# Anterior Coverage Predicts Joint Survival after Transposition Osteotomy of the Acetabulum in Patients with Hip Dysplasia: A 20-Year Experience from Saga University

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INTRODUCTION:

Adequate three-dimensional correction of acetabular coverage is critical for ensuring favorable outcomes of periacetabular osteotomy (PAO). Although the importance of sagittal plane correction has been recognized, the role of relevant radiographic metrics in aiding surgical planning and intraoperative assessment of acetabular fragments is not fully understood.

The purpose of this study was to determine (1) clinical and radiographic outcomes after transposition osteotomy of the acetabulum (TOA) (Fig. 1), a type of spherical PAO; (2) the relationships of postoperative radiographic indicators of anterior, lateral, and posterior acetabular coverage to joint survival after TOA; and (3) prognostic factors for joint survival after TOA.

METHODS:

Data from 616 patients (800 hips) with hip dysplasia who underwent TOA between 1998 and 2019 were reviewed. The median follow-up period was 8.9 years (2–23 years). A medical chart review was conducted to collect demographic data, complications, and modified Harris hip score (mHHS). Radiographic indicators of acetabular coverage, including LCEA, anterior wall index (AWI), and posterior wall index (PWI), were measured on pre- and postoperative radiographs. Wilcoxon signed-rank tests were used to compare pre- and postoperative clinical and radiographic parameters, and cumulative probability of TOA failure (progression to Tönnis grade 3 or conversion to THA) was estimated using the Kaplan–Meier product-limited method. Survivalcurves for the subgroups of postoperative acetabular coverage based on LCEA, AWI, and PWI were compared using the log-rank test with Bonferroni correction. A multivariate Cox proportional hazards model was used to identify independent predictors of TOA failure.

RESULTS: Median mHHS improved from 68 preoperatively to 96 at the latest follow-up ($p < 0.001$). Median LCEA, AWI, and PWI improved from 9.2°, 0.28, and 0.87 preoperatively to 42°, 0.34, and 0.90 postoperatively ($p < 0.001$). During the study period, 51 hips (6.4%) progressed to Tönnis grade 3 or required THA (Fig. 2). The overall joint survival rate was 97% at 10 years and 70% at 20 years. For the postoperative LCEA subgroups, survival in the deficient group was lower than that in the excessive ($p = 0.006$) and normal ($p = 0.007$) groups, with no differences between the excessive and normal groups ($p = 0.405$). For thepostoperative AWI subgroups, survival in the deficient group was lower than that in the excessive ($p = 0.015$) and normal ($p < 0.001$) groups, with no differences between the excessive and normal groups ($p = 0.292$). PWI subgroups showed no differences among the three groups ($p = 0.203$). Multivariate analysis identified age ($p = 0.010$), Tönnis grade 2 ($p < 0.001$), roundness index ($p = 0.003$), fair joint congruity ($p = 0.004$), and postoperative AWI ($p = 0.002$) as independent risk factors.

DISCUSSION AND CONCLUSION:

Our study identified older age, Tönnis grade 2, fair joint congruity, and femoral head deformity as the independent predictors of TOA failure. These findings suggest the need for careful patient selection for PAO when determining candidates for PAO. Among radiographic parameters, decreased postoperative AWI was the only independent predictor of TOA failure. Although the LCEA and Tönnis angle are commonly used to evaluate acetabular correction, recent studies have revealed that adequate sagittal plane correction has a greater impact on improving postoperative prognosis. Hip dysplasia typically manifests as anterolateral acetabular deficiency, with shear and contact stresses concentrated on the anterolateral acetabular rim. Therefore, sufficient anterior acetabular coverage is essential for optimizing the biomechanical environment in dysplastic hips, reinforcing our finding that adequate correction of AWI has one of the greatest impacts on preventing TOA failure.

In conclusion, deficient postoperative AWI adversely affected joint survival after TOA, underscoring the importance of sufficient anterior acetabular coverage, along with accurate surgical indications, to ensure successful hip preservation. Therefore, we recommend incorporating acetabular wall indices into preoperative planning and intraoperative assessment to facilitate adequate fragment positioning, thereby enhancing the likelihood of postoperative joint survival.

**Fig. 1A–C.** AP radiographs of a 34-year-old female with left hip dysplasia: (**A**) At presentation, Tönnis grade 1 OA changes were observed. The LCEA, AWI, and PWI were 6.0°, 0.20, and 1.04, respectively. (**B**) After TOA, the LCEA, AWI, and PWI were 31°, 0.35, and 1.00, respectively. (**C**) At 17 years of follow-up, no OA progression was observed, and the mHHS was 96 points.

**Fig.2**: Distribution of postoperative OA progression or conversion to THA according to preoperative Tönnis grade in hips undergoing TOA.

**Fig. 1**

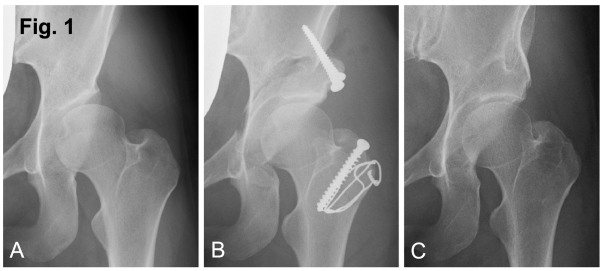
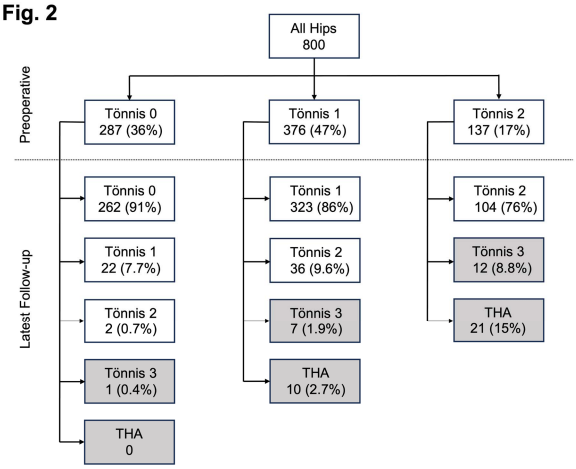

A
B
C

**Fig. 2**


All Hips
800
Preoperative
Tönnis 0
287 (36%)
Tönnis 1
376 (47%)
Tönnis 2
137 (17%)
Latest Follow-up
Tönnis 0
262 (91%)
Tönnis 1
22 (7.7%)
Tönnis 2
2 (0.7%)
Tönnis 3
1 (0.4%)
THA
0
Tönnis 1
323 (86%)
Tönnis 2
36 (9.6%)
Tönnis 3
7 (1.9%)
THA
10 (2.7%)
Tönnis 2
104 (76%)
Tönnis 3
12 (8.8%)
THA
21 (15%)