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Squid's beak may hold key to knee, hip implants

NTU scientists say protein in beak helps make material more durable

By SAMANTHA BOH

THE squid's beak is tough at one end to allow the creature to chop and slice up prey, but becomes gradually softer as it enters the mouth, so it does not bite into the animal's soft flesh.

Local scientists have discovered the secret behind the beak's structure.

They believe the material could be used in next-generation implants such as replacement knees and hips, which would be more comfortable and durable than those available now.

The beak is made up of proteins and interlinked chitin fibres commonly found in the exoskeleton of insects and crustacean shells. Squids process the proteins into a very concentrated liquid solution, which then diffuses through the chitin fibres to the end of the tip. There, it cures – much like how superglue hardens when exposed to air.

This gradient of hardness is due to the precise molecular structure of a particular protein, which lead researcher, Assistant Professor Ali Miserez, and his team at Nanyang Technological University (NTU) have pinned down.

Their findings were published in the prestigious scientific journal Nature Chemical Biology last week.

Prof Miserez, from the schools of materials science and engineering, and biological sciences, believes the same material would be ideal in joint implants.

They currently have to be replaced after around 15 years, often because the lining between the tissue and the implant – made of polyethylene or plastic for smooth motion – degrades due to wear and tear.

"(Then) you have this very stiff material coming into contact with very soft flesh, and you have deep tissue damage," said Prof Miserez. He said mimicking the way the protein works in squids' beaks will prevent such injuries because instead of being very hard or very soft, the change in hardness is gradual. This could also lengthen the lifespan of implants.

Dr Andrew Dutton, medical director and orthopaedic surgeon of SMG Orthopaedic Group, believes that the material may have potential for use as cartilage implants for defective joints.

"(Current cartilage implants) are very soft, they can break down, they can loosen and come off and they may not be well incorporated... There is a lot of room for improvement," said Dr Dutton.

Prof Miserez added that the concentrated liquid protein in the beaks is also able to weave and flow into small gaps easily, a property that, if duplicated, can be used to make strong composite materials by acting as a binder.

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> **– Dr Andrew Dutton, medical director and orthopaedic surgeon of SMG Orthopaedic Group, on the shortcomings of current implants**

"The protein flows into the right place and when there is a change in condition (such as pH levels), it cures," he explained.

He believes he can create high-performance composite materials using natural sources, as the chitin can be obtained from waste seafood and the protein can be grown in the laboratory.

"We can use water-based chemistry instead of using nasty solvents, high temperature and an acidic environment," he said.

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