A Retrospective Multicentric Study of 52 Nasal and Transnasal Implants in 31 Severely Atrophic Patients to Reduce Anterior Cantilever Bending in Full-Arch Implant-Supported Fixed Rehabilitations

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Purpose: To assess the feasibility and success rate of nasal or transnasal implants placed in patients who were affected by severe maxillary anterior atrophy with residual anatomical features that indicate this surgery. ***Materials and Methods:*** In this retrospective multicentric study, 52 nasal or transnasal dental implants were placed in 31 maxillary atrophic anterior sites (Cawood and Howell's class V/VI). All implants were successful after the healing period; 27 nasal implants reached an insertional torque ≥ 50 Ncm^2, and the threshold value was estimated to be able to support an immediate load. ***Results:*** All 52 implants were successful, so the proportion of success was 100%, with a 97.5% one-sided CI of 88.8% to 100%. The success rate was achieved only when at least two of the following criteria were met: *(1)* a torque > 50 Ncm as a minimum sufficient condition to plan immediate loading; *(2)* after a healing period of 16 weeks, no coronal bone resorption (this condition allows for successive prosthetic finalization) observed clinically or radiographically; and *(3)* a possibility of carrying out a full-arch rehabilitation with minimal anterior spread. Insertion torque was < 50 Ncm in 14 patients (45%) and 50 Ncm in 17 patients (55%). Mechanical loading was delayed in the former group of patients and immediate in the latter group of patients. The proportion of torque that was < 50 Ncm was greater in men (69%) than in women (28%; $P = .033$). Immediate torque was not significantly affected by age. ***Conclusions:*** Although the present sample was not extremely numerically significant, it conveyed a clear and significant clinical and surgical meaning that has never been seen before in the literature: nasal or transnasal implants can be very useful in reducing the anterior cantilever and overcoming the anatomical limitations affecting conventional quad zygoma implants. *Int J Oral Maxillofac Implants 2025;40:69–75. doi: 10.11607/jomi.10921*

Keywords: anterior cantilever prostheses, pterygoid implants, severe atrophy, nasal implants, zygomatic implants

Severe maxillary anterior atrophy is often the result of progressive maxillary posterior resorption and usually involves both nasal cavities, which reduces the bone volume available and necessary for implant placement.[1–3]

In its etiopathogenesis, untreated periodontal disease like anterior maxillary bone resorption in an edentulous jaw and progressive pneumatization of the maxillary sinuses can result in an inadequate amount of bone volume to stabilize dental implants. In these specific critical cases, the surgical approaches are usually divided into multiple stages when addressing challenging clinical conditions, such as a graft surgery that increases the bone amount in terms of quality and quantity to re-establish the correct anatomical dentoalveolar relationships. However, more surgical steps and prolonged times are required before delivering the definitive prosthesis.[4–7]

Alternatively, a graftless single-stage surgery exploits a portion of native residual intraoral bone, or even extraoral cavity bone, as a remote anchor for implant-supported rehabilitation.[8–9] The literature specifically refers to zygomatic implants, pterygoid implants, trans-sinus implants, and nasal implants as implants that allow for an immediate and single-step surgery.[9–10] Zygomatic and pterygoid implant surgery are widely reported in the literature and show precise indications, high success rates, as well as some limitations.[11] For example, in some cases zygomatic implants can be positioned anteriorly enough to support the designed prosthesis, but not in all cases. Not only does the quad

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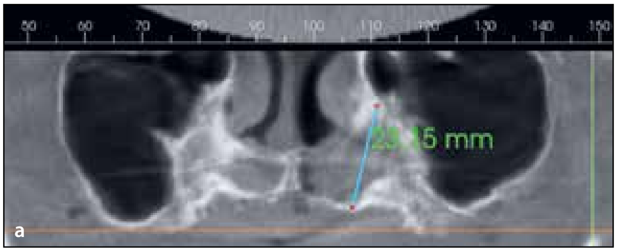
Fig 1 The initial panoramic radiograph reveals a maxillary atrophic condition derived from severe and untreated peri-implantitis. It is a radiologic indication for NZP rehabilitation.



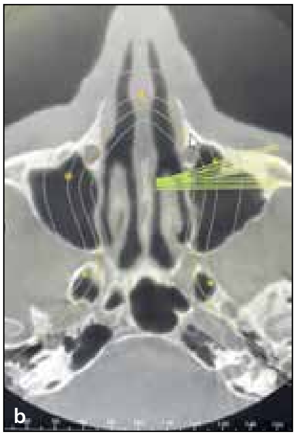


Fig 2 *(a)* 3D CBCT examination to measure the distance between the bone level and the inferior turbinate to be engaged by the nasal implant apex. *(b)* A craniocaudal screenshot of the 3D CBCT examination to investigate anatomical limitations; in this case, a Simmen Type I class shows high-risk damage to the nasolacrimal duct (NLD) too close to the Z point.

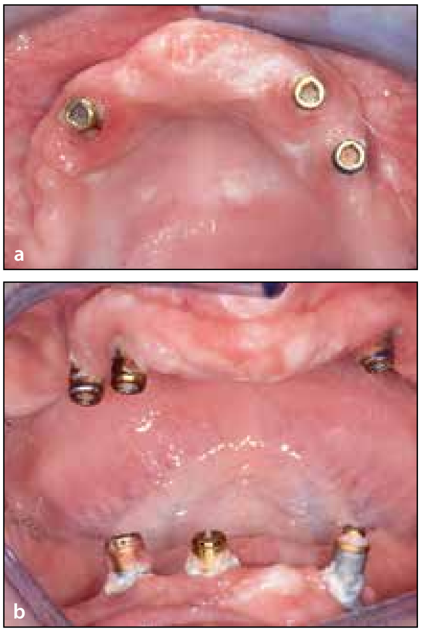


Fig 3 *(a)* Occlusal aspect of the initial case. *(b)* Frontal aspect of the intraoral situation; note the detrimental poor hygienic conditions.

zygoma implant technique require more advanced surgical skill than a single zygomatic implant placement, but it also represents a critical solution treatment with an increased surgical risk due to how close the apex of the second zygomatic implant is to the orbit. It can also serve as a risk to dolichocephalic patients who have a smaller thickness of zygomatic bone compared to the dimension of two anchored implant apices[12,13]; however, note that a specific patient anatomy of the maxilla can limit an anterior positioning of the most anterior zygomatic implant, resulting in an unfavorable anterior prosthetic cantilever.[14–16] Furthermore, in these dolichocephalic patients, the placement of zygomatic implants must be carried out with extreme caution to avoid invading the orbital floor because of the greater verticality of placement.

In these cases, an alternative surgical procedure to quad zygoma therapy is represented by transnasal implants (N) associated with a unilateral zygomatic implant (Z) and pterygoid implant (P) (NZP protocol). This retrospective multicentric study investigated the feasibility and the success rate of transnasal implant placements as a possible first alternative treatment to solve the unfavorable anterior stress generated by the anterior cantilever in quad zygoma therapy while overcoming the anatomical limitations (such as in dolichocephalic patients).

MATERIALS AND METHODS

All team members designed and conceived this retrospective multicenter study with an enrolled sample of 52 transnasal implants to evaluate the reliability and predictability of this anatomically guided surgical technique (Fig 1).

This study was performed in three different clinical offices: *(1)* Dr Tiziano Tealdo's clinical office in Alba, Italy; *(2)* Dr Marco Bevilacqua's clinical office in Boves, Italy; and *(3)* Dr Christian Alberti's clinical office in Rosà, Italy. Only two implant types (Biomax Uniplant or PteriFit TM, Noris Medical) were employed to avoid introducing further variables.

All 31 patients presented after a 3D CBCT scan (Gendex GXDP-700 S, Renew Digital) and showed clinical and radiologic signs of hopeless dentition and severe atrophy (Cawood and Howell's class V/VI). After computer-assisted surgical planning (DTX Studio Clinic software, Nobel BioCare), the implant placement was defined in the maxillary anterior region (Figs 2 and 3).

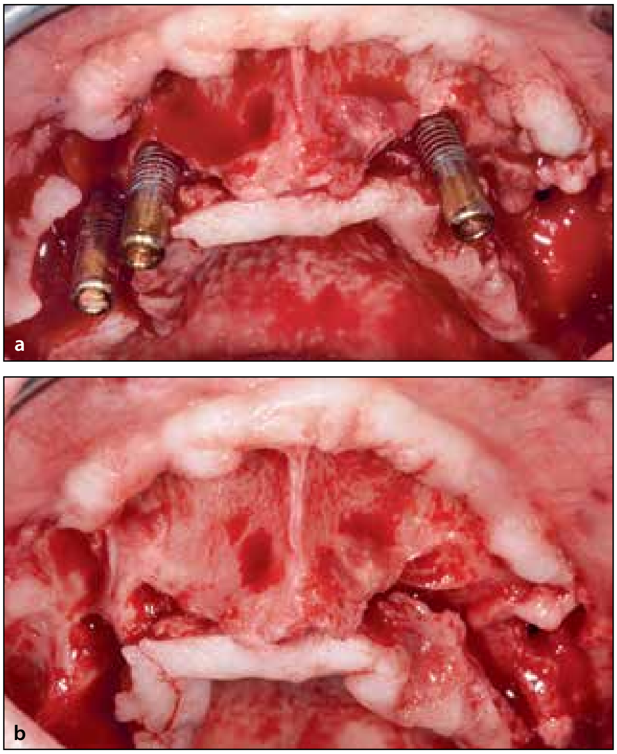


Fig 4 *(a)* After the full-thickness flap elevation, bone defects surrounding the dental implants were exposed. *(b)* Removal of the existing dental implants.

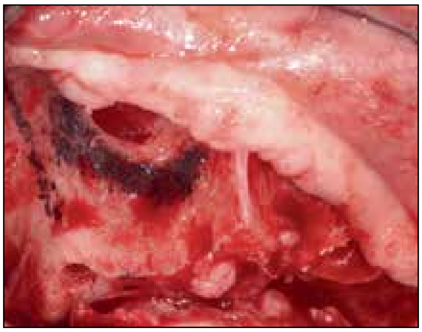


Fig 5 The first plan of the anatomical limits; the implant placement axis was traced with a pencil on the bloodless bone table.

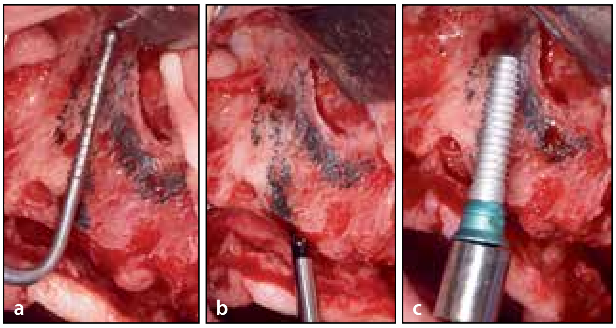


Fig 6 *(a)* A pivotal preliminary check with a buttoned probe. *(b)* Pointed drill site preparation in the Z point. *(c)* The final check before nasal implant placement.

The study was conducted according to the Declaration of Helsinki. Because the authors analyzed patients with preexisting and unidentifiable data, they were all informed about the nature of the data treatment, and a written consent was obtained from each of them before participation.

The transnasal surgery should follow some anatomical indications that can be detected during the diagnostic phase, such as a sufficient bone amount in the frontal process of the maxilla to achieve the anchorage of the extralong implant apex (minimum of 3 mm).[17] With a minimum height of 4 mm from the maxillary ridge and nasal cavity,[17] this quota is pivotal to reach a sufficient primary stability for immediate loading. It should be noted that the body of the implant floats inside the nasal cavity (characterized by the large concavity of the maxillary anterior wall) and is covered only by soft tissues.

There are some contraindications to this kind of surgery, such as a very wide nasal cavity, which would prevent the implant from being anchored to the distal bone wall, thereby making the bone grafting unfeasible after implant placement and affecting respiratory function.[17]

Intravenous sedation was administered with conventional local anesthesia for the transnasal dental implant surgery. Then standard full-thickness incisions were performed with midline release and reflection to reach the piriform aperture. Elevation of the nasal mucosa to the lateral side (remembering that the nasal mucosa is tougher and much more challenging to tear) was performed with attention to some important structures, such as the nasolacrimal canal and the infraorbital nerve. The bony inferior concha core of the inferior turbinate was the limit. Using a small drill to penetrate the nasal cavity and see if the initial orientation was correct, the next step was to advance and meet the "Z" point and go beyond it by at least 3 mm (Figs 4 to 6). Note that some authors even push inside the frontal process.[9]

The implant site was successfully prepared by comparing it to a postextraction one; however, considering the excellent bone quality, underpreparation of the implant sites was not recommended. On the contrary, this may lead to an excessively high insertion torque and could cause bone fractures. For each transnasal implant, the insertion torque was measured with a torque wrench (threshold reference value 50 Ncm). The choice of implant (Biomax or PteriFit) essentially depended on the free bone margin (bone level) distance from the inferior turbinate where the apex should be anchored. The PteriFit allowed it to reach longer distances, while the Biomax had shorter lengths with dedicated smaller diameters of 3.5 mm. Once the transnasal implant was

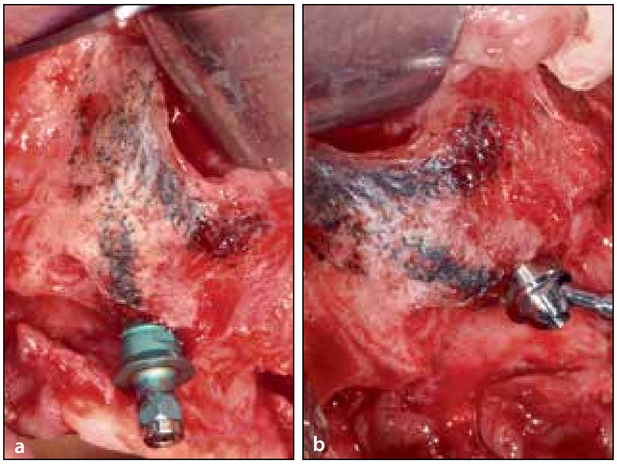


Fig 7 *(a)* Nasal implant placement with a craniocrestal divergent axis. *(b)* The multiunit abutment screwed onto the nasal implant to correct the prosthetic axis.

Fig 8 Panoramic radiograph after provisional prosthesis delivery. In this case, a full-arch screw-retained immediate-load prosthesis was used and delivered only to the two anterior nasal implants and two zygomatic implants. Note that the pterygoid implants were not involved in immediate loading.

Fig 9 After 3 months, a definitive prosthesis was delivered and the panoramic radiograph was scanned to check the precision fit of the framework.

positioned, a 17-degree multiunit abutment (Low Profile, Biomet 3i) was essential to correct the natural negative inclinations for prosthetic purposes (Figs 7 to 9).

Figures 10 to 13 illustrate the anatomical considerations and limitations critical to this surgical approach.

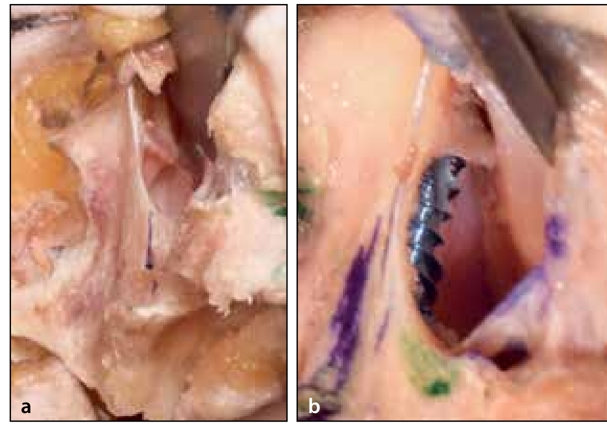


Fig 10 *(a)* Cadaveric cross section showing the reflection of the nasal mucosa to expose the inferior turbinate. *(b)* Cadaveric cross section showing a nasal implant placement with the apex engaging the inferior turbinate and the implant body facing the nasal cavity.

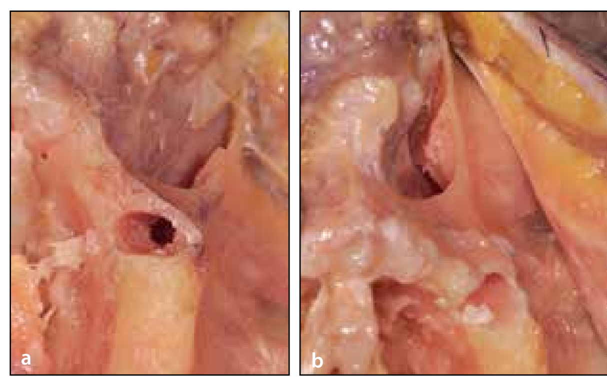


Fig 11 *(a)* Cadaveric cross section showing the entire path that the nasal implant must travel from its entrance on the maxillary side to its apex, which contracts with the inferior turbinate. This is an area where the bone is extremely corticalized, so the implant site must not be underprepared. *(b)* Cadaveric cross section offering a different perspective of the inferior turbinate prominence. Here the nasal implant apex must be engaged with an inclination usually divergent toward the edge of the piriform cavity.

RESULTS

The series comprised 31 patients (18 men and 13 women) who were 65.6 ± 9.1 years old (mean ± SD; range 46–82 years) and underwent surgery between July 2021 and November 2023. Most patients (20 out of 31) received 6 implants, but 5 of the patients received 5 implants, 3 of the patients received 7 implants, and 3 patients received 8 implants (Fig 14).

All 52 implants were successful (100% success), with a 97.5% one-sided CI of 88.8% to 100%. The success rate was achieved only if at least two of the following criteria were met: *(1)* a torque > 50 Ncm as a minimum sufficient condition to plan immediate loading; *(2)* after a healing period of 16 weeks, no coronal bone resorption observed clinically or radiographically, which was a condition that allowed for the successful prosthetic

Fig 12 This picture shows how the head and apex of the implant are engaged in an extremely mineralized bone tissue, while the central core can technically float into the nasal cavity (covered only by soft tissues). The high density of the bone prevents further peri-implant disease, so the success rate can be estimated as soon as the nasal implant reaches secondary stability. This feature of this corticalized area plays a fundamental role in the medium- to long-term stability.

Fig 13 This graphic reviews the salient and decisive aspects that characterize the surgical technique presented here. As indicated in the plastic model, the number 8 identifies the edge of the piriform cavity, while the number 12 identifies the inferior turbinate in which the nasal implant is anchored.

finalization; and/or (*3)* the possibility of carrying out a full-arch rehabilitation with minimal anterior spread.

Insertion torque was < 50 Ncm in 14 patients (45%) and 50 Ncm in 17 (55%). Mechanical loading was delayed in the former group of patients and immediate in the latter group of patients (Table 1). The proportion of torque < 50 Ncm was higher in men than in women (69% vs 28%; $P = .033$). The immediate torque was not significantly affected by age.

All surgeries were performed between July 10, 2021, and November 16, 2023. The placement of five to eight implants per patient (specially designed depending on the clinical case) were performed for a total of 190 dental implants. Moreover, 52 were nasal implants (7 transpyramidal and 45 transnasal), corresponding to 27.4% of the total.

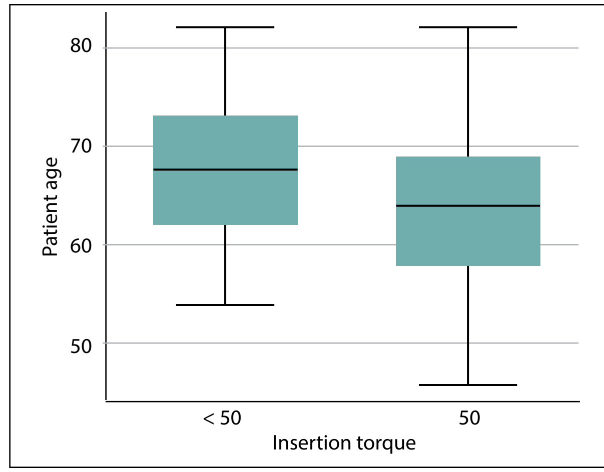


Fig 14 Graph showing the age of the patients vs the distribution of the reached insertion torque values. A threshold value ≥ 50 Ncm was required to deliver an immediate-load provisional prosthesis.

Table 1 Distribution of Immediate Loading Among All the Cases in This Retrospective Multicentric Study

	Immediate loading		
Insertion torque	**No**	**Yes**	**Total**
< 50 Ncm	14	0	14
50 Ncm	0	17	17
Total	14	17	31

Transpyramidal nasal dental implants were used on both sides. The right-side measurements were 11.5 to 15 mm in length and 3.5 to 4 mm in diameter, whereas on the left side they were 11.5 to 15 mm in length and 3.5 to 4 mm in diameter. Note that a diameter of 3.5 mm was reported in only two cases and 18 mm in length in one case.

The diameter of the transnasal dental implants on both sides ranged from 3.3 to 4.2 mm; the length on the right side ranged from 18 to 23 mm, and the length on the left side ranged from 18 to 25 mm. No immediate failures have been reported at the time of writing (January 2024).

DISCUSSION

Moderate and severe maxillary anterior atrophy represents a critical issue in implant-supported rehabilitation, particularly if associated with pneumatization of the maxillary sinuses. As mentioned, zygomatic and pterygoid implants represent a well-established and predictable solution to treat maxillary atrophy. However, excessive unfavorable bending derived from an anterior cantilever could lead to implant overloading during function and may lead to failure.[16]

To the best of our knowledge, the quad zygoma technique has been considered the last therapeutic option in patients affected by anatomical limitations (eg, a small zygomatic bone typical in dolichocephalic patients), biomechanical limitations (eg, an unfavorable anterior cantilever), or lack of alternative solutions in cases of failure.[18]

Our indication for nasal implant surgery arises from the need to find a biomechanical support pillar anteriorly to reduce the anterior cantilever typical of the quad zygoma, even if the literature as reported by Almeida et al[19] indicates the nasal implant placement as an alternative successive treatment to the placement of the zygomatic implant.

Furthermore, quad zygoma surgery requires high surgical skills and an almost obligatory treatment for the patient under hospital narcosis.[20] For this reason, all authors want to propose the insertion of transnasal implants as a first optional choice in solving this critical aspect concerning the quad zygoma. The reason for this recommended "sequence" lies in the fact that in a hypothetical failure of the individual zygomatic implants, it is still possible to attempt to insert two more zygomatic implants (one on each side) distally, which could not be possible in an immediate "quad".

Furthermore, Duan et al[21] noted that the highest stress concentration occurred near the angled-abutment connection and, more evidently, in the most mesial implant in the quad zygoma due to the greater acute angle that was formed between the main implant axis and the main masticatory axis of the future prosthesis. This retrospective study confirms the reliability of the transnasal surgical technique with a success rate of 100%.

More specifically, in the dental literature, the nasal implants are divided into four different categories: *(1)* nasopalatine implants; *(2)* transpyramidal implants, which involve the apex of the fixture engaging the dense residual bone of the canine lump in the lateral portion of the nasal cavity or nasal rim and penetrate (sometimes just for few millimeters) into the nasal cavity itself; *(3)* nasal implants, in a similar way to the previous, placed with an augmentation bone technique of the nasal floor (with few similarities to the most common sinus floor elevation); and *(4)* transnasal implants, which reach the inferior turbinate or inferior nasal concha, where anatomically a substantial and hard portion of bone can be found comparable in size and shape to an olive (only used in Cawood and Howell's class V/VI).[21]

In regard to transpyramidal implants, also known as *nasal rim implants*,[22,23] all dental implants in everyday dental use can be considered transpyramidal when placed at least a few millimeters inside the nasal cavity, with a slight detachment of the membrane to avoid perforation, with or without more invasive approaches to bone augmentation in these locations. The primary advantage of researching the edge of the nasal cavity is the fact that the quality of the bone surrounding the apex of the implant is fundamentally important to obtaining high primary stability.[24,25]

Because the only excellent-quality bone tissue in the anterior maxilla is the one perimetric at the nasal cavity, motivation for research on it is needed to improve anchorage stability. The bone-dense quality in this area allows for sufficient primary stability for immediate loading, as confirmed by the present data. In detail, the present study had a mean value of 50 Ncm in 17 cases (55%).[26,27]

When the oral surgeon approaches this specific area (the Z-point confluence of the lateral nasal wall, inferior concha, and base of the frontal process of the maxilla), they should always consider some technical aspects, such as avoiding underpreparation of the implant site due to the local bone density; this could cause fractures and delimit the surgical field radiologically and surgically. Oral surgeons should also pay attention to structures such as the nasolacrimal duct and the infraorbital nerve.

Fortunately, transnasal implant placement is *not* a blind surgery, and it offers fewer associated operating risks compared to zygomatic and pterygoid surgery, which makes it an outpatient surgery. Accidental trauma of the nasolacrimal duct (epiphora) and infraorbital nerve are the real intraoperative risks, in addition to epistaxis, which is managed relatively easily.

So far, all authors agree on the lack of an implants specifically dedicated to nasal surgery. We adapted two types of pre-existing implants to the surgical situation: the Biomax implant, which was customized with a diameter of 3.5 mm (an ideal diameter in the Z point), and the PteryFit implant (initially designed for the pterygoid area), which offer extra lengths to engage the bony olive of the inferior turbinate with their apex, but with an initial diameter of 4.2 mm. In these cases, a self-tapping apex implant is recommended to penetrate the inferior turbinate.

For the reasons indicated above, the following clinical situations may indicate the use of implants placed directly into the nasopalatine canal or the use of transpyramidal/transnasal implants placed inside the nasal cavity:

- To provide anterior support when pterygoid implants cannot be placed as distal support
- To create a more homogeneous distribution of chewing loads by dividing and removing the main issue of the long anterior cantilever
- To prevent further problems in case of failure when using only two zygomatic implants instead of four
- To provide anchorage when it is not possible to achieve zygomatic anchorage

CONCLUSIONS

Transnasal implants represent a reliable and predictable anchoring strategy in moderately and severely atrophic maxillary anterior sites with a high success rate. Nasal implants can be extremely useful in partial-arch implant rehabilitations and especially in full-arch implant rehabilitations that require immediate loading in the maxilla for severely atrophic patients.[25] The main focus of the present study was aimed at reducing anterior bending movements as much as possible while also minimizing the long lever arm to achieve higher implant survival rates with the following: *(1)* immediate loading, *(2)* a better immediate prosthesis, *(3)* a greater predictability of the time spent in single-stage surgery as an alternative graftless solution, *(4)* and greater long-term success. In our experience, successful results were obtained for all patients.

ACKNOWLEDGMENTS

The authors declare no conflicts of interest.

REFERENCES

1. Scher EL. Use of the incisive canal as a recipient site for root form implants: Preliminary clinical reports. Implant Dent 1994;3:38–41.
2. Peñarrocha M, Carrillo C, Uribe R, García B. The nasopalatine canal as an anatomic buttress for implant placement in the severely atrophic maxilla: A pilot study. Int J Oral Maxillofac Implants 2009;24:936–942.
3. Peñarrocha D, Candel E, Guirado JLC, Canullo L, Peñarrocha M. Implants placed in the nasopalatine canal to rehabilitate severely atrophic maxillae: A retrospective study with long follow-up. J Oral Implantol 2014;40:699–706.
4. Chiapasco M, Casentini P, Tommasato G, Dellavia C, Del Fabbro M. Customized CAD/CAM titanium meshes for the guided bone regeneration of severe alveolar ridge defects: Preliminary results of a retrospective clinical study in humans. Clin Oral Implants Res 2021;32:498–510.
5. De Santis D, Gelpi F, Verlato G, et al. Digital customized titanium mesh for bone regeneration of vertical, horizontal and combined defects: A case series. Medicina (Kaunas) 2021;57:60.
6. Mandelli F, Traini T, Ghensi P. Customized-3D zirconia barriers for guided bone regeneration (GBR): Clinical and histological findings from a proof-of-concept case series. J Dent 2021;114:103780.
7. De Santis D, Umberto L, Dario D, et al. Custom bone regeneration (CBR): An alternative method of bone augmentation—A case series study. J Clin Med 2022;11:4739.
8. Parel SM, Brånemark PI, Ohrnell LO, Svensson B. Remote implant anchorage for the rehabilitation of maxillary defects. J Prosthet Dent 2001;8:377–381.
9. Tealdo T, Gelpi F, Grivetto F, et al. A retrospective multicentric study of 56 patients treated with 92 pterygoid implants for partial/full arch implant supported rehabilitation: Implant and prosthesis success rate. Eur J Muskulokel Dis 2023;12:119–126.
10. Araujo RZ, Santiago Júnior JF, Cardoso CL, Benites Condezo AF, Moreira Júnior R, Curi MM. Clinical outcomes of pterygoid implants: Systematic review and meta-analysis. J Craniomaxillofac Surg 2019;47:651–660.
11. Aparicio C, Manresa C, Francisco K, et al. Zygomatic implants: Indications, techniques and outcomes, and the zygomatic success code. Periodontol 2000 2014;66:41–58.
12. Davó R, David L. Quad zygoma: Technique and realities. Oral Maxillofac Surg Clin North Am 2019;31:285–297.
13. Rigolizzo MB, Camilli JA, Francischone CE, Padovani CR, Brånemark PI. Zygomatic bone: Anatomic bases for osseointegrated implant anchorage. Int J Oral Maxillofac Implants 2005;20:441–447.
14. Bevilacqua M, Tealdo T, Menini M, et al. The influence of cantilever length and implant inclination on stress distribution in maxillary implant-supported fixed dentures. J Prosthet Dent 2011;105:5–13.
15. Lan K, Wang F, Huang W, Davó R, Wu Y. Quad zygomatic implants: A systematic review and meta-analysis on survival and complications. Int J Oral Maxillofac Implants 2021;36:21–29.
16. Bevilacqua M, Tealdo T, Pera F, et al. Three-dimensional finite element analysis of load transmission using different implant inclinations and cantilever lengths. Int J Prosthodont 2008;21:539–542.
17. Camargo VB, Baptista D, Manfro R. Implante transnasal (Tecnica Vanderlin) como opcao ao segundo implante zigomatico. In: Coppede A. Solucoes clinicas para reabilitacoes totais sobre implantes sem enxertos osseo. Quintessence, 2019:198–214.
18. Hung KF, Ai QY, Fan SC, Wang F, Huang W, Wu YQ. Measurement of the zygomatic region for the optimal placement of quad zygomatic implants. Clin Implant Dent Relat Res 2017;19:841–848.
19. Almeida PHT, Cacciacane SH, Arcazas Junior A. Extra-long transnasal implants as alternative for quad zygoma: Case report. Ann Med Surg (Lond) 2021;68:102635.
20. Davó R, David L. Quad zygoma protocol. Atlas Oral Maxillofac Surg Clin North Am 2021;29:243–251.
21. Duan Y, Chandran R, Cherry D. Influence of alveolar bone defects on the stress distribution in quad zygomatic implant-supported maxillary prosthesis. Int J Oral Maxillofac Implants 2018;33:693–700.
22. Nicoli G, Piva S, Ferraris P, Nicoli F, Jensen OT. Extra-long nasal wall-directed dental implants for maxillary complete arch immediate function: A pilot study. Oral Maxillofac Surg Clin North Am 2019;31:349–356.
23. Jensen OT, Adams MW, Butura C, Galindo DF. Maxillary V-4: Four implant treatment for maxillary atrophy with dental implants fixed apically at the vomer-nasal crest, lateral pyriform rim, and zygoma for immediate function. Report on 44 patients followed from 1 to 3 years. J Prosthet Dent 2015;114:810–817.
24. Jensen OT, Cottam JR, Ringeman JL, Graves S, Beatty L, Adams MW. Angled dental implant placement into the vomer/nasal crest of atrophic maxillae for All-on-Four immediate function: A 2-year clinical study of 100 consecutive patients. Int J Oral Maxillofac Implants 2014;29:30–35.
25. Yan X, Zhang X, Chi W, Ai H, Wu L. Association between implant apex and sinus floor in posterior maxilla dental implantation: A three-dimensional finite element analysis. Exp Ther Med 2015;9:868–876.
26. Lioubavina-Hack N, Lang NP, Karring T. Significance of primary stability for osseointegration of dental implants. Clin Oral Implants Res 2006;17:244–250.
27. Gelpi F, Alberti C, Bevilacqua M, Montagna P, De Santis D, Tealdo T. A novel classification and a chart making decision flow proposal for fixed full-arch implant supported prosthesis [epub ahead of print]. Eur J Musculoskel Dis 2024;13:2038–4106/2023.