ISSN- O: 2458 - 868X, ISSN–P: 2458 – 8687
Index Copernicus Value: 68 . 16
PubMed - National Library of Medicine - ID: 101731606

International Journal of Medical Science and Innovative Research (IJMSIR)
IJMSIR : A Medical Publication Hub
Available Online at: www.ijmsir.com
Volume – 5, Issue – 5, September - 2020, Page No. : 151 – 156

Evaluation of Effects of Sterilization on Primary Stability of Mini Implants - A Short Study

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Citation this Article: Dr Amruta Mantri (Chandak), Dr Suchita Tarvade (Daokar), Dr Mitali Brijmohan Sharma, "Evaluation of Effects of Sterilization on Primary Stability of Mini Implants - A Short Study", IJMSIR- September - 2020, Vol – 5, Issue - 5, P. No. 151 – 156.

Type of Publication: Short Study

Conflicts of Interest: Nil

Abstract

Objective: To investigate the primary stability of orthodontic mini-implants before and after autoclave sterilization in goat jaw bone at D2 Density site.

Material and Methods: 10 implants (1.5x 8mm) were placed in goat jaw at D2 Density site (as per 3D Spiral CT Scan). The stability was measured with Osstell ISQ Implant stability meter .These implants were retrieved and subjected to autoclave sterilization and re-inserted in another bone of similar density at similar site. The stability was re-measured.

Result: The results were subjected to paired t-test. Statistically significant difference was noted in the primary stability of mini-implants, before and after sterilization.

Conclusion: Autoclave sterilization reduces the stability of mini implants to a considerable amount and this may have a clinical impact on stability of mini implants.

Keywords: Autoclave, Mini-implants, stability, sterilization,

Introduction

Anchorage is of utmost importance when orthodontic tooth movement is planned. Loss of anchorage can result in undesirable treatment outcome. Anchorage can be gained either extra orally or intraorally. Extra orally it can sourced from cervical, occipital and parietal regions whereas intraorally it can be gained from teeth, muscles and underlying bone. [1]Past few years have shown tremendous use of implants for skeletal anchorage. Implants are available in variety of designs, lengths and diameters in the market. Each implant is designed with an intention to perform specific function at a specific site in the oral cavity. [2]

The success of an orthodontic mini-implant lies in its primary stability. When a mini implant is placed in the cortical bone, its efficient mechanical interlocking defines its primary stability. [3]Factors influencing

primary stability are quality and quantity of bone, how skillfully the mini-implants are inserted and the dimensions of the mini-implants. [4]Evaluating the primary stability post insertion can help us to determine the success of mini implants. There are various methods by which the stability of mini-implants can be evaluated. They are the Periotest, the tapping method, and the radiography method. [5, 6, 7] Every method has its own advantages and drawbacks. With advancement in technology, newer equipments are made available. Resonance frequency analysis (RFA) has proven to be an adequate method to measure stability as it is not invasive and it is contactless. [8]

Implants once used, are discarded. However, for economic considerations, they may be reused after proper sterilization. [9] Autoclaving is the commonest sterilization process used in dental office. [10] The literature search to correlate the effect of autoclave sterilization followed by its re-use on primary stability of implants was found to be inefficient. Considering all the above statements, we found a scope to undertake a research to investigate if autoclave sterilisation and re-use of mini-implant affect the primary stability.

Materials and Method

In 1988, Misch described four groups, based on macroscopic cortical and trabecular bone characteristics as D1, D2, D3, D4 and D5; out of which D2 bone is found most commonly in the region where implant placement is most feasible. [11] Literature states that mini implants can be safely placed in the regions where sufficient interradicular space is available. These locations are mainly the region between second premolar and first molar in the maxillary arch, buccal alveolar bone in the mandibular arch and inter molar region in the palatal bone. [12] In these locations, D2 bone is encountered. Hence D2 density bone of a freshly sacrificed goat for meat purpose was used for the study.10 Orthodontic micro implants of size 1.5×8mm were used. The primary stability of implants was measured using Osstell ISQ implant stability meter using a smart peg. Bone having density equivalent to D1, D3, D4 type simulating human bone and mini implants of different lengths and diameters other than 1.5×8mm were excluded from the study.

Method

In this study fresh bone of an animal sacrificed for meat purpose was subjected to 3D spiral CT scan (fig 1).

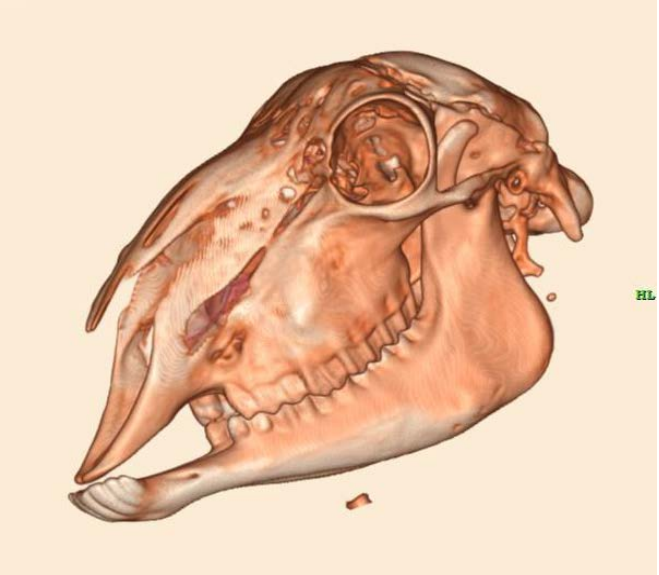

Fig 1: 3D spiral CT scan of goat jaw

The animal used in this study was not sacrificed for this study purpose. The goat was sacrificed for meat purpose and the remaining bones were discarded by the butcher. The jaw was retrieved from the butcher's place for this study. Hence as per NIH guidelines, no animal was harmed or sacrificed for conducting this study. An institutional ethical committee approval was granted for this study (decision number of institutional ethical committee: CSMSS/DC/23/2020).

The density of the goat jaw was matched with D2 bone density of human jaws (fig 2).

Fig 2: evaluation of density of bone in hounsfield units (HU)

The areas of D2 density were marked on the animal jaw bones (fig 3).

Fig 3: areas of D2 density marked on goat jaw

10 implants of 1.5x8mm were placed in one bone and their stability was measured (fig 4) by RFA using Osstell ISQ stability meter (fig 5). The osstell stability meter is not compatible for mini-implants. In order to make it compatible, a connector (fig 6) was customized to attach the implant with the smart peg. To avoid bias, 5 readings were taken for one implant in 5 directions i.e. right, left, front, back and above and their average value was considered as final reading. Table no. 1 shows the measurement of implant stability on first use.

Fig 4: primary stability measured using Osstell ISQ stability meter

Fig 5: Osstell ISQ implant stability meter

Fig 6: customized connector to attach smart peg with mini implants

The implants were retrieved, autoclaved for 20 minutes at 121 degree Celsius temperature and 15 pounds pressure in a front loading autoclave(fig 7) and re-inserted in other bone of similar density and primary stability was re-measured by RFA (fig 8). Their stability was measured using similar placement and measurement protocols as below. Table no.2 shows

measurement of implant stability after retrieval, autoclaving and reinsertion.

Fig 7: front loading autoclave

Fig 8: placement of used autoclaved implants in another jaw of D2 density

Table 1: Measurement of Implant Stability on First Use

	First Use of Implants					
implant	no.of readings					average
	right	left	front	back	above	
1	53	52	56	57	54	54.4
2	77	57	77	65	70	69.2
3	53	48	52	48	30	46.2
4	64	64	62	63	63	63.2
5	59	56	53	53	57	55.6
6	52	56	53	53	57	54.2
7	52	56	52	55	75	58
8	59	61	60	53	57	58
9	53	43	53	53	43	49
10	53	43	45	48	73	52.4

Table 2: Measurement of Implant Stability after Retrieval, Autoclaving and Reinsertion

	Reuse After Autoclaving Implants					
implant	no. of readings					average
	right	left	front	back	above	
1	46	48	49	57	44	48.8
2	43	35	37	46	55	43.2
3	22	51	55	46	51	45
4	32	39	30	41	39	36.2
5	58	57	60	64	56	59
6	46	41	48	32	58	45
7	52	55	51	49	55	52.4
8	head fractured during insertion					
9	43	46	58	39	58	48.8
10	65	61	49	48	62	57

Results

The readings of stability of implants before and after autoclaving were subjected to statistical analysis using paired T test (Table No.3). It was seen that there is significant reduction in stability of mini-implants after autoclave sterilization. Figure No. 9 shows mean stability of implants before and after autoclave sterilization. It was observed that mean stability of mini-implants after autoclaving reduced to 48.14% which was 56.02% prior to sterilization.

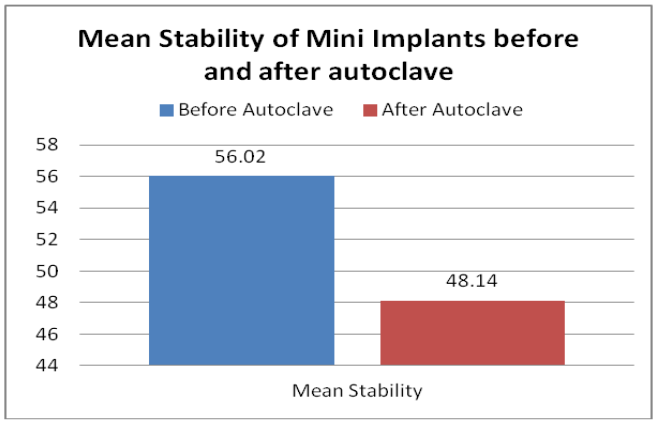

Fig 9: mean stability of implants before and after autoclave sterilization

Table 3: Difference in Mean Stability of Mini Implants before and After Autoclave

Mini implants	Mean Stability	Minimum Stability	Maximum Stability	Std Deviation	p-value (Paired T-Test)
Before Autoclave	56.02	46.20	69.20	6.47	0.001*
After Autoclave	48.14	36.20	59.00	6.60	

*Statistically Significant

Discussion

In this study we found that after the retrieved implants were subjected to autoclaving, the stability of implants was significantly reduced. This may be due to loss of surface texture of implants during retrieval or during autoclaving. Vezeau PJ et al performed an SEM study of autoclaved implants and found that the procedure altered the titanium surface; they also found that this resulted in decreased levels of cell attachment and spreading in vitro. [13]

The results of this study could not be correlated with any previous study as no study has been documented till date.

Conclusion

Reuse of implants after autoclaving resulted in significant loss of stability. We recommend taking this factor in consideration during its clinical application. Other sterilization methods can be studied, giving scope for future studies in this field.

Main Points

1. Re-use of mini implants is usually done for economic reasons.
2. Out of various methods used for sterilization of mini implants, autoclaving is the most commonly used method.
3. Primary stability is the most important factor for success of a mini implant. The greater the primary stability, the more is the anchorage value.
4. Till date, literature did not review any study on effects of sterilization on primary stability of reused mini implants. Hence this study was undertaken.
5. It was observed that there is a substantial decrease in primary stability of mini implants after sterilization. Hence re-use of mini implants is not recommended in clinical practice.

References

1. Roberts-Harry D, Sandy J. Orthodontics. Part 9: anchorage control and distal movement. British Dental Journal. 2004 Mar 13; 196(5):255.
2. Marquezan M, Osório A, Sant'Anna E, Souza MM, Maia L. Does bone mineral density influence the primary stability of dental implants? A systematic review. Clinical oral implants research. 2012 Jul; 23(7):767-74.
3. Singh AK, Kannan S, Arora N, Bajaj Y, Revankar AV. Measurement of primary stability of mini implants using resonance frequency analysis. APOS Trends in Orthodontics. 2018 Jul 1; 8(3):139.
4. O'Sullivan D, Sennerby L, Jagger D, Meredith N. A comparison of two methods of enhancing implant primary stability. Clinical implant dentistry and related research. 2004 Apr; 6(1):48-57.
5. Lachmann S, Yves Laval J, Jäger B, Axmann D, Gomez-Roman G, Groten M, et al. Resonance frequency analysis and damping capacity assessment: Part 2: peri-implant bone loss follow-up. An in vitro study with the Periotest™ and Osstell™ instruments. Clinical Oral Implants Research. 2006 Feb; 17(1):80-4.
6. Hermann JS, Schoolfield JD, Schenk RK, Buser D, Cochran DL. Influence of the size of the microgap on crestal bone changes around titanium implants. A histometric evaluation of unloaded non-

submerged implants in the canine mandible. Journal of periodontology. 2001 Oct 1; 72(10):1372-83.

7. Lukas D, Schulte W. Periotest-a dynamic procedure for the diagnosis of the human periodontium. Clinical Physics and Physiological Measurement. 1990 Feb; 11(1):65.
8. Misch CE. Bone character: second vital implant criterion. Dent Today. 1988 Jun; 7(5):39-40.
9. Ledingham A, Şar Ç, English J, Akyalçın S. Is there a difference between the primary stability of anodized and non-anodized mini-screws subjected to repeated cycles of autoclave sterilization?. Cumhuriyet Dental Journal. 2014; 17(2):129-34.
10. Serro AP, Saramago B. Influence of sterilization on the mineralization of titanium implants induced by incubation in various biological model fluids. Biomaterials. 2003 Nov 1; 24(26):4749-60
11. Misch CE. Bone character: second vital implant criterion. Dent Today. 1988 Jun; 7(5):39-40.
12. Park J, Cho HJ. Three-dimensional evaluation of interradicular spaces and cortical bone thickness for the placement and initial stability of micro implants in adults. American Journal of Orthodontics and Dentofacial Orthopedics. 2009 Sep 1; 136(3):314-e1.
13. Vezeau PJ, Koorbusch GF, Draughn RA, Keller JC. Effects of multiple sterilization on surface characteristics and in vitro biologic responses to titanium. Journal of oral and maxillofacial surgery. 1996 Jun 1; 54(6):738-46