Use-Mediated Thermogenic Properties of Cast Saw Blades

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Abstract

Objective: Cast saw burns (CSBs) are costly, avoidable iatrogenic injuries with a multitude of modifiable risk factors, including the use of old cast saw blades in cast removal. The blade characteristics responsible for contributing to increased CSB risk are not well described in literature. This study aimed to characterize the use-mediated thermogenic properties of cast saw blades to determine when a blade becomes unsafe for use.

Methods: Stryker saw blades with a variable amount of wear were used with a Stryker vacuum cast saw by an experienced orthopedic surgeon to remove fiberglass casts. Blade temperature was recorded both before and after 5 passes and after 10 passes with a K-type Proster thermocouple.

Results: Preliminary data demonstrates a linear, positive correlation between blade wear, defined by its debris and dullness, and increase in blade temperature after 10 passes.

Background

- CSB incidence is 1.3-7.2 burns per 1,000 casts cut.[1,2]
- The average medicolegal cost associated with a single CSB is estimated to be greater than $15,000.[3]
- Using the in-and-out technique with an oscillating, metal blade and a vacuum cast saw results in the safest operating blade temperature.[3]
- Risk factors for thermal injury include blade dullness, blade deformity, excess blade debris, increased cast thickness (>12 layers), fiberglass cast material, and decreased layers of webril.[3-6]

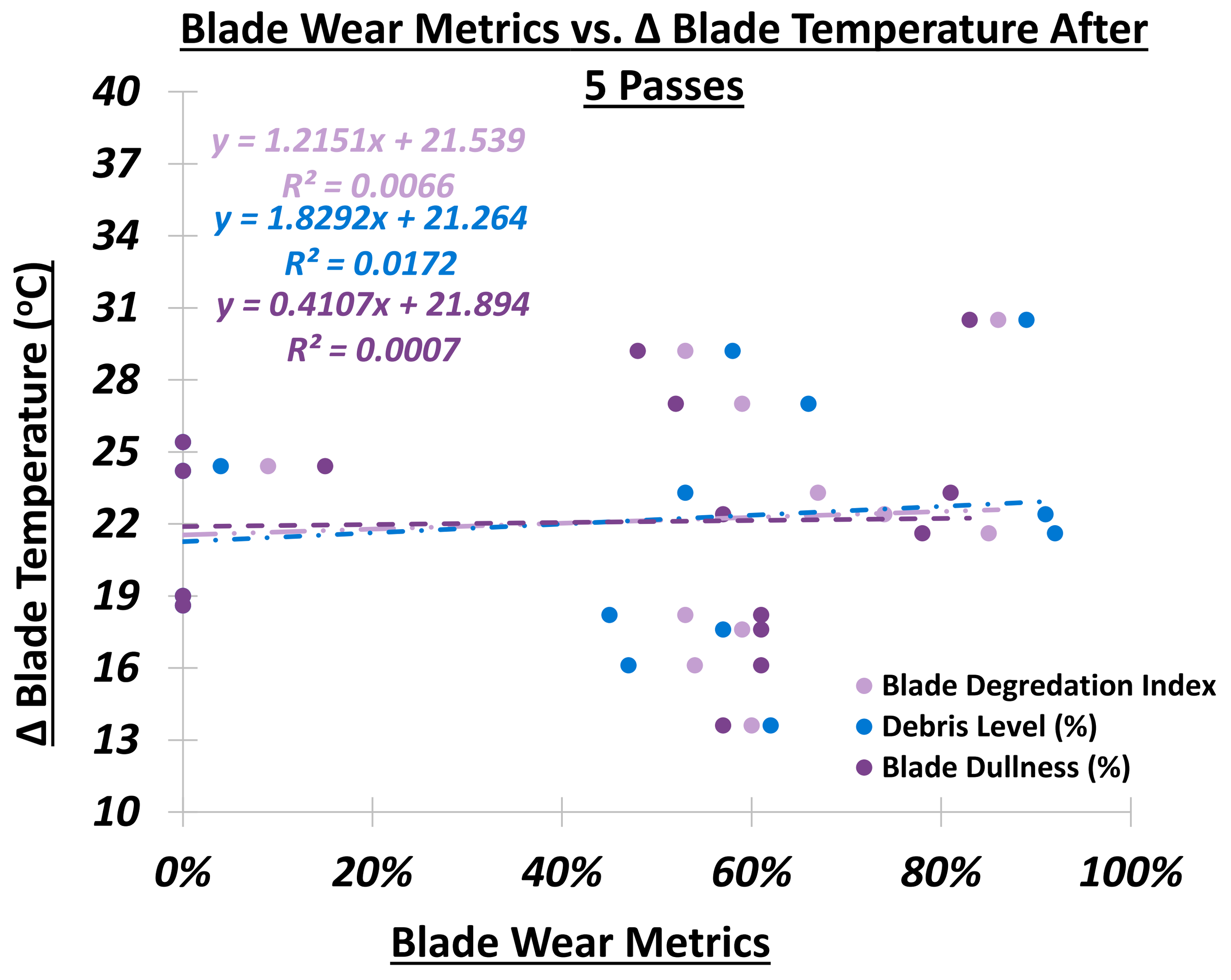
Fig. 1: Cast removal technique

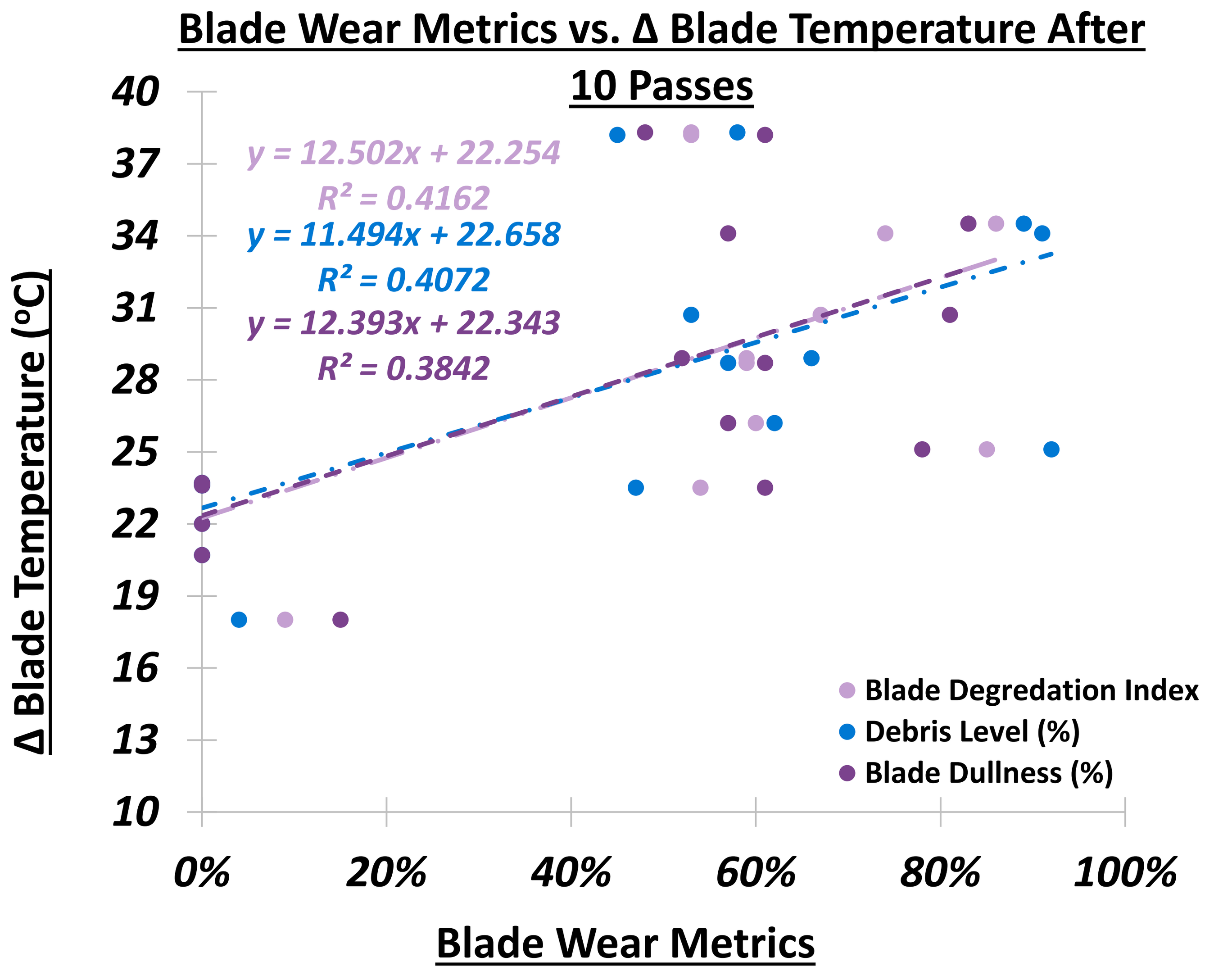
Fig. 2: Cast saw burn

Methods

- A cast mold was created by wrapping a cylindrical pool noodle with 4 layers of webril and 6 layers of fiberglass casting material dipped in cool water. Water temperature was monitored to ensure it stayed within 1 ºC for all created molds.
- The fiberglass cast was given sufficient time to dry (>8 min).
- Stryker saw blades with variable amounts of wear were photographed and assessed using 3 metrics:
  - *Debris level (%)= No. of teeth gaps with debris ÷ 53*
  - *Blade dullness (%)= No. of dulled or debris-obscured teeth ÷ 54*
  - *Blade Degradation Index (BDI)= (No. of teeth gaps with debris + No. of dulled or debris-obscured teeth) ÷ 107*
- Each blade was used to remove the fiberglass cast with a Stryker vacuum cast saw (Model 93040) via the in-and-out technique by an experienced orthopedic surgeon.
- Blade temperature was recorded both before, after 5 passes, and after 10 passes with a K-type Proster thermocouple.
- To replicate the ideal clinical practice as suggested by literature, the surgeon assessed the blade temperature by touch after 5 passes and, when warranted, paused to allow the blade to cool.

Results





- Most of the blades' operating temperature increased from 5 passes to 10 passes.
- A linear, positive correlation exists between quantity of blade debris, blade dullness, and change in blade temperature after 10 passes.
- A stronger correlation exists between quantity of blade debris, blade dullness, and change in blade temperature after 10 passes versus after 5 passes.

Results (cont.)

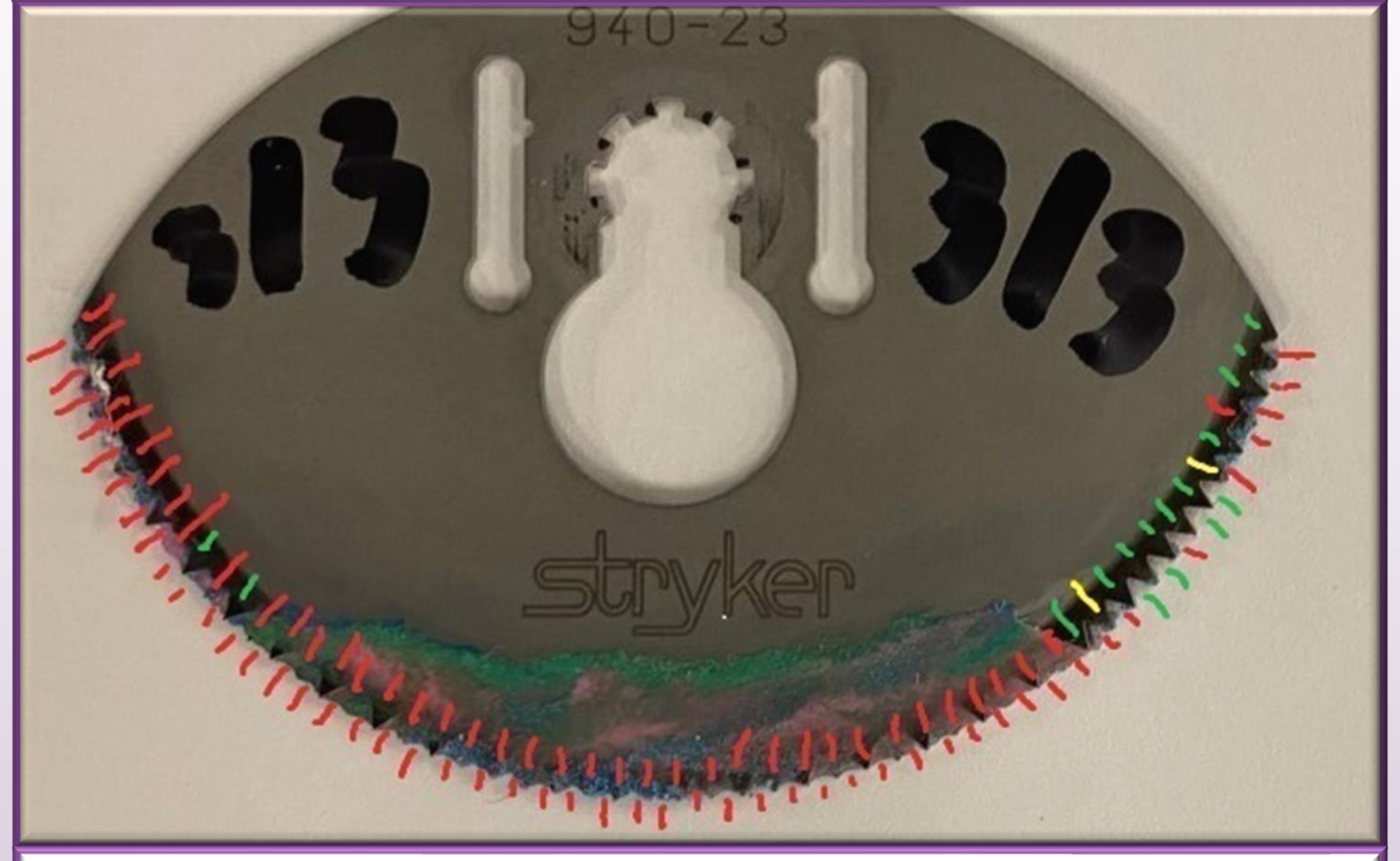


Fig. 3: Saw blade wear analysis. Markings above the teeth are for saw teeth and below the blade are for teeth gaps. Each blade has 53 gaps and 54 teeth. Red= debris, yellow= dullness, green= no debris or dullness.

Analysis and Discussion

- With the promising results of this preliminary study more blade trials are ongoing.
- Debris level, which can be gauged by the naked eye, appears to be a viable proxy for estimating saw blade wear.
- Future plans include testing if removing debris mitigates blade temperature increase and validating our blade quality assessment in clinical practice.

References

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