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Typical metal on metal (MoM) hip prosthesis.

Technological aspects of hip replacement

Although hip replacement has become one of the most successful orthopaedic procedures since its popularisation in the 1960s, wear and dislocation have been ongoing problems in need of solution. Prosthesis head size and material types have been the main focus of attention.

A major advantage of a larger diameter head is enhanced stability. Dislocation risk is greatly reduced. This stability is due to the increased distance the head must 'jump' before it escapes the acetabulum.

For the usual prosthesis, polyethylene (cup) on metal (ball), attempts to reduce wear rates resulted in a small head being chosen – 22 mm diameter. To prevent painful dislocation, patients must adhere to strict rules regarding posture and weight bearing. However, as patients get older they often forget these restrictions resulting in a dislocation, a trip to hospital, anaesthetic and loss of confidence.

Whilst wear rates have been further reduced by changes in methods of manufacture of the polyethylene bearing, wear still remains the main mode of failure.

Metal on metal articulations (MoM) have become available in Australia over recent years after successful use in Europe for more than 20 years. The major advantages of MoM are the high level of stability and the low rate of wear.

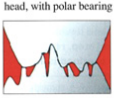
Lubrication

MoM demonstrates a very low wear rate due to fluid film lubrication, that is, a very thin film of joint fluid forms between the articular surfaces to minimise metal on metal contact.

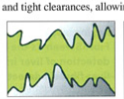
Bearing surface clearances

MoM bearings have lower wear rates associated with larger head diameters, compared to metal on polyethylene bearings. This low wear rate allows the use of head diameters of 50-60 mm. The larger the diameter of the head, the less is the volumetric wear as this graph shows.

In summary, reduced volumetric wear is achieved by use a large diameter head, with polar bearing and tight clearances, allowing fluid film lubrication.



Viewed microscopically, a close relationship between the bearing surfaces results in most wear.



When a fluid film forms between the bearing surfaces, wear reduces significantly due to absence of contact between the bearing surfaces (although there is some contact at "startup", which is when wear occurs).

Large head MoM articulation shown on x-ray.

(A) Equatorial contact causes bearing seizure with increased torque and predisposition to aseptic loosening.

(B) A large clearance results in increased wear rates.

(C) Polar bearing allows fluid film lubrication.

Therefore, the twin problems of dislocation and wear are alleviated.

A ceramic on ceramic bearing (CoC) is the alternative to MoM when it comes to lower wear rates. However, current technology limits the maximum ceramic head size to 36mm diameter, which is less stable than larger head MoM prostheses. There is currently vigorous debate as to the pros and cons of CoC vs. MoM couplings.

There are other advantages to large head articulation:

- High range of motion. The increased ratio between the diameter of the head and the neck diameter results in an improved range of motion as there is no impingement of soft tissue.
- More natural feel. Patients report that the hip feels 'normal' due to improved proprioception.

The patient is shown squatting at 8 weeks post THR (right side, large head used).

Finally, larger heads do not necessarily equate to a larger incision (see photo).

For reasons outlined above, the author is a strong advocate of the large head, MoM artificial joint.