

# Severe maxillary and mandibular atrophy

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## Introduction

Tooth loss leads to progressive alveolar bone resorption, which becomes irreversible unless biomechanical stimulation is restored – typically through dental implants – to preserve the residual bone (Mays, 2014; Bodic et al, 2005).

The resorption process is gradual and highly variable among individuals, lacking a predictable pattern regarding volume and speed of loss.

Notably, maxillary and mandibular resorption differ significantly due to variations in (Bodic et al, 2005):

- Bone density (greater corticalisation in the mandible)
- Anatomical landmarks
- Muscle insertions
- The influence of perioral soft tissue forces. It has been estimated that patients wearing removable prostheses without any socket preservation lose approximately 21% of bone volume within three months post-extraction, 36% after six months, and up to 44% after 12 months (Carlsson and Persson, 1967; Carlsson and Persson, 1970).

Over 25 years, the mandibular ridge may lose 10 to 12mm in height, often resulting in superficialisation of the inferior alveolar nerve in the posterior regions.

Maxillary bone loss is usually slower, sometimes half the rate observed in the mandible (Bodic et al, 2005, Carlsson and Persson, 1967; Carlsson and Persson, 1970; Sennerby et al, 1988).

These patterns are further influenced by co-factors such as age, bone density, sex and systemic conditions affecting bone metabolism (Atwood and Coy, 1971).

In long-term edentulous patients using complete removable prostheses, severe resorptive patterns are common.

In the mandible, this often results in both vertical and horizontal atrophy, with the inferior alveolar nerve becoming submucosal.

In the maxilla, resorption leads to superficialisation of structures such as the nasal fossa and maxillary sinuses, complicating implant placement (Alsaggaf and Fenlon, 2020; Adell et al, 1990).

Managing such cases requires thorough knowledge of surgical and prosthetic options, often combining multiple techniques within the same patient (Alsi, Deshpande and Pande, 2023).

In the maxilla, common approaches for vertical atrophy include short implants, sinus lift procedures (via lateral window or transcrestal techniques), nasal floor elevation, and guided bone regeneration (Lombardo et al, 2022; Felice et al, 2015; Hadzik et al, 2021; Carelli et al, 2021; Anitua, Flores and Alkhraisat, 2016; Anitua et al, 2016).

Short implants have become increasingly favoured in recent years due mainly to their clinical versatility and simplified prosthetic planning.

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Figure 1: Figures 1A and 1B: Images of the patient wearing complete removable dentures, with a reduced lower facial third evident in the lateral view



Figures 1C and 1D: After removing the mandibular prosthesis, the severe resorption of the alveolar ridge becomes apparent, showing a nearly absent residual crest and the facial impact of prosthesis removal on the lower third

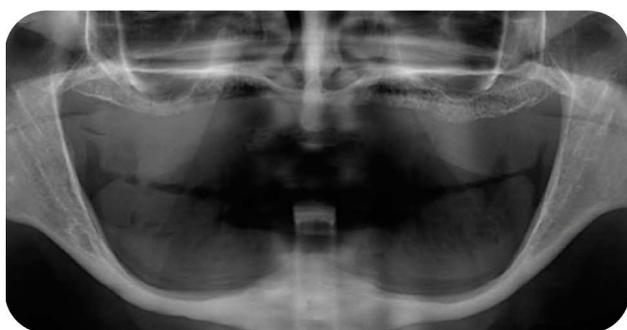


FIGURE 2: Initial panoramic radiograph confirming severe horizontal and vertical bone resorption in both maxilla and mandible

For horizontal atrophy, solutions include ridge expansion, grafting procedures (particulate, block, or mixed), and reduced-diameter or platform implants (Chiapasco and Casentini, 2018; Mendoza-Azpur et al, 2019; Elnayef et al, 2015; Antiuva, Escuer and Alkhraisat, 2022; González-Valls et al, 2021).

In the mandible, vertical atrophy is often managed using short or ultra-short implants, sometimes combined with bone regeneration. Lateralisation of the inferior alveolar nerve is generally reserved for severely resorbed cases where other approaches are not feasible (Altaib et al, 2019; Camps-Font et al, 2016).

Horizontal bone loss is typically managed using narrow-diameter implants, sometimes combined with ridge-splitting techniques (Camps-Font et al, 2016; Anitua, 2022).



FIGURE 3: Panoramic CBCT slice showing extreme mandibular resorption, with only basal bone remaining

The following clinical case describes a rehabilitation performed 20 years ago using the surgical techniques available at that time to treat a case of extreme maxillary and mandibular atrophy with a minimally invasive, conservative approach.

The step-by-step treatment is presented, including its long-term evolution and updates – particularly in prosthetic management – and its stability over 20 years.

### Clinical case

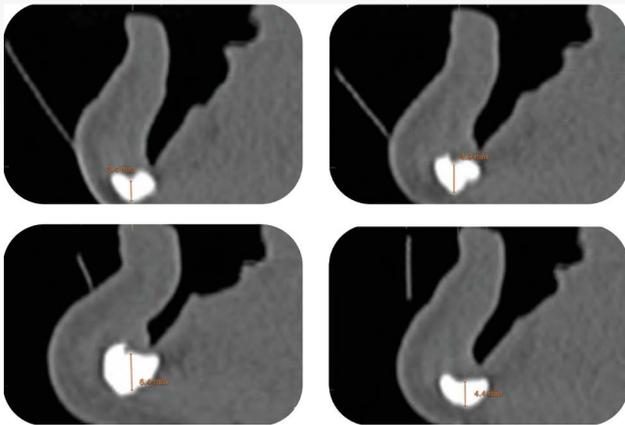
A 69-year-old female patient presented with poorly fitting complete removable dentures that compromised speech and mastication due to instability.

Clinical examination revealed fractured denture teeth and reduced lower facial height.

Upon removal of the dentures, severe mandibular atrophy was noted, with minimal residual ridge volume, making prosthesis retention nearly impossible (Figure 1).

Panoramic radiography confirmed severe maxillary and mandibular atrophy, including pneumatization of the sinuses and nasal floor, and a submucosal inferior alveolar nerve (Figure 2).

A cone-beam CT was performed to complete the



Figures 4A to 4D: Panoramic CBCT slice showing extreme mandibular resorption, with only basal bone remaining



Figures 6a to 6d: Implant planning showing apical stabilisation in the inferior cortical (basal bone) and three-dimensional positioning in the crest

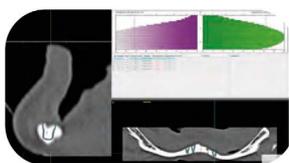


Figure 6e: Planning of a fifth implant distal to the mental foramen using inferior alveolar nerve lateralisation

diagnosis and guide surgical planning. Panoramic and cross-sectional views revealed extreme mandibular atrophy with only basal bone remaining (Figures 3 and 4), compromising mandibular integrity and increasing surgical complexity.

Three-dimensional reconstruction further demonstrated mandibular thinning (Figure 5).



Figure 8a: Custom-milled abutments



Figure 8b and 8c: Hybrid prosthesis with friction-retained telescopic design



Figures 5A and 5B: Three-dimensional reconstructions of the mandible showing pronounced bone atrophy in lateral views

Based on the scans, four implants were planned in the anterior mandible, the only area with residual height before the emergence of the nerve at the crest. These short implants (5.5 to 7.5mm) were anchored in the apical and crestal regions (Figure 6). Additionally, in the third quadrant, a transposition of the inferior alveolar nerve was performed to place a distal implant. The surgery was successful, with immediate loading (Figure 7), and definitive prostheses were initiated three months later.

At that time, a telescopic friction-retained hybrid prosthesis was selected for the mandible, offering reliable retention and removability for hygiene. Custom-milled posts were used, onto which a gold-galvanised substructure was cemented, generating retention through friction (Figure 8). Today, a different prosthetic approach would be used: CAD/CAM-fabricated, screw-retained prostheses on transepithelial abutments, using castable interfaces for passive fit and retrievability.

Following mandibular treatment, the patient requested rehabilitation of the maxilla. Cone-beam sections showed



Figure 7: Radiographic image of the immediate loading of the mandibular implants, except for the distal implant in the third quadrant, which remained unloaded due to nerve transposition



Figure 8d: Final prosthesis exhibiting excellent retention and removability for maintenance, a common choice at the time of treatment

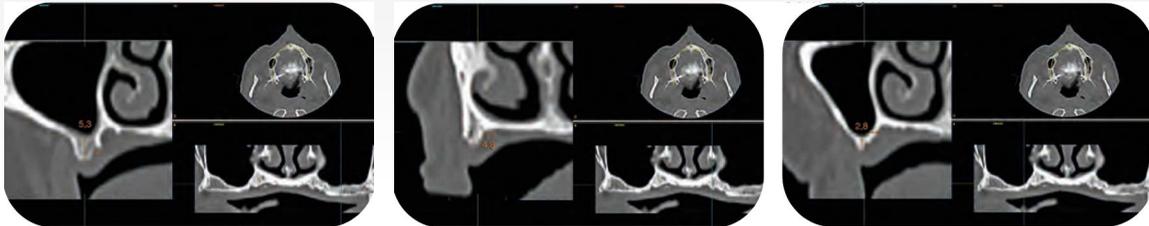


Figure 9a: Second quadrant with sufficient volume for short implant placement despite limited bone height  
 Figure 9b: Premaxilla area showing combined horizontal and vertical atrophy  
 Figure 9c: First quadrant with excessive sinus pneumatization leaving only 3mm of crestal height; traditional lateral sinus lift with simultaneous implant placement was planned



Figures 10a and 10b: Provisional upper resin prosthesis for progressive loading. Used for several months to allow adaptation to new occlusal and vertical dimension parameters. The lower prosthesis extends to the second premolar; the upper is all resin



Figure 12: Radiograph at five-year follow-up showing stable treatment outcome



Figures 11a and 11b: Fabrication of definitive prostheses prior to placement



Figures 13a and 13b: Intraoral images of the new prostheses fabricated 22 years after treatment initiation



Figures 11c and 11d: Upper and lower prostheses in position after five years of follow-up, with fully restored aesthetics and function



Figures 13c and 13d: Radiographic comparison between baseline and 22 years showing significant mandibular changes, particularly increased horizontal bone volume due to implant loading

mixed atrophy: vertical in some areas and horizontal in others. In the first quadrant, the extensively pneumatized maxillary sinus precluded direct implant placement, requiring lateral sinus lift and simultaneous implant insertion (Figure 9).

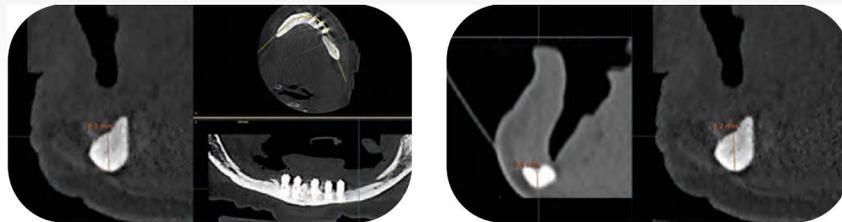
In the maxillary arch, a screw-retained hybrid prosthesis was fabricated over transepithelial abutments, serving as a progressive loading prosthesis (Figure 10). This transitional phase allowed the patient to adapt musculoskeletal structures to the new vertical dimension.

Adjustments were made during this adaptation, and fabrication of the definitive prostheses began two months later.

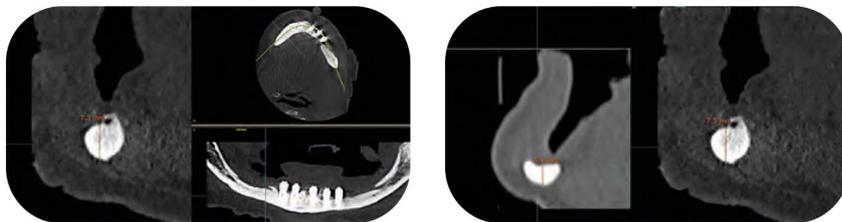
At this stage, the mandibular telescopic prosthesis was

replaced with a screw-retained hybrid design due to retention loss. Both final prostheses consisted of resin hybrid structures with metal frameworks, screw-retained via transepithelial abutments. Five years later, the treatment remained stable (Figures 11 and 12).

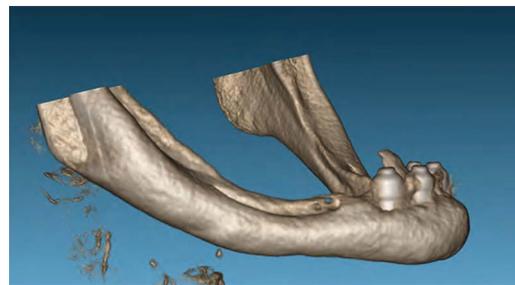
Fifteen years post-treatment, the mandibular prosthesis was replaced with a CAD/CAM hybrid design extending to the molar region, as the telescopic version had lost retention. The maxillary prosthesis remained unchanged due to proper function and fit. Cone-beam images showed remarkable crestal bone stability and notable changes in mandibular structure. A 22-year comparison revealed significant bone volume gain in the mandibular implant regions (Figure 13).



Figures 14a and 14b: Bone volume comparison in the third quadrant, 1 cm adjacent to the implants, showing height gain from <4mm to 8.2mm over 22 years



Figures 14c and 14d: Cross-sectional images 1 cm distal to the last implant in the fourth quadrant, with vertical bone gain from 4.4mm to 7.3mm and reconstruction of a new bony roof over the inferior alveolar nerve, previously absent



Figures 15a and 15b: Three-dimensional reconstructions of the mandible showing pronounced bone atrophy in lateral views

Interestingly, adjacent non-implanted areas also showed vertical bone gain, especially in the third and fourth quadrants – doubling initial bone height. Remarkable findings included reconstruction of the inferior alveolar canal roof, initially submucosal, now encased in bone (Figure 14).

This generalised mandibular thickening was confirmed in 3D reconstructions (Figure 15). Sectional cone-beam comparisons confirmed over two times bone gain in all implant regions (Figure 16).

### Discussion

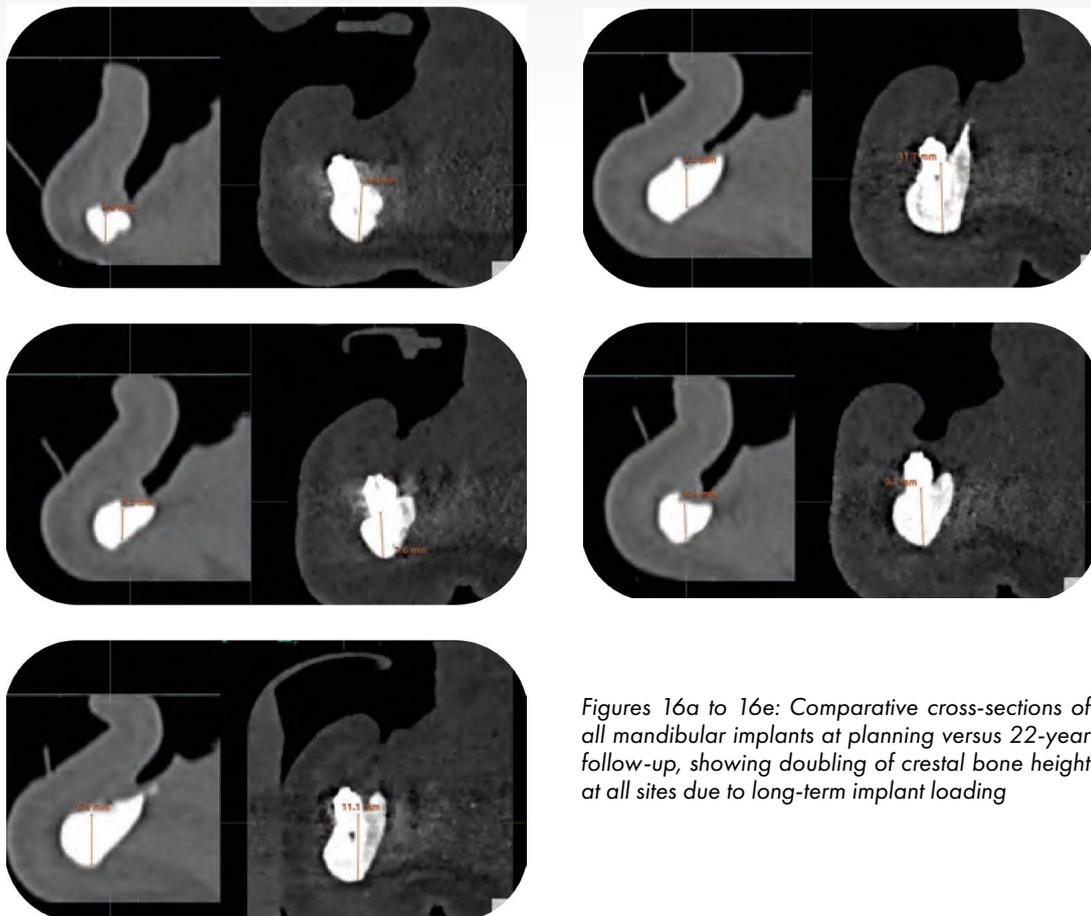
Implant dentistry continues to evolve, both surgically and prosthetically, in pursuit of long-term success (Darcey, 2016). Treating cases with extreme atrophy, such as the one described here, is challenging even today – and was even more so two decades ago (Di Gianfilippo et al, 2022; Torrella et al, 1998).

The advent of short and ultra-short implants has improved treatment options for resorbed jaws. However, at the time this case was treated, the shortest available implants would now be considered nearly standard length (Anitua, 2022; Moraschini et al, 2021; Araki et al, 2020).

Maxillary sinus augmentation techniques have also progressed significantly, moving from lateral window approaches to transcresal techniques – even for cases with residual bone less than 3mm (Anitua, Flores and Alkhraisat, 2016; Anitua et al, 2016; Anitua, 1999).

Implant length is another key point: 20 years ago, longer implants were favoured to gain apical stability, particularly in sinus lift cases.

Today, it's well established that excessive implant length offers no biomechanical advantage and may limit future retreatment options (Anitua, 2022; Anitua, Eguia and Alkhraisat, 2023; Anitua et al, 2010).



Figures 16a to 16e: Comparative cross-sections of all mandibular implants at planning versus 22-year follow-up, showing doubling of crestal bone height at all sites due to long-term implant loading

Our current philosophy emphasises a 'less is more' approach: conservative surgical sites, reduced implant dimensions, and retrievability.

If this case were treated today, many aspects would differ based on these updated principles.

Prosthetic designs have also improved dramatically, shifting from telescopic options to screw-retained hybrid designs with superior seal, hygiene access, and retrievability (Hernández-Marcos, Hernández-Herrera and Anitua, 2018).

This case benefited from ongoing integration of evolving techniques, including prosthetic upgrades built over the original implants.

## Conclusion

The rehabilitation of a case involving extreme maxillomandibular atrophy using implants of varying lengths, diameters and surgical techniques resulted in successful long-term outcomes over a 22-year follow-up.

The gradual incorporation of evolving prosthetic concepts allowed the treatment to remain current at each stage. Careful planning and patient compliance were key to achieving sustained success without complications.

## References

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