

## **INTERVERTEBRAL DISC DEGENERATION AND DISCARTHROSIS IN WHITE-BEAKED DOLPHINS (*LAGENORHYNCHUS ALBIROSTRIS*).**

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### **Abstract**

Pathological changes were observed in cleaned vertebrae of white-beaked dolphins (*Lagenorhynchus albirostris*) in museum collections as well as during autopsies. In comparison several other species were studied in museum collections and during dissections. The pathology could be diagnosed as a degeneration of the intervertebral disc with secondary discarthrosis. White-beaked dolphins seem to be more vulnerable to degeneration of the intervertebral disc with discarthrosis than other cetacean species.

### **Zusammenfassung**

An präparierte Wirbeln von Weisschnauzendelphinen (*Lagenorhynchus albirostris*) wurden sowohl an Museumstücke als auch bei Sektionen pathologische Veränderungen beobachtet. Als Vergleichsmaterial wurden andere Tierarten aus Museen und von frischen Sektionen herangezogen. Die Veränderungen wurden charakterisiert als eine Degeneration der Zwischenwirbelscheibe mit sekundärer discarthrosis. Weisschnauzendelphinen sind anscheinend empfänglicher für eine Degeneration der Zwischenwirbelscheibe als andere Walarten.

### **Résumé**

Des lésions pathologiques ont été constatées aux vertèbres du lagénorhynque à rostre blanc (*Lagenorhynchus albirostris*); ceci aussi bien dans du matériel de musée que pendant les autopsies. A des fins de comparaisons, d'autres espèces conservées dans les musées ont été étudiées. Les lésions sont caractéristiques d'une dégénération du disque intervertébral avec une disque-arthrose sécondaire. Probablement, le lagénorhynque à rostre blanc sont plus sensibles à un dégénération du disque intervertébrale et à une disque-arthrose que d'autres espèces de cétacées.

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### **Key words**

Cetacea, Odontoceti, white-beaked dolphins, *Lagenorhynchus albirostris*, spondylarthropathy, intervertebral disc, disc degeneration, discarthrosis

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### **Introduction**

Pathological changes in the vertebrae of cetaceans are well known from cleaned vertebrae, both in Odontoceti as in Mysticeti. The etiology of this pathology is still a matter of speculation. Most deformations in Odontoceti can be diagnosed as either the result of degeneration of the intervertebral disc (discarthrosis, spondylosis deformans) or as infectious spondylitis (spondylo-osteomyelitis) or spondylodiscitis (1,5,6,7). Most of the pathological changes observed in the vertebrae of Mysticeti are different from those appearing in Odontoceti. It seems that ossification of the longitudinal ligaments has occurred in those cases, rather than the results of disc degeneration. A diagnosis of reactive spondylitis is to consider. Further research on this pathology is needed. A case of vertical intervertebral disc protrusion (Schmorl's node) has recently been found in a harbour porpoise (8).

Proven degeneration of the intervertebral disc has recently been described for the first time in a Cetacean species (6). Degeneration of the nucleus pulposus and the annulus fibrosus with effects on the vertebrae was found during autopsy on a fresh white-beaked dolphin (*Lagenorhynchus albirostris*).

## Materials and methods

A survey through two cetological museum collections in the Netherlands revealed several cases of spondylarthropathy in white-beaked dolphins (*L. albirostris*) and a few cases in two other species. A total of 43 skeletons of white-beaked dolphins of known sex was examined for the occurrence of spondylarthropathy. In comparison, 85 skeletons of harbour porpoises (*Phocoena phocoena*) and 18 skeletons of bottlenose dolphins (*Tursiops truncatus*) of known sex were studied (6). Separation between immature and adult animals was made by looking at the maturity of the vertebral body. In immature dolphins, both vertebral endplates were separable from the bodies in all thoracic and lumbar vertebrae.

In addition autopsies were performed on stranded cetaceans. These consisted of 3 adult female white-beaked dolphins (*L. albirostris*) and 4 immature white-beaked dolphins, 44 white-sided dolphins (*Lagenorhynchus acutus*), 7 common dolphins (*Delphinus delphis*), 2 bottlenose dolphins (*Tursiops truncatus*) and 12 harbour porpoises (*Phocoena phocoena*).

To examine the animals for skeletal abnormalities, in addition to the post mortem examination, radiographs were made of parts where discarthrosis was suspected.

## Results

### Museum collections

In 15 out of 29 adult and in 1 out of 14 immature white-beaked dolphins (*L. albirostris*) preserved in museums traces of spondylarthropathy were found. In all adult animals the conclusion was reached that the pathology was most probably resulting from disc degeneration with secondary discarthrosis (sclerosis of the endplate, marginal osteophytes, 'parrot-beaking', lipping osteophytes, pathological perforations of the end-plate and ankylosis), (Fig. 1). In the immature white-beaked dolphin the observed pathology, atypical for discarthrosis, could be related to spondylo-osteomyelitis. Traces of discarthrosis were found in only one out of 85 studied skeletons of harbour porpoises and in one out of 18 bottlenose dolphins.

### Autopsies

Autopsies on 3 fresh adult female white-beaked dolphins (*L. albirostris*) from the Dutch coast confirmed the hypothesis of disc degeneration. Degeneration of the intervertebral discs was seen as a reduced water content, brown discolouration, crumbling of the nucleus pulposus and reduced disc height. It was found in thoracic and lumbar intervertebral discs in all three cases. Otherwise the dolphins were physically healthy, and one was pregnant. All stages of degeneration were found in the vertebral column: intervertebral discs with only beginning degeneration of the nucleus pulposus and the annulus fibrosus, sclerosis of the vertebral end-plate, but also complete ankylosis between several vertebrae with a total destruction of the intervertebral discs were found. No signs of an infectious etiology were found.

Autopsies on 4 immature white-beaked dolphins, 44 white-sided dolphins (*L. acutus*), 7 common dolphins (*D. delphis*), 2 bottlenose dolphins (*T. truncatus*) and 12 harbour porpoises (*P. phocoena*) revealed only one other case of disc degeneration. In one senile female harbour porpoise, reduced water content and decreased intervertebral disc height, as well as fissuring and crumbling of the nucleus pulposus were found without bony changes (discarthrosis).

### Radiographical findings

The radiographs showed signs of degeneration of the intervertebral disc by narrowing of the disc (loss of the disc height) and lipping osteophytes with the characteristic bird's beak shape arising from the margins of the vertebral bodies. The free ends of these osteophytes were curving into the direction of the intervertebral disc, often coming more or less into close contact with the free ends of the

osteophytes on the adjacent vertebra (Fig. 3). In the normal vertebra the margins are slightly divergent (Fig. 2).

## Discussion

Degeneration of the intervertebral disc can be defined as the structural changes of the intervertebral disc including reduced water and modified proteoglycan content, decreased disc height, brown discolouration of the nucleus pulposus, and fissuring and crumbling of the nucleus pulposus. Disc degeneration is often accompanied or followed by bony changes in the vertebral body, mainly osteophytes and osteosclerosis. As those bone changes are present, the term discarthrosis is pertinent (2). Disc degeneration and discarthrosis can be considered as one continuous process, for which the term 'degenerative disc disease' may be used. The boundary between degeneration of the intervertebral disc and discarthrosis is almost impossible to trace. The former term might be used when the changes are limited to the disc, the latter term when bony changes occur.

Degeneration of the intervertebral disc with discarthrosis is found in several mammal species, including man. Mechanical stress on the intervertebral discs appears to be an important etiological factor. Cetaceans use their lumbar and caudal vertebral column for locomotion. The higher vulnerability to disc degeneration seems to be the price for this adaptation, as the high incidence of discarthrosis as result of the vertical vertebral column is for man (3,4,5). One can speculate that there might be an analogy with the vertebral pathology commonly observed in beavers *Castor fiber* (10).

Spondylarthropathy is incidentally observed and described in many cetacean species, but some species are much more vulnerable than other. The white-beaked dolphin is obviously such a species. Why this is so is hard to say. The white-beaked dolphin is the largest species in the genus *Lagenorhynchus*. It has a very robust and bulky body, giving more resistance during swimming, resulting in more pressure on the vertebral column. This species is furthermore the dolphin with the largest number of vertebrae (88-93), in which characteristic it is only surpassed by the Dall's porpoise (*Phocoenoides dalli*) with 92-98 vertebrae. It is also a fast swimmer and jumper. Furthermore, genetic disposition may play a role.

Disc degeneration with discarthrosis is only observed in adult animals. All intervertebral discs studied in the 4 immature white-beaked dolphins looked healthy. The pressure sustained by the vertebral bodies in immature subjects is similar to, and probably greater than, that sustained by older spines. The reason why discarthrosis is restricted to the adult age could be due to the fact that in young animals the intervertebral discs are intact and hence able to distribute the load to the vertebral end-plates more uniformly, and to absorb shocks more effectively, than in older (degenerated) discs (9).

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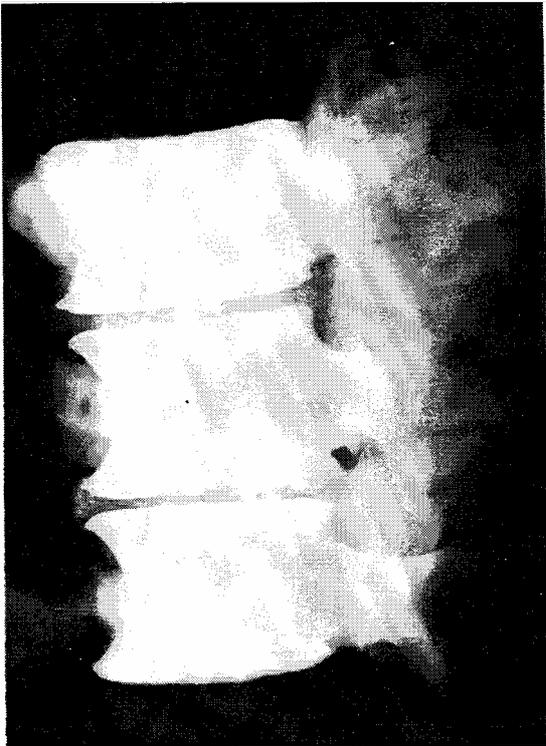
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Figure 2.

Radiograph of three normal lumbar vertebrae. White-beaked dolphin (*L. albirostris*) adult female, 24 January 1995, Island of Texel, The Netherlands.

Figure 3.

Radiograph of three abnormal lumbar vertebrae. White-beaked dolphin (*L. albirostris*) adult female, 24 January 1995, Island of Texel, The Netherlands.



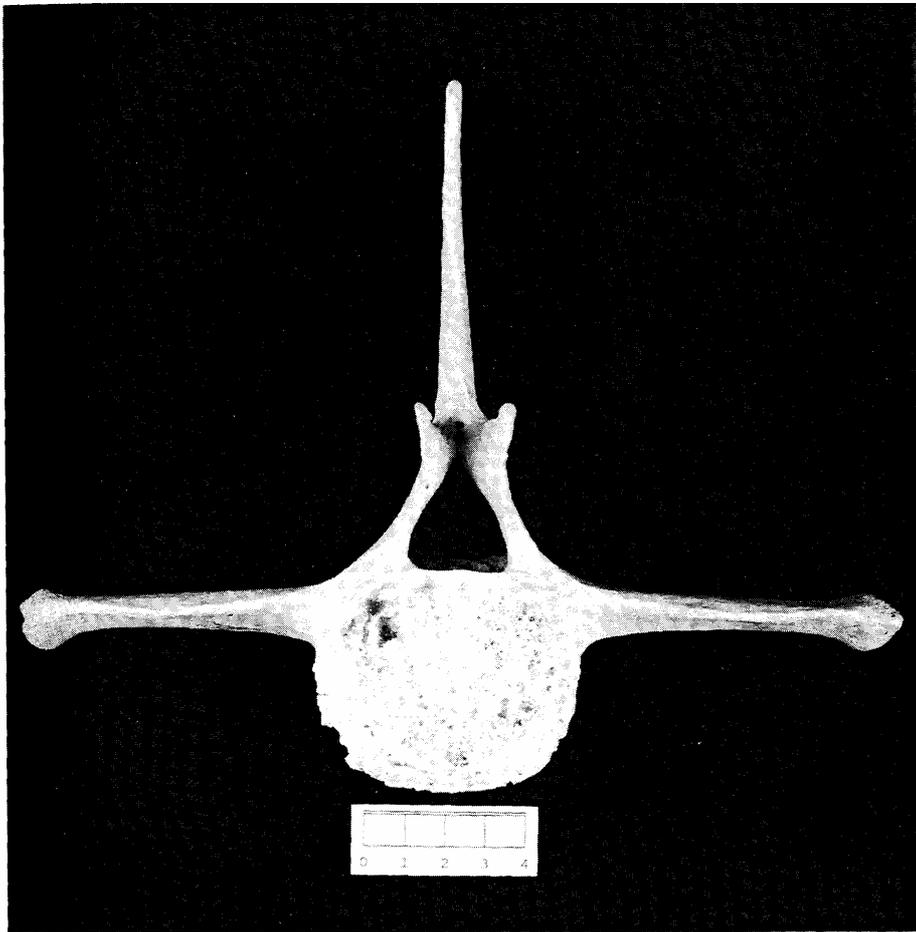


Figure 1.  
Thoracic vertebra with severe discarthrosis. White-beaked dolphin (*L. albirostris*) adult female (collection National Museum of Natural History, Leiden no RMNH 18067). Photograph R. 't Hart.

