

NECK-SHAFT ANGLE REMODELLING AFTER DEROTATION VARUS OSTEOTOMY FOR SEVERE PERTHES DISEASE

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Sixteen patients with a severe form of Perthes disease who underwent containment derotation varus osteotomy (DVO) of the proximal femur were studied retrospectively for the neck-shaft angle (NSA) remodelling. Analysis of results after a mean follow-up of 7 years (minimum of 5 years and maximum of 8.7 years) showed mean preoperative, immediate postoperative and the latest follow-up neck-shaft angles (NSA) as 135°, 110° (none had varus less than 90°) and 125°, respectively. A statistically significant relationship between NSA remodelling and the immediate post-op NSA ($P = 0.0035$) was established. Patients with smaller postoperative NSA showed better remodelling compared with those who had higher degrees of NSA immediately after the surgery. No significant relationship was found between the degree of NSA remodelling and the patient's age at diagnosis, age at surgery, severity of Perthes or the Stulberg grading at maturity. The authors conclude that up to 90° or more varization after DVO for Perthes disease can remodel with time, and the remodelling process is independent of the patient's age at diagnosis, age at surgery, or severity of Perthes or Stulberg grading at maturity.

Keywords : Perthes disease ; femoral osteotomy ; femoral neck shaft angle ; hip joint.

Mots-clés : Maladie de Legg-Calvé-Perthes ; ostéotomie fémorale ; angle cervico-diaphysaire ; hanche.

operated group had good-to-fair radiological results, compared with only 41% fair and no good results in the nonoperated group (6). Jani and Dick (4) have compared three different methods of treatment : conservative treatment alone ; immediate varus osteotomy ; osteotomy alone when risk factors occurred and have shown that the best results were obtained by the immediate varus osteotomy operation. Hoikka *et al.* (3) have noted that the strongest prognostic factor for good results was containment of the femoral head after osteotomy. Opinions are divided on the optimal amount of varus acceptable to achieve containment of the femoral head by derotation varus osteotomy (DVO). Weiner *et al.* (9) have concluded that the amount of varus angulation should barely position the femoral head beneath the lateral rim of the acetabulum, avoiding varus less than 105°, and that consideration should be given to performing a greater trochanteric epiphysiodesis at the time of initial femoral osteotomy. Evans *et al.* (1) have demonstrated that the varus neck-shaft angle and leg-length discrepancy resulting from the osteotomy was not permanent. Even though DVO is not an uncommon procedure for the severe grades of Perthes disease, the issue of NSA remodelling after

INTRODUCTION

A study from the authors' institution comparing nonoperative and operative methods of treatment in Perthes disease showed 75% of the hips in the

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this surgery has not been well represented in the literature. We have reviewed 16 hips to look into the way NSA behaves after DVO in severe Perthes.

MATERIALS AND METHODS

Roentgenograms of 25 patients, who underwent derotation varus osteotomy of the femur for Perthes disease after 1983 were retrospectively analyzed. Femoral neck-shaft angles were calculated on the supine anteroposterior pelvis xrays with the big toe pointing to the roof taken preoperatively, postoperatively and at the last follow-up visit in all 25 patients. Roentgenograms were analyzed for NSA., lateral pillar grading, and preoperative head at risk signs (HARS). At the most recent follow-up, all hips were rated with the method of Mose and classified according to the Stulberg *et al.*, (8) grading system. Data on two patients were not sufficient for analysis, and seven patients with less than 5 years of follow-up were excluded from the study. This left us with 16 patients for the analysis of neck-shaft angle remodelling after derotation varus osteotomy for Perthes disease (2 female and 14 male patients).

RESULTS

Mean follow-up after DVO was 7 years (5 to 8.7 years), mean age of the patients at last follow-up was 13.4 years (8.9 to 21.11 years), mean age at surgery was 6.5 years (3.6 to 9.2 years) and mean age at diagnosis was 5.98 years (3 to 8.6 years). By the lateral pillar classification (2), 7 hips were grade B and 9 hips were grade C. Preoperative head at risk signs (HARS) analysis showed 1 HARS in 2 patients, 2 HARS in 2 patients, 3 HARS in 7 patients, 4 HARS in 2 patients, 5 HARS in 1 patient and none in 2 patients. Mose's concentric circles showed less than 2-mm incongruity in 11 patients and more than 2-mm incongruity in 5 patients. Of the patients studied, 3 patients belonged to Stulberg grade I, 8 were Stulberg II, 3 were Stulberg III and 2 patients were classed as Stulberg grade IV.

Neck-shaft angle analysis

Mean neck-shaft angle before surgery was 135.1° (125°-160°). Mean post-op neck-shaft angle

immediately after surgery was 110° (90°-125°). Mean neck-shaft angle at the last visit (mean follow-up of 7 years) was 125.38° (110°-138°, standard deviation 7.667°). Mean remodelling of NSA was 15.38° (0°-43°, standard deviation 10.04°). Out of 3 patients who had NSA. of less than 120° at maturity, 2 were more than 8 and one was 4 years of age at the time of surgery. Five patients were below the age of 13 and 4 of these had remodelled the NSA to more than 120° at the time of this study. The number of years of follow-up since surgery, preoperative NSA, age at diagnosis, Stulberg grading, age at last xray, present NSA. and the age at surgery did not show any statistically significant relationship ($P > 0.0500$) with the amount of NSA remodelling (table I). Pearson correlation showed a statistically significant relationship between NSA immediately after surgery and the degrees of remodelling at the latest visit NSA ($P = 0.0035$). Fig. 1 illustrates the regression analysis of immediate postoperative NSA with the degree of remodelling of the NSA ($R^2 = 0.47$). The patients with the lesser degrees of NSA immediately after DVO remodelled the most, and those who had higher NSA after surgery remodelled the least.

DISCUSSION

Derotation varus osteotomy (DVO) is a commonly performed procedure for severe Perthes disease in the authors' institutions. There is no consensus with regard to the amount of acceptable varus to attain containment of the femoral head (9). Karpinski *et al.* (5) have observed that the bone remodelling in response to surgical varus was unpredictable. However the same study (5) has observed that the remodelling at follow-up in those with more varus immediately after surgery was less satisfactory compared with lesser degrees of varus immediately after surgery. Our results contradict this finding. Four patients in the group studied had less than 105° of varus angle. Patients who had 90° and 95° of varus angle remodelled to 133° and 116°, respectively. In most of the subjects studied the degree of remodelling plateaued once the NSA had approached 120°. Outcome analysis at maturity showed 70% of the patients had excellent results

Table 1. — Data of all patients' Herring grading, NSA, NSA remodelled over the follow-up period, age at last follow-up and Stulberg grading at maturity

Hospital Number	Herring Grading	Preop N.S.A	Age at Operation	Postop N.S.A	Present N.S.A.	N.S.A. Remodelled	Age at last xray	Stulberg grading
Patient 1	B	140°	8.11	110°	110°	0°	17.4	3
Patient 2	C	140°	6.1	120°	126°	6°	15.9	4
Patient 3	B	125°	7	115°	123°	8°	13.5	1
Patient 4	C	135°	4.11	125°	133°	8°	13.5	1
Patient 5	C	135°	3.6	115°	123°	8°	21.11	2
Patient 6	B	135°	9.2	115°	125°	10°	12.7	3
Patient 7	B	130°	5.5	110°	123°	13°	10.2	2
Patient 8	C	160°	4.8	120°	135°	15°	9.7	1
Patient 9	C	135°	8.1	100	115°	15°	14.3	2
Patient 10	B	135°	6.11	105°	120°	15°	13.11	2
Patient 11	C	130°	4.7	110°	128°	18°	8.9	2
Patient 12	B	135°	8.3	110°	128°	18°	13.2	2
Patient 13	C	130°	7	110°	130°	20°	14.3	3
Patient 14	C	132°	4.1	95°	116°	21°	9.1	2
Patient 15	C	135°	6.3	110°	138°	28°	14.5	4
Patient 16	B	130°	4.9	90°	133°	43°	13.1	2

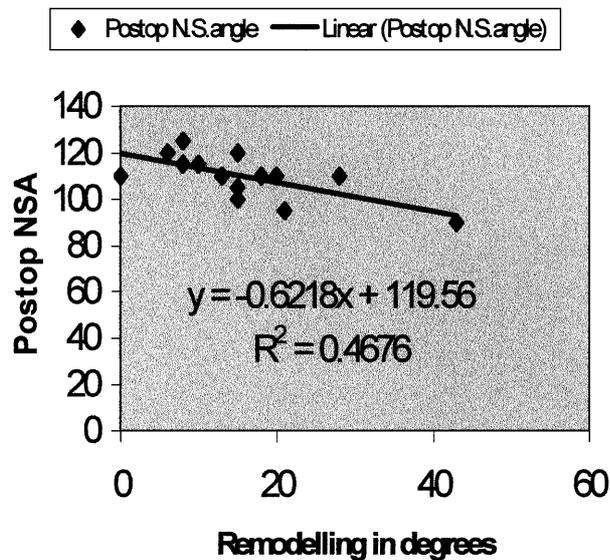


Fig. 1. — Postop. N. S. angle and remodelling

(Stulberg grade 1 and 2). The degree of varus angle did not affect Stulberg grading at maturity. Postoperative varus of the two patients who had grade IV Stulberg was 120° and 110°. Of the five patients below the age of 13 at the time of this

study, four had already remodelled the NSA to more than 120°. Since there was no deterioration in the NSA in any of the case studied, we can only assume that these four patients will either continue to improve the NSA with time or may have reached the upper limit of remodelling. Without consideration of the rotational component of DVO, comparing the preoperative to the post-operative radiographs for the evaluation of NSA was not possible.

The authors conclude that the neck-shaft angle after varus derotation osteotomy for severe Perthes disease does remodel and is not dependent on factors like age at diagnosis, age at operation or the severity of Perthes disease. Prognostic Stulberg grading is not affected by the degree of NSA after surgery. The remodelling is influenced by the physiological need of near normal varus angle for the efficient functioning of the hip abductors. The patients with the lesser degrees of NSA immediately after DVO remodel the most, and those with higher NSA remodel the least. In the circumstances where the surgeon may have to increase the varus of the femur to less than 90° to obtain containment one can still expect the femur to remodel satisfactorily.

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SAMENVATTING

I. S. TALKHANI, D. P. MOORE, F. E. DOWLING, E. E. FOGARTY. Evolutie van de cervico-diaphysaire hoek na derotatie-varisatie osteotomie bij ernstige gevallen van Legg-Calvé-Perthes.

Zestien patiënten werden retrospectief bestudeerd. Na een gemiddelde follow-up van 7 jaar (uiterste waarden 5 en 8,7 jaar) noteerde men preoperatief een gemiddelde cervico-diaphysaire hoek van 135°, onmiddellijk postoperatief van 110°, en finaal van 125°. Tussen de onmiddellijk postoperatieve correctie en de finale uitkomst bestond er een statistisch significante correlatie: $p = 0,0035$. Hoe groter de onmiddellijke correctie, hoe meer

uitgesproken het uiteindelijk resultaat. Er was echter geen significante correlatie met de leeftijd bij diagnosestelling, de leeftijd bij operatie, de ernst van de aandoening of de Stulberg score. De auteurs besluiten dat de cervico-diaphysaire hoek zich gedeeltelijk kan herstellen, zelfs wanneer de hoek werd gereduceerd tot 90° of minder. Dit herstel is onafhankelijk van de leeftijd bij diagnose of ingreep, van de ernst van de aandoening, en van de Stulberg score..

RÉSUMÉ

I. S. TALKHANI, D. P. MOORE, F. E. DOWLING, E. E. FOGARTY. Evolution de l'angle cervico-diaphysaire après ostéotomie fémorale de varisation et de dérotation dans les formes graves de maladie de Legg-Calvé-Perthès.

Seize patients qui présentaient une forme grave de maladie de Legg-Calvé-Perthes ont subi une ostéotomie de varisation et de dérotation au fémur proximal ; ils ont été étudiés rétrospectivement en ce qui concerne l'évolution de l'angle cervico-diaphysaire. L'analyse des résultats avec un suivi moyen de 7 ans (extrêmes : 5 ans et 8,7 ans) a montré les valeurs moyennes suivantes pour l'angle cervico-diaphysaire : 135° en préopératoire, 110° en post-opératoire immédiat et 125° au dernier recul. Il existait une corrélation statistiquement significative entre le remodelage de l'angle cervico-diaphysaire et la valeur de l'angle immédiatement après l'intervention ($p = 0,0035$). Les patients dont l'angle cervico-diaphysaire était le plus réduit ont montré la correction la plus importante, par comparaison avec ceux dont l'angle conservait une valeur élevée immédiatement après l'opération. Aucune relation significative n'a été observée entre le remodelage post-opératoire de l'angle cervico-diaphysaire et l'âge au moment du diagnostic, l'âge au moment de l'opération, la gravité de la maladie ou l'évaluation selon Stulberg. Les auteurs concluent que, jusqu'à une valeur de 90° voire davantage, on peut attendre un remodelage de l'angle cervico-diaphysaire après ostéotomie de varisation-dérotation pour maladie de Legg-Calvé-Perthès. Le processus de remodelage apparaît indépendant de l'âge au moment du diagnostic, de l'âge à l'opération, de la gravité de la maladie ou de l'évaluation selon Stulberg.