Can short Zweymüller-type implant obtain the adequate fixation to the femur? a three-dimensional quantification.

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INTRODUCTION: The tapered rectangle cementless stem for the hip arthroplasty is fixed to the metaphyseal to the diaphyseal of the femur. We developed the short Zweymüller-type implant (MIRFY, Mizuho, Tokyo) for the anterior approach. It is unclear how the newly short stem obtains the adequate fixation to the femur. The aim of this study is to quantify and compare the implant-femur contact state between the short Zweymüller-type implant and conventional Zweymüller-type implant (Profemur Z, MicroPort Orthopaedics Arlington, Tennessee) using three-dimensional templating software.

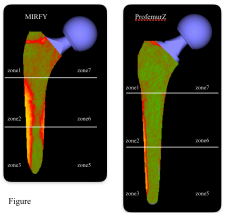
METHODS: This was an observational radiographic study of consecutive patients who underwent total hip arthroplasty (THA) using Zweymüller-type implant via a direct anterior approach. The study protocol was in compliance with the Helsinki Declaration, approved by the institutional review board, and all patients gave written informed consent before any study-related procedures were performed. We identified 522 patients between 2013 and 2021 with pre- and post-operative CT. The subjects were divided into two groups regarding the stem, MIRFY and ProfemurZ. Exclusion criteria were a previous hip surgery such as osteotomy or trauma. A total of 102 cases per group were selected, propensity score-matched for age, gender, BMI, and Canal Flare Index (CFI). Contact state were examined using three-dimensional templating software (ZedHip LEXI, Tokyo). CT values of 600 HU or greater were defined as the area of contact between the stem and femoral cortex and were evaluated according to Gruen's zone classification (Figure). The incidence of varus and flexion insertion of the stem more than 2°, and the presence of more than 2 degrees of stress shielding [1], radiolucent line, and subsidence (more than 2 mm) were determined by two joint surgeons using anteroposterior X-ray one year after surgery.

RESULTS: The demographic data are shown in Table1, and radiographic evaluation are shown in Table2. There were significant differences between MIRFY and ProfemurZ in contact state (zone 2, 3, 6, 7), varus insertion (15%, 28%, respectively, p = 0.0172), flexion insertion (15%, 48%, respectively, p = 0.003), and radiolucent line (47%, 29%, respectively, p = 0.0095). And no significant differences were observed in stress shielding and subsidence. No fracture and loosening were observed in both groups during the clinical course.

DISCUSSION: The short Zweymüller-type implant MIRFY contact state was slightly more distal but was more likely to be neutral insertion. Bone reaction was comparable to that of the conventional type, and initial fixation was good without fracture or loosening. Although the contact state of MIRFY was slightly distal, the stem length can affect the alignment in DAA approach. Further long-term study is needed to evaluate the biomechanical fixation.

SIGNIFICANCE: The newly developed short Zweymüller-type implant can obtain the adequate fixation to the femur despite the more distal contact.

REFERENCE: 1) Engh CA, Bobyn JD, Glassman AH. Porous-coated hip replacement. The factors governing bone ingrowth, stress shielding, and clinical results. J Bone Joint Surg Br. 1987;69(1):45-55.



Figure

Tabel 1

	MIRFY	ProfemurZ	P
age(years)	65.3	65.1	0.891
Body Mass Index	24.2	24.7	0.711
Canal Flare Index	3.72	3.71	0.400

Tabel 2

	MIRFY	ProfemurZ	P
contact area(%)			
zone 1	7.08	5.91	0.200701
zone 2	8.11	16.8	0.0000001
zone 3	26.66	21.81	0.002577
zone 5	30.75	23.02	0.000006
zone 6	10.9	17.86	0.0001
zone 7	16.51	14.61	0.1923
varus insertion(%)	28.43	14.71	0.0172
flextion insertion(%)	48.04	68.3	0.003
stress shielding(%)	25.49	31.37	0.3517
radiolucent line(%)	47.06	29.41	0.0095
subsidence(%)	4.9	3.92	0.733