What is the Best Position (High Hip vs Anatomic) for the acetabular component in patients with severe DDH?

Mortazavi SMJ, Hosseini-Monfared P , Gahramanov A, Bulent A, Shubnyakov I, Chen CF, Bilgen OF, Zagra L, Kreuzer S, Razzaghof M

Response/Recommendation:

The findings of the previous studies demonstrate that the functional outcomes, limb length inequality, revision rates, and complications including nerve injury rates and dislocation were not significantly different between the high hip or anatomic center groups for patients with developmental dysplasia of the hip who underwent total hip arthroplasty.

Level of Evidence: Limited

Rationale:

Total hip arthroplasty (THA) in patients with severe developmental dysplasia of the hip (DDH) presents a significant challenge for orthopedic surgeons due to complex anatomical deformities and compromised bone stock. THA aims to reestablish the anatomical hip center, thereby reducing hip load, enhancing the biomechanics of the hip, and supporting normal gait. The high hip center (HHC) technique has emerged as an alternative to evade these issues and improve bone-implant contact. This method involves placing the cementless cup at a higher position than the anatomical center, leveraging the superior periacetabular bone stock available in this region. Despite its potential advantages, there have been reports of complications associated with HHC, including higher rates of aseptic loosening, dislocation, limb-length inequality, and increased hip joint reaction forces. These concerns have led to a cautious adoption of the technique. However, recent studies have reported promising results with the high placement of the acetabular cup, suggesting that with careful patient selection and surgical precision, the HHC technique can yield satisfactory outcomes.

Among the 14 studies comparing the outcomes of the high hip center technique with the anatomical center, most of the studies were retrospective cohorts and only three of them were prospective studies designed to compare these two methods.

We evaluated the outcomes of THA in dysplastic hips as measured by the Harris hip score, revision rates, and postoperative complications in two groups of cup position of the acetabular cup in the high hip center versus the anatomic hip center.

Only the Yang et. al. and Karaismailoglu et.al studies included patients with severe DDH (Crowe III and IV). The two studies conducted by Karaismailoglu et.al. were designed to evaluate the gait of the patients following total hip arthroplasty and excluded patients with limb length discrepancy > 2 cm and Harris Hip Score < 85 points and therefore were not included in the meta-analysis [1, 2].

The definition of the high hip center was different among the included studies. The longitudinal position of the acetabular cup at the high hip center was defined regarding the inter-teardrop line in eight studies and six studies used the Anatomic Head Centers (AHC) as the reference for defining the high hip center (**Table 1**). The longitudinal cup position was significantly higher in the postoperative radiographic evaluations in the high hip center group compared to the anatomic center (p-value<0.01) as demonstrated in Figure 1.

Postoperative function was assessed using the Harris Hip Score (HHS) in seven of the included studies. The meta-analysis demonstrated significant heterogeneity among these studies (I2=73.26, p-value<0.01) suggesting variability in the effect sizes across the studies. This could be due to differences in study design, population characteristics, or other factors. The results of this meta-analysis demonstrated that there is no significant difference between the HHS scores of the high hip center and anatomic center groups (p-value=0.59) (Figure 2).

The abductor lever arm was measured in three of the included studies. Comparing the abductor lever arm between the two groups did not show any significant difference (p-value=0.89). The three studies had moderate degree of heterogeneity (I2=73.15%, p-value=0.02).

The meta-analysis of limb leg difference between the two methods demonstrated no significant difference (p-value=0.32) (Figure 4).

Although Watts et. al. reported a higher incidence of cup revisions in the high hip center group, the meta-analysis demonstrated no significant difference between the two groups regarding the cup revision rates as indicated in a forest plot in Figure 4 (p-value=0.25) [12]. Studies had low heterogeneity (I^2=8.82%, p-value=0.43). Also, any cause revisions were not significantly different between the two groups (Figure 5).

Nerve injury rates were reported in four studies and the meta-analysis demonstrates no significant difference between the high hip center and anatomic groups (p-value=0.13) (Figure 6) [3-5, 10].

The incidence of postoperative dislocations was also evaluated in six studies. The meta-analysis demonstrated no significant difference regarding the dislocation rate between the two groups (p-value=0.96) (Figure 8).

References

[1] Karaismailoglu B, Erdogan F, Kaynak G. High hip center reduces the dynamic hip range of motion and increases the hip load: A gait analysis study in hip arthroplasty patients with unilateral developmental dysplasia. The Journal of arthroplasty 2019;34:6:1267-72. e1.
[2] Karaismailoglu B, Kaynak G, Can A, Ozsahin MK, Erdogan F. Bilateral high hip center provides gait parameters similar to anatomical reconstruction: A gait analysis study in hip replacement patients with bilateral developmental dysplasia. The Journal of Arthroplasty 2019;34:12:3099-105.
[3] Demirel M, Kendirci A, Saglam Y, Ergin O, Sen C, Öztürk I. Comparison of high hip center versus anatomical reconstruction technique in crowe types ii and iii developmental dysplasia of the hip: A retrospective clinical study. Acta Chirurgiae Orthopaedicae et Traumatologiae Čechoslovaca 2022;89:4.
[4] Christodoulou NA, Dialetis KP, Christodoulou AN. High hip center technique using a biconical threaded zweymüller® cup in osteoarthritis secondary to congenital hip disease. Clinical Orthopaedics and Related Research® 2010;468:7:1912-9.
[5] Dogra S, Singh J, Bhatia N, Khare S. Clinical and radiographic outcomes following high hip center vs anatomical acetabular component placement in total hip arthroplasty for dysplastic hips: A comparative study. Int J Acad Med Pharm 2023;5:3:851-5.
[6] Fukui K, Kaneuji A, Sugimori T, Ichiseki T, Matsumoto T. How far above the true anatomic position can the acetabular cup be placed in total hip arthroplasty? Hip international 2013;23:2:129-34.
[7] Murayama T, Ohnishi H, Okabe S, Tsurukami H, Mori T, Nakura N et al. 15-year comparison of cementless total hip arthroplasty with anatomical or high cup placement for crowe i to iii hip dysplasia. Orthopedics 2012;35:3:e313-e8.
[8] Nawabi DH, Meftah M, Nam D, Ranawat AS, Ranawat CS. Durable fixation achieved with medialized, high hip center cementless thas for crowe ii and iii dysplasia. Clinical Orthopaedics and Related Research® 2014;472:2:630-6.
[9] Shen J, Sun J, Ma H, Du Y, Li T, Zhou Y. High hip center technique in total hip arthroplasty for crowe type ii–iii developmental dysplasia: Results of midterm follow-up. Orthopaedic surgery 2020;12:4:1245-52.
[10] Traina F, De Fine M, Biondi F, Tassinari E, Galvani A, Toni A. The influence of the centre of rotation on implant survival using a modular stem hip prosthesis. International orthopaedics 2009;33:1513-8.
[11] Wang Z-J, Qiang X-J, Liu T. Acetabular cup position on high hip and anatomical position in total hip arthroplasty for crowe iii developmental dysplasia of hip joint. Zhongguo gu Shang= China Journal of Orthopaedics and Traumatology 2018;31:10:922-6.
[12] Watts CD, Martin JR, Fehring KA, Griffin WL. Inferomedial hip center decreases failure rates in cementless total hip arthroplasty for crowe ii and iii hip dysplasia. The Journal of arthroplasty 2018;33:7:2177-81.
[13] Yang T-C, Chen C-F, Tsai S-W, Chen W-M, Chang M-C. Does restoration of hip center with subtrochanteric osteotomy provide preferable outcome for crowe type iii–iv irreducible development dysplasia of the hip?? Journal of the Chinese Medical Association 2017;80:12:803-7.
[14] Zhang Z, Wu P, Huang Z, Yu B, Sun H, Fu M et al. Cementless acetabular component with or without upward placement in dysplasia hip: Early results from a prospective, randomised study. Journal of orthopaedics 2017;14:3:370-6.

Figures:

Table 1 Summary of the included studies

Study	Study Design	Number of Patients	Dysplasia Classification	High Hip Position Definition	Reference Landmark
Demirel,2022[3]	Retrospective	57 patients / 57 hips	Crowe type-II, type-III	Vertical distance of 15 mm from AHC	Anatomic Head Centers
Christodoulou, 2010 [4]	Retrospective	88 patients / 104 hips	Hartofilakidis classification	>35 mm from the inter-teardrop line, >15 mm from AFHC	Inter-teardrop line
Dogra, 2023 [5]	Prospective	30 patients / 30 hips	Crowe type-II, type-III	>15 mm from AHC	Inter-teardrop line
Fukui, 2013 [6]	Prospective	200 patients / 200 hips	Crowe type I, II, III	>22 mm from the inter-teardrop line	Inter-teardrop line
Karaismailoglu 2019-1 [1]	Retrospective	20 patients / 20 hips	Crowe III/IV	>15 mm superior to AHC	approximate femoral head center
Karaismailoglu 2019-2 [2]	Retrospective	10 patients / 20 hips	Crowe III/IV	>15 mm superior to AHC	approximate femoral head center
Murayama, 2012 [7]	Retrospective	43 patients / 43 hips	Crowe I-III	>24.5 mm above inter-teardrop line	Inter-teardrop line
Nawabi 2013 [8]	Retrospective	46 patients / 51 hips	Crowe I-III	>10 mm superior to AFHC	Inter-teardrop line, (Ranawat method)
Shen, 2021 [9]	Retrospective	42 patients / 42 hips	Crowe II–III and IV	>22 mm above inter-teardrop line	Inter-teardrop line
Traina, 2008 [10]	Retrospective	67 patients / 88 hips	Crowe I-IV	≥30 mm above inter-teardrop line	Inter-teardrop line
Wang, 2017 [11]	Retrospective	68 patients / 86 hips	Hartofilakidis classification	>35 mm above inter-teardrop line	Inter-teardrop line
Watts, 2018 [12]	Retrospective	88 patients / 88 hips	Crowe II-III	>1 cm superior and >1 cm lateral to AFHC	Inter-teardrop line, (Pagnano and Ranawat method)

Yang, 2017 [13]	Retrospective	21 patients / 21 hips	Crowe III-IV	Superior displacement	Inter-teardrop line (Pierchon method)
Zhang, 2017 [14]	Prospective	40 patients / 42 hips	Crowe I-III	Upward placement of 5-20 mm	Inter-teardrop line

Notes: AHC, anatomic hip center, AFHC: approximate femoral head center

Figure 1 Postoperative Cup Position

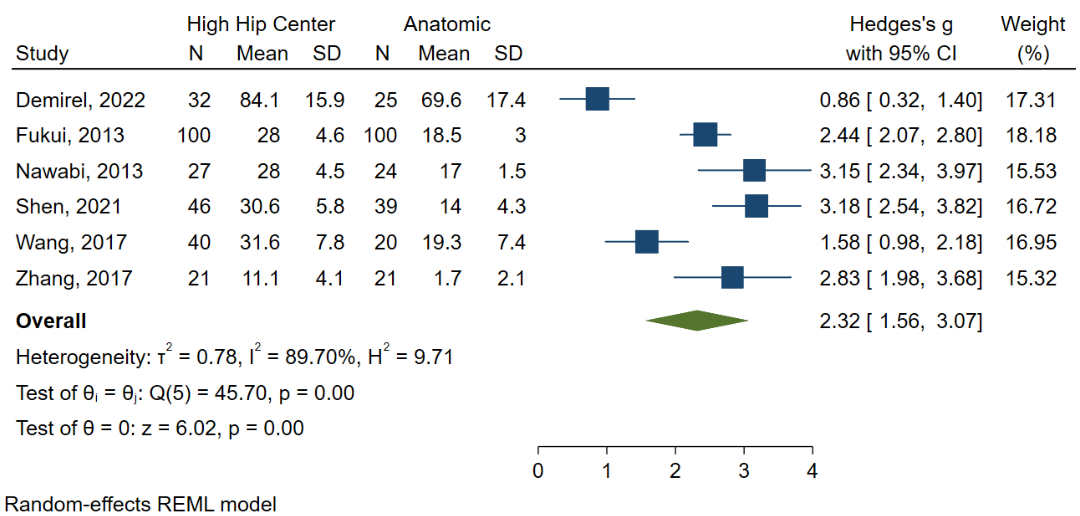

Figure 2 HHS scores

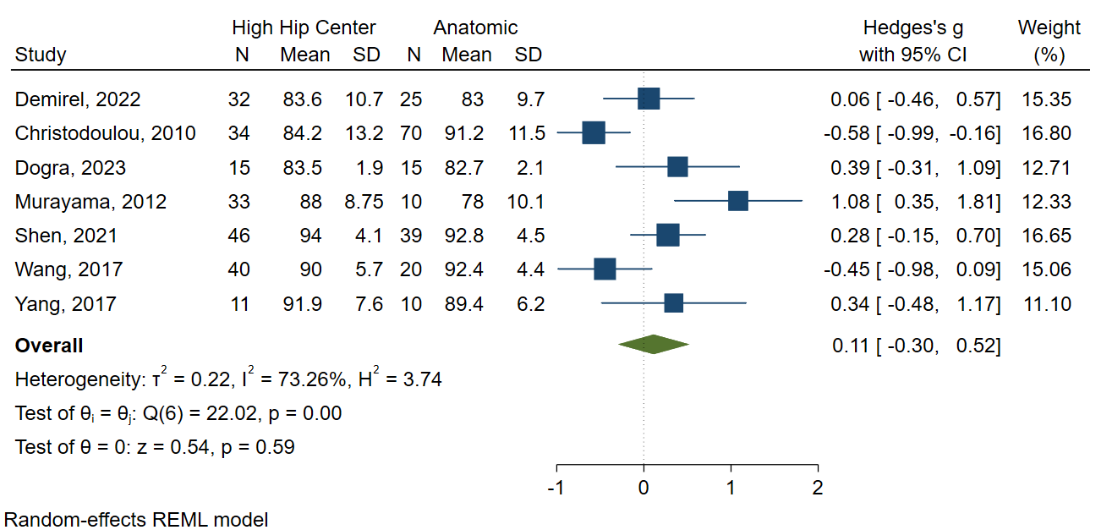

Figure 3 Abductor Lever Arm

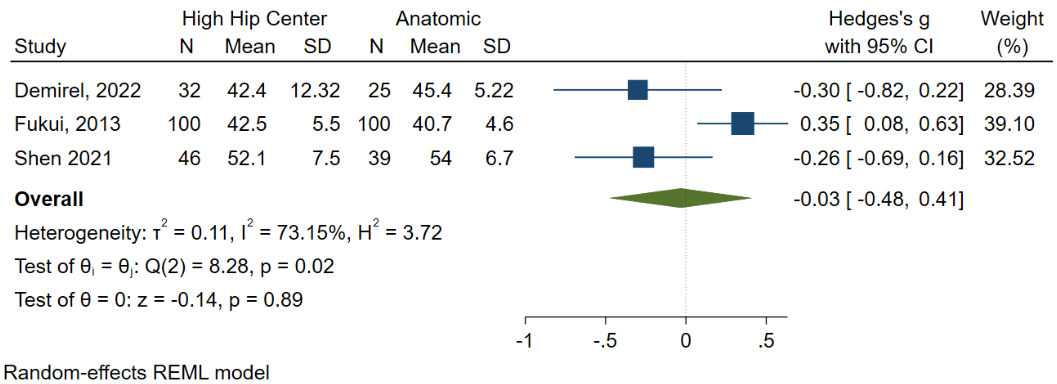

Figure 4 Limb Leg Difference (mm)

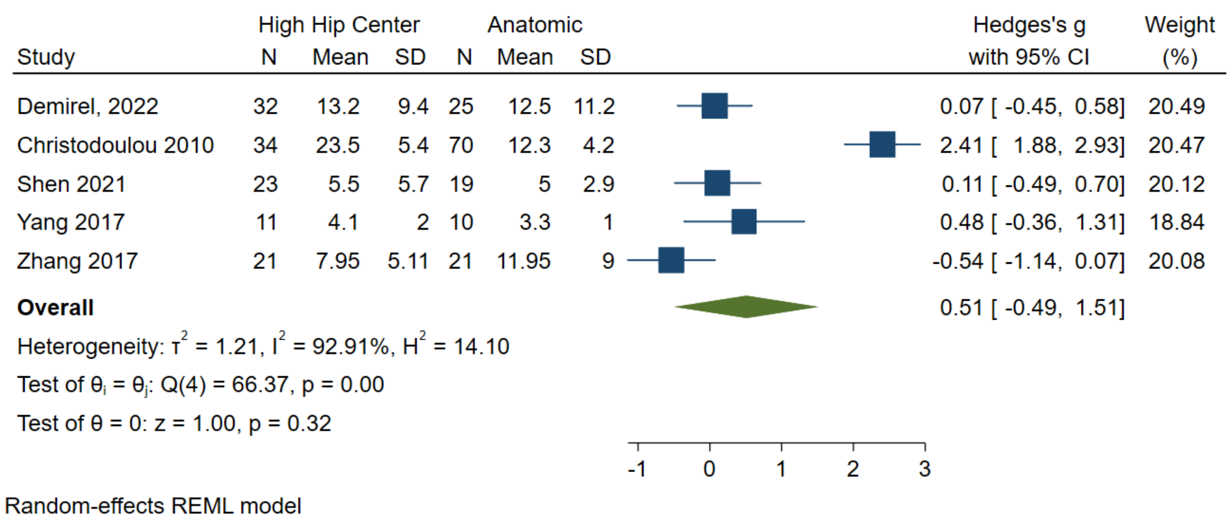

Figure 5 Acetabular Cup Revisions

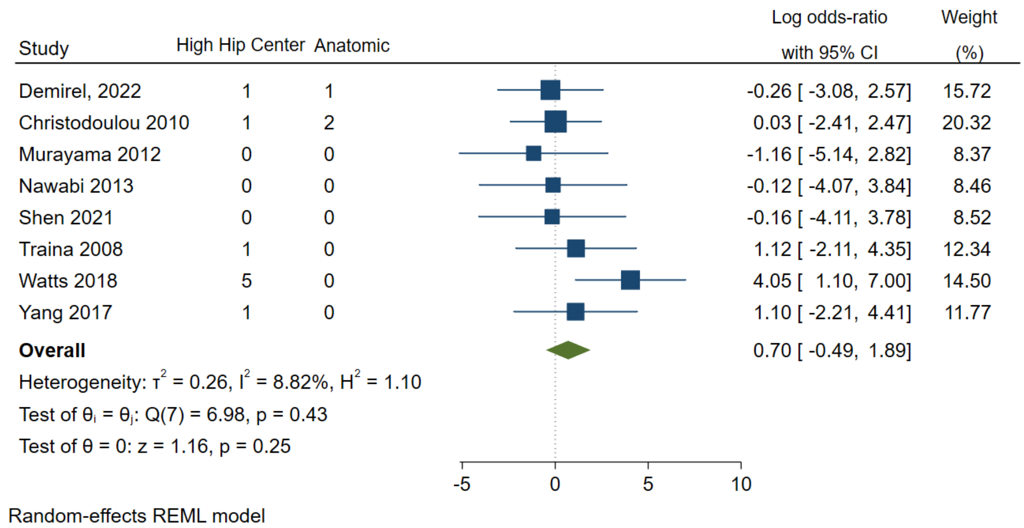

Figure 6 Any Cause Revisions

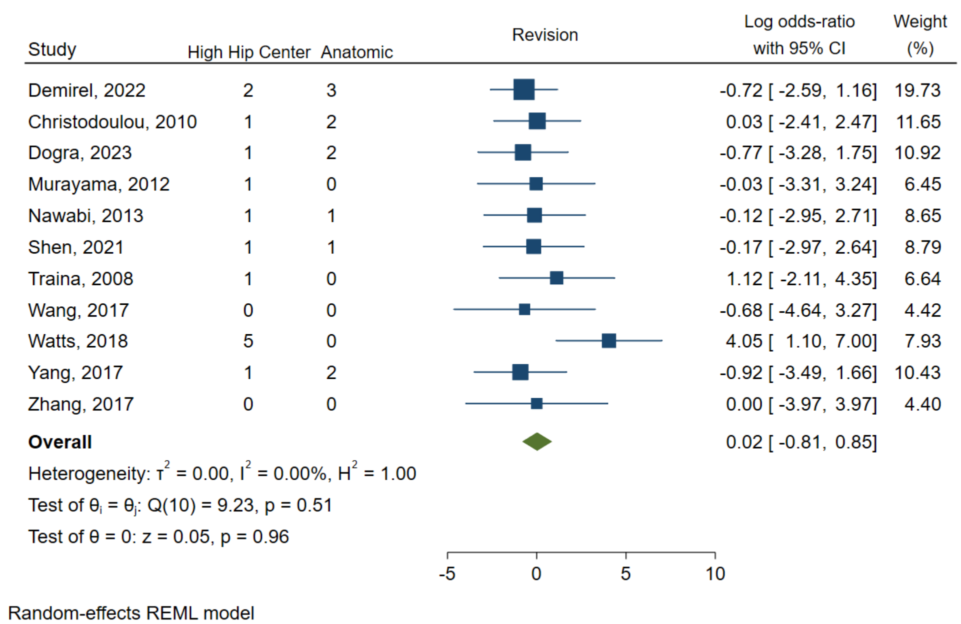

Figure 7 Nerve Injury

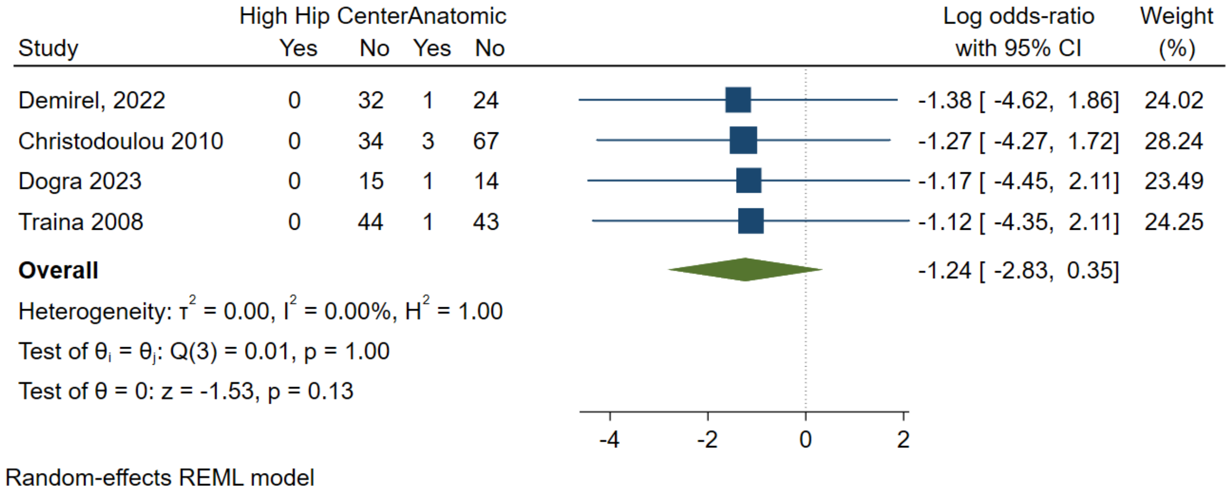

Figure 8 Dislocation Rate