

# 3D Movie Reveals Mechanisms Inside Medical Equipment

**Is it possible to see where, when and how the mechanism inside medical equipment such as an insulin pen wears down? The answer is yes. Novo Nordisk researchers have found a way to do it using X-rays. The results – including the creation of animations of the interior actions of the components of this vital product for diabetics – have gained the company much useful knowledge.**

Around 468 million adults worldwide have diabetes. At least 280,000 Danes are diabetic, and more than 150,000 of them depend on insulin in some form. Insulin pens are an easy way to inject the life-saving medicine and ensure the right dosage, but it is crucial that the pen never fail.

Headquartered in Denmark, Novo Nordisk is a leading global healthcare company and one of the world's leading producers of insulin and insulin pens. Several models have a reusable hypodermic needle; these can last years, and patients can bring them anywhere.

## X-Ray Views of Mechanical Movements

To better understand its products, Novo Nordisk wanted to see how insulin pens were affected by wear and tear when their mechanisms were activated. The solution was to use X-rays. Facilitated by the LINX Association (an innovation platform that specializes in facilitating X-ray techniques), Novo Nordisk collaborated on the project with the Technical University of Denmark (DTU).

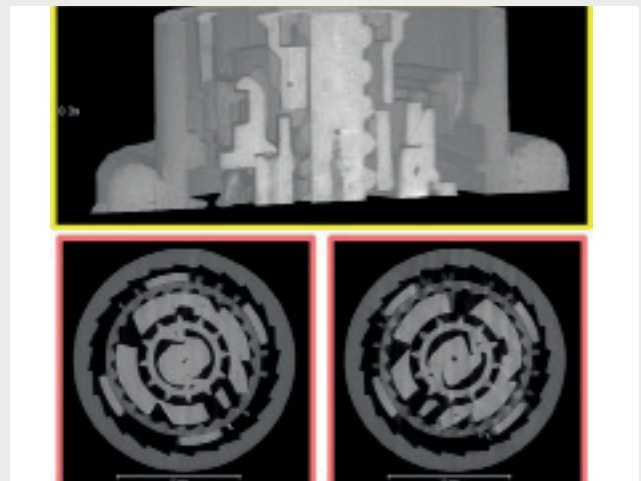
DTU researchers traveled to Grenoble, France, to ESRF (the European Synchrotron Radiation Facility). The facility can generate X-ray beams 10 trillion times brighter than medical X-rays, enabling DTU researchers to record microstructures in extremely high-resolution images – down to 24 microns (0.0024 centimeters).

The insulin pen was examined using extremely fast CT X-ray scans, and ESRF and DTU produced so-called tomographic reconstructions, i.e., 3D images, which could be viewed from numerous angles – it is possible to zoom in on various details of interest in very high resolution, penetrating the material.

These zoomed 3D images of the insulin pen's inner mechanisms could then be compiled into short "movies," with which Novo Nordisk could map wear and tear. Revealing the insulin pen's inner mechanism in action is extremely valuable, both for future product development and for determining how many times a patient may use a pen before replacing it, and this information could not have been obtained in any other way.



A modern insulin pen is a piece of advanced equipment with many moving parts, which wear down over time.



"Live" recordings made by X-rays revealed areas of wear on the interior mechanical parts of the insulin pen.

Producing physical prototypes is time consuming and expensive: It takes many tries to find the ideal shape, the best material, the perfect compounds, etc. These X-ray techniques and methods of data collection and analysis make it possible to render virtual versions of the products directly on a computer, where they can be subjected to a variety of virtual actions that test their susceptibility to wear and tear. This will help ensure faster and cheaper product development