaedist. In the earlier years KVDs up to 15 – 18 had been tolerated. In recent years some pubertal patients with KVD less than 10 were operated on, especially, if there in the follow up had been signs of progressive ankle valgus deformity.

For the purpose of the retrospective study, medical data of the patients with temporary epiphyseodesis due to knee valgus deformity were studied, and the

following variables were recorded: sex, age at the onset of arthritis, age at operation, immunosuppressive medication (oral steroid or ACTH, methotrexate, azathioprine, chlorambucil or cyclosporine), pattern of stapling and all the complications which could be related to stapling. Valgus deformity was measured clinically and from weight-bearing (standing) knee radiographs at two time points: before stapling and at the time of staple removal. The length of the stapling period was recorded. Nine patients were excluded due to insufficient data leaving 177 knees of 112 patients for evaluation.

The results are expressed as median and inter-quartile range (IQR). The most important descriptive values were expressed with 95% confidence interval (C.I.). Statistical significance was calculated using binomial test.

Results

Sex distribution in the study group was 19 boys (29 knees) and 93 girls (148 knees), and mean age at the time of operation was 8 (range: 3 – 16) years and 7 (2– 15) years, respectively. The mean duration of the disease by the time of the operation was 5 (range: 1 – 14) years. Distribution of the patients into different diagnostic categories according to EULAR criteria is presented in Table I. The number of patients with oligoarthritis developing to polyarthritis (extended oligoarthritis) is included in the Table I. Eighty of the patients were on immunosuppressive medication at the time of stapling, 64 with oral steroid or ACTH and 16 with various combinations of methotrexate, azathioprine, chlorambucil or cyclosporine.

Table I. Distribution of diagnoses in the study group.

Diagnosis	All patients No. (%)
Systemic arthritis	18 (16)
Polyarthritis:	
RF-positive	5 (4)
RF-negative	46 (41)
Oligoarthritis:	39 (35)
Extended	25 (22)
Psoriatic arthritis	2 (2)
Other arthritis	2 (2)
Total	112 (100)

Table II. Distribution of stapling methods used.

Method of stapling	All patients N (%)
FM1	2 (1)
FM2	158 (89)
FM3	2 (1)
FM2-TM2	12 (7)
FM2-TM1	2 (1)
TM2	1 (1)
Total	177 (100)

F: femur; T: tibia; M: medial side; 1 – 3: number of staples inserted.

Most of the knees (158 / 177) were stapled only at the distal femoral epiphysis by using 2 vitallium staples medially, other patterns are shown in Table II. The average age of the patients with only medial femoral staples was 7 (2 – 15) years at the time of temporary epiphyseodesis. In 14 cases the staples were also installed on the medial aspect of the proximal tibial epiphysis; the average age of these patients was 9 (2 – 16) years. In one child stapling of the proximal tibia only was performed; the age of the patient was 9 years.

Pre-operative median knee valgus angle was 11° (IQR: 9, 14) and at the time of removal of the staples 4° (IQR: 2, 5). Median time of temporary epiphyseal stapling was 10 (IQR: 8, 13) months. In 120 of 177 knees (68% [95% CI: 61 – 74], $p < 0.001$) the physiological angle (3 – 8°) was reached. In 23 knees (13% [95% CI: 8 – 19], $p < 0.001$) the knee angle turned to varus. The results are presented in Figure 1. In all the cases (35/177) with the knee angle being physiological in native roentgenograms before stapling the operation was based on clinical findings. Twenty-one (60%) of these patients showed physiologic knee valgus both in roentgenorams and clinically by the time of staple removal. In four knees, the follow-up visit was delayed and resulting varus deformity required stapling of the lateral side of the knee epiphyses in order to correct the iatrogenic deformity. In the other 10 knees the staple removal was scheduled so that the knee was slightly over-corrected. In further follow-up these knees resulted in physiological angle, and none of the knees have so far required implant arthroplasty or other orthopaedic intervention.

Six (3% [95% CI: 2 to 7]) major complications were documented among the 177 stapled knees. One patient with deep infection developed a fistula in the knee joint which was managed by fistulotomy. In three cases the staples were inserted incorrectly and in one case one staple loosened prematurely. These were re-inserted without delay. The only irreversible complication was one premature epiphyseal plate closure in a 5-year-old girl causing a progressive varus deformity. Several re-staplings on the lateral side of her femur and tibia and epiphyseodesolyses on the medial femur were made in an unsuccessful attempt to correct the malalignment. A supracondylar osteotomy of the femur was then performed at the age of 14. The varus deformity of the knee and the high activity of the underlying disease finally caused extensive destruction in all lower extremity joints.

Discussion

In the light of previous studies on leg length discrepancy the results of this retrospective study show that the use of stapling in correcting angular malalign-

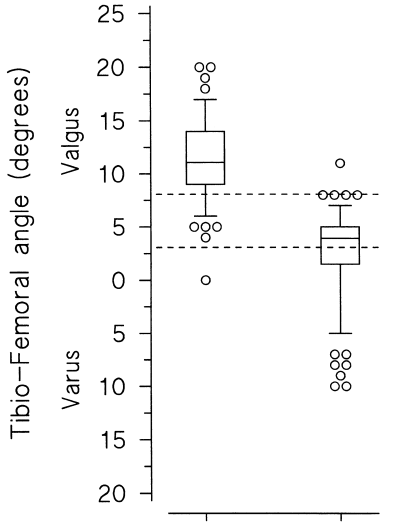

Fig. 1. Tibio-femoral angle before stapling and at the time of staple removal. Box shows the distance between the quartiles with the median marked as a line. The whiskers show ninety-five percentiles. Extremes are shown as open circles.

Fig. 2. Native X-rays taken in two of the study patients, demonstrating medial stapling due to valgus deformity in the (**a**) distal femur, and (**b**) distal femur and proximal tibia.

ment requires a lot of clinical experience. In this study, the tibiofemoral angle was measured clinically and from weight-bearing knee radiographs. However, the lower extremity must be evaluated as an entity in planning the operation. A combination of knee and ankle valgus deformity can disable the whole leg and thus stapling may be indicated even in cases with only moderate knee valgus. The majority of patients with valgus deformity is affected by aggressive systemic arthritis and polyarthritis (both rheumatoid factor negative and positive) compared to the predominantly oligoarthritic patients in the previous study on leg length discrepancy. Patient selection and indication for operative treatment should be carefully set in the treatment of these disabling deformities.

The complication rate (3%) of the operated knees was somewhat lower in this study compared to the 10% in our previous study on managing leg length discrepancy with temporary epiphyseal stapling (10). This may result from a lower number of staples used in treating valgus deformity, or from a shorter stapling time. Most of the major complications related to epiphyseal stapling are reversible, but considering the possible risk of premature closure of growth plates, the operation must always be carried out under fluoroscopic guidance.

In our institute, 38 (17%) of the 225 operations were re-staplings for KVD due to continuing disease activity and recurrent malalignment in the course of the disease. All primary KVD corrections had yielded satisfactory results in these cases. The follow-up of the children after removal of staples is thus important, and, with low complication rate and short stapling time, temporary epiphyseal stapling allows flexible re-correction when required.

We find temporary epiphyseal stapling a safe and effective method in managing knee valgus deformity in patients with JCA. The required duration of epiphyseal stapling is somewhat shorter in correcting valgus deformity compared to that in leg length discrepancy treatment. This must be borne in mind in planning the operation and follow-up. We consider stapling at clinical or radiographic valgus exceeding 10-15, or even smaller angle with notable ankle valgus deformity. In excessive valgus and closer to the cessation of growth we use both femoral and tibial staples; in other cases only femoral staples are used. Follow-up is arranged at 2-month intervals to avoid overcorrection, and staples are removed at a slight overcorrection (tibiofemoral angle 0-3º). Immediate post-operative mobilisation with physical therapist and continuous passive motion (CPM) is commenced on the first day after operation.

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