Tooth ache is hard to bear

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Normally polar bears seem to have an unshakeable constitution: moving across snow, ice and open water to hunt for food the endangered species endures extreme conditions. A necrotic pulp nonetheless is intolerable for both humans and those magnificent animals. Lars, father to the world’s most famous polar bear cub Knut, recently underwent surgery in Aalborg Zoo to treat some serious endodontic problems.

RCTs rank among the not quite so popular dental treatments for both patients and general dentists. Sometimes patients literally have to be carried to the surgery like Lars, a full-grown polar bear that was suffering from two inflamed fangs due to complicated crown fractures. In order to get the bear ready for the comparatively risky endeavour, it took ten people to lift the anaesthetised animal onto the operating table. However, the team of veterinary dental specialists encountered even more challenges: the affected root canals were extremely long and curved making the RCT more challenging. The traumata to the teeth were estimated to have taken place some time ago and the pulp tissue was expected to be necrotic.

Unusual circumstances

The patient in this case report is by far not unknown to the public: Twenty-one-year-old polar bear Lars was born in captivity in Hellabrunn Zoo and lived in various other German zoos. In 2006 he fathered a polar bear cub that rose to absolute celebrity status—little Knut turned into an international media phenomenon and generated a lot of interest in captive polar bears and animal welfare in general. Since the beginning of 2015, Lars lives in Aalborg Zoo in Denmark. People still care about Knut’s family and their fate. Several Danish TV stations and newspapers came to report on the treatment of the zoo’s wildly popular inhabitant, who even sports his own private fan club.

Anaesthesia

To anaesthetise the polar bear it was first darted with strong sedatives by the zoo’s veterinarian Trine Hammer Jensen. After ten minutes the animal was ready to be transported to the operating area. For
safety and to make use of precious time the dental team did not want to move the polar bear far from his compound. The senior veterinarian, Hanne Kortegaard from the Department of Clinical Veterinary and Animal Science, Copenhagen University, operated out in the open on an improvised table made of various Euro-Pallets covered with a mat. The structure should be stable enough to carry a stately weight of 400 kg.

All keepers, doctors and medical experts assisting in the procedure joined forces to lift the huge animal (resting in a special canvas) to the table top. When the bear was finally in place, the specialists had to act swiftly to proceed with the actual endodontic treatment. Being under general anaesthesia for a long time may be dangerous to a patient. To minimise this risk it was decided not to do both RCT at the same day, but to postpone the treatment of the second tooth for some weeks.

Getting down to business

Access to the pulp chamber was gained by opening the already broken tooth at the fracture site. A portable X-ray machine and indirect radiograph system helped to locate and visualise the root canal system during the operation. The canal was extremely long and curvy. So-called tiger and bear files were used for the preparation, which have an overall length of 120 mm. Nevertheless, even with those instruments it was not possible to reach the apex due to the curvature of the tooth. A second opening at the mesial side of the tooth a few millimetres above the gingiva became necessary to secure a straight access to the apex and a thorough preparation of the canal. Working length from this point of entry still added up to 65,5 mm. The file with the biggest diameter used in the procedure was an ISO 80. Although this file was yet too small in diameter for the wide canal, it at least did not transport any debris into the system when the canal was cleaned and shaped.
Apart from the extra-long endodontic files and veterinary paper points especially developed for the treatment of animals, all materials used during the surgery were common dental products, which can be found in every human dental surgery as well. For the first rinsing of the canal NaOCl 0.5% was used. Amongst other things even short blades of grass and a fish bone were discovered in the root canal system. After the canal had been cleared of all debris and necrotic tissue, the irrigation protocol was finalised with CanalPro NaOCl 6% and sterile saline. Before obturation the canal was thoroughly dried with the above-mentioned paper points and thin sterile cotton sticks.

Reliable filling in tough conditions

In order to create a permanent, durable filling, the veterinarian eventually needed a modern filling system with excellent flow properties. Swiss dental specialist COLTENE recently introduced an intelligent obturation material that is quick to use with process times of only 10 to 15 minutes. GuttaFlow bioseal combines fluid gutta-percha with a suitable sealer at room temperature. The bioactive material thereby actively supports the regenerative processes in the tooth. In contact with fluids, it provides natural repair components such as calcium and silicates. It furthermore sets in motion corresponding biochemical processes that provide additional support in the regeneration of the root canal. After curing the innovative material can form so-called hydroxylapatite crystals on the surface. These crystals improve adhesion significantly and help to stimulate the regeneration of bone and dentin tissue in particular. Until now, only dental materials such as MTA or bioglass exhibited similar regeneration-supporting properties. However, the disadvantage of these traditional materials is primarily their long curing time or complicated handling.

The catalytic effect triggered by the special composition of GuttaFlow bioseal was exploited in order to create a long-lasting solution for a denture that is exposed to an enormous masticatory force. Dimensions in the anatomy of a full-grown polar bear are slightly different to those of the human body, too. A feline urinary catheter was adjusted to prolong the mixing tip of the gutta-percha syringe in order to reach further down the canal. Whereas dentists use less than 1 ml of material on human patients, practically half of the content of a 5 ml automix syringe had to be used to fill the root canal system. After the root canal has been securely sealed with GuttaFlow bioseal and a thin layer of glass ionomer, the restoration was topped off with a composite built up. The dual-curing bulk composite Fill-Up! allowed to fill the two access cavities very quickly and efficiently. Light-curing only required 5 seconds and the marginal integrity was high due to the low shrinkage forces. In Lars’ case it was again vital to use materials that are fast to apply, but yet reliable and robust enough to defy comparatively tough conditions. Using dental material on carnivores and large animals can become a real endurance test for the substances employed in the restoration. The veterinary dentist in charge was thus looking for high-quality products with a proven track record that would meet those strict criteria.

A promising prognosis

After three hours the polar bear finally got off the operating table again. Two months later, another surgery was scheduled to perform a root canal treatment in his second broken fang. This time the pulp chamber was accessed immediately from the mesial side of the tooth because the team already knew about the problem the long, curved root canals posed. On the one hand this procedure helped to reach the pulp chamber much quicker, on the other hand the removal of more dentin naturally weakens the tooth. Again, an extra reliable and strong filling material was needed to create a durable solution. The masticatory forces working in the mandible of a polar bear even chal-
lenged the R & D department of COLTENE as dental materials normally function on a much smaller scale. Luckily, the bulk composite Fill-Up! allows to fill cavities of more than the average four to five centimetres still using the single-layer technique.

Thanks to the experience of the first surgery, the second endodontic treatment ran without any complications. After two hours the right mandibular canine tooth was successfully operated too. The left mandibular canine was radiographed for follow-up. Within the next months the supervision of Lars’ eating habits will reflect the results of the two RCTs. A post-operative X-ray documenting the status quo like in a human patient would mean another anaesthesia for the huge animal and will be executed in 9 to 12 months. At the moment the polar bear is recovering fast and chewing on regular food again.

Fortunately, the zookeepers in Aalborg were versed enough to react fast: they spotted the apparent problems the polar bear had with his fangs first. Acknowledging a dental problem in a wild animal can be a challenge and will often be overlooked. Educating caretakers at the zoo about dental problems and the effect this has on the animal, will protect these creatures against discomfort and pain and improve their quality of life since early action can be taken. In the small animal dental clinic at Copenhagen University Hanne Kortegaard sees mostly cats and dogs and caters for their endodontic problems and needs. European and American veterinary dentists are comparatively well-trained given the level of practical education they receive: in their training programme they have to treat several endodontic cases as well as handle a large number of extractions, maxillofacial surgical cases as jaw fractures or cancer surgery, orthodontic, prosthodontics and restoration cases. Dentists helping human patients can in fact benefit a lot from the considerable experience of their veterinary colleagues.

**Conclusion**

Operating in extreme conditions clearly demonstrates how much even a skilled and experienced dentist relies on dependable material that is easy to handle. Time constraints sometimes add extra pressure on the treatment as such. Innovative 2-in-1-filling systems combine sealer and gutta-percha for a tight seal of the root canal. State-of-the-art composites also add to the success of the restoration. With the help of tried and tested material endodontic problems can be cured really fast, which means that nobody has to endure tooth ache—whether it is sensitive human beings or stout Nordic creatures.

**Hanne Kortegaard** works as a Seniorvet in the surgery group at the Department of Veterinary Clinical and Animal Sciences at Copenhagen University, Denmark. She specialises in veterinary dentistry, mainly in small animals and helps in treating zoo animals in Denmark whenever called. Since 1998 Kortegaard has been teaching veterinary students in veterinary dentistry and surgery.

**Polar bear Lars** was born in 1993 in the Zoo Hellabrunn, Munich. In line with the European Endangered Species Programme (EEP) he lived in various German zoos, i.e. Hellabrunn, Berlin, Wuppertal and Rostock. In 2015 he was moved to the Aalborg Zoo in Denmark. The polar bear (Ursus maritimus) is classified as a so-called vulnerable species with varying estimates of global population numbers. In wildlife, polar bears face growing habitat loss due to climate change, pollution and oil and gas development.

**Website** [www.coltene.com](http://www.coltene.com)

Documentation is also available on YouTube under the title “Endo Treatment Polar Bear Lars, COLTENE 2015”.

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