ORIGINAL PAPERS

Nagoya J. Med. Sci. **59.** 129 ~ 133, 1996

MACROMOTION OF THE FEMORAL COMPONENT IN ARTIFICIAL HIP JOINT

YUKIHARU HASEGAWA, TOSHIKI IWASE, KOUICHI KAWAMOTO, SEIKI IWASADA and HISASHI IWATA

Department of Orthpaedic Surgery, Nagoya University School of Medicine, Nagoya 466, Japan

ABSTRACT

Macromotion of the femoral component was analyzed in seven loose hips associated with six patients utilizing the manual compression and distraction test. The mean vertical and varus movement of these hips were 6.4 mm and 1.2 degrees, respectively. Out of a total 120 cementless total hip arthroplasties, there was no macromotion in the control group of six patients with moderate to severe thigh pain. There was also no relationship between macromotion and the severity of thigh pain. Micromotion or rotational instability, which could not be analyzed by conventional stress radiograms, may contribute substantially to thigh pain.

Key Words: Total hip arthroplasty, Macromotion, Radiogram

INTRODUCTION

Cementless total hip arthroplasties have been recommended to solve large bone defect-related problems at the time of revision surgery, which have been a common concern in cemented total hip arthroplasty.[2,4] Unfortunately, cementless total hip arthroplasty has been unsuccessful in solving various controversial problems, in particular, failed stem fixation.[1] In cementless total hip arthroplasty, it was thought that if initial fixation failed, micromotion would cause thigh pain: and that in cemented total hip arthroplasty, initial fixation would not exhibit any complications. While studies of three-dimensional micromotion of about 100 microns or less have been reported,[6,8] there were few reports about macromotion observed by conventional stress roentgenograms.

As discussed in this paper, our study sought to measure the macromotion in the loose femoral component of the artificial hip joint using conventional manual stress radiograms, and to compare and investigate the level of thigh pain in patients who received a cementless total arthroplasty with the loosened femoral component.

PATIENTS AND METHODS

Six out of 15 patients (or a total of seven hip joints) were investigated, each of whom received revision total hip arthroplasty from 1992 to 1994 due to definite loosening of the femoral

Correspondence to: Dr. Y. Hasegawa, Department of Orthopaedic Surgery, Nagoya University School of Medicine, 65 Tsurumai-cho, Showa-ku, Nagoya 466, Japan
Tel: (81)52-741-2111
Fax: (81)52-744-2260

Table 1. Patients data

Case	Age	Gender	Cause	BHP/THA	Cement	Infection	Vertical (mm)	Varus (degree)
1	51	M	ANF	BHP	−	−	14.9	1.1
2	61	F	OA	THA	+	−	2.2	2.2
3	53	M	ANF	BHP	+	+	10.0	1.0
4	64	F	Fr	THA	+	+	2.5	−0.5
	65			THA	−	+	6.4	0.0
5	58	M	ANF	THA	+	−	2.4	0.5
6	77	F	OA	THA	+	−	6.2	4.5

M: male, F: female
ANF: avascular necrosis of the femoral head
Fr: hip fracture
OA: osteoarthrosis
BHP: bipolar endoprosthesis
THA: total hip arthroplasty
Vertical: vertical movement
Varus: varus movement
Cement: + = arthroplasty with cement, − = arthroplasty without cement

component with an apparent clear zone. Three patients (three hip joints) were male and three were female (four hip joints) (Table 1). In case 3 macromotion was observed even after revision arthroplasty with the cementless femoral component. The average age at the time of each operation was 62 years (range: 51−77 years old). Prior to revision surgery, all patients had undergone hip arthroplasty 1−22 years previously (average: 9.0 years) and had complained of thigh and hip pain. The primary causes of disease were osteonecrosis of the femoral head in three patients (postoperative examination detected a deep infection in one patient), osteoarthrosis in two patients (two hip joints), and a cervical neck fracture in one patient (twice revised in the same case). Surgery consisted of two bipolar endoprostheses (cemented in one and cementless in the other), total hip replacement in four patients (five hip joints) with four joints cemented and one joint cementless. Before revision surgery, both case 3 and case 4 were treated with osteosynthesis and curettage for deep infection.

Patients were evaluated both clinically and radiographically. The clinical evaluations were made according to the location, degree of pain, gait capacity and overall Harris hip scores. Manual stress radiograms were made under an image intensifier with compression and distraction of legs using a weight of about 30 kg. The angle between the center of the femoral canal and the femoral component was measured. The distance between the tip of greater trochanter and the distal tip of the femoral component was measured. The vertical and varus movement of the stem were measured three times by a computer-associated digitizer (Graphtec Co., KL4300, Tokyo, Japan). The interobserver error of the vertical and varus measurement was 0.8 mm and 0.5 degrees, respectively. A radiogram of the frog leg position was also examined in the first five patients, but its findings were excluded because, due to the position of the leg in each case, the radiograms could not accurately measure movement. The control group of six patients (six hips) was evaluated for their pain level (in the range moderate to severe) using the same manual stress test to measure the motion of the femoral components. All patients were female with an average age of 64 years old (range: 56−70 years old). Two of the six patients with severe thigh pain were revised to total hip arthroplasty. Statistical analyses were performed by Student's test and chi-square test.

RESULTS

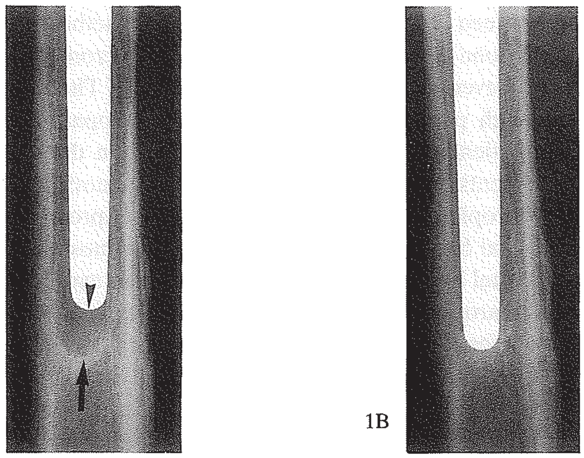
All patients before revision total hip arthroplasty had complained of thigh pain and five patients experienced inguinal pain. Of the cementless total hip arthroplasty patients, three had severe thigh pain, and three had moderate thigh pain. The severity of the thigh pain did not significantly correlate with the movement of the stem on the stress radiograms. All patients could not walk more than 500 m, and five required a crutch or a cane before revision surgery.

The results for six patients (six hips) with failed total hip arthroplasty or endoprosthesis are shown in Table 1. Stress radiograms indicated that compression of the stem showed vertical and varus movement at the same time in all but one hip. At the time of revision sugery, all femoral components apparently moved during the manual stress test. The mean vertical movement was 6.4 mm (range: 2.2—14.9 mm) and the mean varus movement was 1.2 degrees (range: —0.5—4.5 degrees). In six cementless hips, neither vertical nor varus movement was observed on conventional radiograms. No vertical macromotion more than 0.5 mm nor varus movement more than 0.5 degrees was observed in two patients who had revision arthroplasties with a cementless femoral component.

After revision surgery, thigh pain disappeared in all but one patient and all the of the pain-free patients could walk more than 1 km. The mean overall Harris Hip score improved from 52 to 78 points.

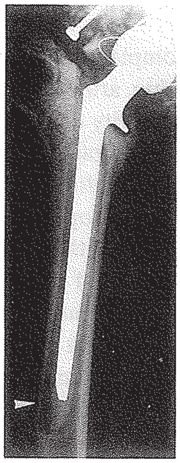
ILLUSTRATIVE CASE REPORTS

Case 1: A 51-year-old male was treated by bipolar endoprostheses due to bilateral avascular necrosis of the femoral head. Five years after surgery, the patient complained of severe thigh pain and felt as if he was putting on boots which were too large. Manual stress radiograms showed vertical movement of 14.9 mm and varus movement of 1.1 degrees concurrently (Fig 1A, B). At the time of surgery, macromovement was observed. The thigh pain completely disappeared after revision surgery.

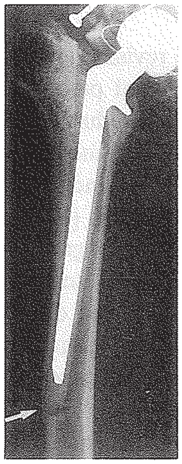


1A 1B

Figs. 1A, B: Antero-posterior roentgenograms of the right hip. Fig. 1A: under distraction roentgenogram. Fig. 1B: under compression roentgenogram. Pedestal and calcar were used as the reference points. Arrow showed the pedestal. The distance between the arrow and the tip of the femoral component (arrow head) indicated macromotion.



2A



2B

Figs. 2A, B: Antero-posterior roentgenograms of the right hip. Fig. 2A: under distraction roentgenogram. Fig. 2B: under compression roentgenogram. Arrow showed the tip of the cement. The radiolucent zone between the femur and femoral component (arrow head) indicated macromotion.

Case 2: A 61-year-old female was treated by cemented total hip arthroplasty. The patient complained of severe left thigh pain 6 years after primary total hip arthroplasty. Manual stress radiograms showed simultaneous vertical and varus movement of 2.2 mm and 2.2 degrees, respectively (Fig 2A, B). At the time of surgery, macromovement was observed. The thigh pain completely disappeared after revision surgery.

DISCUSSION

Micromotion is considered sufficient to cause thigh pain in failed cementless total hip arthroplasty.[8] The difference between macro- and micromotion is whether the measurement of the femoral component can be done or not by stress radiograms. Micromotion can be observed immediately after arthroplasty, even in the case of macromotion.[5,8] There was no relationship between macromotion and thigh pain in our study. Even when apparent macromotion was observed in three of the six patients, thigh pain was not severe. On the contrary, thigh pain was severe in three of the six patients, even when there was no macromotion in the cementless stem.

Cementless total hip arthroplasties are being developed to improve and solve the problems associated with cemented total hip arthroplasties.[4,9] One of the most serious ongoing problems associated with cementless total hip arthroplasty, is the thigh pain caused by the failed initial fixation.[3] Thigh pain occurs in around 5 to 20 percent of all patients. There is also the problem of osteolysis to be solved; the overall clinical and radiographic results were not superior to those of cemented total hip arthroplasty. It is speculated that the cause of thigh pain was due to micromotion of the femoral component. To evaluate micromotion, a roentgen stereophotogrametric analysis (RSA) was developed using tatalum ball markers.[5-8] However, there have been few reports about conventional stress radiograms. Three-dimensional analyses have failed due to inaccurate measurement of the leg, especially in the frog leg position. Stress radiograms indicated that compression of the stem showed vertical and varus movement at the same time in all but one hip. On the contrary, there was no macromotion in patients with thigh pain.

We concluded that micromotion or rotational instability, which could not be measured by conventional stress radiograms, may be the main cause of thigh pain.

REFERENCES

1) Berzins, A., Summer, D.R., Andriacchi, T.P. and Galante, J.O.: Stem curvature and road angle influence the initial relative bone-implant motion of cementless femoral stem. *J. Orthop. Res.*, 11, 758–769 (1993).
2) Engh, C.A., O'Connr, D., Jasty, M., McGovern, T.F., Bobyn, J.D. and Harris, W.H. Quantification of implant micromotion, strain shielding and bone resorption with porous-coated anatomic medullary locking femoral prostheses. *Clin. Orthop.*, 285, 13–29 (1992).
3) Green, D.L., Bahniuk, E., Libelt, R.A., Fender, E. and Mirkov, P.: Biplane radiographic measurements of reversible displacement (including clinical loosening) and migration of total joint replacement. *J. Bone Joint Surg.*, 65-A, 1134–1143 (1983).
4) Hua, J. and Walker, P.S.: Relative motion of hip stems under load: an in vitro study of symmetrical, asymmetrical and custom asymmetrical designs. *J. Bone Join Surg.*, 76-A, 95–103 (1994).
5) Kärrholm, J., Malchau, U.H., Snorrason, F. and Herberts, P.: Micromotion of femoral stems in total hip arthroplasty: a randomized study of cemented hydroxyapatite-coated, and porous-coated stems with roentgen stereophotogrammetric analysis. *J. Bone Joint Surg.*, 76-A, 1692–1705 (1994).
6) Nistor, L., Blaha, D., Kjellestrom, U. and Selvik, G.: In vivo measurement of relative motion between a cemented femoral total hip component and femur by roentgen sterophotogrammetric analysis. *Clin. Orthop.*, 269, 220–227 (1991).
7) Önsten, I., Sanzén, L., Carlsson, Å. and Besjakov, E.: Migration of uncemented, long-stem femoral components in revision hip arthroplasty: a 2–8 year clinical follow-up of 45 cases and radiostereometric analysis of 13 cases. *Acta Orthop. Scand.*, 66, 22–224 (1991).
8) Ryd, L.: Roentgen stereophotogrammetric analysis of prosthetic fixation in hip and knee joint. *Clin. Orthop.*, 276, 56–65 (1992).
9) Sugiyama, H., Whiteside, L.A. and Engh, C.A.: Torsinal fixation of the femoral component in total hip arthroplasty: the effect of surgical press-fit technique. *Clin. Orhtop.*, 275, 187–193 (1992).