ISSN: 1812–1217

Effect of Cooling an Irrigation Solution During Preparation of Implant Site on Heat Generation Using Elite System for implant.(Experimental Study)

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الخلاصة

الأهداف: لمقارنة الحرارة المتولدة عند استخدام سائل الغسل عند درجة حرارة 5 مئوية و 25 مئوية خلال تحضير موقع الزرعة باستخدام أدوات نظام الزراعة Elite **.المواد والطريقة:**تم استخدام المزدوج الحراري لقياس درجة الحرارة المتولدة خلال عملية الحفر في العظم وذلك باستخدام عظم الفخذ ألبقري على جهاز الميلنك علما إن معدل ضخ ماء الغسل ثابت.حرارة ماء الغسل تم تثبيتها عند 5 مئوية و 25 مئوية وعمق الحفرة 8مليم والقطر 2مليم.عملية تسجيل الحرارة تمت بعد كل عملية حفر لكل درجة حرارة بالإضافة إلى الوقت المستغرق لعودة الحرارة إلى المستوى القياسي. **النتائج:** اظهرت النتائج سائل الغسل المبرد عند 5 مئوية خفض الحرارة المتولدة عند الحفر إلى مستوى ملحوظ أكثر من السائل في درجة حرارة الغرفة **.الاستنتاجات:** استخدام ماء مبرد خلال عملية التحضير العظمي للزرعة يقلل الحرارة المتولدة وبالتالي يقلل الضرر الحاصل للعظم.

ABSTRACT

Aims: To compare heat generation when using irrigating solution at 5°C and 25°C during preparation of an implant site in bone using the tools of ELIT implant systems. **Materials and Methods:** Thermocouple technology was used to measure temperature level generated while drilling during osteotomy procedure for implant place in a bovine femoral cortical bone model. Drilling was accomplished by using milling machine .External irrigation at a constant ratio was used. The temperature of this irrigating solution was stabilized at 5°c and 25°C and The drilling depth was 8 mm and diameter of 2mm. Heat measurements were recorded after the final drilling for each irrigating solution in addition to time necessary to drop to base line level was recorded . **Results:** Results showed that cooled solution at 5 °C can decrease the temperature to a significant level better than solution at room temperature. In addition time needed to return to base line temperature levels is less than when using solution at room temperature. **Conclusions:** It can be concluded that the using cold irrigating solution can decrease the heat generated at implant site preparation consequently leading to decrease damage in the bone.

Keywords: Implant system, irrigation solution.

Al–Dabag AN, Sultan AA. Effect of Cooling an Irrigation Solution During Preparation of Implant Site on Heat Generation Using Elite System for implant (Experimental Study). *Al–Rafidain Dent J*. 2010; 10(2): 260–264.

Received: 12/3/2009 ***Sent to Referees:*** 16/3/20009 ***Accepted for Publication***: 22/4/2009

INTRODUCTION

Since the advent of dental implantology for the restoration of missing dentition, its use has increased markedly due to the phenomenon of osseointegration. This process is dependent on several factors, the most important of which is active primary healing of the implant site. [1] As implant site preparation and healthy bone are critical precursors to primary healing, thermal and mechanical damage to the bone must be minimized during the preparation of the implant site. Drilling and trephining procedures during dental implant site preparation may cause not only mechanical damage to the bone, but also heat–induced bone tissue injury. [2]

The extent to which bone physiology must be respected has been studied. The temperature of denaturation of alkaline phosphates which is (56 °C)should not be exceeded; however, this value has been corrected by Lundskog who recommended the temperature not going beyond 50 C°

for 1 minute.[3] Eriksson *et al*., showed in studies on the thermal chamber for intravital microscopy and bone growth chamber, that after drilling, it was possible to obtain functional bone regeneration, (both qualitative as quantitative), if a temperature of 44 C° is not exceeded for one min.[4]

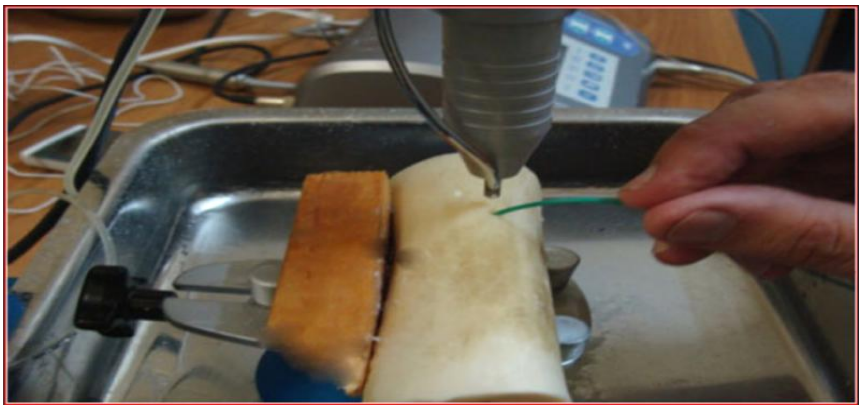
MATERIALS AND METHODS

Armamentariums of the Italia ELITE implant drill system were evaluated in vitro using bovine femoral cortical bone. The rationale of choosing bovine bone was to keep the cortical thickness constant which is about 15 mm .The torque and speed was constant (12 Nm,2500 rpm)from Bio–Art Company (Brazil made). The bone was placed in a thermostat–controlled bath containing physiologic saline at 37°C(C.K type thermoelectric couple 830c,837,838 made in Taiwan) and (KI&BNT digital thermometer) which was used to measure temperature Figure(1).

Figure(1): Thermostat–controlled bath containing physiologic saline.

Care was taken during to ensure each of the initial specimens was at 37°C before drilling. If the temperature dropped under 37°C, the specimen was reimmersed in warm saline bath.

One thousand Max Milling Machine from Bio–Art Company (made in Brazil) was used for fixation of bone during preparation and to apply constant load as possible during preparation of the hole in the bone and to keep drill depth a constant in all specimens (8 mm). External Cooling system was fixed at a constant ratio (40m/min) by using motor pump mounted in the NSK motor system (Japan made). Normal saline (Iraq made) was used as the irrigating solution. Irrigation temperatures that were compared were 5°C and 25°C. After fixation of bone on the milling machine and stabilizing the temperature of the specimen at 37°C, osteotomies were performed on the specimen by using a 2 mm drill from ELITE system after that the thermocouple inserted in the hole prepared and temperature recorded , and the time till the temperature dropped to baseline temperature (37°C) also recorded Figure (2). This procedure was repeated 10 times in a different specimens.



Figure(2): Bovine bone fixed on milling machine and head of the thermoelectric couple to measure the temperature generated during osteotomy procedure.

RESULTS

Rresults showed that mean temperatures when using the cold irrigation solution (5°C) was 41.9 °C while when using irrigating solution at room temperature (25°C) was 55.7°C. The time that was needed to drop the temperature to base line levels was 10.8 °C seconds for 5 °C solution and 28.8 second for 25°C Table (1).

Table (1): Mean temperature, time and number of osteotomies.

Group		N	Mean(C°)	**SD	Std. Error Mean
*Temp	25 degree	10	55.70	11.567	3.658
	5 degree	10	41.90	3.814	1.206
Time	25 degree	10	28.80	8.217	2.598
	5 degree	10	10.80	7.983	2.525

Temp: temperature ; **SD: standard deviation

Result of the *t*–test revealed significant differences in heat levels generated during the osteotomy procedure between the two groups with the least level when using cooled irrigating solution at ($p \leq 0.001$) . A significant difference in suspect to the time necessary to drop to baseline level was shown with the least time for cooled irrigating solution at ($p \leq 0.01$) Table (2).

Table (2): Significant results between both groups.

t–test for equality of mean							
95%confidence interval of the differences		Std.error difference	Mean difference	Sig(2 tailed)	df	t	
upper	lower						
21.992	5.708	3.851	13.80	.002	18	3.583	TEMP*
25.611	10.389	3.623	13.80	.000	18	4.969	TIME

DISCUSSION

Different types of materials in the literature have been used for heat studies during osteotomy procedure: bovine cortical bone [5–7] porcine ribs[8], polymeric material[9] bovine blocks (cortical and medullary bone), pig maxilla and mandible[10].

Heat generated during osteotomy procedure is related to the presence and temperature of irrigating solution used [11,12]. amount of bone being prepared[13], drill sharpness and design[14,15], time of preparation, depth of the osteotomy[16], pressure on the drill [17,18], drill speed, variation in cortical thickness [19,20,1], torque and the type of drill serration [21].

Thermonecrosis of vital bone due to elevated temperatures during surgical procedure has been previously reported in the literature[8]. Use of coolants is a highly important factor for preservation of the vitality of the bone, reduces friction and facilitates bone chip removal[12].

The result is revealed with the result obtained by Reingewirtz who used chilled irrigating solution and found that irrigation allowed the drill to cool down faster than irrigating solution at room temperature[22].

The result also come in parallel with the results of Carl Misch who also suggested the use of cooled irrigation and particularly in class D1 bone which is hardest type of bone[23].

CONCLUSIONS

Using of chilled irrigating solution at 5° C could be more effective in preservation the vitality of bone around implant site preparation thereby increase success rate of osseointegration.

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