

## MAXILLARY SINUS LIFT TO ENABLE ONE STAGE IMPLANT PLACEMENT USING NANOBONE AND PRF WITH OR WITHOUT SIMVASTATIN

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### ABSTRACT

**Objective:** Aim of this study was to evaluate the effect of using Nanobone and PRF with or without simvastatin on sinus lift and one stage implant placement.

**Material & Methods:** 20 patients need sinus lift for implant placement in atrophied posterior maxilla were divided in two groups (group I: maxillary sinus lift made by using synthetic bone substitute (NanoBone) and PRF Without simvastatin, while in group II using NanoBone and PRF with simvastatin.

**Results:** Six months after surgery the mean of bone height gain in group I was 11.349 mm and the mean bone density was 297.8 Hounsfield units, while in group II the new bone height was 11.889 mm and the mean bone density was 314.3 Hounsfield units. During and after surgery there were no major complication and no implant failure. For endo sinus bone gain results were statistically significant in favour of group II ( $P < 0.05$ ).

**Conclusion:** Both regenerative approaches showed significant improvements in clinical and radiographic results. However, adding simvastatin in combination with Nanobone and PRF showed better bone gain at 6 months in maxillary sinus lift and implant placement.

**Clinical Relevance:** For maxillary sinus lift the additional use of simvastatin to Nanobone and PRF offers a clinical benefit in terms of bone height gain and bone density.

**KEYWORDS:** bone substitutes, sinus lift, dental implant, simvastatin.

### INTRODUCTION

Dental implant is a standard treatment to replace missing teeth and support dental prosthesis for obtaining proper aesthetic and functions.

Rehabilitation of the atrophied posterior maxilla is not an easy procedure *Esposito M et al. 2014*. The first trial for maxillary sinus augmentation was in 1980 and this technique has been studied over the years. Lateral window approach technique has been

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used commonly for maxillary sinus augmentation **Moon JW et al. 2015**. Maxillary sinus lift is a surgical technique done to increase bone height in posterior maxilla by repositioning the maxillary sinus floor in upward direction to create adequate bone height suitable for placing dental implants **Al-Dajani M 2016**.

Autogenous bone is the gold standard for ridge augmentations **Xavier SP et al. 2015** but amount of the available autogenous bone are limited, creating morbidity to the donor site, and the time of the surgical operation is longer **Ahmet S et al 2016**.

Nanotechnology has been used in periodontal tissue regeneration. Several studies demonstrated the significant effect of nanoscale geometry and topography on the cell differentiation and regeneration **Bartold PM et al. 2015**. Nanobone (Artoss co, Germany) consisted of synthetic nano crystalline hydroxyapatite and silica fabricated in a sol/gel process. Nanobone increases osteoblasts proliferation better than deproteinized bovine bone mineral (DBBM) **Liu, Q. et. al.2011**. Study showed that the inflammatory reaction is less in nano bone graft than Beta-Tricalcium phosphate graft **Ghanaati et al. 2013b**.

**Heinemann, F et al. 2009** studies showed good results in clinical long term of implant insertions and simultaneous maxillary sinus augmentation by using Nanobone which provide reliable and dimensionally stable bone substitute material **Kruse, A et al. 2011**.

Strategies for accelerating bone healing include using of platelet rich plasma (PRF) which is highly concentration of the patient platelets that is rich in various groups of growth factors such as platelet derived growth factor, transforming growth factor beta, vascular endothelial growth factor, insulin growth factor 1 and others **Marx RE. 2001**. PRP considered as a complement to autogenous bone graft and osteoconductive graft material which improve bone healing **Khairy NM et. al 2013**.

Studies showed good results about the effect of using PRF when combined with bone substitute for maxillary sinus augmentation **Taschieri S, et al 2015**.

Statins are a drug used for the treatment of hypercholesterolemia by inhibiting 3-Hydroxy 3-Methylglutaryl coenzyme A reductase and convert it to mevalonate and decrease hepatic synthesis of cholesterol **Horiuchi N et. al 2006**. Statin derivate mevalonate and suppress the expression of the receptor for activation of nuclear factor kappa B ligand and activation of nuclear factor kappa B which inhibits osteoclast differentiations and induces osteoclast apoptosis **Mo H et al 2012**. **Mundy et al. 1999** studies showed that using of statins give rise to the so called pleiotropic effects by increasing the expression of bone morphogenetic proteins which stimulate the differentiation of osteoblast and increase its activity. Studies concluded that statin have an anabolic effect on bone **Ho, M.L. et al 2009**. Animal studies showed that when statin applied locally give good bone regeneration **Goes P et. al. 2006** and enhance new bone formation and bone to implant contact **Fang, W et. al. 2015**.

Therefore, the aim of the present study was evaluating the clinical and radiographic effect of simvastatin when added to nano bone and PRF for maxillary sinus lift and simultaneous implant placement.

## MATERIALS AND METHODS

The study designed for evaluating bone substitute effect; Nanobone (Artoss GmbH, Rostock, Germany) and PRF (group I, control group) compared to the same bone substitute and PRF with simvastatin (Corvast 80 mg, Egyphar, Egypt) (group II, test group) for maxillary sinus lift and placement of implants (Impla implant system, Scheutz dental group). This study included 20 patients, all of them required sinus lift and conducted in the Department of Periodontology, Oral Medicine

and Oral Diagnosis, Faculty of dentistry, South Vally university.

Exclusion criteria were as follows: The exclusion criteria were bleeding index and plaque index of >25%, smoker patient, pregnant women, patients with active periodontal disease or periapical lesions, pathologic lesions of maxillary sinus, and patients with systemic diseases.

Inclusion criteria: All patients have 4 mm bone height in the posterior maxilla, the alveolar bone ridge was wide enough to enable implant placement during sinus lift and no maxillary sinus pathological lesion. Cone beam computed tomography done preoperative and 6 months postoperative and used to evaluate bone height gain and bone density of new formed bone.

### **Surgical phase**

Lateral window technique with simultaneous implants insertion used. Before the surgical procedure, patient preparation was done by antibiotics (Augmentin 1gm, GlaxoSmithKline co). One gram given to the patient one day before the operation and continue for seven days. 0.2% chlorhexidine gluconate mouth wash used for all patients for 2 minutes before surgery.

Surgery was done under local anaesthesia and using piezosurgery (Piezosurgery, Acteon Co) to minimise surgical trauma and complications. Midcrestal mucosal incision done with releasing vestibular incision anteriorly and posteriorly to osteotomy site. Full thickness flap reflected to expose the lateral maxillary wall. Bony window created with the piezoelectric instrument so that the schneiderian membrane preserved and became visible. The sinus membrane elevated and fractured bone section kept attached to the astral lining and no attempt was made to separate it. Implants site prepared and the sinus cavity filled by Nanobone and PRF without simvastatin in Group I, while in Group II the sinus cavity filled with Nanobone and PRF with simvastatin, then implants inserted .

According to Choukroun's protocol to prepare PRF, patient blood samples harvested immediately before the surgery. PRF clots prepared and mixed with Nanobone in (group I) while in (group II), mixed with Nanobone and simvastatin. Part of PRF used as a membrane to cover wound before the closure *Choukroun, A. et al. 2006*.

After surgery patients were followed up and evaluated: seven days, one month, six months postoperatively. Patient clinically evaluated regarding any postoperative complication like pain, oedema, wound dehiscence, graft or implant failure.

Panoramic x ray taken after the surgery and CBCT was performed six month after surgery to evaluate the bone formation and bone density of new formed bone, and prosthetic rehabilitation started.

### **Prosthetic restoration**

After 6 months of sinus lift and simultaneous placement of the implants, the cover screw of each implant was removed and a gingival former was placed. Gingival former removed after seven days. By closed tray technique, impression was taken. At 15 Ncm, the abutment tightened using a torque driver. PFM (porcelain fused to metal) crowns fabricated and cemented with zinc phosphate cement.

### **RESULTS**

After six-months follow up period for 20 partially edentulous patients who treated for sinus floor augmentation and one stage implant placement by using Nanobone and RPF without simvastatin in Group I, while in group II Nanobone and RPF with simvastatin has been used. The results of our study showed 100% success rate. No intraoperative clinical complication such as sinus membrane perforation nor postoperative complication such as maxillary sinusitis or pain. Healing of the surgical site took place without any complication or infection, but at the second day after surgery, one patient reported minor discomfort and was managed by analgesics.

### Radiological Results

By comparing the finding of CBCT preoperative and 6 months after surgery, the end sinus bone height gain is measured by subtraction the preoperative residual bone height from the postoperative new bone height. The mean vertical bone gain height 6 months after surgery was 11.349 mm in group I and 11.889 mm in group II.

The bone density in the grafted areas were evaluated in both groups. The residual bone height (RBH) measurement from the preoperative CBCT images showed the vertical distance from

the cortex bone under the floor of the maxillary sinus to the alveolar bone crest. This difference in sinus augmentation height did reach statistical significance. Comparison of radiographic findings, the mean of new formed bone density was 297.8 Hounsfield in group I while it was 314.3 Hounsfield in group II. The difference in the density of new formed between the two groups was statically significance for group II ( $P < 0.05$ ). This results showed that the density of new formed bone in group II was denser than the density of new formed bone in group I.

TABLE (1) Showing radiographic CBCT results for bone height and bone density.

Patient number	New bone Density (hounsfield units)		Bone Height (mm)	
	Group I	Group II	Group I	Group II
1	295	293	11.50	11.95
2	278	325	11.50	13.00
3	260	339	13.00	12.50
4	315	242	11.75	11.80
5	301	350	11.89	11.90
6	332	299	12.10	12.50
7	298	327	11.4	11.7
8	287	289	9.55	10.69
9	304	323	10.3	11.10
10	308	356	10.5	11.78
Mean of differences (IQR)	297.80	314.3	11.349	11.889
P value	0.039		0.192	

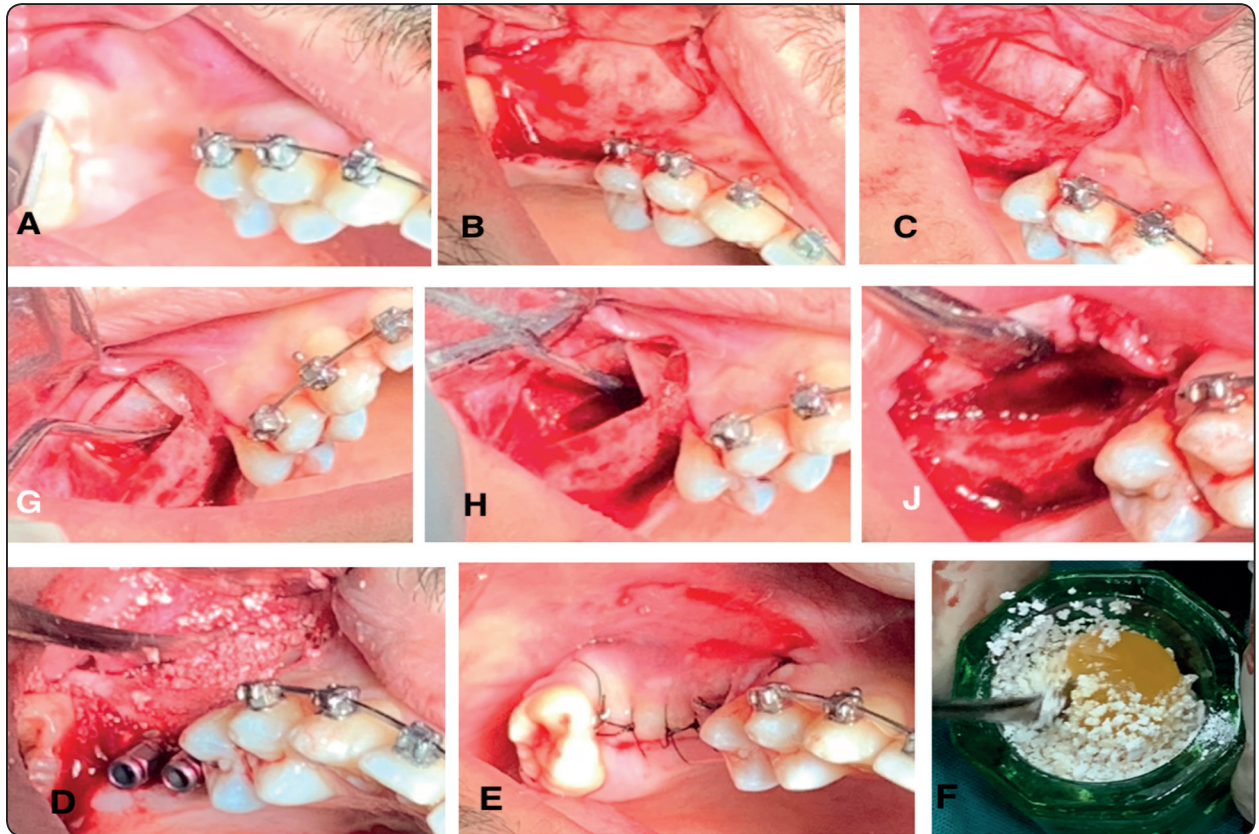


Fig. (1) Fig.1: Showing surgical sinus operation lift and one stage implant placement: A) Maxillary posterior ridge before sinus lift. B) Flap design. C,D and E): Bony window created with the piezoelectric instrument. F) Preparation of implant site. G) Placement of Nanobone & PRF with simvastatine. H) Suturing. J) Mixing of Nanobone, PRF and simvastatin.

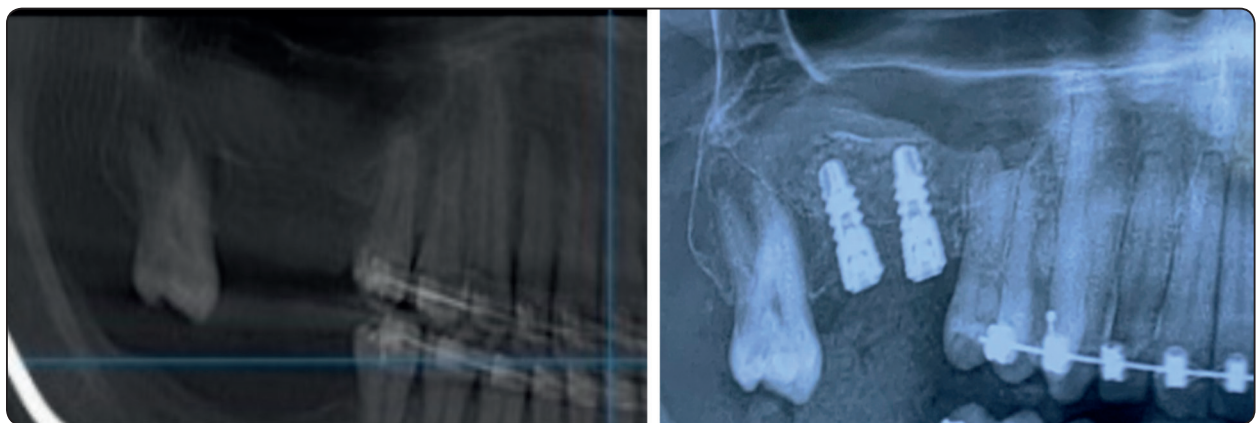


Fig. (2) Showing preoperative & postoperative panoramic x ray.



Fig.3: Showing preoperative CBCT.

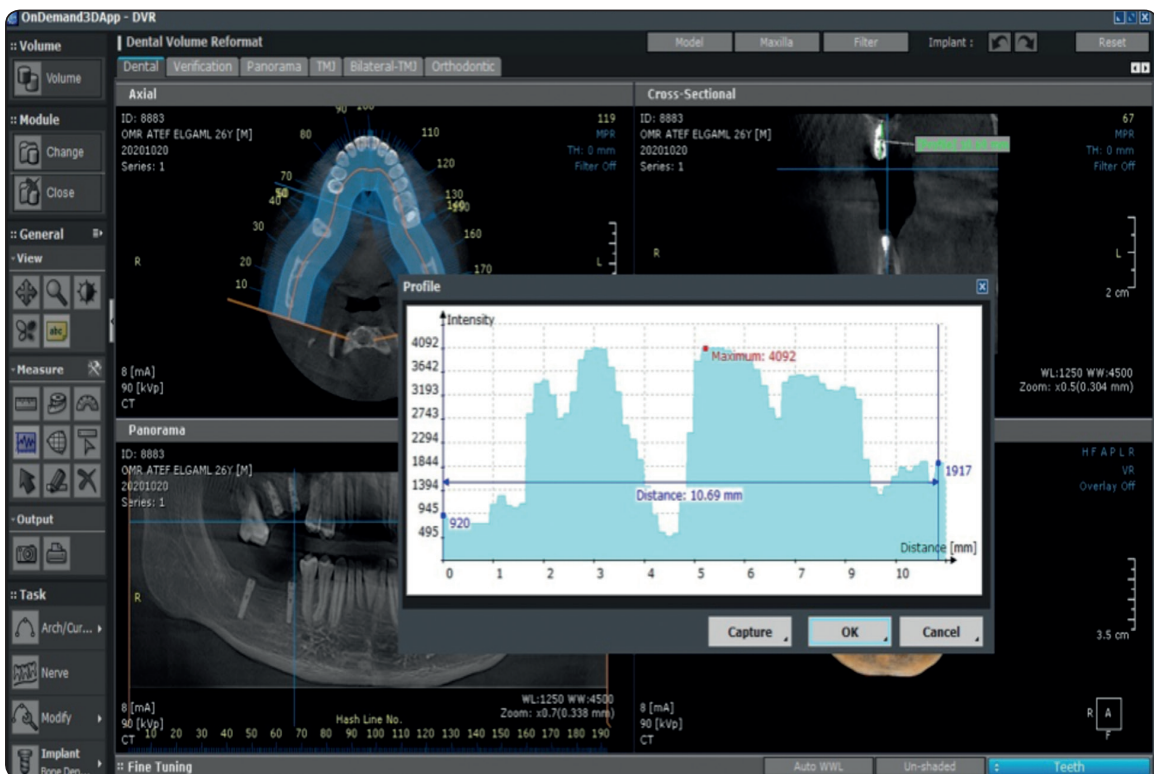


Fig. 4: Showing 6 months postoperative CBCT, measuring the height of endo sinus bone gain.

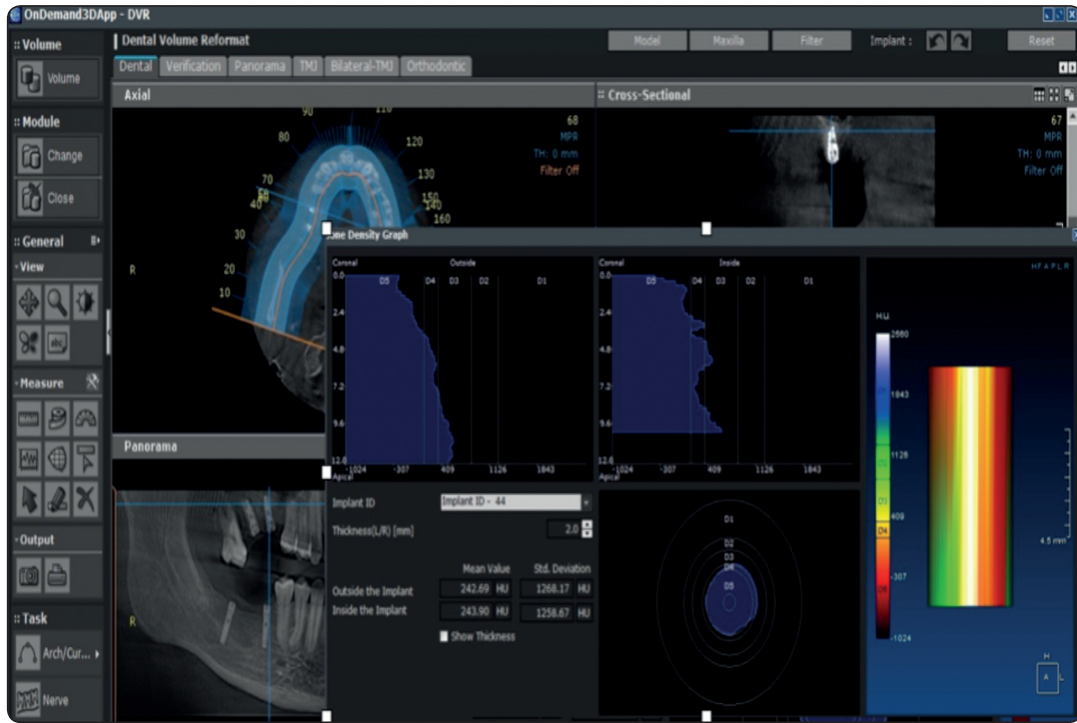


Fig. 5: Showing 6 months postoperative CBCT, measuring the height of endo sinus bone density.



Fig. (6) Prosthetic Phase. A) Photo showing ridge 6 months after sinus lift and implant placement. B) Photo showing placement of gingival former. C) Photo showing of gingiva and gingival former after one week. D) Photo showing gingiva after removal of gingival former after one week. E) Photo showing placement of abutments. F) Photo showing cementation of the prosthetic crowns.

## DISCUSSION

Maxillary sinus lift is a well accepted procedure for increasing bone volume in the posterior maxilla. Three options are available for maxillary sinus lift and placement of the implant; two stage lateral sinus lift, one stage lateral sinus lift with simultaneous implant placement, and one stage crestal approach with simultaneous implant placement, each of this options has advantages and disadvantages. Two stage lateral sinus lift indicated when the available bone height is less than 3 mm, one stage lateral sinus lift indicated when the available bone height 4 mm and one stage crestal approach indicated when the available bone height is above 4 mm **Kendrick DE 2016**. In this study all included patients have 4 mm bone height in the posterior maxilla and the alveolar bone ridge was wide enough to enable implant placement during sinus lift.

Lateral approach technique for sinus lift is invasive and associated with more complications than crestal one stage approach **Bechara et al. 2016**. In this study, using piezoelectric device for lateral window preparation and membrane separation decreased the intraoperative complications. This result was correlated with the results of **I. Woo & B. T. Le 2004** and the histomorphological studies of **Pavlikova G et al. 2011**. The piezoelectric surgery increases the concentration of bone morphogenic protein, transforming growth factor beta 2, tumor necrosis factor and decreases proinflammatory cytokine in the bone. Piezosurgery acts only on mineralized tissue and inactives on soft tissue, hence soft tissue damage is absent **S. S. Wallace 2012**.

This study was designed to compare the efficacy of combining simvastatin to Nanobone graft and PRF in maxillary sinus lift based on the new bone height gain and the density of new formed bone. Nanobone graft is well documented and have applications in oral surgery, as it promotes bone regeneration because it is biocompatible and osteoconductive. Combining simvastatin to bone

substitute has been less investigated. PRF is an autologous fibrin matrix. It is used to enhance bone regeneration as it stimulates osteoblast proliferation **C.H. Tsai 2009**. Animal studies showed that, PRF influenced the early bone healing and was beneficial for less vascularized areas, such as maxillary sinus **Gerard, E et al. 2006 and Miron R. J. et al 2010**. The radiological analysis of new formed endo sinus bone density was conducted on the study of **Consolo U. 2007 and Olgun E et al. 2018** which reported that, the bone density of PRF group was better than the bone density of control group.

This study evaluated 40 implants placed in 20 patients, the success rates for sinus lift and implants placement were 100%. The success of maxillary sinus lift determined by the amount of new formed bone in the augmented area **Loin J et al. 2019**. The results of this study showed that, an average vertical bone gain in group II was 11.889 mm, while in group I was 11.349 mm. This result was correlated with the results reported in other studies **Kiliç et al. 2016, Cucchi, A et al. 2017 and Fouad, W et al. 2018** but differed significantly from the data reported by **Meyer et al. 2009**. They observed a mean height bone gain of 16 mm, but in their study they used beta tricalcium phosphate and PRF for maxillary sinus lift. It should be taken into account that during the surgery bone graft was placed as much as necessary until all the implants were covered and that could be a plausible reason for longer implants to have obtained greater regeneration. These results was correlated with the results reported in the study of **Tanaka, K et al. 2019**.

The results of this study showed that, the mean of new formed bone density was 297.8 Hounsfield units in group I, while in group II the mean of new formed bone density was 314.3 Hounsfield units. This result was correlated with the results reported in other studies **Khairy N et al 2013, Kiliç et al. 2016, Cucchi, A et al. 2017 and Fouad W et al. 2018**.



## CONCLUSION

The results of this study showed that, the new bone height gain and new formed bone density in group II was better than the group I. The results of this study confirms that, combining simvastatin with Nanobone graft & PRF has a more positive impact on increasing the bone gain and bone density when compared with Nanobone and PRF alone.

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