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ORIGINAL PAPER

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Racial and gender variations in adult hip morphology

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Abstract Pelvic X-rays of 99 adult patients (198 hips) were analysed in 58 men and 41 women to determine the morphology of the adult hip in Malawians. For each hip the centre edge angle of Wiberg, the acetabular angle of Sharp and the acetabular head index were measured. For each parameter, women were more dysplastic than men, and for the acetabular angle of Sharp there was a significant gender difference ($p<0.05$, t test). Our figures were compared to those of Fujii et al. who had measured the same parameters in Japanese and British hips. His results taken with ours showed that within a racial group, women were more dysplastic that men and that Japanese hips were more dysplastic than British hips, which were in turn more dysplastic than Malawian hips.

Résumé Les radiographies pelviennes de 99 malades adultes (198 hanches) ont été analysées chez 58 hommes et 41 femmes pour déterminer la morphologie de la hanche adulte au Malawi. Pour chaque hanche, l'angle de Wiberg, l'angle acétabulaire de Sharp, et l'Index Tête /Acétabulum ont été mesurés. Pour chaque paramètre les femmes étaient plus dysplasiques que les hommes et pour l'angle acétabulaire de Sharp il y avait une différence significative selon le sexe (p <0.05, t-test). Nos chiffres ont été comparés à ceux de Fujii et coll. qui avaient mesuré les mêmes paramètres sur des hanches japonais et britanniques. Ses résultats, considérés avec les nôtres, ont montré que dans un groupe racial les femmes étaient plus dysplasiques que les hommes, et les hanches japonaises étaient plus dysplasiques que les hanches britanniques elles-même plus dysplasiques que les hanches du Malawi.

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Introduction

It is recognised among orthopaedic surgeons who practice in sub-Saharan Africa that the incidence of congenital dysplasia of the hip (CDH) in children is very low; indeed, in 5 years of predominantly paediatric orthopaedic practice in Malawi, the first author has not seen a case of CDH. Similarly, the incidence of dysplasia of the acetabulum in adults is also recognised to be low (personal communication following discussions at the Association of Surgeons of East and Central Africa Section of Orthopaedics).

There are, however, no firm statistics about the incidence of acetabular dysplasia or CDH in this region, and a Medline search revealed no published literature on this subject. It would be unethical to X-ray a large number of asymptomatic infants to find out the normal acetabular morphology. However, a large number of adults without hip pathology have pelvic X-rays for other reasons, and we were able to measure these to determine the normal adult acetabular morphology for the population.

Material and methods

Pelvic X-rays of 58 men and 41 women who attended two hospitals in Blantyre for non-hip pathology were analysed. For each of the 198 hips analysed we measured the centre edge angle of Wiberg [5], the acetabular angle of Sharp [4], and the acetabular head index [2]. Centre edge angle of Wiberg is measured between a true perpendicular line intersecting the centre of the femoral head and a second line from the centre of the femoral head to the superior lip of the acetabulum. The smaller the angle the more dysplastic the hip (Fig. 1).

Acetabular angle of Sharp is measured from the intersection of a horizontal line passing through the bottom of the "tear drop" and a line connecting the bottom of the tear drop to the lateral lip of the acetabulum. The greater the angle the more dysplastic the hip (Fig. 2).

Fig. 1 Centre edge angle of Wiberg

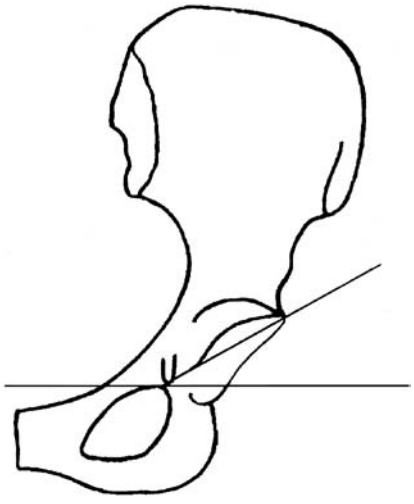

Fig. 2 Acetabular angle of Sharp

To measure the acetabular head index, vertical lines are drawn intersecting the most medial and the most lateral parts of the articular surface of the femoral head and the lateral part of the articular surface of the acetabulum. The acetabular head index is the ratio of the covered part of the head to the whole head, i.e. B/A+B below, expressed as a percentage. The smaller the index the more dysplastic the hip (Fig. 3).

These measurements were chosen as they all have a high index of interobserver reliability [3]. They were measured on X-rays held on a light box using lines drawn with a chinagraph pencil and a hand-held goniometer. The results were analysed using the S-PLUS statistical package for Windows version 4.

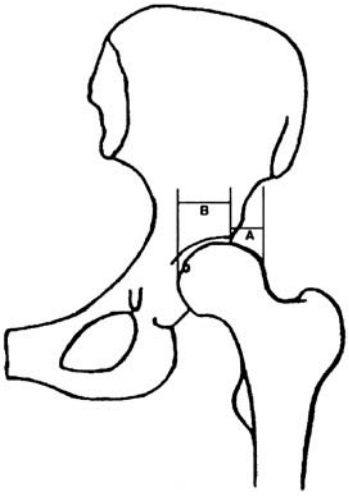

Fig. 3 Acetabular head index

Table 2 Statistical differences between the sexes and between Malawians and Japanese and British hips for all three parameters

	t value	*P* value
1. Center edge angle		
(a) Malawian men vs women	0.196	>0.5
(b) Japanese men vs women	0.541	<0.001 *
(c) British men vs women	1.500	<0.1
(d) Malawian men vs Japanese men	4.33	<0.001 *
(e) Malawian women vs Japanese women	5.28	<0.001 *
(f) Malawian men vs British men	1.92	<0.05 *
(g) Malawian women vs British women	3.07	<0.001 *
2. Acetabular angle of sharp		
(a) Malawian men vs women	1.83	<0.05 *
(b) Japanese men vs women	11.67	<0.001 *
(c) British men vs women	6.06	<0.001 *
(d) Malawian men vs Japanese men	3.78	<0.01 *
(e) Malawian women vs Japanese women	4.10	<0.001 *
(f) Malawian men vs British men	1.09	<0.05 *
(g) Malawian women vs British women	0.49	<0.5
3. Acetabular head index		
(a) Malawian men vs women		>0.5
(b) Japanese men vs women		<0.05 *
(c) British men vs women		>0.5
(d) Malawian men vs Japanese men		<0.001 *
(e) Malawian women vs Japanese women		<0.001 *
(f) Malawian men vs British men		<0.001 *
(g) Malawian women vs British women		<0.001 *

* Significant difference

Table 1 Means and standard deviations of the mean centre edge angle of Wiberg, the mean acetabular angle of Sharp and of the mean acetabular head index in 198 hips of Malawian patients compared to published values for British and Japanese hips

	Mean centre edge angle of Wiberg (°)	Mean acetabular angle of Sharp (°)	Mean acetabular head index as %
Malawian men	34.0±7.5	36.9±4.0	85.5±5.1
Malawian women	34.3±7.5	38.6±4.9	84.8±5.0
British men	31.7±5.5	36.2±2.8	82.3±5.2
British women	30.4±5.4	39.0±3.2	81.6±5.0
Japanese men	29.5±5.9	39.0±3.2	81.1±5.0
Japanese women	27.9±6.5	41.8±3.4	80.6±6.4

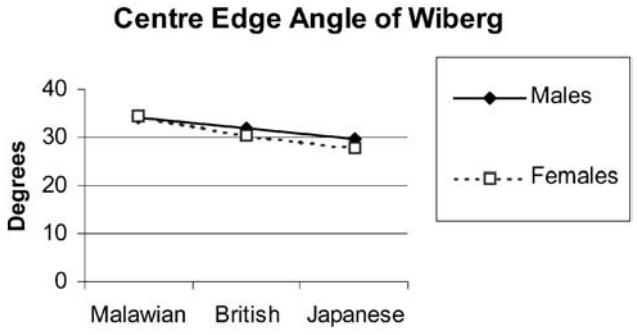

Fig. 4 Centre edge angle of Wiberg (a lower angle represents more dysplasia)

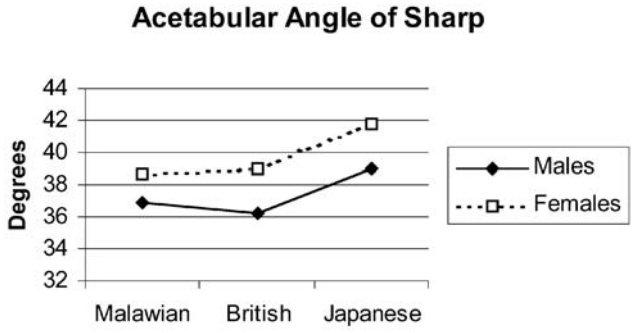

Fig. 5 Acetabular angle of Sharp (a higher angle represents more dysplasia)

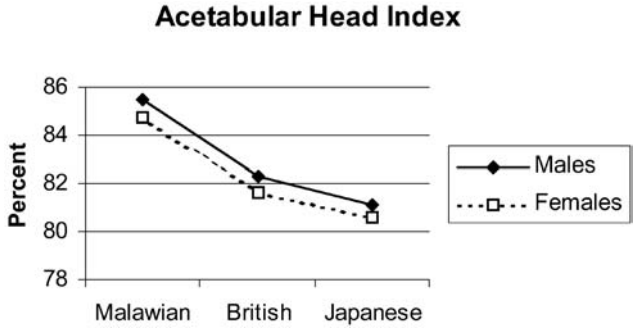

Fig. 6 Acetabular head index (a lower percentage represents more dysplasia)

Results

Table 1 summarises the means and standard deviations of the centre edge angle of Wiberg, the acetabular angle of Sharp and the acetabular head index in Malawians. For comparison, in the same table we have added the published values for British and Japanese hips [1]. The means are presented graphically in Figs 4, 5, and 6. Table 2 shows the statistical differences between genders and between Malawians and Japanese and British hips for all three parameters.

Discussion

From our results it can be seen that Malawian female acetabula in our study population are more dysplastic than males using all three methods of measurement. However, only the acetabular angle of Sharp showed a difference that was significant at $p<0.05$ (using the t test). There is also a clear tendency in the figures of Fujii et al. for female hips in Japanese and British populations to be more dysplastic than their male counterparts.

We also see a geographic or racial trend for each index, with Japanese hips being more dysplastic than British hips which in turn are more dysplastic than Malawian hips. The cause of these anatomical differences is most likely to be genetic, but it is also possible that cultural differences in the way babies are carried may also affect hip development and ultimate adult hip morphology. In Malawi, like most parts of sub-Saharan Africa, for example, babies are carried for most of the time on the mother's back with the hips widely abducted around her waist. This practice will tend to check any tendency to instability, as it places the femoral head in the most stable reduced position.

There do not appear to be any clinical differences associated with the slight changes in adult acetabular morphology that we have reported; for example the incidence of degenerative change is not higher in Japanese hips than it is in British hips as might be expected, and if anything it is lower [6]. It is possible that further studies correlating clinical and anatomical features will show more ethnic differences. However, even if no major clinical differences are shown, for the surgeon who is performing hip replacement and acetabular surgery in a multicultural society, an awareness of geographical and gender variations in hip morphology will be helpful in pre-operative planning and surgical practice.

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