In vivo intraosseous temperature during implant placement: the influence of the drilling protocol, implant surface and surface lubrication: A study in sheep

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Abstract

The intraosseous temperature during implant insertion has never been evaluated in an in vivo controlled setup. The aims were to investigate the influence of a drilling protocol, implant surface and surface lubrication on the intraosseous temperature during implant installation.

Methods:

Eighty Brånemark implants were installed in the metatarsal bone in sheep according to two different drilling protocols (undersized preparation and normal preparation), two surfaces (turned and moderately rough), and with or without lubricant body fluid (sheep saliva). The intraosseous temperature at the distance of 1 mm from implant surface and in a depth of 2 mm from bone surface.

Results:

Undersized preparation and absence of a lubricant body fluid provoked significantly higher temperature increase. No statistical difference between moderately rough surface and turned implant surface were found.

Conclusion:

Undersized preparation induces a greater risk of bone overheating. The presence of a lubricant fluid on implant surface reduced the temperature increase, while implant surface characteristics did not show any influence on temperature modifications.

Keyword:

Undersized preparation, intraosseous temperature, dental implant

Methods and Materials

Ten female Finnish Dorset crossbred sheep were used. Each metatarsal bone received four implants. Eight experimental groups were created based on the following features: undersized and conventional osteotomy, moderately rough and turned surface, presence and absence of a lubricant fluid (sheep saliva) on the implant surface (Table 1). Intraosseous bone temperature was measured with a type-K thermocouple (Figure 1). The position of the sensor tip was at the distance of 1 mm from implant surface and depth of 2 mm from bone surface (Figure 2). Bone temperature was continuously measured from 5 seconds before implant insertion until 1 minute after the implant placement. Maximum and minimum values were registered. The values of temperature change for each implant were calculated. Three-way ANOVA was used to evaluate the influence of the osteotomy preparation, implant surface and frictional characteristics.

	Surgical procedure (Undersized or Normal preparation)	With or Without fluid on implant surface	Surface topography (Moderately rough or Turned surface)
Group 1	Undersized	With fluid	Moderately rough
Group 2	Undersized	Without fluid	Moderately rough
Group 3	Normal	With fluid	Moderately rough
Group 4	Normal	Without fluid	Moderately rough
Group 5	Undersized	With fluid	Turned
Group 6	Undersized	Without fluid	Turned
Group 7	Normal	With fluid	Turned
Group 8	Normal	Without fluid	Turned

Table 1

Figure 1

Figure 2

Results

The mean values of temperature change were 6.4, 8.2, 4.0, 5.1, 8.1, 9.6, 3.4, and 5.2 °C increase respectively from Group 1 to 8 (Figure 3). Regarding the surgical drilling protocol, the overall test showed that undersized groups showed significantly higher temperature than conventional osteotomy groups (P value = 0.000). In the presence or absence of a lubricant body fluid, the overall test showed that absence of a lubricant body fluid, yielded significant higher temperature change than when it was present (P value = 0.002). Differences of implant surface topography, the overall test presented no statistical differences between moderately rough surface and turned surface (P value = 0.651).

Figure 3

Conclusion

Intraosseous temperature change during implant insertion was mainly affected by osteotomy dimension. Undersized osteotomy induces a greater risk of bone overheating. The presence of a lubricant fluid on implant surface reduced the temperature increase, while surface characteristics did not show any influence on temperature modifications. To reduce the risk of implant failure due to bone overheating, implant insertion in undersized sites should be cautiously performed in cortical bone. Future research should investigate the clinical effectiveness of lubricant fluid during implant insertion.

References

M.Stocchero, Y.Jinno, M.Toia et al., Intraosseous Temperature change during during Installation of Dental implants with Two Different Surfaces and Different Drilling Protocols: An In Vivo Study in sheep, Journal of clinical medicine 8(8), 1198 (2019)

Background and Aim

Background:

Bone overheating during osteotomy preparation for dental implant has been investigated. However, thermal changes during implant insertion have not been investigated in the past. Several factors might influence heat generation, such as the osteotomy dimension, implant surface and the friction between implant and bone. A common approach to reach high levels of primary stability is to undersize the implant osteotomy and the use of rough implant surfaces, which might increase the risk of bone overheating.

Aim/ Hypothesis:

The aim was to evaluate the *in vivo* bone temperature change at implant insertion using different osteotomy dimensions, implant surfaces and frictional characteristics. It is hypothesized that implant insertion in an undersized osteotomy with moderately rough surface and without lubricant would generate a greater temperature change.