The cementless Vektor stem used in total hip arthroplasty

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The cementless Vektor hip prosthesis stem is made of a special titanium alloy (TiAI6Nb7), and has a three-dimensional conus and an optimal proximal anchoring property. The aim of this prospective study was to scrutinise the first clinical and radiographical experiences of this stem used in 206 total hip replacements. The mean age of the patients including 126 women and 80 men was 54.6 years (range, 22.5-77.7 years). The mean follow-up time was 2.8 years (range, 1-5 years). The Merle d'Aubigné score improved from 9.3 to 17.1. A distal cortical hypertrophy was found twice, an atrophy of the proximal femur in 6 cases, and progressive radiolucent lines in one case. Two subfascial hematomas, two single dislocations, and two recurrent dislocations of the hip prosthesis, four lesions of the sciatic nerve (one persisting), two deep venous thrombosis, two pneumonias, and one lethal pulmonary embolism were detected. A stable proximal fixation was achieved in 95.6 % of the cases. Compared with other THA stems with a proximal anchorage, the outcome was improved with the Vektor stem.

Total hip replacement (THR) is one of the most successful principles in orthopaedic surgery. As the number of primary THRs of younger patients multiplies, the demands of the best available outcome including the bearing of increased biomechanical loading of the prosthesis grow. This had led to the more frequent use of cementless prosthesis among younger patients (1-3). To improve the attachment of the prosthesis implants, bony ingrowth, and fixation, special coatings (hydroxyapatite, porous coating), or materials (Ti and CoCr alloys) have been used (1-3).

The first cementless stems from the 1980's had a high rate of aseptic loosening with increased osteolysis, and thigh pain due to distal anchorage of the stem, and the polyethylene wear of the acetabular cup (4). In principle, the main difference between the different prosthesis is based on the force transmission depending on the type of the prosthesis anchorage (4-11). The distal anchoring has the disadvantage of proximal femoral atrophy, the distal cortical hyperthrophy, and thigh pain (11). With the use of Zweymüller stem a good longlasting clinical outcome, but also a high rate of proximal radiolucent lines have been observed. Thus the principle of proximal anchorage could be mor useful (5, 8, 11). Although good clinical results have been achieved in using the CLS stem, a high percentage of bone resorption of the proximal femur in the Gruen zones 1 und 7 referring to the problems of the proximal anchoring have been published (4, 5, 8, 9). A special attention should be paid to the surface treatment, and the design of a cementless hip prosthesis. The femoral stem should guarantee the proximal transmission of force to avoid the proximal femoral atrophy caused by stress shielding. The goal is to develop an implant that is optimal for anchoring, and tolerates well the loading of the prosthesis.

The Vektor stem is a cementless prosthesis stem made of a special titanium alloy (TiAI6Nb7). It has a three-dimensional conus, and ventral, dorsal, and lateral longitudinal ribs which are firmly attached to the spongious bone during the insertion of the stem, and thus improve the rotational stability by means of proximal fixation. The parableformed zones between longitudinal ribs improve the attachment of the stem to the bone, and preserve vital bone. A fourcorner crosssectional conical form prevents the distal anchoring, and minimizes cortical contact. The surface of the stem has a roughness of 40-60 µm Rz. The usual implants used are the Euroconus 12/14, 10 standard sizes (1-10) and 3 special sizes,

dysplasia stems (-l to -3). The aim of this prospective study was to scrutinise the first clinical and radiographical outcome of this stem.

Patients and methods

A total of 246 THRs were performed with the Vektor stem during 1.1.1997-31.12.2000. Of these, 206 could be followed-up. The mean age of the patients including 126 women and 80 men was 54.6 years (range, 22.5-77.7 years). The mean height of the patients was 186.4 cm (range, 150-193 cm). The average weight of the patients was 75.4 kg (range, 49-119 kg). The mean follow-up time was 2.8 years (range, 1-5 years). In all cases a ceramic femoral head was used. A standard acetabular cup was used in 96 cases, a Vektor cup (Fa. Peter Brehm, Weisendorf) in 41 cases, a cemented acetabular cup in 6 cases, and an acetabular reconstruction ring in 63 cases. Indications for THA were primary osteoarthritis in 96 cases, secondary osteoarthritis in 17 cases, osteoarthritis due to a dysplasia in 67 cases, destructive osteoarthritis in 4 cases, avascular necrosis of the femoral head in 18 cases, a femoral neck fracture in one case, and a stem revision because of an aseptic loosening in 3 cases (Table 1).
The Merle d'Aubigné score (12) was used for definition of the clinical outcome. The bone changes were observed from the standard anteroposterior and Lauenstein radiographs: progressive or not progressive local osteolysis, radiolucent lines in the zones according to Gruen (13), and heterotopic ossification by Brooker (14).

Results

The Merle d'Aubigné Score improved from the mean preoperative value 9.3± 2.3 to the mean postoperative value of 17.1 ± 1.9. A total of 204 patients were satisfied with the operation result. In two cases a distal cortical hypertrophy as a sign of distal fixation was observed. In 6 cases a proximal femoral atrophy, and in one case progressive radiolucent lines of zones 1 and 7 according to Gruen were detected. Otherwise a proper proximal anchorage of the stem was achieved. In 5 cases a general complication (two deep venous thrombosis, two pneumonias, one lethal pulmonary embolism), and in 12 cases a local complication (two evacuated subfascial hematomas, two single dislocations, two recurrent dislocations of the hip prosthesis, two acetabular loosenings, and four lesions of the sciatic nerve) were noticed (Table 2).

Discussion

As the number of primary THRs of younger patients multiplies, the demands of the best available outcome including the bearing of increased biomechanical loading of the prosthesis grow. This has led to the more frequent use of cementless prosthesis among younger patients, as well as to the improvement of the design and material of the prosthesis (1-3). In principle, the main difference between the prosthesis types is based on the force transmission due to the prosthesis anchorage (4-11).

Table 1. Indications for the total hip replacement with a Vektor stem followed-up for 1-5 years

Indication	Number
Primary osteoarthritis	96
Secondary osteoarthritis	17
Osteoarthritis due to dysplasia	67
Destructive osteoarthritis	4
Avascular necrosis	18
Fracture of the femoral neck	1
Stem revision	3
Total	206

With the use of distal anchorage e.g. in Zweymüller prosthesis, proximal radiolucent lines have been detected in 81%, and distal cortical hypertrophy in 64% of the operated cases (11).

Table 2. General and local complications of the total hip replacement with the Vektor stem

Complication	Number
Deep venous thrombosis	2
Pulmonary embolism	1
Pneumonia	2
Hematoma of the wound	2
Sciatic nerve lesion	4
- transient	3
- permanent	1
Simple dislocation	2
Recurrent dislocation	2
Loosening of the acetabular cup	2
Total	17

With a cementless THR prosthesis stem with a proximal anchorage e.g. the CLS stem (4, 8), the proportion of radiolucent lines has been 33.7%, partial resorption of the calcar 28% (8), osteolysis especially in zones 1 and 7 according to Gruen 30.8-43.5% (4, 8, 9), and in zones 2 and 6 35% (8). This is referring to that the aim of proximal fixation has not been completely obtained. In another study the proportion of radiolucent lines in the zone 1 was 21%, and was explained by the micromotion between the prosthesis and bone (15). The average migration of the CLS stem has been 2-3.66 mm in 2-7 years postoperatively (5).

The bony integration is possible when the motion of the prosthesis is less than 150 µm (6). Especially rotational stability is essential. In the present study, a stable proximal fixation was achieved in 95.6 % of the cases. Radiographical evidences of distal fixation (proximal atrophy in 6 cases, distal cortical hypertrophy in 2 cases, and a progressive radiolucent line in the zones 1 and 7 in one case) were observed in 9 cases. In these cases the stem diameter was too small, or the stem was positioned into varus too much.
The mean Merle d'Aubigné scores reported with the CLS stems have been 16.7-16.8 (4, 9). Thus, the clinical outcome of the Vektor stem proved to comparable good with the recently published studies of other THA systems with a proximal anchorage. Compared with the CLS stem, the principle of proximal fixation was improved in the Vektor stem. Long term follow-up studies are needed to confirm the good results.

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