

Severe Maxillary Osteomyelitis in a Gray Wolf (*Canis lupus*)

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Barber-Meyer, Shannon. 2012. Severe maxillary osteomyelitis in a Gray Wolf (*Canis lupus*). *Canadian Field-Naturalist* 126(3): 238–241.

Whereas dental injuries and abnormalities have been documented in Gray Wolves (*Canis lupus*), severe maxillary necrosis has not previously been implicated in a Gray Wolf fatality. Here I report maxillary osteomyelitis in a wild Gray Wolf from northeastern Minnesota of such severity that I hypothesize it ultimately led to death by starvation.

Key Words: *Canis lupus*, carnassials, Gray Wolf, maxillary osteomyelitis, pressure necrosis, Minnesota.

Dental injuries to or abnormalities in functionally important teeth and associated bones in predators may significantly reduce the ability to kill and consume prey (Lazar et al. 2009). This impairment is likely exacerbated in coursing predators, such as Gray Wolves, that bite and hold onto fleeing and kicking prey with their teeth. Damage to carnassials (upper fourth premolar, P⁴, and lower first molar, M₁) and associated bones in Gray Wolves may especially inhibit the consumption of prey because these teeth slice meat and crush bone. Here I report maxillary osteomyelitis involving the carnassials in a wild Gray Wolf from northeastern Minnesota of such severity that I hypothesize it ultimately caused the wolf to starve to death.

Study Area and Methods

As part of a long-term research project on wolves in the Superior National Forest of northeastern Minnesota (48°N, 92°W), female Wolf 7188 was captured with a rubber-padded-jaw, foot-hold trap on 4 November 2011 and was fitted with a VHF mortality-sensing radio-collar (Mech 2009). She was estimated by tooth wear to be one and a half years old (Gipson et al. 2000), and her teeth condition was noted as “good with minimal wear”. No teeth were recorded as chipped or broken, and no foreign object was wedged across the upper palate. No facial or oral infection was apparent at capture. She weighed 20 kg (typical for a female of her age in northeastern Minnesota) (Mech 2006), and technicians described her as in “generally good condition.”

Results

Following her release, I located her approximately weekly via aerial radio-telemetry. Except for one location, she was either alone or her locations (no visual observation) did not correspond to those of any of our other radio-collared wolves. She was located on 20 March 2012 with a radio-collared three-year-old female, Wolf 7117, but by the next location (4 April 2012) the two wolves had separated.

On 22 May 2012, I detected the signal of Wolf 7188 on mortality mode. I had last detected her signal on active mode on 16 May 2012 (although she may have already been dead by that date, because her location was aerially indistinguishable on 16 and 22 May and the state of carcass decay suggested more than six days had passed since death). The collar may have been tripped back onto active mode as it collapsed through the decaying carcass or it may have been nudged by a small animal potentially inspecting the carcass.

Wolf 7188 had travelled at least 4.8 km since 24 April 2012. Her skeleton (largely articulated) was almost entirely denuded of flesh. The wolf was somewhat curled up with her legs generally tucked under her torso. There was no evidence of a struggle and no evidence of other mammal activity at the site.

I necropsied Wolf 7188 on 22 May 2012 at the apparent location of death. Severe maxillary osteomyelitis 3.4 cm wide by 1.7 cm high extended 0.8 cm into the dorsal portion of the zygomatic bone on the left side of the maxilla near the left P⁴ (part of the left carnassial pair) and upper first molar, M¹ (Figures 1A and 1B; collection of US Geological Survey (USGS) Wolf and Deer project, Ely, MN). Minimal chipping on the left P⁴ and M¹ cusps was noted in contrast to the right P⁴ (part of the right carnassial pair), which was substantially chipped (enamel loss on the lingual aspect) and pink. Beginning stages of maxillary lysis were apparent on the right side corresponding to the severely necrotic location on the left side. Except for chipped cusps on the M₁ teeth and pink discoloration of some teeth, no other mandibular abnormality was noted. No broken bone or other abnormality was detected on the rest of the skeleton. Two femurs and one radius/ulna were devoid of marrow.

Discussion

Because of the symmetrical location of the necrosis across the upper palate, it is likely that a foreign body such as a stick or bone was “lodged transversely between the carnassial teeth, resulting in pressure necro-



FIGURE 1. Severe maxillary osteomyelitis 3.4 cm wide by 1.7 cm high extended 0.8 cm into the dorsal portion of the zygomatic bone on the left side of the maxilla of Wolf 7188 near the upper left fourth premolar (P^4 , part of the left carnassial pair) and upper first molar (M_1); lateral/posterior view (A) and dorsal/ posterior view (B). Photo: Shannon Barber-Meyer, U.S. Geological Survey.

sis” and “ulceration of the adjacent palatine mucosa” (Wobeser 1992, page 272) followed by maxillary osteomyelitis (Henderson et al. 1984) and “denudation of the root of the carnassials” of the right maxilla (Bradclaw 1935, page 46) associated with a secondary bacterial infection.

The maxillary necrosis on Wolf 7188’s skull somewhat resembled another skull from our study, Wolf 6747 (Figure 2; collection of USGS Wolf and Deer project, Ely, MN). Adult female Wolf 6747 was captured on 10 June 1985 and had a stick (5.5 cm in length) wedged between the carnassials across the upper palate (we removed the stick). She was necropsied on 7 February 1986 (although she may have died by 17 January 1986) and another stick was found lodged between the carnassials. The necrosis was much less severe around the carnassials and on the buccal aspect of the maxilla than I observed in Wolf 7188, but it displayed greater palatine lysis extending into the nasal passages (Figure 3). Similar to Wolf 7188, the mandible of Wolf 6747 had chipped cusps on both of the M_1 teeth. The chipped cusps likely resulted from occlusion with the stick because, upon articulation of Wolf 6747’s mandible with her maxilla, both M_1 contacted the stick and elevated it dorsally into the palatine cavity that connects to the nasal passages. Wolf 6747 apparently did not die as a direct result of this, but was possibly killed and eaten by other Wolves, as only her chewed head was found with several attached neck vertebrae. Fur and blood were found at the scene and another radio-collared Wolf 6749 was located in the area.

Another skull in our research collection (identity unknown) also had a stick wedged between the carnassials at death with similar maxillary necrosis, but was again much less severe than in Wolf 7188. Like Wolf 7188, this wolf’s skull did not display palatine lysis. The mandible of the unidentified wolf was not available for comparison.

Numerous reports of dental injury and anomaly exist in wolves (e.g., Dolgov and Rossolimo 1964; Van Valkenburgh 1988; Hell 1990; Vilà et al. 1993; Andersone and Ozoliņš 2000; Miles and Grigson 2003; Pavlović et al. 2007; Lazar et al. 2009). Other researchers have described dead wolves with sticks wedged across their palate (Wobeser 1992; Theberge et al. 1994) but did not report maxillary osteomyelitis and did not implicate the lodged stick and subsequent pathology in the cause of death. Wobeser (1992) necropsied 241 wolves and noted that the one wolf with a stick lodged between the carnassials and resulting “ulceration of the adjacent palatine mucosa” was in “good body condition” (Wobeser 1992, page 272).

Biologists often collect wolf skulls (e.g., Mech et al. 2011). I suspect that the severity of maxillary osteomyelitis observed in Wolf 7188 is not common, because I was able to find no similar published records. Because I found only the skeleton and fur (no foreign body inside the mouth), I could not definitively determine the cause of the necrosis or death. Nevertheless, based on other wolf skulls, I hypothesize that Wolf 7188 had a foreign object (i.e., stick or bone) wedged between the carnassials that led to severe osteomyelitis and a secondary infection that ultimately resulted in starvation.

I suspect starvation was the proximate cause of death because the severity of the maxillary osteomyelitis made it probable that Wolf 7188 had a draining facial lesion and infection that would have compromised her ability to secure and consume prey (Richard Hanson, DVM, personal communication). The starvation hypothesis is supported by the lack of marrow in the femurs and radius/ulna. I excluded intraspecies aggression as the cause of death because the carcass was largely articulated and no sign of struggle was apparent (no broken vegetation or bloodied area).



FIGURE 2. Maxillary necrosis of the skull of Wolf 6747 (left). The necrosis is similar to but less severe than the necrosis of Wolf 7188 (right). Photo: Shannon Barber-Meyer, U.S. Geological Survey.

Acknowledgements

This study was part of a long-term study supported by the U.S. Geological Survey (USGS) and directed by L. D. Mech. Bob Peterson and Hans Martin live-trapped Wolf 7188. I thank Richard Hanson (veterinarian consultant, International Wolf Center, and owner/practitioner, Ely Veterinary Clinic, Minnesota) for examining the skull of Wolf 7188. Reviews by L. David Mech (USGS), Diane K. Boyd (Montana Fish, Wildlife and Parks) and two anonymous referees greatly improved the manuscript.

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FIGURE 3. Palatine lysis extending into the nasal passages of Wolf 6747. Both lower first molars (M_1) contact the lodged stick (5.5 cm in length) and elevate it dorsally into the palate. Photo: Shannon Barber-Meyer, U.S. Geological Survey.

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Received 7 August 2012

Accepted 17 October 2012