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Trans-nasal dental implants: indication and the report of 10 cases

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Background: The rehabilitation of the atrophic maxillae with dental implants represents a challenge that can be addressed with zygomatic dental implants and traditional axial implants. In the event of a severely atrophic pre-maxilla, a quad-zygoma approach may be necessary to provide anchorage for the fixed restoration. The proximity of anatomical features can increase the possible morbidity of the quad-zygoma approach and instead, trans-nasal implants may serve as a viable anterior anchorage alternative in the atrophic pre-maxilla region.
Methods: A total of 10 patients diagnosed from a class 2B edentulism received a combined treatment with trans-nasal implants paired with a single zygomatic implant were included in this study. Trans-nasal implant marginal bone level changes were evaluated on CBCT (Cone Bean Computed Tomographic) images taken immediately after trans-nasal implant placement and 1 year of follow-up post loading. The reference point for the CBCT measurement of mesial and distal bone loss after 1 year was the horizontal interface between the implant and the abutment. Secondary measurements taken at the 1 year follow up measured the amount of bone available in the sub-nasal, lateral and apical areas of the dental implant in contact with bone.
Results: The retrospective CBCT analysis of 18 trans-nasal implants (size ranging from 22 to 25 mm with an average of 24.1 mm) placed in 10 patients (all 10 patients were female ranging from 38 to 67 years old with an average age of 59.1 years old) shows an average marginal bone loss of 0.70 mm over a time period of 1 year following restorative loading, $P < 0.0001$. While the sub-nasal, lateral and apical engagement shown respectively 5.46, 12.92, and 2.70 mm of radiographical bone contact with the implant.
Conclusion: The marginal bone loss observed in trans-nasal implants 1 year post loading is comparable to the marginal bone loss of conventional implants under similar conditions. The cumulative radiographical bone to implant contact between the subnasal and the apical bone seems to be of a value of 8.16 mm which seems to correspond to the size of a conventional dental implant. Therefore, it is believed that trans-nasal implants can be considered as an acceptable anterior anchorage alternative to the superior/ anterior zygomatic dental implant in the atrophic pre-maxilla region when paired with a single posterior zygomatic implant.

Keywords: atrophic maxilla, paranasal implant, quad-zygoma, trans-nasal, zygomatic implant

Introduction

The rehabilitation of an atrophic maxilla with dental implants presents challenges. Vertical bone loss in the maxilla presents a challenge due to the maxillary sinus posteriorly and the nasal cavity anteriorly which limit the vertical bone height available for conventional placement of an implant.

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Utilizing the Bedrossian classification[1] to segregate the maxilla into three zones: Zone 1 – the premaxilla, Zone 2 – the premolar area, Zone 3 – the molar area (Fig. 1) clinical decisions related to optimal implant placement in the maxillary arch can be anticipated. Treatment planning in the atrophic maxilla, anatomical limitations need to be considered to ensure suitable anterior-posterior (A-P) spread of implants. A challenge is presented particularly in Zone 1, where due to severe atrophy, there may be ≤2 mm of alveolar bone present subnasally[2]. Implant placement in an atrophic Zone 1 provides minimal bone-implant contact with the added risk of resorption during function and increased risk of late rhino/sinus – oral communication.

Solutions that address minimal subnasal bone generally attempt to increase vertical height by vertical bone augmentation (VBA). However, VBA does not have consistent and predictable results. Unlike the maxillary sinus which can be augmented in a lateral or crestal approach to increase the vertical height of available bone, the nasal cavity is occupied by turbinates. In addition to respiratory and olfactory function, nasal turbinates aid in humidifying and warming the inspired air and the nasal cavity can therefore not be augmented with bone to increase vertical dimensions. Furthermore, in a highly atrophic pre-maxilla, it is common for bone to be absent subnasally, influencing the clinician to place an axial implant in

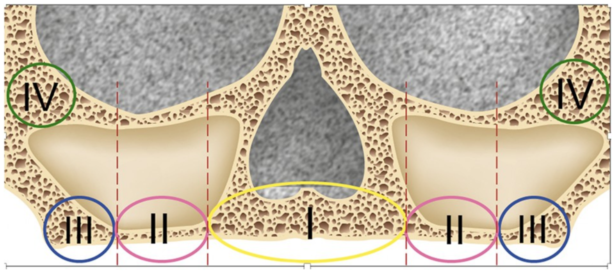

Figure 1. Bedrossian classification – when only bone is available in Zone 1 (canine to canine) zygomatic dental implants are indicated to provide posterior support and appropriate AP spread to the implant supported restoration.

a more posterior and less ideal position[3]. This sub-ideal implant placement creates a short A-P spread between implants creating an unfavorable cantilever[3].

Several solutions to the severely atrophic maxilla have been proposed. These include M-4 implant placement, trans-sinus implant placement, and zygomatic implant placement to avoid placing a short implant subnasally[4,5]. Zygomatic implants allow utilization of the zygomatic bone and avoidance of sinus augmentation to permit restoration of the atrophic maxilla. But this may result in an anterior cantilever when resorption has resulted in the premaxilla. Trans-nasal implants permit implant placement in the atrophic premaxilla without the need for extensive grafting to allow implant placement in conventional sites. Thus, trans-nasal implants can be utilized to augment zygomatic implants or conventional implants when the full arch is being treated when significant resorption has presented in the anterior maxilla to avoid an anterior cantilever.

M-4 technique is an angled-implant solution when minimal bone is available subnasally[6] (Fig. 2). This technique angles the apex of two implants towards what is termed the M-point which is the maximum bone mass at the lateral pyriform rim above the nasal fossa, so the implant apices engage cortical bone for primary stability[3]. With this technique, the anterior implant has the apex angled distally, while the posterior implant has the apex angled mesially. Angling the implants allows the clinician to avoid bone grafting while permitting use of 10–13 mm implants in areas of severe atrophy with otherwise less than 7 mm of available vertical bony height[6]. Utilization of the M-technique requires angled abutments (MUA) of 17° or 30°. However this technique requires at least 5 mm of vertical bone height to allow for angulation into the lateral pyriform rim[6]. The advantage provided is increased biomechanics, wider A-P ratio available for the restorations.

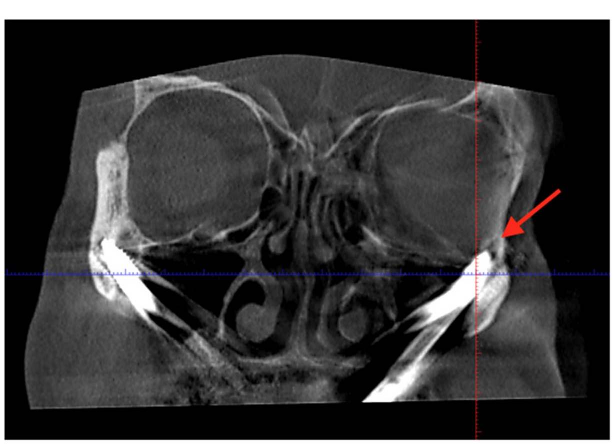

Figure 2. Quad zygoma CBCT – the arrow indicates the proximity of the superior zygomatic implant to the inferior part of the orbital floor.

Trans-sinus implant placement with engagement of the nasal cortical bone in combination with short subnasal implants is another proposed method where atrophy of the maxilla prevents insertion of traditionally tilted implants where the platform of the implant is directed posteriorly[4,7]. The trans-sinus implant body is placed with the apex angled mesially, minimally transversing through the maxillary sinus with engagement in the inferior and anterior cortical walls of the maxillary sinus extending the apex of the implant into the nasal cortical wall, described as a double bi-cortical anchorage[4]. The benefit of this is good implant anchorage with a large inter-implant distance without undertaking the technically demanding approach of zygomatic implant placement or undergoing extensive bone grafting procedures. However, this technique still requires adequate subnasal bone in order to place axially directed implants to support the prosthesis in unison with the tilted trans-sinus implant. This approach was reported to show similar and comparable survival rates to implants in immediate function placed in grafted bone and zygomatic anchored implants through the extra-maxillary technique[8,9].

When bone is not available in Zones 2 and 3, zygomatic dental implants are indicated in the

treatment planning of the severely atrophic maxilla in order to provide adequate anterior- posterior (A-P) spread of the implants. When treating Zone 1 edentulism, a paucity of metrics helps the clinician to make a standard decision between treatment algorithms (hybrid zygoma or quad zygoma). In order to clarify and quantify the Zone 1 edentulism and assist the clinician to make a standard decision based on metrics, in 2023, Aalam et al[10] published a decision tree making that divided the Zone 1 into two classes:

- Class 1, robust pre-maxilla eligible for a hybrid zygoma cases (width >5 mm, length >10 mm).
- Class 2, atrophic that is further divided into subcategories A (width 3–5 mm, length <10 mm) and B (width < 3 mm, length<10 mm).
- Class 2B represents the severely atrophic maxilla requiring the utilization of the quad zygoma.[1,2,11]
- Despite been a well-documented surgical technique[12], the quad zygoma is associated with some limitations:
- A very high level of training and expertise is required by the clinician. This technique should be performed by the most experienced practitioner and surgical specialists.
- Anatomical limitations. Not every zygomatic bone can accommodate 2 implants from an inferior-superior plan[13]. Even more so, if the anatomy is associated with a low infra orbital foramen restricting the zygomatic bone availability and safe implant trajectory (orbital proximity).
- High morbidity (orbital proximity, oral antral communication, buccal soft tissue dehiscence) associated with the superior/ anterior implant in the quad zygoma configuration (Figs. 2 and 3).

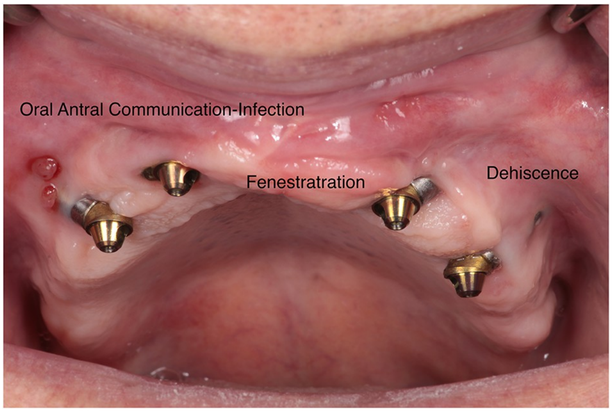

Figure 3. Soft tissue deformities – quad zygoma can be associated with complication associated with mucosal retraction that could lead to oral antral communication.

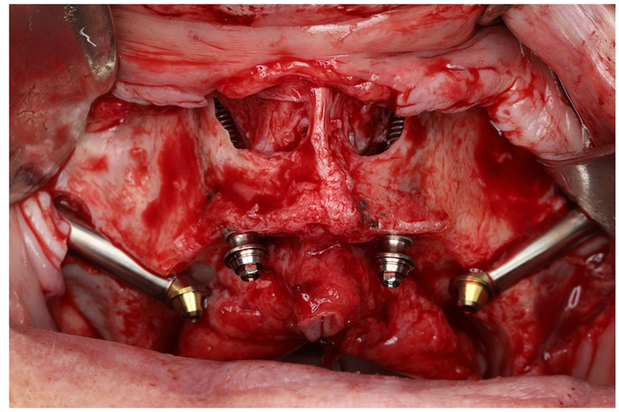

Figure 5. Configuration of trans-nasal implant – the anterior implant surrounded by bone assuring the stability of the soft tissue around the implants. Due to its favorable accessible location, complications and handling are of easy access and treatment.

- In order to reduce the surgical risks associated with the quad zygomatic surgical techniques and specifically with the anterior superior implant, in 2019[14] and 2021[15] and 2023[16] practitioners introduced and alternative surgical technique by placing an extra-long standard dental implant anchoring in the inferior turbinate of the nasal cavity (type 1 bone) attempting to replace the anterior superior zygoma implant (Figs. 4 and 5) in conjunction with a single posterior zygomatic dental implant.

This anterior implant placed with high torque, surrounded by native bone and good quality keratinized tissue coupled with great access and visibility appears to be a safer and more accessible replacement of the anterior superior zygomatic dental implants (Fig. 6).

Existing publications[14-16] support the clinical utilization of such protocol but there is to the best of the authors knowledge no published data concerning the short- and long-term survival rate of such protocol and the actual clinical amount of bone anchorage obtained in such procedure.

The purpose of this retrospective analysis is to evaluate the outcome of 10 patients treated via the extra-long trans-nasal implant as an anterior anchorage in combination with a bilateral single posterior zygomatic implant. Trans-nasal implant marginal bone loss after 1-year of function will be reported as the primary finding. Additionally, this study aims to provide quantitative data related to the amount of cortical apical engagement, cortical lateral engagement of paranasal bone, and the sub-nasal bone.

Methods

In accordance with the Declaration of Helsinki – "Every research study involving human subjects must be registered in a publicly accessible database." The research number for this project is researchregistry10644 and can be obtained from, https://www.researchregistry.com/browse-the-registry#home/?view_2_search=10644&view_2_page=1.

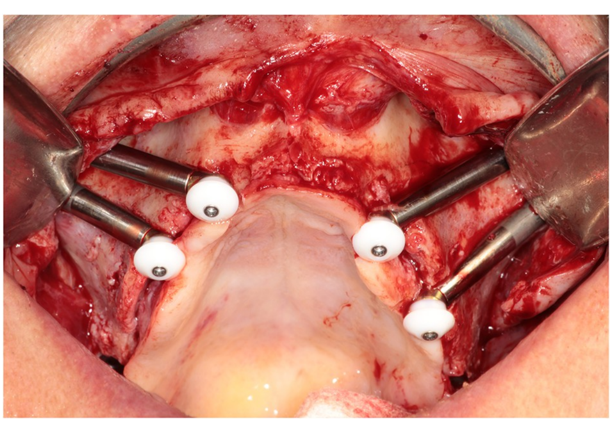

Figure 4. Configuration of a quad zygoma – in the case of ZAGA 3–4 classification, zygomatic implant and specifically the anterior superior one are not surrounded by bone. This precarious predicament associated with bending moment associated with the long anterior prosthetic cantilever can lead in time to the retraction of the soft tissue around the crestal bone.

Figure 6. Soft tissue findings around trans-nasal implant – the soft tissue volume and stability are predictable due to the presence of underlying bone and the lack bending moment (Unlike the quad zygoma configuration) maintaining the integrity of the soft tissue attachment.

Patient selection

All patients underwent standard surgical and prosthodontic diagnostic and treatment planning work up. The patient was selected according to the following inclusion and exclusion criteria.

Inclusion criteria:

- ASA class 1–2.
- Class 2B[1] maxillary atrophy indicating a quad zygoma treatment modality.
- Sub-nasal bone availability of 3–5 mm minimum.
- 3–4 mm of bone available at the inferior turbinate area.
- 1 mm of safety margin between the estimated implant apex and the naso-lacrymal duct.
- Patient receiving an immediately loaded fixed restoration.

Exclusion criteria;

- Oral infections, or acute/chronic sinus diseases contra-indicating zygomatic surgery.
- Chronic nasal infection contra- indicating the nasal membrane elevation and the trans-nasal implant placement.
- Medical history that would complicate the study outcome such as alcohol, drug dependency, history of smoking, poor health, or any other medical, physical, or psychological reason that might affect the surgical procedure or the subsequent prosthodontic treatment and required follow-up examinations.
- Lack of primary stability forcing to abort the immediate loading of the prosthesis.

Surgical procedure

All patients were treated under general anesthesia with local traditional dental anesthesia protocols. The surgical protocol followed the Vanderlim technique[5].

In summary, once the mucoperiosteal flap and the nasal mucosa were elevated, the inferior turbinate was insulated, and the nasal mucosa protected with a periosteal elevator. The osteotomy followed the manufactured recommendation making sure that at least 3 mm of buccal bone was present at the time of the implant placement. Implants were inserted leaning to the lateral border of the nasal cavity and care was taken to ensure that the apex of the dental engaged the mass of the bone available in the inferior turbinate.

All implants achieved a clinical mechanical stability of 60 Ncm. No ISQ measurements were taken. The final multi-unit abutments were placed and secured permanently to the final manufactures torque recommendation. No grafting was performed against the dental implant. Posterior zygomatic dental implants were subsequently placed, the flap was closed, and a standard immediate loaded conversion was performed in order to rehabilitate the patient with a fixed restoration within the same day of the surgery (Figs. 7-14).

Care was taken to allow space in the prosthesis intaglios for tissue swelling during the initial healing period as well as to deliver group function occlusal scheme. Care was taken to eliminate any balancing contact (non-working). Antibiotherapy and post op pain management followed standard dental implant surgical protocols. Patients were seen at 2 weeks (suture removal), 4 months (all implants were tested for clinical and radiographic integration and final prosthetic phase) and 1 year post implant placement (CBCT).

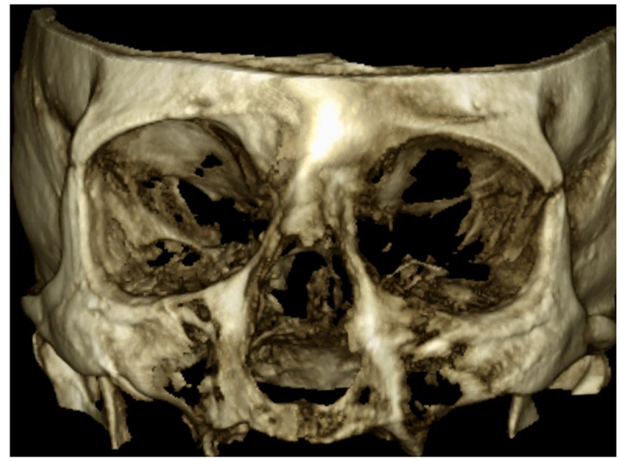

Figure 7. CBCT analysis – class 2B severely atrophic maxillae requiring quad zygoma or trans-nasal dental implant.

Radiographic evaluation:

Immediately after the surgery and at 1-year, CBCTs were taken to provide linear measurements regarding:

a. marginal bone loss of trans-nasal implant at mesial and distal sites
b. Amount of bone engagement at 1 year (Fig. 16):
    - Implant in contact with the residual subnasal bone.
    - Implant in contact with the lateral cortical paranasal bone.
    - Implant in contact with the apical bone in the inferior turbinate.

a. marginal bone loss of trans-nasal implant at mesial and distal sites.

Peri-implant marginal bone level changes were evaluated on the CBCT image immediately after implant placement, and

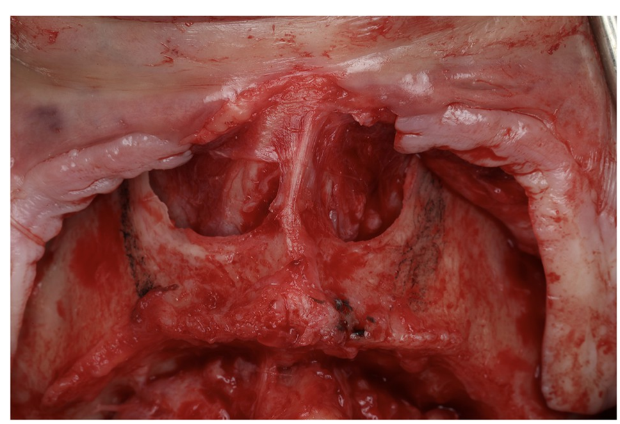

Figure 8. Flap – a full thickness flap is elevated exposing and elevating the nasal membrane all the way superior to the inferior turbinate. Pencil can be used to draw the direction of the osteotomy.

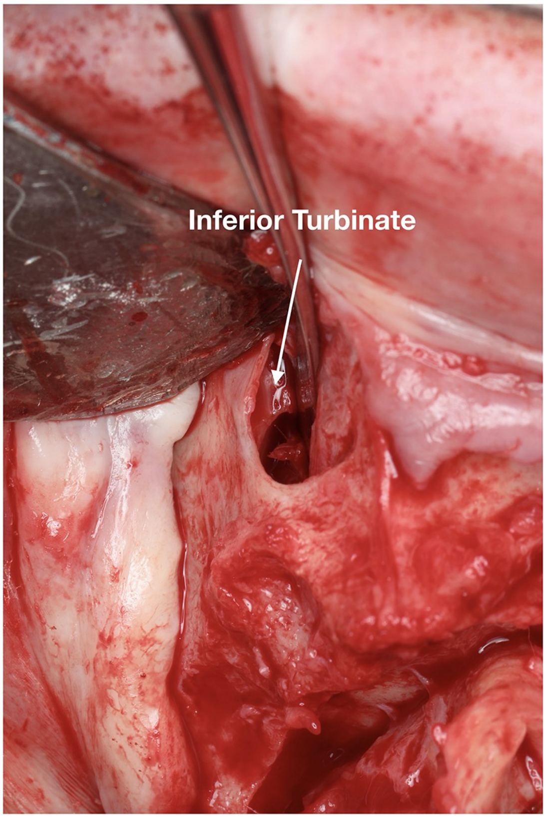

Figure 9. Inferior turbinate – once identified and isolated, a retractor is used with constant contact to guide the drilling direction and to prevent any damage to the membrane.

1 year post loading follow-up. The reference point for the CBCT measurement of mesial and distal bone loss was assessed via the horizontal interface between the implant and the abutment (implant platform). Image analysis software utilized was (BlueSkyPlan4, version 4.7.55, Blue Sky Bio, Libertyville, IL).

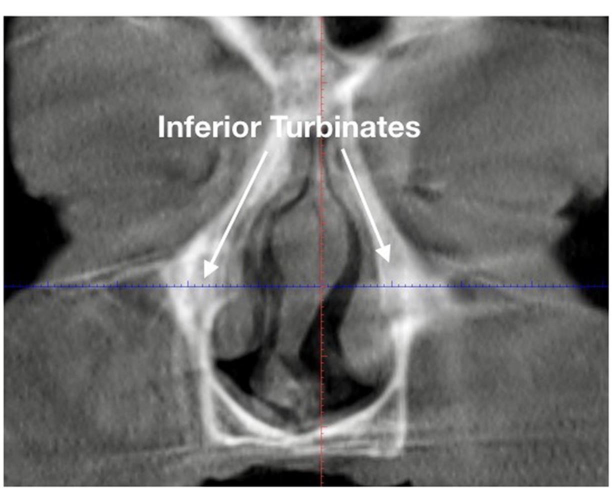

Figure 10. CBCT of the inferior turbinate – the thick bone pad of the inferior turbinate represents the apical bone anchor of the long trans-nasal dental implant. Type 1 bone is often identified in that zone contributing to good primary stability of the dental implant.

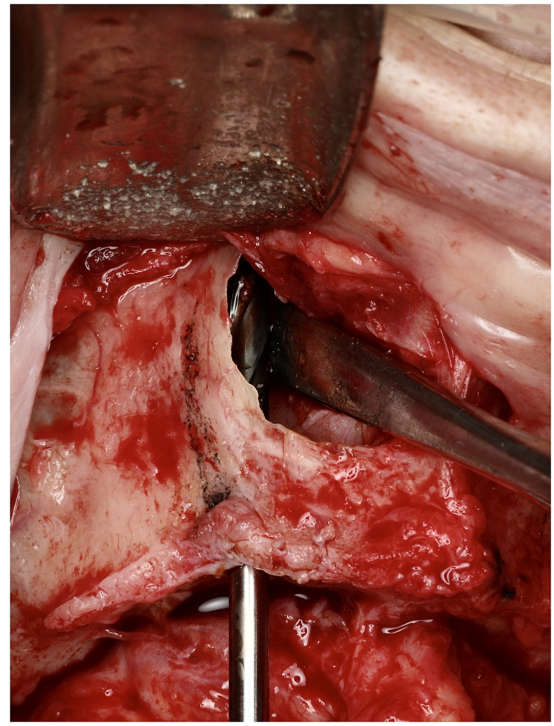

Figure 11. Preparation – drilling sequences based on the manufacturer recommendation are used to the final length and diameter of the selected dental implant.

Marginal bone remodeling was defined as the difference in marginal bone level at 1 year post loading in comparison to the marginal bone level present immediately after surgical placement of the implants.

b. Amount of bone engagement at 1 year:

- Subnasal bone was defined as the amount of alveolar bone located inferior to the nasal fossa and was measured from the crest of the alveolar ridge to the internal cortical border of the nasal fossa. Lateral cortical contact was defined as the lateral portion of the trans-nasal implant that engaged primarily with the cortical paranasal bone as the implant transects the nasal cavity. Specifically, this measurement of the cortical bone to lateral implant contact was a linear value spanning from the internal border of the cortical nasal bone (where the implant initially enters the nasal fossa inferiorly) and ending at where the implant fully enters the lateral border of the nasal fossa after completely traversing the fossa.
- The cortical apical engagement of implant is defined as the portion of the apical end of the trans-nasal implant that was fully encased in the cortical lateral paranasal bone after the implant transversed the nasal fossa. This was a linear measurement beginning from the internal cortical border of the lateral nasal fossa (after the implant transversed the nasal fossa) and ending at the most apical location of the implant (Fig. 15).

Statistical analysis

Demographic and implants length data are presented descriptively.

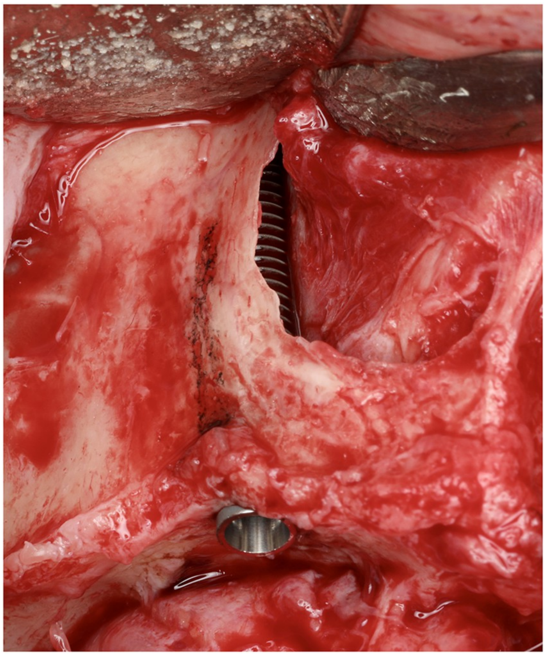

Figure 12. Implant placement – the long implants (22–25 mm) are placed alongside the lateral border of the nasal cavity with maximum contact with the lateral wall of the cavity. Care is taken to respect a minimum of 2 mm of superficial crestal bone around the dental implant. Gentle insertion technique is recommended to avoid the fracture of the residual subnasal bone due to extreme high torque.

Variables were assessed for normality using a Shapiro-Wilk test and found to be normally distributed. CBCT analysis was utilized to provide linear measurements regarding marginal bone loss of trans-nasal implant at mesial and distal sites ($n = 36$), availability of sub-nasal bone at the proposed implant site ($n = 18$), implant lateral contact with cortical paranasal bone ($n = 18$), and implant apical engagement in cortical paranasal bone ($n = 18$).

The work in this article has been reported in line with the PROCESS criteria[17].

Results

The retrospective CBCT analysis studied 18 trans-nasal implants (size ranging from 22 to 25 mm with an average of 24.1 mm) placed in 10 patients (all 10 patients were female ranging from 38 to 67 years old with an average age of 59.1 years old).

All 18 implants were clinically stable and considered successful. They exhibited no pain, mobility, signs of infection nor suppuration. No clinical signs of peri-mucositis nor peri-implantitis were reported.

Statistical analysis reveals at 12-months post-placement and functional loading of transnasal implants a mean marginal bone loss was 0.70 mm (95% CI: −0.90 to 0.50 mm); paired t-test reveals that the amount of bone loss is statistically significant ($P < 0.0001$) (Table 1). Furthermore, subnasal bone availability at the proposed implant sites was found to have a mean value of 5.46 mm (95% CI: 4.94–5.98 mm). Additionally, when evaluating the linear amount of lateral contact with cortical paranasal bone, a value of 12.92 mm (95% CI: 11.28–14.56 mm) was observed. Regarding the linear measurement of the apical engagement in cortical paranasal bone, the value was measured to be 2.70 mm (95% CI: 2.31–3.09 mm).

The average estimate of bony engagement from the apical and the subnasal is 8.16 mm which will correspond to the size of a regular length dental implant.

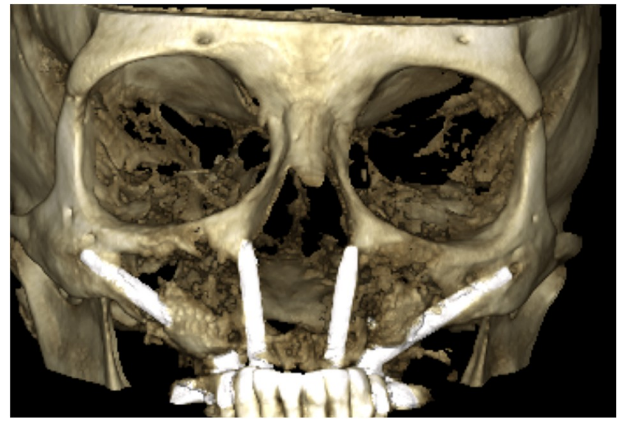

Figure 14. CBCT post insertion – post surgery CBCT showing the Zygomatic dental implant and the trans-nasal implant anchoring in their respective bony landmark away from vital structures.

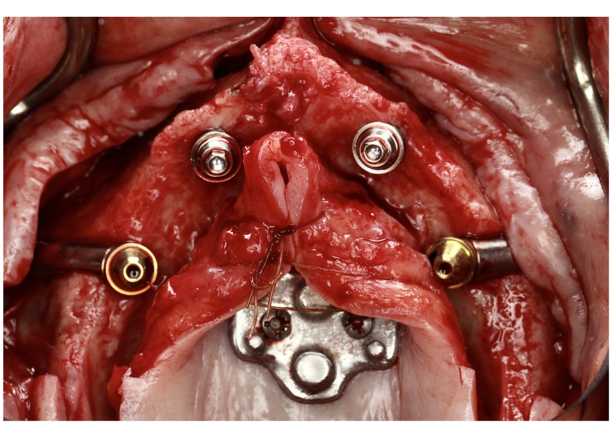

Figure 13. Occlusal view – proper A-P spread of the implant is observed. Note the full bony crestal engagement of the anterior implant.

Figure 15. Prosthesis in place – all cases were immediately loaded with a functional screw retained cross arch interim restoration.

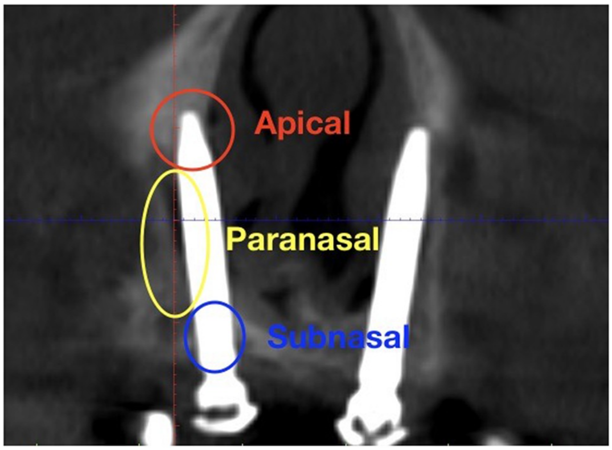

Figure 16. Area of measurement – the three areas were measured during the study, the subnasal lateral border and the apical portion of the implant engaging into the patient native bone.

Discussion

To the best of the author's knowledge, this is the first report documenting trans-nasal dental implants as an alternative to quad zygoma configurations without implants in the resorbed anterior maxilla.

No peri implant complications were reported in this study. The success is attributed by the authors to:

Proper CBCT evaluation is part of the case selection. If the landing spot of their implant apex would not allow the proper placement of the implant apex (3 mm minimum), then this clinical scenario represents a contraindication to a trans nasal implant and an alternative anterior implant option should be looked at such as the Quad Zygoma.

- Proper access and visibility to the surgical site and direct control of the implant drilling preparation and insertion (contrary to the superior implant of the zygoma).
- Implant placed in an "Intra osseous" fashion with the implant coronal aspect and restorative platform surrounded by bone and thick, soft tissue that is supported and maintained.
- Engaging at least 3 cortices (crest, floor of the nose, inferior turbinate) providing primary stability and avoiding the possible tilting and micromotion of the implant due to robust apical anchorage . No musculature tension that could cause tissue retraction (orbicularis oris) as opposed to the zygomatic implant (strong Buccinator muscle pulling on the neck of the zygomatic implant if placed on an extra maxillary fashion of on a ZAGA 3–4[18].
- Proper and careful elevation of the nasal mucosa allowing a thick tissue to cover the implant protecting it from the extra oral environment. Special hygiene care and rinses are not necessary and will not improve the implant success. In case of soft tissue dehiscence a few treatments option is to be considered:

- Soft tissue perforation at the time of the implant placement due to membrane rupture can usually be corrected by the approximation of the membrane edge and closure with 6.0 resorbable suture.

- Soft tissue dehiscence's occurring post implant placement (early or late) are usually much harder to correct as the implant body is now contaminated and thus the maintenance of the flap closure is unpredictable. The implant needs to be removed, the membrane repaired, and a new implant is to be placed 8–10 m weeks post repair if the site allows for it.

- In case of complications, If the trans-nasal has to be debrided or removed (failure), the favorable access will allow an easy repair or removal (vs the zygoma). The anterior, superior zygomatic bone is still now available to receive a zygoma implant and provide the patient with a fixed appliance and proper continuity of care. In examining the marginal bone loss surrounding trans-nasal dental implants at 1-year post loading, it was found to have a mean value of 0.70 mm with a 95% confidence that the population mean is between −0.90 and −0.50 mm. (Fig. 17)

Additionally, a paired *t*-test reveals that the amount of bone loss 1-year post transnasal implant placement is statistically significant ($P < 0.0001$). The significance of this finding is in the comparison of the marginal bone loss of transnasal implants after 1-year as compared to conventional implants. The results suggest that trans-nasal implants undergo a similar amount of

Table 1

Patients demographic and implant size

Patient	Age	Gender	Implant system	First implant implant size	Secondary implant size
1	67	F	Noris Pteryfit	4.2 × 22.5 mm	4.2 × 25 mm
2	52	F	Noris Pteryfit	4.2 × 25 mm	X
3	67	F	Noris Pteryfit	4.2 × 25 mm	4.2 × 25 mm
4	63	F	Noris Pteryfit	4.2 × 25 mm	4.2 × 25 mm
5	63	F	Noris Pteryfit	4.2 × 25 mm	4.2 × 22.5 mm
6	38	F	Neodent	3.75 × 22.5 mm	3.75 × 22.5 mm
7	65	F	Neodent	3.75 × 22.5 mm	3.75 × 22.5 mm
8	64	F	Noris Pteryfit	4.2 × 25 mm	4.2 × 25 mm
9	50	F	Noris Pteryfit	4.2 × 25 mm	4.2 × 25 mm
10	62	F	Noris Pteryfit	4.2 × 25 mm	X

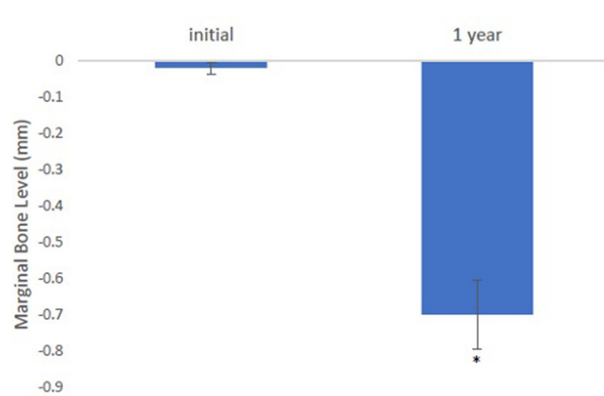

Figure 17. Marginal bone levels of trans-nasal dental implants were assessed during surgical placement and 1 year post loading. Error bars represent standard error of the mean (SEM). Statistical analysis is via paired t-test. *P<0.0001.

marginal bone loss as conventional implants and the marginal bone loss of trans-nasal implants is within the accepted range of peri-implant bone loss 1-year after placement of conventional implants. According to the 2017 World Workshop on the "Classification of Periodontal and Peri-Implant Diseases and Conditions," an acceptable amount of peri-implant bone loss after 1-year is defined as 1–1.5 mm of bone loss, and <0.2 mm annually thereafter[19,20]. Therefore, specifically in relation to the observed marginal bone loss, it is suggested by this study that the placement of trans-nasal implants is comparable to and therefore an acceptable alternative to conventional implants to achieve anterior anchorage when paired with zygomatic implants.

Although conventional implants have significantly more studies examining their success, the patient population seeking rehabilitation due to an atrophic maxilla are not typically considered suitable candidates for conventionally placed implants due to a limitation of vertical bone height present sub-nasally (Class 2 B). In this study, the amount of sub-nasal bone present at the intended anterior implant sites was averaged measured to be 5.46 mm (mean is between from 4.94 to 5.98 mm,) but other studies report as little as 2 mm of available subnasal bone[2]. Therefore, the utilization of a short (6 mm) implant will not be a sensible solution due to the amount of sub-nasal bone atrophy.

In addition, measurements taken to access the amount of bone-implant contact in the apical region of the trans-nasal implant. In this study, the apical bone to implant contact of the trans-nasal implant was observed to be 2.70 mm (mean is between 2.31 and 3.09 mm). The significance of this apical bone engagement provides, possibly for the first time, objective data relating to the amount of cortical bone to implant contact at the apical end of the trans-nasal implant.

The combined values of the trans-nasal implants' apical and subnasal bone engagement that an equivalent bone to implant contact comparison can be established between trans-nasal implants and conventional implants.

This is significant because without long-term studies evaluating trans-nasal implants, the success rate of trans-nasal implants may possibly be predicted by comparing them to conventional implants with a similar amount of bone engagement. A systematic review and meta-analysis examining the success of short 6 mm implants reported a 97.7% success rate in the maxillary arch after 4 years[21]. Similarly, a separate systematic review reported a 94.1% success rate for short implants placed in the maxillary arch after 5.8 years[22]. Likewise for 8 mm implants placed in the maxillary arch, two separate systematic reviews determined a success rate of 95.5% and 92.6% with a follow up of 4 and 5.5 years, respectively[23,24]. Compared conventional short implants, there is currently no long-term documentation of the trans-nasal implant success due to the relative novelty of their use. However, by summation of the coronal and apical bone to implant contact, the trans-nasal implants have a mean bone-implant contact of 8.16 mm.

This value represents the linear length of the trans-nasal implant that, like a conventional implant, is fully encased in bone. The value of 8.16 mm of bone-implant contact of trans-nasal implants allows for two key deductions: trans-nasal dental implants may possibly be comparable to conventional implants of similar 8 mm lengths. Additionally, trans-nasal implants may possibly have a similar success rate as 8 mm conventional implants under similar conditions.

Moreover, trans-nasal implants have the benefit of lateral engagement with the paranasal bone in which this study also sought to measure. The lateral contact was defined as the portion of the trans-nasal implant that laterally engaged cortical paranasal bone as the implant is traversing the nasal cavity. The lateral bone to implant contact of the trans-nasal implants in this study was measured to be 12.8 mm (mean is between 11.28 and 14.56 mm). The significance of this value is supplementary to the previous measurements of the coronal and apical bony engagement of the trans-nasal implant. Although no direct correlation to conventional implants may be made, the additional lateral bone to implant contact of the trans-nasal implant allows one to infer that trans-nasal implants have additional anchorage and therefore a potentially higher primary stability and functional load capacity than a similarly placed 6- or 8-mm conventional implant.

This present study has a number of limitations primarily due to the retrospective nature of the study. Those include: (1) having a limited sample size and population; therefore, it cannot be concluded if the obtained results are also indicative of a broader population and (2) having a short-term length of study; therefore, the results of this study can only be interpreted and compared to conventional implants within the first year of post-functional loading. Additionally, (3) not having a control group; due to the clinical wants and needs of the patients to undergo full mouth rehabilitation via a zygomatic approach due to severe maxillary atrophy, conventional implants were not placed or present to serve as a direct control to this study. Rather the acceptable range of marginal bone loss around conventional implants 1-year post-loading was determined in previous research studies.

Conclusion

The main objective of this study was to investigate whether trans-nasal implants may be deemed a viable alternative for conventional implants when utilized as anterior anchorage to a zygomatic implant in the atrophic premaxilla. This study determined that marginal bone loss of trans-nasal implants at 1-year post-loading was similar to conventional implants in the anterior maxilla. Therefore, it is concluded that under the short-term comparison time-frame of 1-year post loading, trans-nasal implants may be considered as an acceptable alternative to conventional implants when utilized as anterior anchorage to zygomatic implants (8.16 mm when adding the subnasal and apical bone engagement). This is especially relevant in clinical cases where there is minimal (<6 mm) sub-nasal bone available due to severe atrophy in the pre-maxilla region (Class 2B). Trans-nasal implants should be considered as part of the planned treatment when treating the severely atrophic maxilla as an alternative to grafting the anterior region to augment zygomatic implant utilization.

Future directions can be if there is an ample population size available, a prospective study can be undertaken where patients with an atrophic pre-maxilla will be grouped as having >6 mm subnasal bone (to receive conventional implants) and those with <6 mm bone (to receive trans-nasal implants). That study could compare conventional implants vs trans-nasal implants as anterior anchorage in patients with pre-maxilla atrophy when paired with zygomatic implants with post functional loading compared at 1, 3, 5, and 10-years.

Ethical approval

IRB committee, University of Southern California, LA CA USA waiver # HS-22-00317.

Consent

No identifying aspects in data or images of the patients are possible and alterations do not distort the scientific meaning. A statement on consent is at the end of the article. Written informed consent was obtained from the patient for publication and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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Yes, data is available upon request.

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