

## Best option for total hip replacement in young: evidence from National Joint Registry of United Kingdom and Australian Orthopaedic Association National Joint replacement Registry

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### Abstract

#### Introduction

Implant longevity is crucial in determining the clinical success of THA. Hence THA in young patients will need careful consideration as the failure and revision rates of THA are higher due to high functional demands.

#### Method

Reviewed the latest evidence from the 17th annual report of the National Joint Registry (NJR) of United Kingdom and the 2020 annual report of Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) to determine the optimal mode of fixation, bearing surface and the head size for THA in a patient before the age of 55 years.

#### Results

In THA of patients under 55 Years, the 10 Year RR was highest in Uncemented fixations compared to other modes but this difference is insignificant according to the AOANJRR. Uncemented and hybrid fixations were preferred over cemented fixations but uncemented was the predominant mode of fixation and this preference was rising over the past years. COC and COP bearing surface combinations reported to have the lowest 10 YRR and the use of COP in young patients has been rising both in the UK and Australia in the recent past. In COC the head size of 40mm showed the best survival rate and in COP 36mm was the largest size with better survival. In COP the increased quality with XLPE (ultra-high molecular weight polyethylene) has been the reason for the ability to use a larger head size with low dislocation rates better survival with low wear compared to Non-XLPE used in the past.

#### Conclusion

Both Registries favour the use of Uncemented or Hybrid fixations with COC and COP bearings in patients <55 years and COC and COP bearings were compatible with best

survival rates. Improved wear resistance with modern XPLE has been the reason for better survival with COP and the ability to use larger head sizes like in COC, reducing the risk of dislocations. Uncemented /Hybrid fixation with COC with 40 mm head size or modern XLPE COP with 36mm head size would be the best choice for a THA in a patient <55 years of age.

#### Introduction

Total Hip Arthroplasty (THA) is performed worldwide is increasing according to the International Joint registries as it is one of the most successful surgical procedures in orthopaedics, which can provide a high satisfaction rate and significant improvement in quality of life for the patient. [1-3]

Arthroplasty in a young patient is challenging due to a higher risk of failure and revision as these are often more complicated primary surgeries warranted by early OA due to congenital, developmental, or traumatic anatomical abnormalities and the higher risk of wear and secondary loosening caused by high functional demands [4-6].

By the end of this decade, more young patients will have THAs, increasing the percentage of Primary THAs among <65 years of age, up to 52% [7]. As a consequence, the number of revisions is expected to increase dramatically. The same authors reported around 5% revision risk for THA in patients at age 70 years, and the risk increased up to 29% for the age category 50–54 years [7,8].

According to the recently published 17th annual report data from The National Joint Registry (NJR) of United Kingdom [9] which is comprised of 1,191,253 primary hip replacement records with a potential of 16.75 years of follow up, Overall revision rate for patients <55 Y at 10 years was 8.29% for females and 6.96% for Males. At 15 yrs these rates increased up to 12.95% and 10.68% for females and males respectively.

In the Australian Orthopaedic Association National, Joint Replacement Registry (AOANJRR) [10] is another important registry where 499,439 primary total conventional hip replacement procedures were reported for the period from 2003 to 2019. In its 2020 annual report the calculated Overall revision rates for patients <55 Y at 10 years were 6.2% for

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**Table 1.** Data from Table 3.H6 of the 17th report of The National Joint Registry (NJR) [9]

<b>Kaplan-Meier estimates of 10-year revision rate (95% CI) of primary hip replacements in &lt;55-year population by gender and fixation.</b>					
Male	<55	10Y RR	Female	<55	10Y RR
Cemented	5149	4.84	Cemented	7918	4.97
Uncemented	38216	7.35	Uncemented	40360	7.13
Hybrid	10878	5.23	Hybrid	13998	4.20
Other	16942			9432	
<b>Total</b>	<b>71,185</b>			<b>71708</b>	

females and 5.7% for Males. At 15 yrs these rates increased up to 9.7% for females and 8.7% for males, indicating in both registries young females had a higher revision rate compared to young males.

The objective of our article is to evaluate the results from the latest Annual reports of Both NJR and AOANJRR to determine the best choice of implant eg: Fixation method, bearing surfaces and the Head size when THA is considered in <55 Y old patients.

#### **Mode of Fixation**

In the United Kingdom, the proportion of all cemented THA has nearly halved despite the stable absolute number of cemented implants used annually. Proving the popularity of hybrid and uncemented implants, the use of uncemented THA doubled and the hybrid THA use has tripled over the same period. Mean ages for all Cemented, Uncemented and Hybrid used patients are 73.0 (+/-9.1), 64.4 (+/-11.3) and 69.1 (+/-10.9) respectively indicating the Uncemented implants were more prevalent among Young. As expected, Uncemented and hybrid fixations were more commonly used in patients <55 years of age. Considering the 10 Y revision rates Hybrid fixations had better survival compared to Uncemented fixations, but whether this difference is statistically significant is not determined. Still, the use of Uncemented fixations was nearly 3 times more than hybrid fixations among patients <55. [9]

Unlike in UK, according to AOANJRR, uncemented fixation was the most preferred choice to cemented and Hybrid fixations throughout and this was more obvious for the age category <55 Years. This preference for uncemented fixation has further increased from 51.3% in 2003 to 60.8% in 2019. For the same period when hybrid fixation increased from 34.8% to 36.3%, Cemented fixation declined from 13.9% to 3.0%.

Considering all categories of age, the rate of revision for Cemented THA compared to Hybrid THA was insignificant. Cementless THA has a higher rate of revision compared to Hybrid THA. Except for the post-operative 1st month where Cementless THA shows a higher revision rate compared to

Cemented THA, the revision rate of Cementless THA compared to Cemented THA was insignificant. Specifically, for patients aged <55 years, there is no difference in the rate of revision when comparing fixation methods but it's worth noting that the number at risk for cemented was significantly low as the predominant fixation type was uncemented.

Even though the 10 Y revision rate for Hybrid fixations was 5.0 (4.2, 6.0) compared to Uncemented fixations 5.4 (5.0, 5.8), when considering the number, the use of Uncemented fixations were nearly 5 times more than hybrid fixations among patients <55 years of age. [10]

#### **Bearing Surface Combinations**

Many factors such as age distribution among patients, disease pattern, efficacy of the medical supplies of the country and payment types, may affect the choice of bearing surface. [11]

In UK, since 2012 there has been a marked increase in the use of COP (Ceramic on Polyethylene) bearings in all 3 types of fixations but more significantly in Uncemented and Hybrid fixations. There was a corresponding decrease in the use of COC (Ceramic on Ceramic) bearings. When specifically considering Uncemented fixations, Patients receiving COC [Men age 58.7] and COP [Mean age 63.0] bearings tend to be younger than those receiving MOP (Metal on Polyethylene) [Mean age 69.9] indicating COC and COP implants were more frequently used among the young. Similar trend can be seen among hybrid fixations.

Even among cemented fixations where COC is absent there was a 10Yr mean age difference between the MOP (74.2) and COP (64.5), indicating the use of COP was more frequent among younger patients.

The failure rates for COP bearings remain particularly low and it is encouraging that these are becoming more widely used with time. According to the NJR relatively good results obtained with COC and COP bearings in younger patients are striking [9].

Unlike in NJR in UK the AOANJRR reported XLPE (ultra-high molecular weight polyethylene that has been irradiated by high dose (>50kGy) gamma or electron beam radiation)

**Table 2.** Data from Table 3.H6 of the 17th report of The National Joint Registry (NJR) [9]

Kaplan-Meier estimates of 10-year revision rate (95% CI) of primary hip replacements of <55 years of Age by gender, fixation and bearing. (from Table 3.H6 of 17 <sup>th</sup> NJR 2020)						
	<55 Male			<55 Female		
	Cemented	Uncemented	Hybrid	Cemented	Uncemented	Hybrid
MOP	2,137	4,766	1,750	3,665	5,813	2,489
10Y RR	6.19	5.45	6.54	5.53	4.36	4.53
(95% CI)	(4.95-7.73)	(4.53-6.56)	(5.01-8.50)	(4.62-6.61)	(3.61-5.25)	(3.50-5.84)
COP	2,953	9,898	5,449	4,162	10,276	6,551
10Y RR	3.44	3.76	3.48	4.25	3.86	3.3
(95% CI)	(2.59-4.57)	(3.08-4.58)	(2.55-4.73)	(3.32-5.42)	(3.17-4.69)	(2.43-4.49)
COC		19,937	3,198		21,496	4,565
10Y RR		4.6	3.46		4.46	3.15
(95% CI)		(4.22-5.01)	(2.74-4.35)		(4.10-4.86)	(2.57-3.86)
Total	5,149/71185	38,216/71185	10,878/71185	7,918/71708	40,360/71708	13,998/71708
10Y RR	4.84	7.35	5.23	4.97	7.13	4.2
(95% CI)	(4.04-5.79)	(6.96-7.76)	(4.58-5.98)	(4.30-5.73)	(6.76-7.51)	(3.70-4.77)

**Table 3.** Data from the table HT30 of Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) 2020 [10]

Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Bearing Surface (Primary Diagnosis OA)				
	Total	Revised	10Y-RR (95% CI)	15Y-RR (95% CI)
Metal/Non XLPE	35265	2821	6.5 (6.2, 6.7)	
Metal/XLPE	165771	5792	4.6 (4.5, 4.7)	6.3 (6.1, 6.6)
Ceramic/XLPE	91245	2484	4.3 (4.1, 4.6)	5.9 (5.4, 6.4)
Ceramic/Non XLPE	7986	582	7.2 (6.5, 7.9)	
Ceramicised Metal/Non XLPE	297	50	12.5 (8.9, 17.3)	
Ceramicised Metal/XLPE	25323	724	3.8 (3.5, 4.1)	
Ceramic/Ceramic	94733	3876	5.0 (4.8, 5.1)	7.1 (6.8, 7.4)

and non XLPE separately when reporting on Polyethylene acetabular component. When reporting the femoral head component, they reported Ceramic and ceramicised metal separately. As a result, Australian Registry has evaluated 10 bearing surface combinations and 8 of which have been used in more than 5,000 procedures. [Table 2].

Ceramicised metal/XLPE combination has the lowest rate of revision at 10 years followed by Ceramic/XLPE. Ceramic/XLPE rates were better than MOP and even COC even at 15 years of follow up. But the Registry urges caution in the interpretation of this result as this bearing is a single company product, the lower rate of revision could be due to limited product combinations of femoral and acetabular prostheses. [Table 3].

Clearly, Ceramic/XLPE has a statistically significant lower rate of revision compared to metal/XLPE after 2 years

HR=0.83 (0.77, 0.91),  $p < 0.001$ .] For Ceramicised metal/XLPE compared for metal/XLPE this significance was evident even after 1 year as 1Yr - 2Yr: HR=0.59 (0.46, 0.76),  $p < 0.001$  & beyond the 2nd year: HR=0.61 (0.54, 0.70),  $p < 0.001$ . Interestingly, when compare Ceramic/Ceramic vs Metal/XLPE for the entire Period there was no statistically significant difference among the revision rates. [HR=1.00 (0.96, 1.05),  $p = 0.826$ ]. [10]

Irrespective of the type of fixation type, in both registries, Metal-on-metal bearings continue to perform worse. As noted in several Joint Registries and review articles, serious complications such as Adverse Reaction to Metal Debris (ARMD), Adverse Local Tissue Reaction (ALTR), metal granuloma (Aseptic Lymphocytic Dominated Vasculitis Associated Lesions (ALVAL), toxic and carcinogenic effects of cobalt ions are serious complications caused by metal debris of these implants. [12-15]

### Head size

As uncemented COC and COP being the fixation and bearing surfaces with best survival rates in the age group of <55 years, it is worth to see the best head sizes for the same. NJR indicates a statistically significant differences between four head sizes (28,32,36 and 40mm) (P<0.001) for uncemented COC hips.

Even though the numbers are small, survival rate for head size of 40mm was the best while the highest failure rate reported with the head size of 28mm. Head sizes of 32mm and 36mm showed similar failure rates, yet the rates were poor than for rate of head size 40mm. For, Uncemented COP hips, similar four head sizes showed a statistically significant difference among the survival rates. When the best implant survival is with 32mm and 36mm head sizes, the 28mm and 40mm heads shows the worse outcomes.[9]

Stability of the THA is an important factor to determine the outcome of a THA and larger head size will provide more stability to the THA. But, traditionally the higher revision rates were noted with larger head sizes when used with non XLPE. According to AOANJRR the use of modern XLPE has clearly allowed the use of more larger head sizes without increasing the revision rates [10].

**Table 4.** Data from the table HT31 of Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) 2020 [10]

Ten-year revision rate of primary total conventional hip replacement by polyethylene type and head size (Primary diagnosis OA)			
		>32mm	32mm
XLPE	10Y RR	4.9(4.7-5.1)	4.1(4.0-4.3)
	N at risk	8921	14344
Non XLPE	10Y RR	14.2 (9.8-20.4)	7.0(6.1-7.9)
	N at risk	10	1399

### Conclusion

Both Registries favour the use of uncemented/Hybrid fixations in patients <55 years and COC and COP bearings were the favourites and compatible with the best survival rates. There has been a marked increase in the use of COP bearings in young patients both in the UK and Australia in the recent past. Due to the improved wear resistance of modern XLPE, the ability to use a larger head size has been possible with COP bearings similar to COC implants, reducing the risk of dislocations. Uncemented /Hybrid fixation with COC bearings with 40 mm head size or modern XLPE containing COP bearings with 36mm head size would be the better choice for a THA in a patient <55 years of Age.

### Abbreviations:

THA – Total Hip Arthroplasty  
 COP – Ceramic on Polyethylene  
 COC – Ceramic on Ceramic  
 MOP – Metal on Polyethylene  
 NJR - The National Joint Registry  
 AOANJRR - Australian Orthopaedic Association National Joint Replacement Registry  
 XLPE - ultra-high molecular weight polyethylene  
 Non XLPE – Non-ultra-high molecular weight polyethylene

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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