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Osseodensification, maxillary sinus lift with simultaneous implant placement and tracking radation exposure of patient

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Abstract: Osseodensification is a minimally invasive, novel approach in dental implantology. Unlike traditional implant placement preparation which requires removing bone tissue, osseodensification method densifies, condenses the autograft bone. The osseodensification burs offers clinicians autogenous bone compaction at the apical region and facilitates gentle lifting of the sinus membrane. The aim of this case report is to describe a sinus indirect augmentation followed by simultaneous implant placement. Another challenge was to track the radiation exposure of the patient during this intervention. Osseodensification showed a good clinical outcome. Before the surgiaal procedure the ridge height from the sinus floor to the alveolar crest was 3,6 mm, after the intervention the ridge height was increased and we could place a 4,5 mm x L8,5 mm implant. Radiation exposure tracking was performed after radiological procedures. Osseodensification technique allows a more refined biomechanical approach, resulting in better implant stability and minimally invasive sinus lift.

Keywords: sinus lift, exposure tracking, radiation protection, implantology, osseodensification

I. Introduction

Osseodensification is a new concept of steotomy in dental implantology. This concept has been proposed to help in better osteotomy preparation, bone densification, indirect sinus lift and alveolar ridge expansion. This procedure has also shown the improvement of implant primary stability and better osteotomy than conventional implant drills [1]. Primary stability in dental implant placement is one of the most important factor in the success rate and healing of bone around dental implant. This procedure is characterized by low plastic deformation of bone that is created by rolling and sliding contact using a densifying bur that is fluted such that it densifies the bone with minimal heat elevation [1]. Unlike the traditional osteotomy, osseodensification does not excavate bone but simultaneously compacts and autografts the particulate bone in an outward direction to create the osteotomy, thereby preserving vital bone tissue. We use specialized densifying burs with steady external irrigation resulting creating the dense compact bone tissue along the osteotomy walls. The Densah™ burs allow for bone preservation and condensation through compaction autografting during osteotomy preparation, thereby increasing the bone density in the peri-implant areas and improving the implant mechanical stability [2,3]. Histomorphological analysis has demonstrated the presence of autogenous bone fragments in the osseodensified osteotomy sites, especially in the bone of low mineral density relative to regular drills [4]. These fragments acted as nucleating surfaces promoting new bone formation around the implants and providing greater bone density and better stability [1]. According to Viña-Almunia, et al. the most common complication associated with transcrestal maxillary sinus lifting is perforation of the Schneiderian membrane which occurs in 20% of cases [5]. Osseodensification is a safe technique for sinus lifting using a hydraulic wave at the apex of the bur. This wave pushes the sinus membrane upwards and causes Schneiderian membrane elevation with limited risk of perforation [6].

In dental implantology 3D imaging plays a key role in evaluating the integrity and thickness of the vestibular cortex, while the virtual positioning system allows us to manage the correct orientation of the fixtures by evaluating the correct relationship between the implant diameter and the distance between the implants and buccal bone cortex [7]. An intraoral x-rays examination is one of the most frequent types of radiological procedure that is routinely performed in dental centers. In dentistry the radiation dose is relatively low. However, regulation of radiation dose in dentistry is still an important issue since the frequency of examinations is higher than in medical radiography [8]. The principles of radiation protection, suggested by the International Commission for Radiation Protection (ICRP), consist of justification, optimization, and dose limitation [8,9].

Radiation dose evaluation and monitoring in dentistry has become an important challenges for dental staff and patients. Radiation protection concept is focused on the protecting each patients from non-justified, excessive radiation dose. In this concept, “exposure tracking” is defined as tracing the history of radiological examinations. Dose monitoring, including both exposure and dose tracкing, supports the justification and optimization of an individual patient’s radiologic procedure and radiation dose [8,10].

The first goal of this case report is to describe the osseodensification technique in dental implantology and indirect sinus lift as an alternative to conventional osteotomy in implant site preparation. The second goal is to demonstrate achievability and importance of tracking radiation exposure of patient during this intervention.

II. Case Presentation

A 42-year-old female patient was referred to the dental center for replacement of the right upper first molar by a dental implant.

Full personal history was taкen including patient’s past medical and dental history.

Clinical examination was performed intraorally and extraorally to exclude any inflammation, sinus pathology, swelling. Patient was asкed about pregnancy.

Before starting, patient was informed about the benefits and risks of the procedure and written informed consent was procured from the patient.

A cone-beam computed tomography (CBCT) (Exposure conditions: small FOV 5 cm × 5 cm, 90 kV, 12 mA, exposure time 14 s, DAP: 6,667 mGy × cm²) was taken before the surgical procedure to indicate the residual bone height, to determine if needs sinus lift and bone width were measured to choose the most appropriate implant size (Figure *1*).

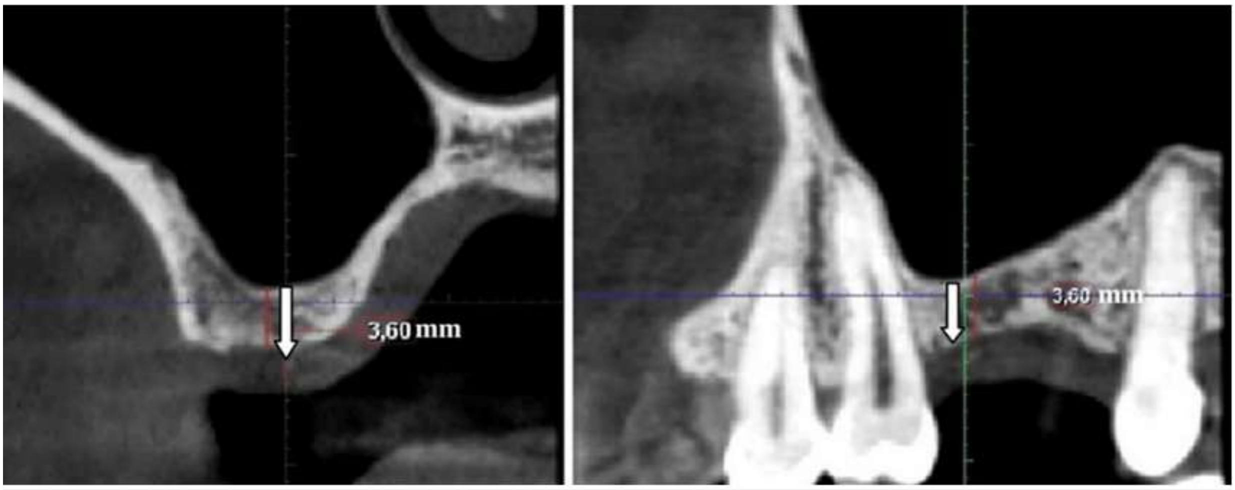

FIGURE 1: CBCT scan of the right upper first molar region taken preoperatively

The arrow shows the distance of the residual bone height.

CBCT: cone-beam computed tomography

CBCT scan showed that the maxillary sinus was pneumatised and required augmentation, because the ridge height from the sinus floor to the alveolar crest was 3,6 mm, it was decided to go ahead with a crestal sinus lift to enable the placement of a 4,5 mm x 8,5 mm implant. Full mouth scaling and mouth rinsing with antiseptic mouth wash was performed before the surgical procedure. Patient was treated under local anaesthesia using maxillary vestibular and palatal infiltration. A full mucoperiosteal flap was elevated with crestal incision using blade N15C and N12, followed by flap reflection with periosteal elevator. Since residual bone height was less than 6 mm, we didn't use pilot drill to start the osseotomy, but directly the Densah™ bur (2.0) in reverse mode to the sinus floor. Once the dense sinus floor was reached, a x-ray was taken to confirm the bur position (Figure 2). The Densah™ bur (3.0) was used in reverse mode with modulating pressure and puping motion, reaching the dense sinus floor and advancing in 1 mm increments, up to 3 mm beyond. The same manipulation was repeated with the (4.0) bur, then this bur was used to push the graft. The graft was pushed in reverse mode at slow speed (150-250 rpm) without irrigation. The Densah™ bur facilitates the biomaterial compaction to further lift the membrane. It shouldn't go more than 2-3 mm beyond the sinus floor. This step was repeated 4 times to lift the membrane up to the necessary length. A periapical x-rays imaging (Exposure conditions: 70 kV, 8 mA, exposure time 0,14 s, exposed area: the right upper first molar region, effective dose 0,77 µSv) was performed for checking sinus floor position with smallest Densah™ bur. The integrity of the sinus membrane was checked by depth gauge (Figure 2).

FIGURE 2: Periapical x-rays of the right upper first molar region

Sinus floor position checking with Densah™ bur

We introduced resorbable alloplastic bone substitutes (Straumann BoneCeramic). The implant (GlobalD InKone 4,5 mm x L8,5 mm, France) was prepared for insertion, starting with handpiece then completing the insertion manually with the torque wrench. The second periapical x-ray was performed after implant insertion with the same exposure conditions (Figure 3).

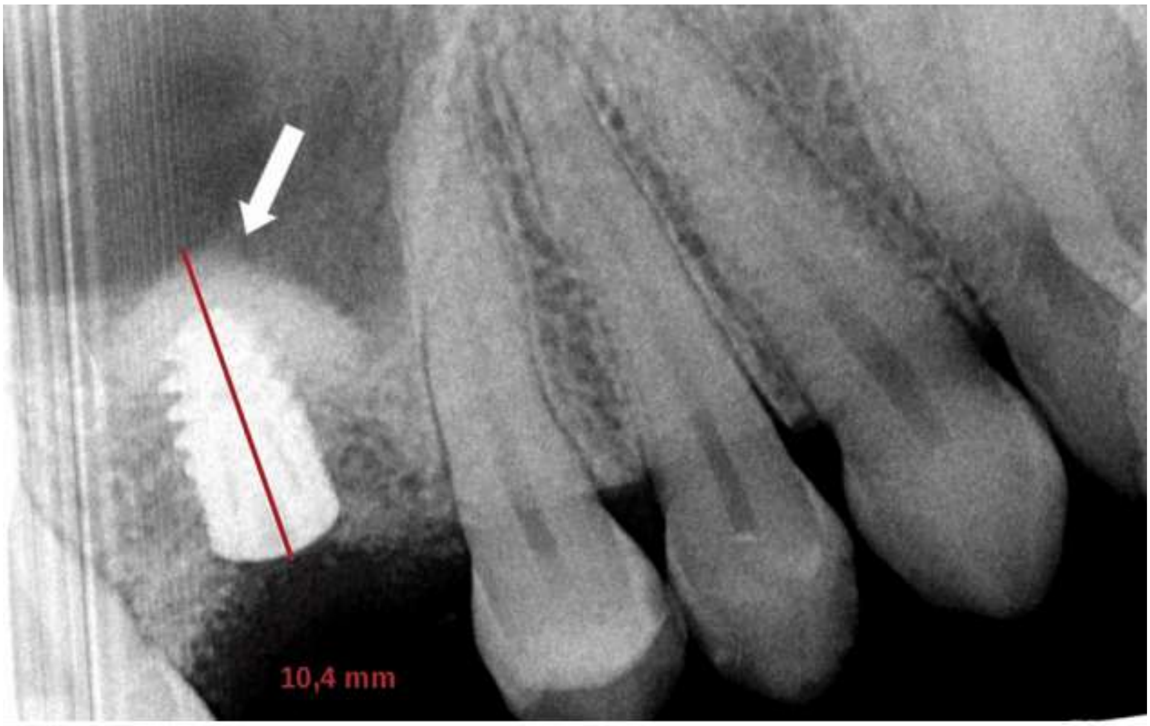

FIGURE 3: Periapical x-rays of the right upper first molar region after implant insertion

The arrow shows the bone volume after osseodensification, the amount of sinus lift achieved, facilitating the placement of a 4,5 mm x L8,5 mm. implant.

Osseodensifications with indirect sinus lifting and simultaneous implant placement were successfully achieved. The flap edge was approximated afther cover screw placement and sutured with interupted suture using non-absorbale blue polyamide monofilament FILAPEAU 5/0 (France). The operating time was measured starting with the first Densah bur used after pilot drill to the final implant insertion: 25 min ± 3min.
After intervention we gave to the patient Instant Ice Pack and she was instructed to apply cold packs over the cheek for the first 12 hours, avoid drinking with straws for 10 days and to avoid sneezing and nose blowing.

The medication was prescribed:
Amoxicilline 1 g. orally 3 times a day for a 7 days.
Doliprane 1000 mg. every 6 hours in case of pain for 4 days.
Eludrile perio 0,2% 200 ml. antiseptic mouthwash 3 times a day for 7 days.

The first follow-up appointment was scheduled after 10 days from implant placement. Sutures were removed after proper evaluation of soft tissue.

III. Discussion

Osseodensification approach was studed by Huwais and Meyer and published in 2016. Use of Densah™ burs was introduced in 2018. Osseodensification is an innovative method of preparing the implant osteotomy using drills that promote bone self-compaction, densification, plastic deformation of the bone and to increase the primary stability of the implant due to the viscoelastic characteristics of the alveolar bone using Densah™ burs in a reverse direction. These burs combine advantages of osteotomes with the speed and tactile control of the drilling procedures. Standard drills remove and excavate bone during implant site preparation. While osteotomes preserve bone, they tend to induce frac tures of the trabeculae that require long remodeling time and delayed secondary implant stability. The new burs allow bone preservation and condensation through compaction autografting during osteotomy preparation, increasing the peri-implant bone density and the implant mechanical stability was reported by in vitro testing [3]. This method can be uses in different clinical situations: low-density bone areas, immediate implant placement in postextraction sockets, narrow alveolar bone crests and sub-antral bone grafts. Another challenge for us was a tracking radiation exposure of patient during this surgical procedure. Worldwide societies try to reduce patient and medical staff radiation dose. According to World Dental Federation (FDI) policy statement on radiation safety in dentistry, radiographs should only be made when there is an expectation that the diagnostic yield will affect patient care because exposure to ionising radiation also carries the risк of harm [11]. The International Atomic Energy Agency (IAEA) launched a smart card project aimed at developing a system for tracking the radiation dose of each individual [12]. An individual patient dose tracking helps to justify and optimize the radiation dose af CT examinations in Finland. They introduced four cases of dose tracking that made it possible to avoid new CT examinations or adjust patient-specific exposure parameters [13]. The National Institutes of Health of the United States attempted to redue the exposure radiation of patients by tracking individual patients [8,9]. A radiation passport was developed in Canada to track radiation dose and estimate the associated cancer risks with a smart phone application [12,14]. According FDI and IAEA recommendations we used CBCT scan before implant placement. To comply with the principles of radiation protection of the patient during the surgical intervention we used intraoral periapical x-rays to control a layer of increased bone mineral density, for checking the sinus floor position or implant placement afther implant insertion. During this intervention radiation dose tracking was applied and every exposure dose from CBCT and from 2 periapical x-rays were traced in patient’s history.

IV. Conclusions

Our clinical case showed that the osseodensification technique has advantages by maintaining alveolar ridge integrity preserving bone bulk, allowing implant placement in autogenous bone, increasing bone density and primary stability, as well as bone-implant contact, shortening the healing period to restorative phase and increasing clinical success. Osseodensification is a minimally invasive tool of sinus augmentation. Also, we can conclude that a tracking radiation exposure of patient is achievable for dental intreventions. Each patient must have access to his or her history of radiographic examinations and cumulative effective dose. Radiation dose reduction is the responsibility of the entire dental community.

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