ORIGINAL ARTICLE

Outcome analysis of surgical treatment of Blount disease in Nigeria

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Abstract

Objective: The objective was to evaluate the results of surgery of Blount diseases using the postoperative metaphyseal-diaphyseal angle (MDA) at 2-year follow-up. Background: The goal of surgery in Blount disease is to restore the normal configuration of the articular surface of the proximal end of the tibia in proper relationship to the mechanical axis of the limb. Our hypothesis is that patients will demonstrate significant clinical improvements following surgery and predictive models can be developed. **Materials and Methods:** All patients who had surgery for Blount disease from January 2002 till December 2007 at the National Orthopaedic Hospital Lagos Nigeria and follow-up for 2 years were included. Data extracted were gender, affected limb, Blount's type, age when deformity was noted, and age at presentation, preoperative femoral tibial angle (TFA), Langenskiold score, preoperative MDA, and postoperative MDA. Linear regression was used to assess the predictive effect of selected clinical and radiographic measures on post-MDA. The model was adjusted for confounders: age deformity noted, age at presentation, affected limb, Blount's type, and gender. Variables in the adjusted model achieving significance at $P < 0.05$ were included in a multiple regression analysis. **Results:** Eighty-six knees in 57 patients were included. The mean preoperative and postoperative MDA at 2 years was $34.6° \pm 8.9°$ and $10.6° \pm 4.3°$, respectively. Seventy-three knees (84.9%) have correction of ≤10° with recurrence in 13 (15.1%) knees at 2 years ($P < 0.001$). The postoperative MDA was graded into good outcome if ≤10°. There was a significant improvement between preoperative MDA and postoperative MDA ($P < 0.001$). The multilinear analysis demonstrated that the preoperative MDA was a significant predictor of the postoperative MDA. The postoperative MDA was predicted with a standard error of 0.92 with the following formula: post-MDA = ~ 1.027 + 0.404 pre-MDA. **Conclusion:** The mean postoperative MDA of 84.9% of the knees operated at 2 years was $9.4° \pm 3.1°$ with recurrence rate of 15.1%. Postoperative MDA is a good outcome measure for surgical treatment of Blount disease and surgical correction should aim at producing post MDA ≤10°.

Key words: Blount disease, metaphyseal--diaphyseal angle, Nigeria, outcome

Introduction

In 1922, Erlacher[1] reported the first case of tibia vara. Blount[2] in 1937 reported 13 more cases and reviewed 15 other previously reported cases. Blount disease is the eponym for tibia vara, the term he suggested in 1932. Blount disease is a growth disorder of the proximal tibia.[1,2] It has been postulated to result from increased stress on the medial a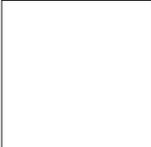spect of the knee.[3-8] The long-term effect of the varus is to potentiate the development of degenerative arthritis of the knee.[9,10] For this reason, early diagnosis and unloading of the growth plate, by bracing or osteotomy before 4 years of age, have been advocated.[11-13]

Many methods have been used to evaluate surgical outcome of Blount disease.[14-17] The goal of surgery for Blount disease

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has been well defined but the use of postoperative MDA as an outcome measure has not been established. The aim of this study is to identify preoperative clinical and radiologic parameters that correlate with postoperative MDA grade scores in order to establish treatment goals in the settings of surgical management of Blount disease. Our hypothesis is that patients will demonstrate significant clinical improvements following surgery and predictive models can be developed.

Materials and Methods

All patients who had surgery for Blount disease from January 2002 till December 2007 at the National Orthopaedic Hospital Lagos Nigeria and followed up for 2 years were included in this study. Data extracted were gender, affected limb, Blount's type, age when deformity was noted, and age at presentation. The femoral-tibial angle (TFA) was measured standing with a goniometer in all the patients and recorded in degrees. Standing (weight bearing) preoperative plain radiograph were taken. Lateral views and anterior-posterior views with the patella centered and pointing anteriorly were obtained as described by Jones *et al*.[17] Langenskiold scores were measured and appropriately graded and MDA were measured with the goniometer and appropriately recorded. A standing anterior-posterior view of the knee at 6-month post surgery was assessed and MDA was also measured and recorded in degrees. The postoperative MDA was graded into good outcome if ≤10° and poor if it is >10°.

Statistical method

As noted in the work of Jones *et al*,[17] linear regression was used to assess the predictive effect of selected measures of geometry and angulation on the postoperative MDA as the outcome measure. Each possible risk factor was fitted into the unadjusted model and a second model adjusting for five potential confounders (age deformity noted, age at presentation, affected limb, Blount's type, and gender). Terms achieving significance in the adjusted model ($P < 0.005$) were included in a multiple regression model of risk factor for the postoperative MDA.

Linear terms for angulation variables were included in our final model when statistically significant. Statistical Package for Social Sciences (SPSS) 17.0 was used to analyze the data; P-value of <0.05 is significant. Ethical approval was given before the commencement of this study.

Results

Eighty-six knees in 57 patients (3.8 F:1 M) were operated on. The mean age at presentation was 9.7 ± 3.9 years and the mean age when the deformity was noted was 2.1 ± 1.8 years.

Forty-eight (84.2%) were classified as infantile Blount (deformity before the age of 4 years), 7 (12.3%) patients

were juvenile Blount (deformity between 4 and 10 years) and 1 (3.5%) patient was adolescent Blount (deformity after 10 years). There were 29 bilateral limbs, 24 unilateral left limb, and 4 unilateral right limb involvement. The modal Langenskiold score was 4, with the mean score of preoperative TFA and MDA and postoperative MDA were 36.8° ± 14.4°, 34.6° ± 8.9°, and 10.6° ± 4.3°, respectively. The surgical procedure carried out was 39 (68.4%) lateral-based wedge osteotomy, 10 (17.5%) dome osteotomy, 5 (8.8%) double based, and 3 (5.3%) chevron osteotomy. At 2 years of evaluation, 73 knees have a post-MDA of 9.4 ± 2.6 ($P < 0.001$). There was recurrence in 13 knees at 2 years evaluation.

The Pearson correlation analysis showed a small but significant correlation ($r = 0.298$, $P = 0.01$) between the age at the time of surgery and the postoperative MDA. Interestingly postoperative MDA was also correlated with preoperative Langenskiold ($r = 0.416$, $P < 0.001$), preoperative TFA ($r = 0.568$, $P < 0.001$), and preoperative MDA ($r = 0.805$, $P < 0.001$). The analysis of variance (ANOVA) showed no significant difference between the different types of surgery or between the difference type of limb affection (bilateral, unilateral left or right) and the postoperative MDA. The analysis of the entire group of patients (paired *t*-test) demonstrated a significant improvement between preoperative MDA (38.4° ± 13.6°) and postoperative MDA (10.6 ± 4.3°) ($P < 0.001$). The Table 1 shows the mean and SD for preoperative MDA and postoperative MDA (all patients, then by surgery type, then by limb affection) and the *P*-value from paired *t*-test analysis.

The multilinear analysis with a stepwise condition demonstrated that the preoperative MDA was a significant predictor of the postoperative MDA. The postoperative MDA was predicted with a standard error of 0.92 with the following formula ($r = 0.788$, r square = 0.616): post-MDA = -1.027 + 0.404 pre-MDA. Of note, none of the other parameters entered in the stepwise analysis (age, type of surgery, Blount type, gender, Langenskiold or preoperative TFA were significant predictor of the postoperative MDA).

Table 1: Mean and SD for pre-op and post-op MDA (all patients, then by surgery type, then by limb affection) and the *P*-value from paired *t*-test analysis

Group	N	MDA pre	MDA post	t-test
All patients	57	34.6° ± 8.9°	10.6° ± 4.3°	<0.001
Lateral based wedge osteotomy	39	36.6° ± 9.8°	11.4° ± 6.2°	<0.001
Dome osteotomy	10	30.4° ± 9.2°	10.6° ± 4.7°	<0.001
Chevron	3	54.0° ± 17.09°	14.0° ± 12.7°	0.005
Double based osteotomy	5	41.3° ± 12.3°	12.3° ± 6.8°	0.005
Unilateral right	4	31.3° ± 9.3°	11.9° ± 7.2°	0.011
Unilateral left	24	31.7° ± 10.3°	11.1° ± 7.6°	<0.001
Bilateral	29	37.8° ± 11.5°	12.9° ± 8.1°	<0.001

Discussion

The main goal of surgery of Blount disease is to restore the normal configuration of the articular surface of the proximal end of the tibia in proper relationship to the mechanical axis of the limb. This is to forestall the subsequent development of degenerative arthritis of the knee.[9,10] The aim of this study is to evaluate the results of surgery of Blount diseases using the postoperative metaphyseal--diaphyseal angle (MDA). This study evaluates whether for a predetermined postoperative range of radiologic parameters as outcome measure, there are preoperative clinical and radiologic parameters that would demonstrate significant correlation and to developed a predictive model for preoperative planning. These preoperative parameters that have a significant relationship with a well-defined postoperative outcome measure could then serve as a guide during surgery to ensure a good outcome.

The MDA is a measure of the varus deformity of the proximal tibial metaphysis; a higher positive value reflects greater varus deformity.[17] The preoperative MDA is the only clinical and radiologic parameter that showed significant correlation with postoperative MDA. This postoperative MDA value of ≤10° is consistent with the established recommendation of physiologic alignment for normal weight bearing force of the tibia. In this study, 84.9% of the patients had a postoperative MDA of 9.4° ± 3.1 at 2 years of review. This is however significant. This study suggests that our hypothesis is true and supports the idea that achieving a postoperative MDA ≤10° is associated with overall good surgical outcome.

Conclusions

The mean postoperative MDA of 84.9% of the patients at 2 years was 9.4° ± 3.1° with recurrence rate of 15.1%. Postoperative MDA is a good outcome measure for surgical treatment of Blount disease and surgical correction should aim at producing post-MDA ≤10°.

Acknowledgments

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