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# Can rotational atherectomy cause thermal tissue damage? A study of the potential heating and thermal tissue effects of a rotational atherectomy device.

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PURPOSE: Thermal tissue damage (TTD) is customarily associated with some lasers. The thermal potential of rotational atherectomy (RA) devices is unknown. We investigated the temperature profile and potential TTD as well as the value of fluid flushing of an RA device. METHODS: We used a high-resolution infrared imaging system that can detect changes as small as 0.1 degree C to measure the temperature changes at the tip of a fast RA device with and without fluid flushing. To assess TTD, segments of porcine aorta were subjected to the rotating tip under controlled conditions, stained by a special histochemical stain (picrisirius red) and examined under normal and polarized light microscopy. RESULTS: There was significant heating of the rotating cam. The mean "peak" temperature rise was 52.8 +/- 16.9 degrees C. This was related to rotational speed; thus the "peak" temperature rise was 88.3 +/- 12.6 degrees C at 80,000 rpm and 17.3 +/- 3.8 degrees C at 20,000 rpm ($p < 0.001$, t-test). Fluid flushing at 18 ml/min reduced, but did not abolish, heating of the device (11.8 +/- 2.9 degrees C). A crater was observed in all segments exposed to the rotating tip. The following features were most notable: (i) A zone of "thermal" tissue damage extended radially from the crater reaching adventitia in some sections, especially at high speeds. This zone showed markedly reduced or absent birefringence. (ii) Fluid flushing of the catheter reduced the above changes but increased the incidence and extent of dissections in the media, especially when combined with high atherectomy speeds. (iii) These changes were observed in five of six specimens exposed to RA without flushing, but in only one of six with flushing ($p < 0.05$). (iv) None of the above changes was seen in control segments. CONCLUSION: RA is capable of generating significant heat and potential TTD. Fluid flushing reduced heating and TTD. These findings warrant further studies in vivo, and may influence the design of atherectomy devices.