# The Effect of Dried Plum on Orthodontic Micro-Implant Stability: An experimental study

## *Running title: Effect of Dried Plum on Bone Response.*

Zaid Salim Twafeeq[1], Dr. Mustafa MuathHamed Al-Sultan[2]

[1]Lect. (B.D.S., M.Sc.) University of Mosul/ College of Dentistry/ Department of Pedodontics Orthodontics and Preventive Dentistry.
[2]Assist. Prof. (B.D.S., M.Sc., Ph.D.) University of Mosul/ College of Dentistry/ Department of Pedodontics Orthodontics and Preventive Dentistry.

**ABSTRACT**

**Background and objective:** For long time, orthodontists have struggled to achieve efficient control of anchorage; this study aims to obtaining a stable micro-implant through enhancing bone response around it using Dried Plum.

**Methods**: A thirty orthodontic micro-implants (1.3 mm in width and 5 mm in length) (Dentos, Abso Anchor) were used in this research; three micro-implants were inserted in the right tibia of ten male New Zealand rabbits. The rabbits divided into two groups, five control (C) and five experimental (DP) group. The primary stability measured using Periotest device (Medizintechnik Gulden/Germany). The rabbit in experimental group fed25% wt/wt dried Plum during the four weeks healing period. At the end of the experimental period, the rabbits were sacrificed, and the secondary stability was measured.

**Results:** Paired t-test results showed a significant increase in secondary stability after four weeks healing period when compared with the primary one for the experimental group, while for the control group, a non-significant increasing in the secondary stability was shown when compared with the primary one.

**Conclusion:** From this study it is concluded that the Dried Plum might be attributed to enhance bone response around orthodontic micro-implant within four weeks interval period.

**Key Words**: Dried Plum, Micro-Implant, Stability.

## INTRODUCTION

Anchorage in orthodontics refers to the resistance which, the den to facial structures offer, to change in form or position under applied force.[1]Conservation of anchorage in totality has been perennial problem to traditional orthodontist, Orthodontic micro-implants are temporarily fixed to bone for the purpose of enhancing orthodontic anchorage either by supporting the teeth of the reactive unit or by obviating the need for the reactive unit altogether.[2]

These micro-implants are small enough for placement at any surface of the alveolar process, even in the inter dental areas. They are relatively inexpensive, and the techniques for their placement and retrieval issimple.[3]Implant stability is determined by biomechanical evaluation of bone tissue around the implant.[4]

This primary stability is defined as stability at the time of implant placement. It is a prerequisite for direct bone formation on the surface of the implant. Primary implant stability is only a mechanical phenomenon and depends on the contact between the implant and the bony bed.[5]During the healing period, the primary implant stability is replaced by the secondary implant stability, which is a biological phenomenon.[6]

The Periotest is a successful device in assessing the stability status of an implant; it has the advantage of offering reproducible findings by measuring the levels of subclinical mobility using an ultrasonically vibrating probe.[7]Periotest value (PTV) is marked from -8(low mobility) to +50(high mobility)[8].

Different studies regarding the dietary effect on skeletal health were done over the past decade; such studies found a positive association between the general quantity of vegetables and fruit consumption and the health of skeleton.[9]

Previous experiments carried out showed that common herbs and vegetables commonly consumed in the Western diet significantly inhibited bone resorption at a dose of 1 g/day.[10]

Studies on adults; concluded that consumption of food with a higher percentage of fruit and vegetables is beneficial to bone mineral density.[11-15]

It was shown that certain food types including prunes were considered bone resorption inhibitory food items.[16]Plums are the fruits of the genus Prunus in the Rosaceae family. The fruit of Prunusdomestica is a common fruit consumed by humans, and the dried fruit of some cultivars of P. domestica is called dried plums,[17] others also consumed as a medicine.[18]Dried plum is among one of the fruits that have bone modulating activities and revealed an effect on bone health [19]

This research hypothized that Dried Plum consumption could enhances bone responses around orthodontic micro-implant within four weeks healing period, and finally improving the secondary stability of implants.

## METHODS

Ten, 8-10 months old, New Zealand male rabbits(five control and five experimental group), with a weight range between 2.1-2.3 Kg were used in this research. Each rabbit placed in an individual cage under monitoring and supervision of the veterinarian for one month before the experiment, to be sure that every think is well regarding animal's behavior, eating standard quantity and quality of diet, drinking, defecation, weight monitoring and activity.

A thirty sterile Orthodontic micro-implants(Dentos, AbsoAnchor, SH1312-5/ tapered type, South Korea), made of Ti-6Al-4V alloy, with a diameter of 1.3mm and 5mmlength were used. At the time of the surgery, each experimental animal was premeditated using intramuscular injection of 0.2 ml/kg B.W. of Ketamine 10% (anesthetic solution) and 0.025ml/kg B.W. of Xylazine 2% (muscle relaxant drug), the medial surface of the right tibia anaesthetized by 1ml of local anesthetic solution 2% Xylocaine, after shaving the site, the exposed skin disinfected using 10% Povidone Iodine. An incision of approximately 35 mm in length (Figure 1), in the dorsal aspect of the tibia, down in the skin parallel to the longitudinal axis of the tibia, dissectingthe fascia and the periosteum was stripped and elevated denuding the medial aspect of the tibia bone (Figure 2).

**Figure (1)An incision parallel to longitudinal axis of the tibia**

**Figure (2) Rabbit's Tibia Bone**

Three small holes (Figure 3) approximately 10 mm apart (with a 1 mm rounded head drill) were done using implant surgical engine (Surgic XT – NSK/ U.K), the rotational speed was 1100rpm, "FWD-<" clockwise rotation", and a torque of 35newton/cm.

**Figure (3) A small hole preparation**

The micro-implants were inserted by special handdriver, the longaxis of the micro-implant was kept perpendicular to the external cortical tibia as possible (Figure 4).

**Figure (4) Three Orthodontic Micro-Implants in Place**

The primary stability then tested using Periotest Mdevice (Medizintechnik Gulden – Germany), the Periotest M device held horizontally with the starting bottom up, the tip of the hand piece was kept at a distance about 2-3 mm from the micro-implant head, and perpendicular to the micro-implant head as possible. Three readings for each micro-implant were taken, and the mean for such three readings were taken as a final reading (Figure 5).

**Figure (5) Primary Stability Reading**

Then the deep fascia and skin repositioned in its place and sutured with an absorbable suture (Braided polyglycolic suture) (Braided polyglycolic absorbable suture 3/0), Post surgery the animals medicated for three days, with antibiotics Pen Vet 300 0.1ml/ (Procaine Benzyl penicillin, Alfasan International B.V., Woerden, The Netherlands).

Dried Plum feeding protocol for the experimental group was started at the day of surgery, and continued for 28 days. The daily dose of the dried plum used in this study was 25 % wt/wt, andthe selected dose was based on previous studies[20-22]

At the end of the experimental period, the experimental animals were sacrificed by administration of an over does of ketamine hydrochloride[23], the surgical site was exposed by an incision and a full thickness flap reflected, the orthodontic micro-implants were carefully exposed, and the secondary stability reading using Periotest M was taken using the same technique as in primary one.

## RESULTS

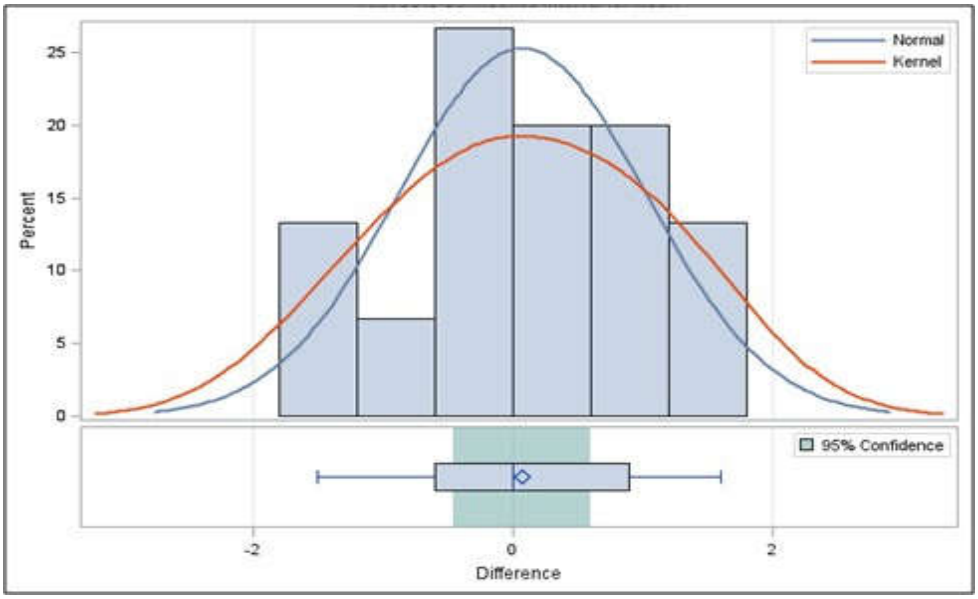
In this study the success rate of the micro-implants were 100%, no side effects related to the dried plum. The results of this study were statistically analyzed using SAS system. The descriptive statistics including (mean, standard deviation, slandered error, minimum and maximum values) for the primary stability and secondary stability of the control and experimental group were shown in the Table (1).

**Table 1 Descriptive Statistics (Mean, Standard Deviation, Standered Error, Minimum and Maximum Values) for the Primary and Secondary Stability of the Control and Experimental group**

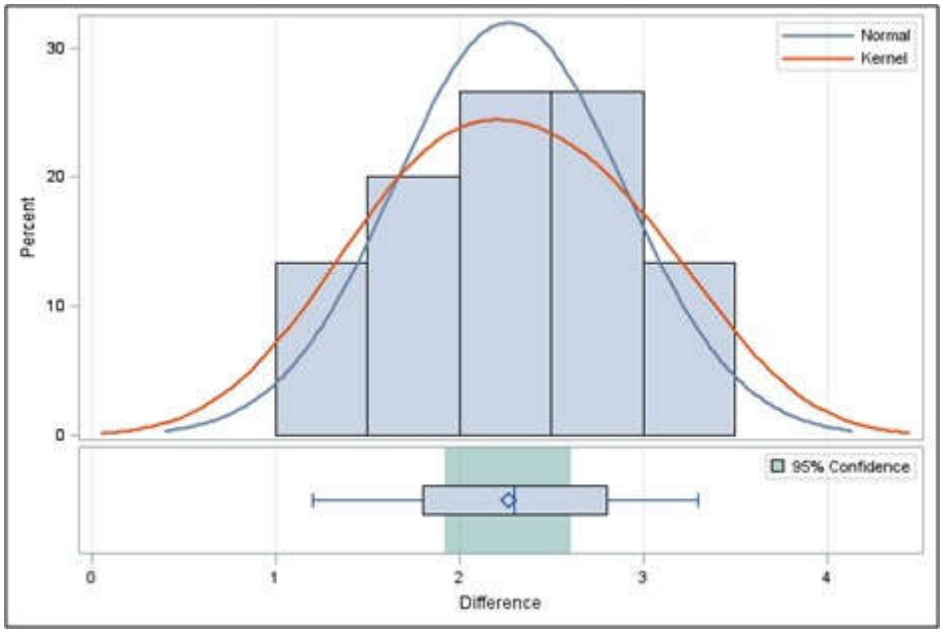
| | Treatment | No. | Mean | Std. Dev. | Std. Err. | Minimum | Maximum |
|---|---|---|---|---|---|---|---|
| 1 | Pr.C | 15 | -2.7333 | 0.4467 | 0.1153 | -3.4000 | -1.9000 |
| 2 | Pr.DP | 15 | -2.7467 | 0.1685 | 0.0435 | -3.1000 | -2,5000 |
| 3 | Sc.C | 15 | -2.8067 | 0.8498 | 0.2194 | -4.1000 | -1.4000 |
| 4 | Sc.DP | 15 | -5.0133 | 0.6435 | 0.1662 | -6.0000 | -3.9000 |

The result of Paired t-test (dependent t-test)for the same group, showed non-significant differences (P-Value 0.7684) between mean values of Periotest primary (Pr.C) and secondary (Sc.C) stability for the control group. On the other hand, on comparing the primary stability with the secondary stability for the Dried Plum group, a highly significant difference (P-Value <.0001) higher for the secondary stability (Sc.DP) when compared with the primary one (Pr.DP).

The distribution of difference for (Pr.C and Sc.C) is shown in the histogram (1), while the distributions of difference for (Pr.DP and Sc.DP) shown in the histogram (2).




**Histogram 1: Distribution of Difference (Pr.C and Sc.C)**




**Histogram 2: Distribution of Difference (Pr.DP and Sc. DP)**

## DISCUSSION

The goal behind using orthodontic micro-implant is to maintain absolute anchorage, which reduces the chance of any reciprocal effects on the anchorage units. This can be obtained by maximizing the stability of the micro-implant. It is essential for the micro-implant to be stable to act as an effective anchor and to resist forces of orthodontic [24]

In this study the success rate of the micro-implants were 100%, no implant loosing or bone crack, in addition, the whole micro-implant was covered by the mucosal tissue and skin "closed technique", this eliminates the possibility of infection from the outer environment or other risk factors. Furthermore, no side effects related to the dried plum.

In the current research, the control group showed non-significant increasing in micro-implant stability after four weeks healing period. This is could be contributed to inadequate healing period for enhances bone response around orthodontic micro-implants. Wu et al., in (2009)[25]mentioned in their conclusionthatmini-screw healing is a continuous process, and week 4 is a critical time point in this process.

The Dried Plum considered one of highest antioxidant capacity among the fruits and vegetables, which is related to itsphenolic contents[26], in addition to its contents like potassium, boron, copper and phenolic compounds, which have a powerful effect in bone metabolism, also Dried Plums completely stopped and were able to reverse bone loss.[27]

The antioxidant capacity and minerals content of dried plum possibly, could explain the significant increase in the micro-implant stability after four weeks healing period in Dried Plum group. A study done on mice fed 25% wt/ of dried plum for four weeks, concluded that dried plum could limit the decrease in spine bone mineral density and mineral content induced by ovaries to my, such study indicates that dried plum has positive effects on bone structural and biomechanical properties[21].These results could support the results of this research, and the Dried Plum could possibly enhance bone response around micro-implants and increases its stability.

## CONCLUSION

From the result of this research, it could be concluded that Dried Plum have the possibility of augmenting bone responsearound the orthodontic micro-implant and thus increasing its stability when compared to the control group.

## ACKNOWLEDGMENTS

The authors wish to thanks Prof. Dr. Ali Rajih Al-Khatib for his kind advices.

**Conflict of Interest**

No potential conflict of interest related to this article was reported. The authors received no financial support for this research.

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