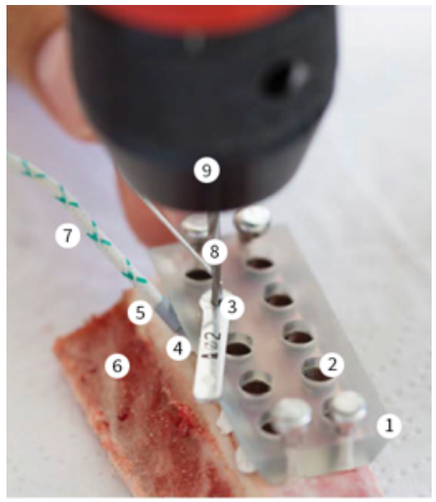
HOW ABOUT HEAT?
ARE SURGICAL GUIDES SAFE?

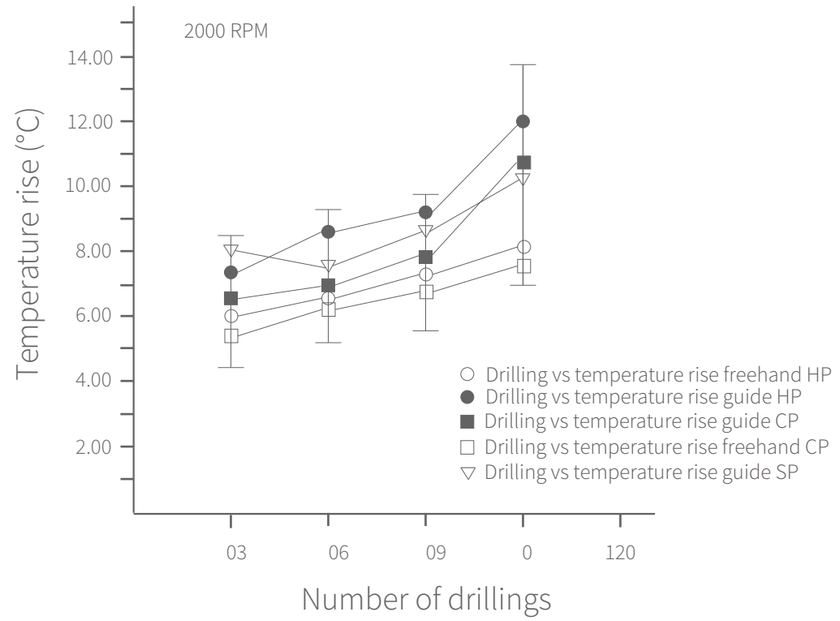
This is a frequently asked question.
Dentists often wonder if cooling - always to be used when performing osteotomy - is efficient enough, given the closed space around the drill. This is, of course, a very important question, as at 47°C necrotic processes may start that would do irreparable damage tot he patient's bone. We can assure you that the system is 100% safe. But let us tell you how we checked this.

Naturally, such questions are not studied in a clinical setting, so we set up an in vitro model: bovine ribs. Our choice fell on bovine ribs as their characteristics are quite similar to those of the human mandible (see the article for details). Once the ribs were prepared, surgical guides were designed for them, and we started drilling, like this:

Right: experimental setup to measure heat generation.
(1) Surgical template,
(2) guiding tunnel,
(3) 2-mm narrowing sleeve
(4) cortical bone,
(5) thermocouple to measure temperature,
(6) cancellous bone,
(7) wire to thermometer
(8) 2-mm drill bit,
(9) bench drill (room temperature cooling fluid came from a cannula through another device not shown in this image).



The osteotomies were performed with 2.0 mm diameter stainless steel drill bits from the SMART Kit, under 3 sterilization protocols of different roughness, at 800, 1200, 1500, and 2000 rpm (extreme speeds not occurring in real-life implant surgery were applied on purpose).



Sterilization was performed after every 3 drilling. Temperature was measured after every 30 drilling. To provide control, freehand drillings were also performed. The main question was how soon we reach the 47°C necrotic threshold, considering whether the drillings were performed freehand or guided, the roughness of the sterilization applied and drilling speed. We show only the results (means and standard deviations) for the most extreme speed here (2000 RPM), to illustrate our point:

The necrotic threshold is at +11°C increment (*). CP means the control sterilization protocol (running water only); SP: soft treatment; RP: rough treatment. The results show that irrigation could exert its effect efficiently even at this very high speed. The temperature increments remained in the safe range up to 60 drillings in all groups. At 90 drillings, the necrotic threshold was exceeded, but even then only in the guided group where the drills were treated in a sterilization protocol with high damaging potential (rough brush, ultrasonic treatment and agressive chemical disinfection).

Based on these results, we recommend that when one performs guided osteotomy, one should apply low drilling speeds (800 RPM), the bits should be replaced at reasonable intervals (preferably after every 50th sterilization cycle), should not be exposed to rough sterilization, and cooling should never be omitted. This way, guided osteotomy does not carry an extra safety risk as compared to freehand osteotomy.

LITERATURE

Barrak I, Joob-Fancsaly A, Varga E, Boa K, Piffko J (2017). Effect of the Combination of Low-Speed Drilling and Cooled Irrigation Fluid on Intraosseous Heat Generation During Guided Surgical Implant Site Preparation: An In Vitro Study. Implant dentistry 26(4):541-546.

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Boa K, Barrak I, Varga E, Jr., Joob-Fancsaly A, Varga E, Piffko J (2016). Intraosseous generation of heat during guided surgical drilling: an ex vivo study of the effect of the temperature of the irrigating fluid. The British journal of oral & maxillofacial surgery 54(8):904-908.