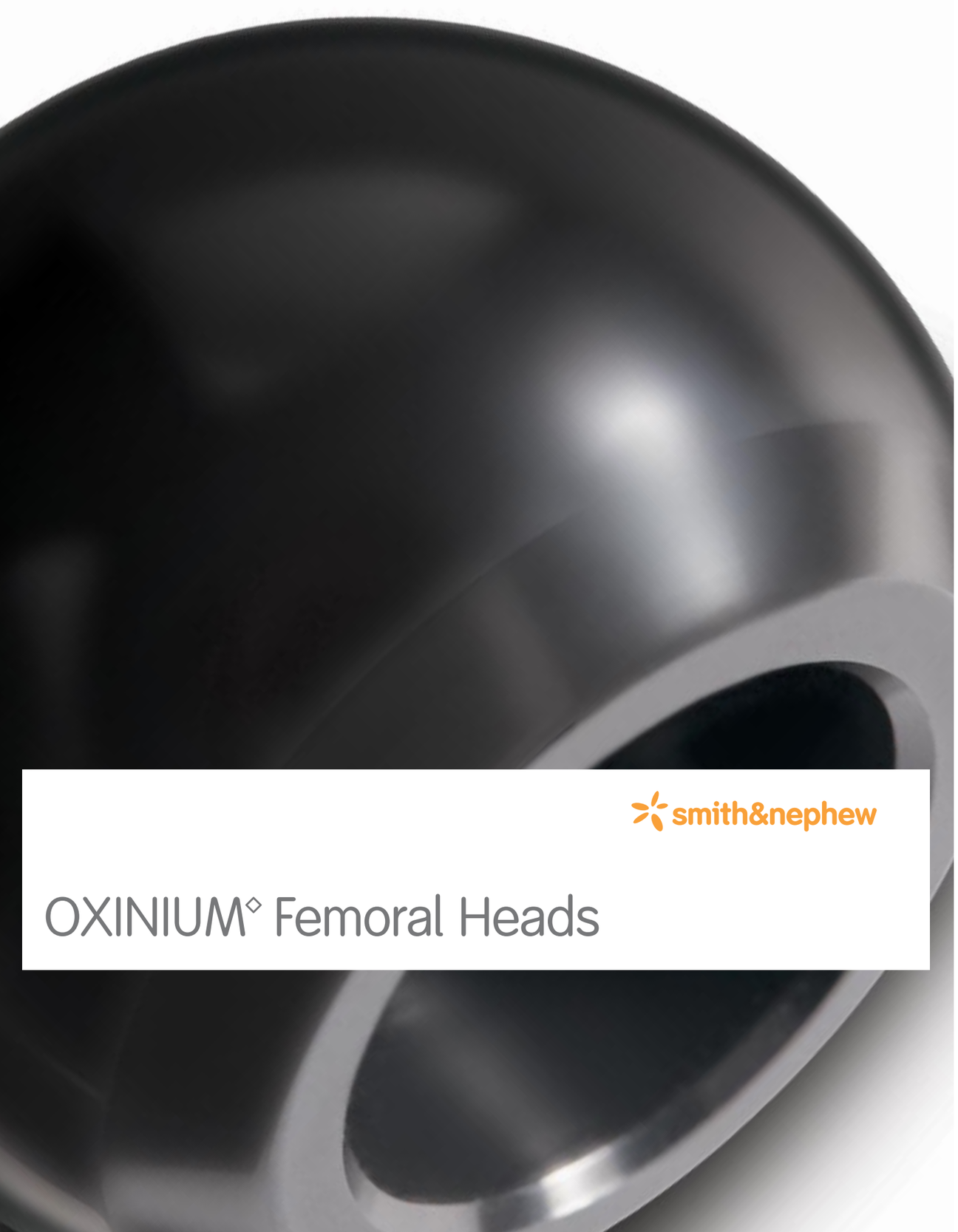


smith&nephew

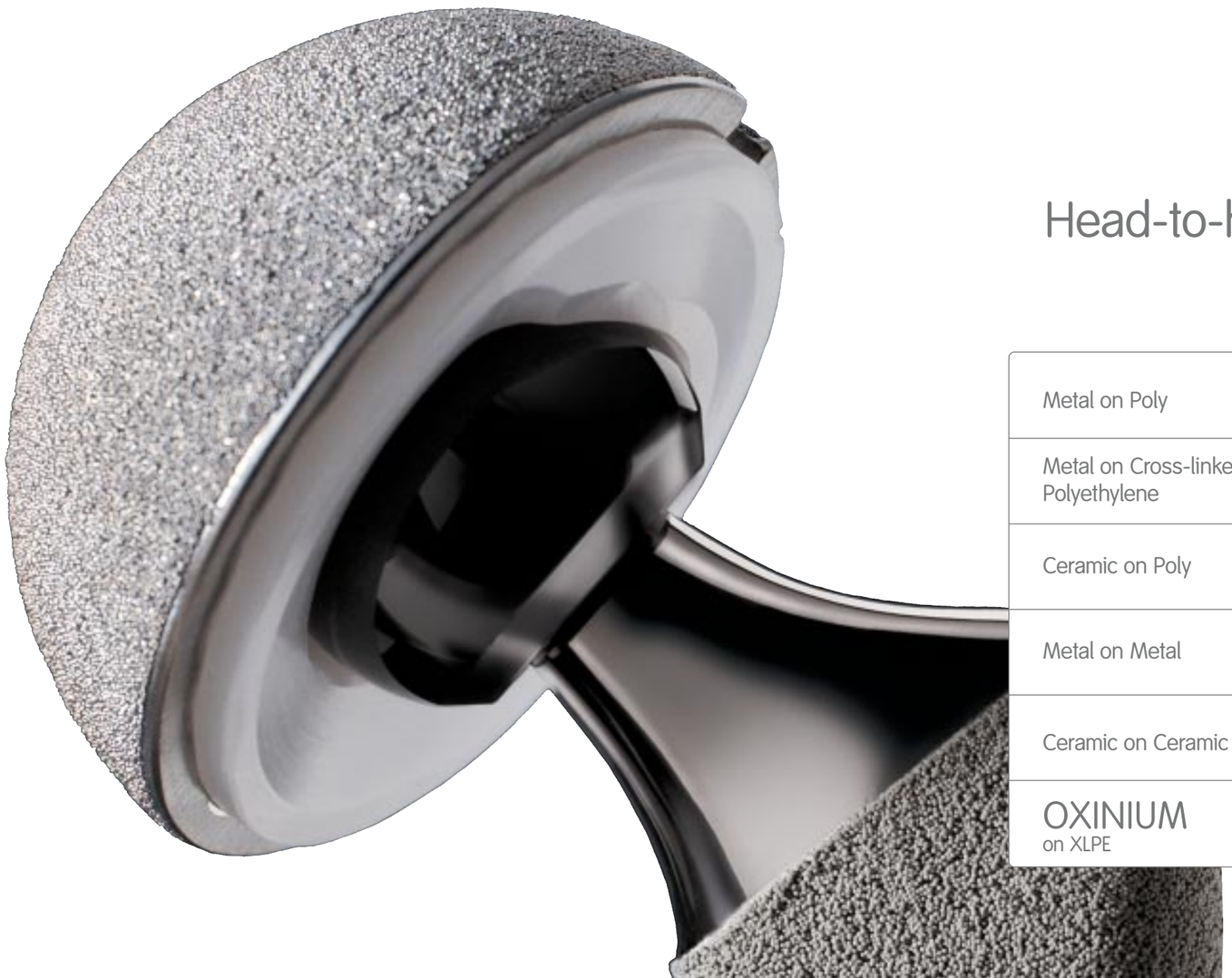
OXINIUM® Femoral Heads

Less wear – More options – Without the risks

Even the best cobalt chrome and ceramic femoral heads come with the risks of wear or breakage. But with OXINIUM® femoral heads, those risks are history. OXINIUM technology combines the strength of metal with the smoothness of ceramic to offer the benefits of both without the risks.

OXINIUM – oxidized zirconium – is created from two of the most biocompatible metals known. Through a proprietary process, the surface of this alloy is transformed into a smooth ceramic. The rest of the alloy remains metal for toughness.

It's all the strengths without the risks.



Beyond compromise

Femoral heads made from cobalt chrome and ceramic require surgeons and patients to accept compromises. With OXINIUM® femoral heads, these compromises no longer apply.

Cobalt chrome femoral heads perform well because of strength and toughness. However, cobalt chrome roughens over time and scratches.[1-4] And cross-linked polyethylene liners are extremely sensitive to scratched heads.[5-7]

Ceramic femoral heads are scratch resistant, but they can fracture.[8-20] Plus, they offer only limited sizing and revision options. Ceramic can be too brittle for some head lengths and cannot be used for revision on an existing stem.

Even with the best cobalt chrome and ceramic heads, there are still risks. OXINIUM heads eliminate those risks.

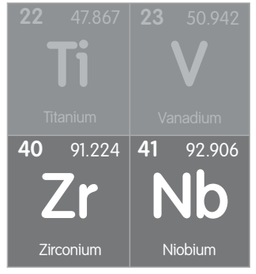
Head-to-head summary

	Strengths	Risks
Metal on Poly	Head Size and Neck Length Options Toughness	Wear
Metal on Cross-linked Polyethylene	Head Size and Neck Length Options Toughness	Head Scratches Negate Benefits
Ceramic on Poly	Reduced Wear Abrasion Resistance Low Friction	Fracture Risk No Head Exchanges Limited Neck Length Options
Metal on Metal	Reduced Wear Head Size Options Toughness	High Ion Levels Less Liner Options Sensitive to Abrasion
Ceramic on Ceramic	Reduced Wear Abrasion Resistance Low Friction	Fracture Risk Limited Head Size, Neck Length and Liner Options No Head Exchanges
OXINIUM on XLPE	All	None

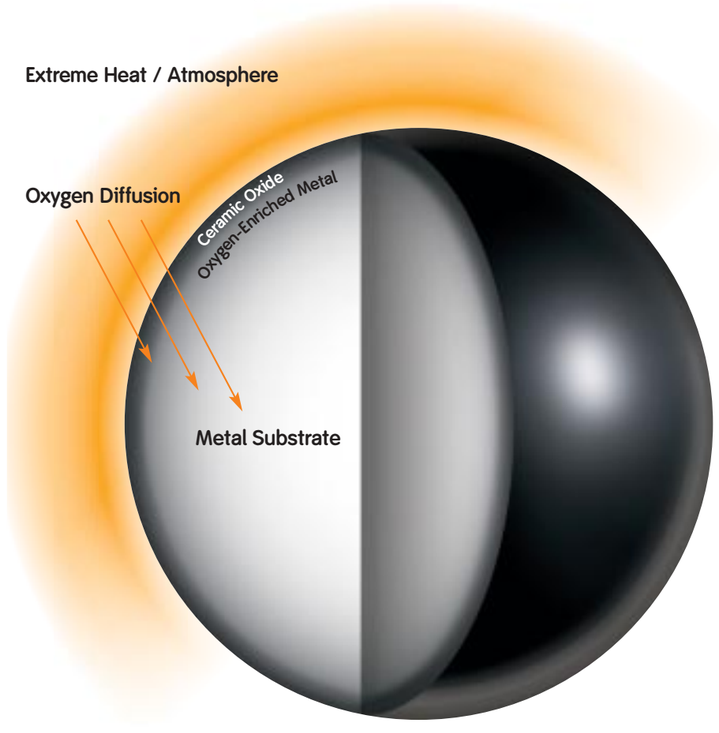
An extraordinary alloy

OXINIUM® material is created from a compound of 97.5% zirconium and 2.5% niobium — two of the most biocompatible metals known — and with a proprietary process involving extreme heat and oxygenation. This process yields a revolutionary material with a 5-micron thick ceramic surface on a core of metal — providing OXINIUM material with its superior strength and wear characteristics.

Oxinium is alloyed from zirconium and niobium, two of the four most biocompatible metals.



The OXINIUM material is a metal with the surface transformed into a ceramic. Oxygen diffuses into zirconium creating a 5-micron thick ceramic surface and leaving a metal core to retain strength and flexibility.



Abrasion resistant

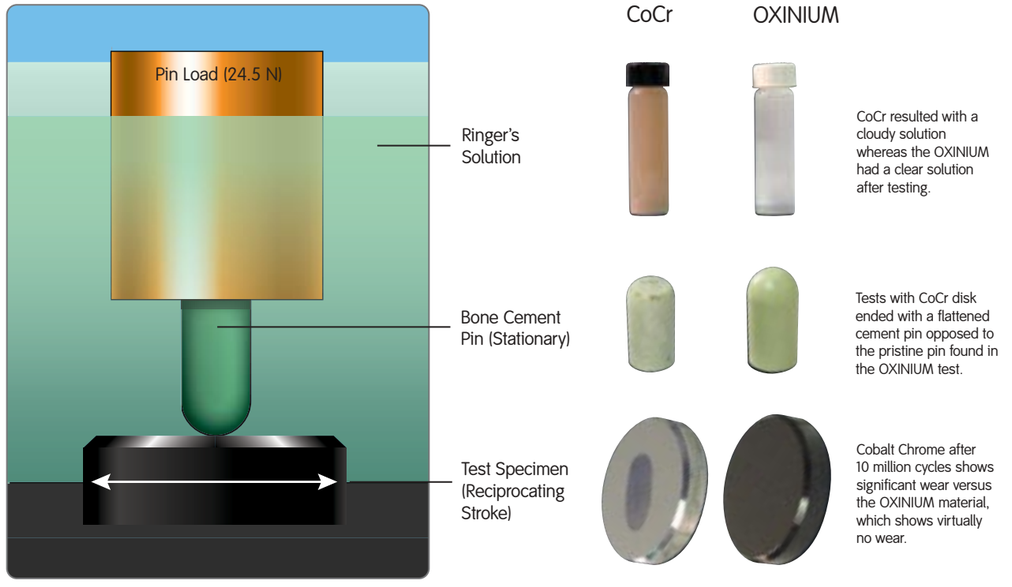
Surfaces that are more resistant to abrasive scratching reduce the potential for abrasive wear. OXINIUM® heads have significantly higher abrasion resistance than cobalt chrome heads. Hunter et al. conducted cement pin-on-disk tests which articulated cement pins against an OXINIUM disk for ten million cycles.[21] The study proved:

OXINIUM material is 4900 times more resistant to abrasion than cobalt chrome

OXINIUM material is more than 160 times smoother than cobalt chrome

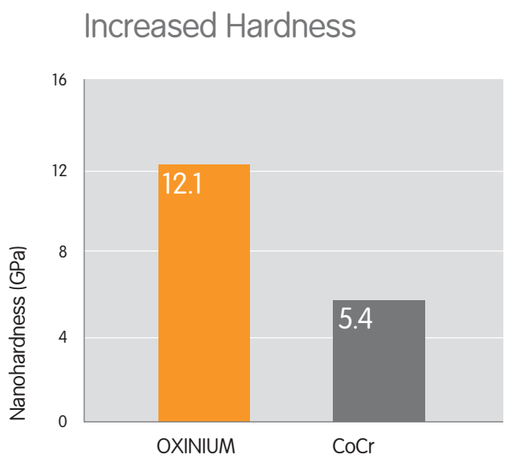
Not only is the OXINIUM head much more difficult to scratch, but even when scratched, it causes less harm to the liner.

Pin-On-Disk Test



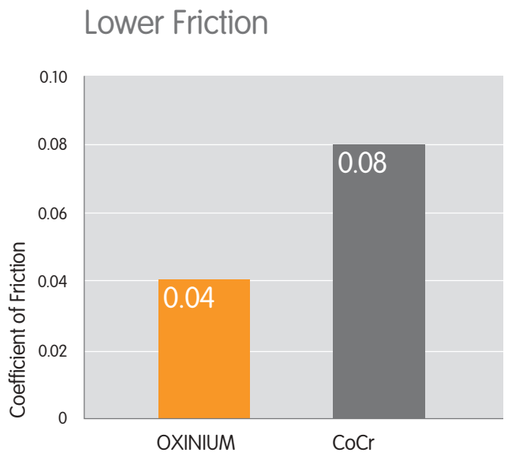
Twice the hardness

The OXINIUM® material is more than twice as hard as cobalt chrome.[22] That translates directly to an increase in resistance to scratching.



Half the friction

The OXINIUM material has a coefficient of friction that is half that of cobalt chrome.[23] This dramatic decrease in friction corresponds with a decrease in wear.

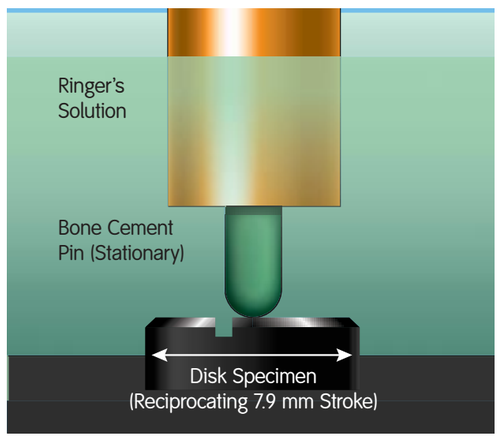


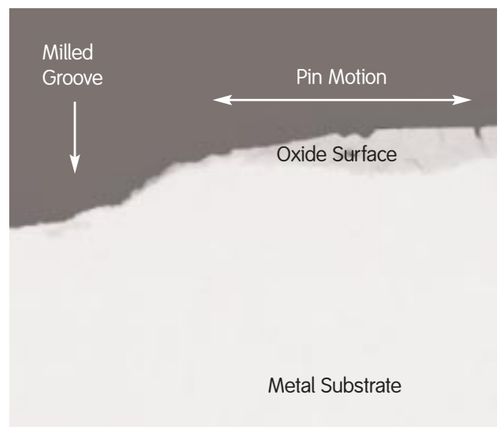
"This improved wear performance of oxidized zirconium may be due to the ionic character of its ceramic surface that enhances wettability, its high surface hardness that minimizes abrasive scratching, and its immunity to oxidative wear."[24]

Surface integrity

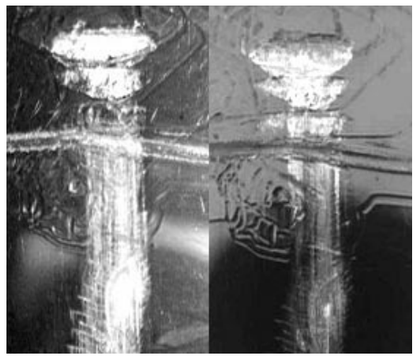
Testing has shown that the oxygen-enriched metal within the femoral head maintains a strong bond with the ceramic surface.[25] Consider:

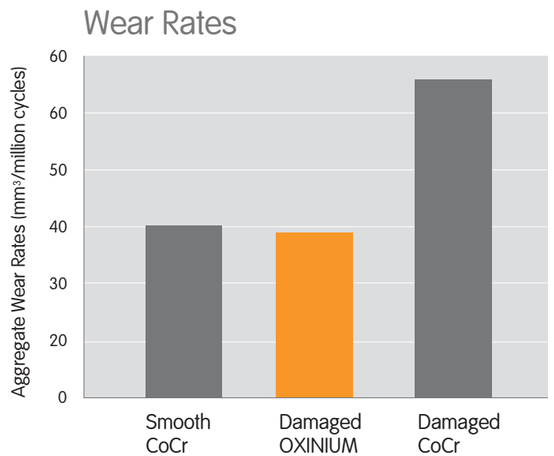
A groove was milled through the ceramic surface of an OXINIUM head and pin-on-disk tests were performed. After 10 million cycles of the pin moving across the groove, there was no delamination or flaking of the ceramic surface.





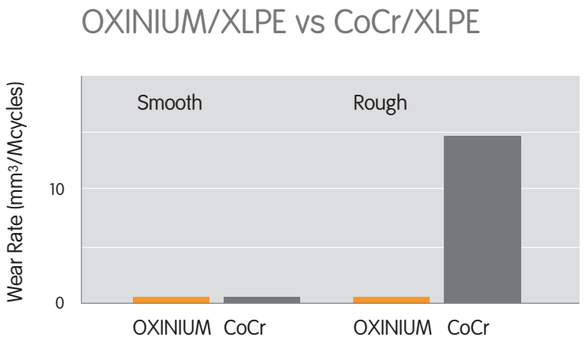
An extreme damage test simulated an OXINIUM head dislocating against a shell and being abraded by beads on the shell.[26] After five million cycles on a hip simulator, the extremely damaged head caused slightly less wear than a clean, new cobalt chrome head. The same damage test on a cobalt chrome head showed a dramatically higher wear rate.

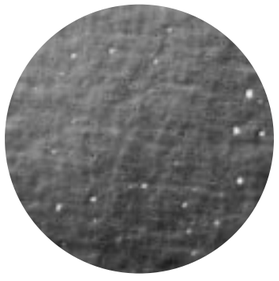




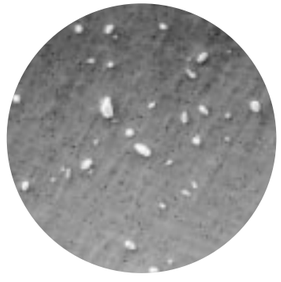
Less wear

Over the life of an implant, foreign material can be introduced into the bearing couple that can roughen the surfaces and increase wear.[1-4] Cobalt chrome and OXINIUM® heads were roughened *in vitro* to simulate wear and scratching over time. OXINIUM heads produce nearly undetectable wear, even after being subjected to abrasive conditions.[6] Conversely, scratched CoCr heads dramatically reduce the benefits of cross-linked polyethylene.[5-7]





Wear debris from roughened OXINIUM on XLPE



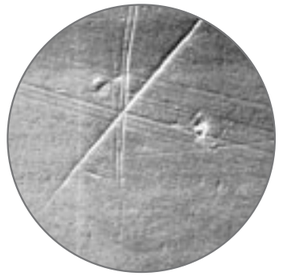
Wear debris from roughened CoCr on cross-linked polyethylene

Not all wear debris are equal. Studies show that metal-on-metal bearing couplings may elevate potentially hazardous chromium ion levels as much as 100 times and cobalt levels may increase as much as 50 times the normal levels.[27] OXINIUM femoral heads do not create either of these risks.

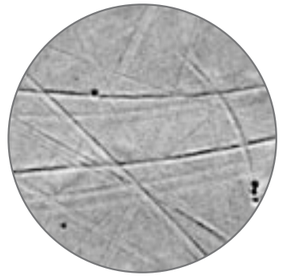
OXINIUM material is not a traditional metal and should not be considered a standard bearing coupling. OXINIUM material is an advanced bearing coupling and offers exceptional wear characteristics.

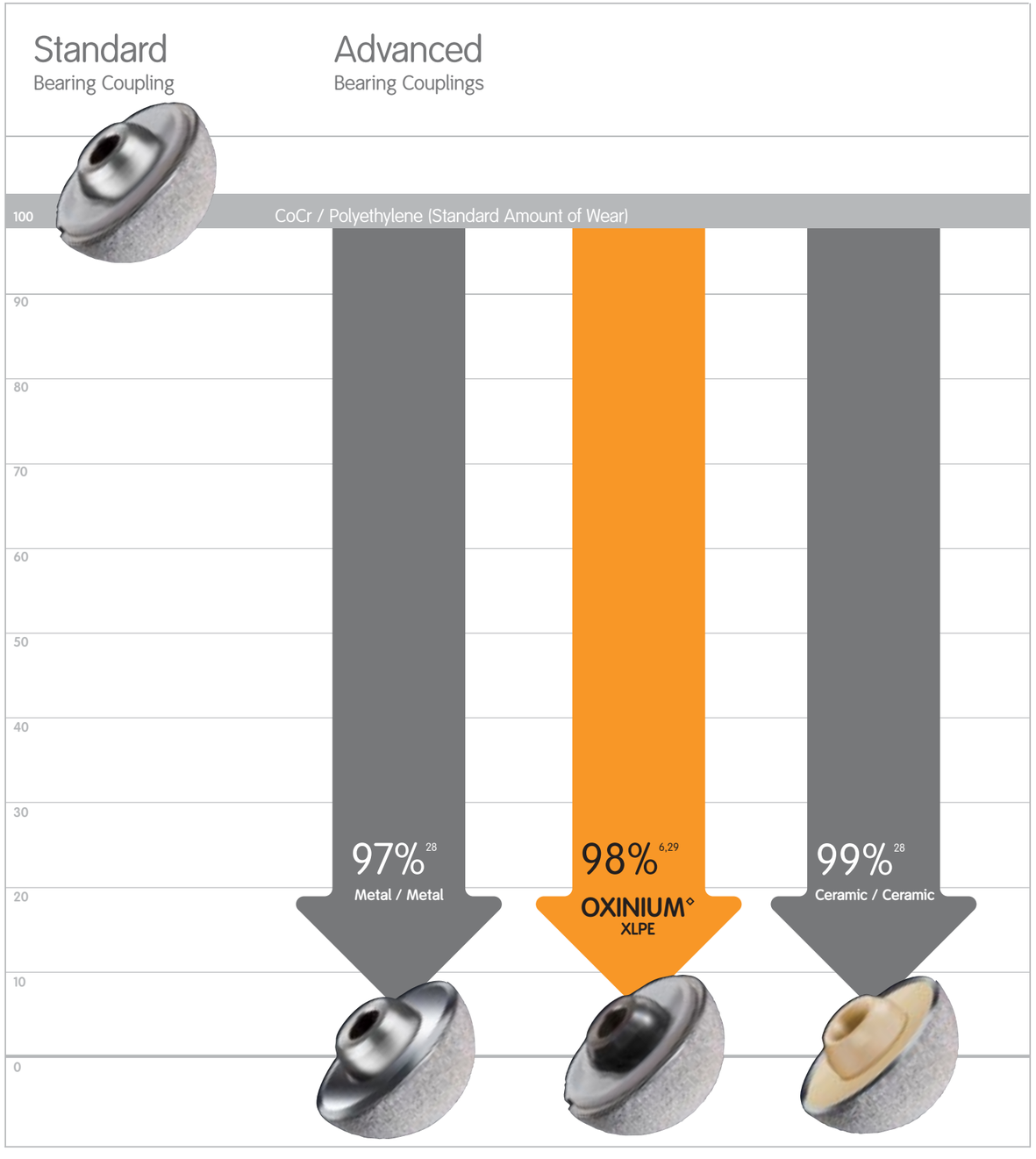
To simulate abrasion encountered *in vivo*, femoral heads were tumbled in abrasive media. The effects were similar to abrasions seen with actual retrievals.

Tumbled CoCr Head



Retrieved CoCr Head





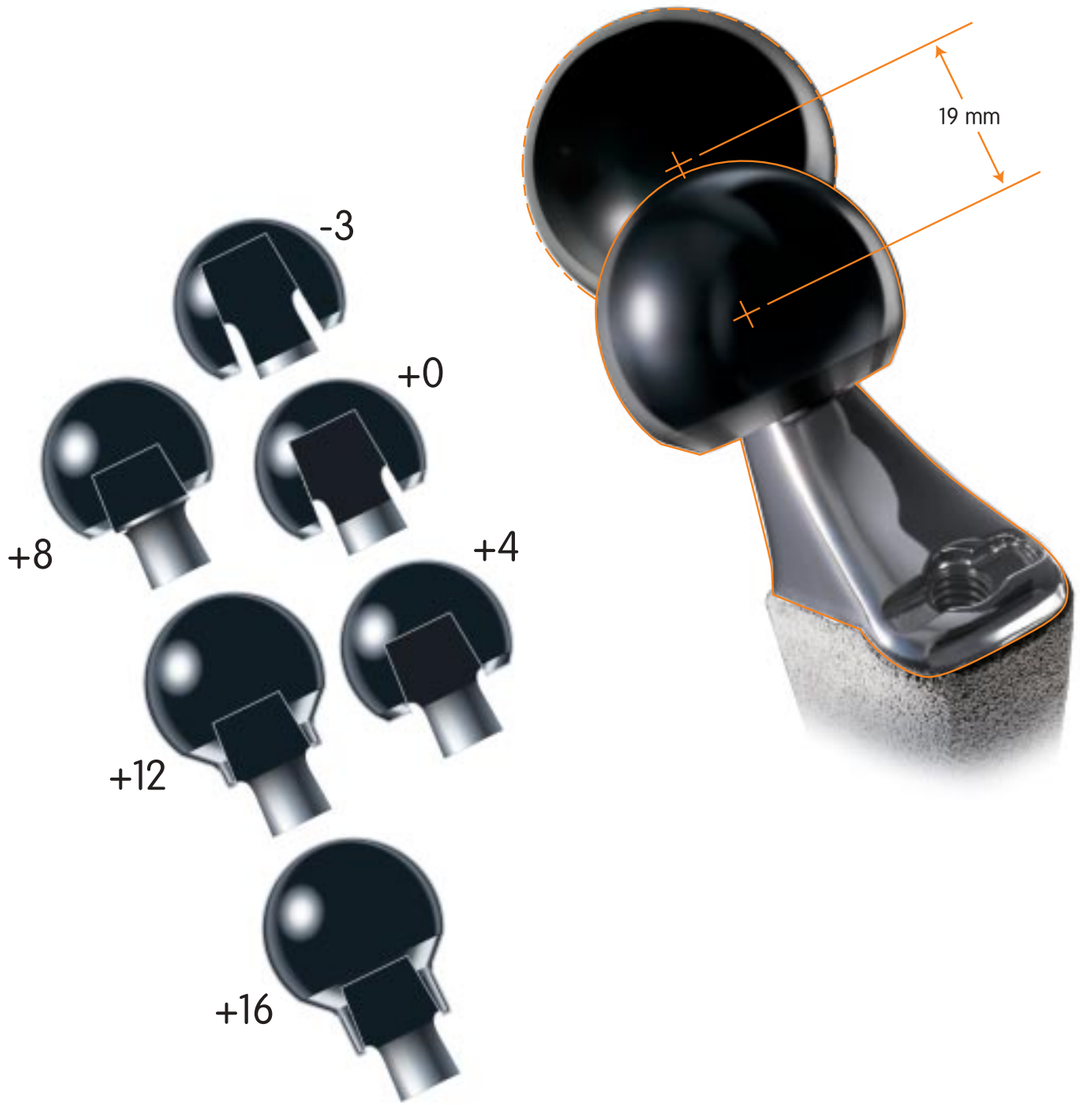
All three advanced bearing couplings produce nearly undetectable wear compared to cobalt chrome and conventional poly.

OXINIUM femoral heads with REFLECTION® XLPE liners produce nearly undetectable wear.

More options

Compared to OXINIUM®/XLPE, other advanced bearings have limited head and liner options. With an average of 60 combinations for every cup size, OXINIUM and XLPE limit wear, not options. Ceramic-on-ceramic bearings typically only have three combinations per cup size.

OXINIUM femoral heads and XLPE liners maximize intraoperative options to minimize the risk of dislocation and leg length discrepancies.[30-33] Both of these risks remain inherent with other advanced bearing couplings, because of the limited head and liner options. With hard-on-hard bearings, cup placement and orientation must be more precise to minimize these complications.[34]



REFLECTION® XLPE liners are available in four different styles

Neutral 0° liners provide maximum range of motion and are best used when the cup has sufficient anteversion and abduction.

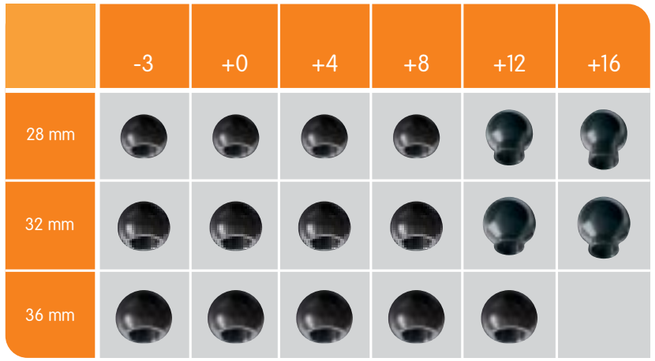
+4 Lateralized neutral liners have the face moved out 4 mm for when the cup is properly oriented but is too deep or when there is not enough neck length on the femoral side.

20° Overhang liners provide additional coverage to protect against minor instability.

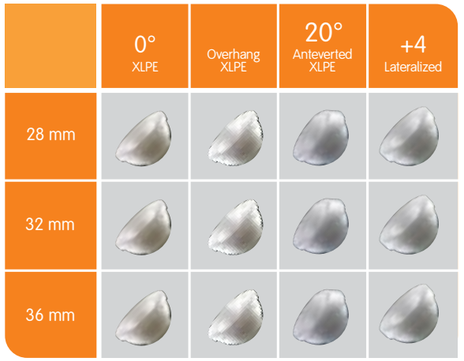
Anteverted liners are lateralized liners that provide 20° more coverage on one side but have material removed opposite the build-up to decrease the likelihood of impingement.

More options

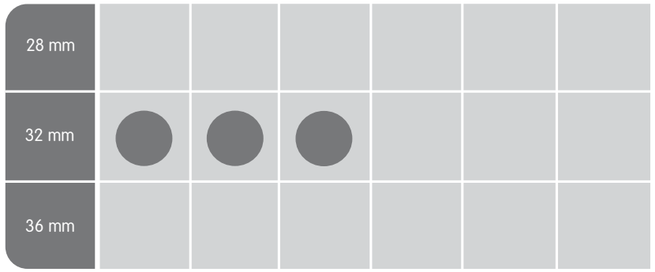
OXINIUM® Head Options Size 54 Cup



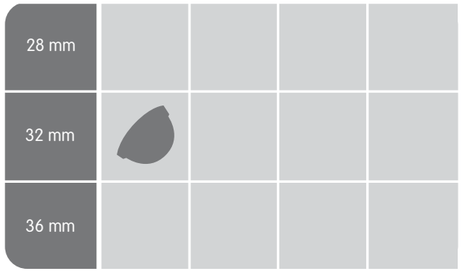
XLPE Liner Options Size 54 Cup



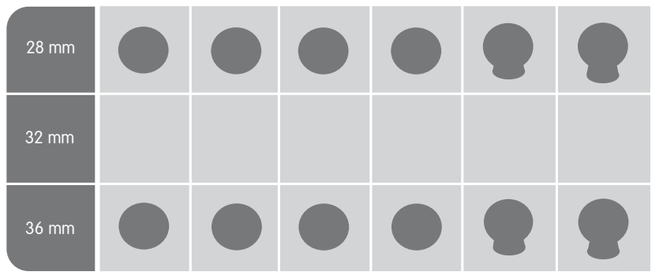
Typical ceramic-on-ceramic head options



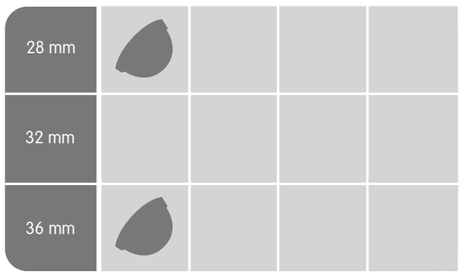
Typical ceramic-on-ceramic liner options



Typical metal-on metal head options



Typical metal-on-metal liner options



OXINIUM® femoral heads coupled with REFLECTION® XLPE liners provide a level of versatility usually associated only with standard bearings.

The diverse range of neck length, liner, and sizing options available in OXINIUM femoral heads creates the versatility necessary to avoid leg length discrepancies and dislocations.

This is especially true when OXINIUM and XLPE options are compared to other advanced bearings in a size 54 cup, the most frequently used cup size.

In addition, the REFLECTION MicroStable liner locking mechanism allows 24 liner positions, so the overhang can be oriented to best suit each patient.

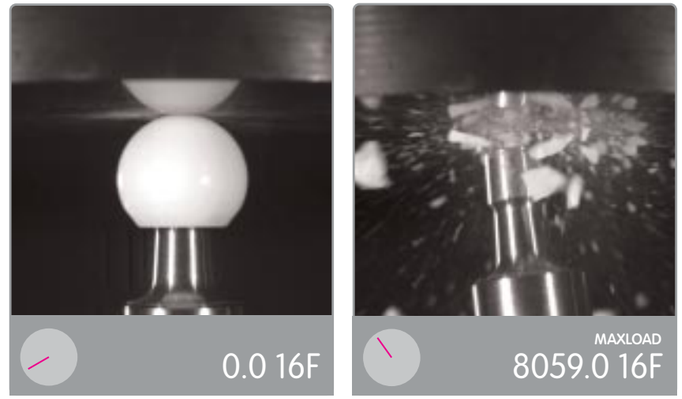
Without the risks

Advanced bearing couplings can reduce wear debris more than 97% as compared to standard cobalt chrome-on-polyethylene bearing couplings. Unfortunately, ceramic-on-ceramic and metal-on-metal couplings have serious risks to consider.

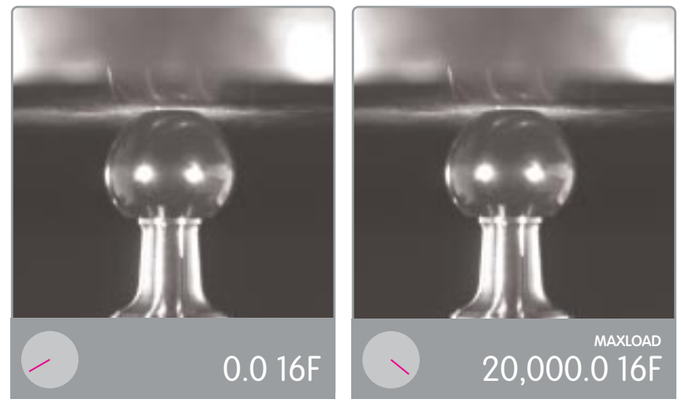
Laboratory testing shows ceramic femoral heads can withstand only a fraction of the force an OXINIUM® femoral head can withstand.[35] As pressure increases, the ceramic head fractures and then fails. The failure produces thousands of fragments and requires an immediate revision. Fragments can also stay in the joint and ruin future bearing couplings. The strength of OXINIUM® femoral heads exceed the limits of standard laboratory equipment used to test femoral heads.

Wear debris is the leading cause of aseptic loosening[36] — which is the leading cause of implant failure.[37] While other advanced bearing couplings produce nearly immeasurable wear debris, they do produce measurable risks. Metal risks elevated ion levels. Ceramic risks fracture. OXINIUM risks neither.

Ceramic femoral heads experienced catastrophic failure at an average of only 8,059 pounds of force.



At 20,000 pounds of force, OXINIUM femoral heads demonstrated virtually no signs of damage.



Less wear – More options – Without the risks

Until now, femoral head materials have forced surgeons and patients to make vital compromises. Cobalt chrome can scratch and increase wear, and ceramic risks fracture. Likewise, the other advanced bearings lower wear but limit options and risk elevated metal ions, impingement, and/or fracture.

OXINIUM® Femoral Heads are made from a revolutionary material that is smooth, resistant to abrasion, and as “Strong as an Ox”. Also, OXINIUM Heads and REFLECTION® XLPE liners come in many sizes, which give surgeons the options they need to adjust leg length and reduce dislocations.

OXINIUM Heads on XLPE Liners have **less wear** and **more options**, **without the risks**. That is a winning combination for surgeons and patients.

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