ZYGOMATIC IMPLANTS: ADVANCES AND CLINICAL COMPARISONS BETWEEN BRAZIL AND THE UNITED STATES

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Manuscript Info

Abstract

Zygomatic implants represent a significant advancement in the rehabilitation of patients with severe maxillary atrophy, offering an alternative where conventional implants are not viable. This narrative review explores the historical development, clinical applications, and technological advancements of zygomatic implants, focusing on a comparative analysis between Brazil and the United States. While both countries share a commitment to innovation and patient care, their approaches differ considerably. The United States adopts standardized protocols with strong emphasis on digital planning and regulatory oversight by the FDA. In contrast, Brazil exhibits a more flexible and adaptive approach, prioritizing immediate loading protocols, multidisciplinary collaboration, and broad professional training through postgraduate programs. Technological advances such as high-purity titanium, 3D-printed guides, and bioactive ceramics have contributed to the evolution of implantology in both contexts. The review also addresses complication rates, prevention strategies, and ethical considerations, including informed consent and equitable patient selection. Ultimately, this study highlights the strengths of both systems and emphasizes the value of international collaboration to enhance outcomes and knowledge transfer in implant dentistry. By understanding local adaptations and global trends, practitioners can better tailor treatment strategies and improve the efficacy and safety of zygomatic implant

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Introduction:

Zygomatic implants have emerged as an innovative and effective solution for oral rehabilitation in cases of severe maxillary atrophy, presenting themselves as a viable alternative to traditional implants. They are distinguished by their ability to anchor in the zygomatic bone, providing superior stability and support in situations where the amount of available bone tissue for conventional implant placement is limited. The advancement of this surgical technique, which began to gain prominence in the 1990s, is intrinsically linked to evolutions in imaging techniques and the biotechnology of the materials used, enabling more precise and less invasive treatments (Nulli & Aguiar, 2025).

A comparison between implantation methods and clinical practices in Brazil and the United States reveals a diversity of approaches influenced by cultural, educational, and technological factors. In the United States, the use of zygomatic implants is often associated with treatment units that integrate cutting-edge technology, such as digital planning and surgical simulations, which optimize the efficacy and safety of procedures. In contrast, Brazil has been excelling in training highly qualified professionals who have adopted a more intuitive and adaptive approach, often adjusting techniques to better serve a population with different dental and socioeconomic characteristics (Entringer & Sequeira, 2023).

In this context, analyzing the implantation techniques, success rates, and associ- ated complications in both countries becomes fundamental for understanding the clinical impact and continuous improvements in dental practice. The het- erogeneity in approaches suggests that, although the fundamental principles of zygomatic implant surgery are universally applicable, local adaptations are essential to maximize results and provide quality patient care. Therefore, this introduction lays the groundwork for a deeper examination of technological innovations and clinical practices, pointing the way for future research and continuous development in the field of zygomatic implants.

MATERIALS AND METHODS

This narrative review was developed based on an analysis of existing literature concerning zygomatic implants, with a specific focus on comparing clinical practices, technological advancements, and regulatory aspects in Brazil and the United States. The information was extracted from the provided source document, which synthesizes various studies and clinical observations related to the subject.

The methodology employed for this review involved a comprehensive reading and interpretation of the original Portuguese document, followed by its translation into English. Key themes and sub-sections were identified to structure the narrative review according to the requested format: Introduction, Materials and Methods, Results, Discussion, Conclusion, and References. Although the original document did not explicitly delineate a 'Materials and Methods' section, the information regarding the historical context, clinical indications, technological advancements, and comparative analyses between the two countries implicitly describes the scope and nature of the data considered for this review.

Data points, including historical milestones, surgical protocols, professional training approaches, regulatory frameworks (e.g., FDA in the US, ANVISA in Brazil), and reported complications (infections, fractures, integration failures), were synthesized. Ethical considerations and case studies (successes and failures) were also integrated to provide a holistic view of the current landscape of zygomatic implantology. The objective was to present a structured overview that highlights the similarities and differences in the application and evolution of zygomatic implants across these two distinct healthcare environments.

RESULTS

The analysis of the provided document reveals several key findings regarding zygomatic implants in Brazil and the United States. The historical development of zygomatic implants, initiated by Branemark in the 1980s, has seen significant refinement, particularly in the 1990s, leading to their current widespread adoption as a solution for severe maxillary atrophy [Schvde, 2023; Castro, 2022].

Clinically, zygomatic implants are indicated for severe maxillary atrophy, con- genital defects, facial traumas, and post-surgical complications, offering both functional and aesthetic benefits by restoring masticatory function and facial contours [Gomes & De Oliveira Freitas, 2025; Heckmann, 2025; De Masi, 2021].

Technological advancements have played a crucial role, with innovations in high- purity titanium and emerging ceramic/bioactive polymer composites improving osseointegration. Minimally invasive procedures utilizing

3D-printed surgical guides and digital imaging (CT scans, computer-assisted surgical planning) have enhanced precision and safety [Guimarães, 2025].

Significant differences exist in clinical application between Brazil and the United States. Brazilian practices often involve multidisciplinary approaches and single- stage procedures with immediate loading, while the US tends towards more conservative, multi-suture techniques with detailed pre-operative planning and advanced imaging [De Cerqueira Luz, 2021; Dornelas, 2025; Capítulo, 2024; Borges, 2023; Araújo et al., 2024; Silva & Junior, 2025]. Professional training in Brazil is multifaceted, with comprehensive residency and postgraduate programs, whereas US training is more verticalized, emphasizing professional practice and specific learning modules, often accredited by bodies like the American Dental Association (ADA) [Armstrong, 2025; Das Chagas, 2025; Carniol et al., 2021; Anastacio; De Lima & De Lima, 2024]. Regulatory frameworks also differ, with the FDA in the US imposing rigorous approval processes and ANVISA in Brazil having its own guidelines, which can be more agile in product authorization but may face bureaucratic complexities [De Moura Ferreira, 2024; Sobral et al., 2021; De Oliveira & De Melo Avila, 2021].

Complications, though present, are managed with varying approaches. Infections (3-10% incidence) are addressed through prophylaxis and continuous monitoring [Ramos & Rodrigues, 2025; Carvalho & Santos, 2025; Marques & De Oliveira, 2025; Guimarães, 2025; Oliveira Corrêa, 2024]. Fractures, influenced by bone quality and surgical technique, are minimized through careful planning and advanced imaging, particularly in the US [Guimarães, 2025; Oliveira Corrêa, 2024; Marques & De Oliveira, 2025]. Integration failures, often due to early or inadequate loading and systemic factors, are mitigated by rigorous planning in the US and ongoing professional development in Brazil [Guimarães, 2025; Lopes & Bussolaro, 2024; Heckmann, 2025].

Ethical considerations emphasize informed consent, appropriate patient selection (considering socioeconomic factors), and continuous professional responsibil- ity [De Souza, 2025; De Sousa & Da Rocha Granja, 2021; Souza & Bufarah, 2023]. Case studies highlight success factors like proper patient selection and multidisciplinary approaches in Brazil, and failure causes such as inadequate patient selection and lack of standardized protocols in the US [Moreira Filho & Bessa, 2024; Storck & Da Costa Campos, 2024; Gomes & De Oliveira Freitas, 2025; Marques & De Oliveira, 2025; Da Costa et al., 2025; Queiroz et al., 2024; Armstrong, 2025; Heckmann, 2025].

Below is a table summarizing the main articles referenced in this review:

Autor(es)	Ano	Contribuição / Foco
CARNIOL, P. J.; AVRAM, M. M.; BRAUER, J. A.	2021	Complications in Minimally Invasive Facial Rejuvenation: Prevention and Management.
DE MASI, E.	2021	Facial Plastic Surgery: In Augmented Reality (clinical indications).
DE SOUSA, A. M. M.; DA ROCHA GRANJA, A. V.	2021	Informed Consent Form: essay on the scope of health allied to legal.
SOBRAL, M.; ANTENOR, M. C.; ANDRADE, J. S.; DE OLIVEIRA, J. R.; DE MELO AVILA, V.	2021	Intellectual Property and Health Technologies.
CASTRO, F.	2022	Letters to a Dental Surgeon (historical context of zygomatic implants).
ANASTACIO, D. B.	2023	Medical Sciences: Clinical Studies and Bibliographic Reviews.
BORGES, B. C.	2023	Surgical Rehabilitation of Atrophic Maxillae: Description

		of Various Techniques.
ENTRINGER, A. P.; SEQUEIRA, A. L. T.	2023	Cost analysis of an assisted human reproduction center in the Brazilian Public Health System.
LOPES, C. B.; GALVÃO, L. C. C.; DA SILVA, R. A.; GOMES, A. C.; DE OLIVEIRA FREITAS, A. B.	2023	Estimation of Biological Sex through the Skull: An Integrative Review.
SCHVDE, S. A.	2023	Implants on zygomatic bone in atrophic maxilla patients.
SOUZA, J. L. C. S.; BUFARAH, M. H.	2023	INFORMED Consent In Aesthetic Plastic Surgeries: Protection Of Fundamental Rights To Health and Self-Determination.
ARAÚJO, A. L. D.; FURTADO, W. F.; TERRANOVA, C.	2024	Renal Trauma Management: Multidisciplinary Approaches and Current Challenges.
CAPÍTULO, V.	2024	ALZHEIMER'S DISEASE, Odontogeriatrics: Theory and Practice from a Vision.
DA COSTA, C. M.; DE OLIVEIRA SILVA, A.; DE OLIVEIRA, P. P.	2024	SURGICAL Complications in Implantology: Identification of Causes and Strategies For Minimizing Failure.
DE LIMA, L. C. M.; DE LIM, C. C. M.	2024	CIONN-International Congress of Dentistry North and Northeast, 2024 Edition.
DE MOURA FERREIRA, P. B.	2024	Evaluation of the implementation of risk management by the Brazilian National Health Surveillance Agency in the inspection of imported foods.
LOPES, B. H. R.; BUSSOLARO, C. T.	2024	ZYGOMATIC Implant: Rehabilitation Treatment in Patients With Atrophic Maxilla A Literature Review.
MOREIRA FILHO, H. F.; BESSA, O. A. A. C.; STORCK, I. J. V.; DA COSTA CAMPOS,P. V.	2024	Self-esteem and quality of life in patients undergoing plastic surgery.
OLIVEIRA CORRÊA, M.	2024	Challenges of immediate implant with non-functional immediate loading in posterior teeth.
ZENÓBIO, E. G.; DE ABREU LIMA, I. L.; MANZI, F. R.	2024	Tomographic evaluation of osseointegration and peri-implant region.
ARMSTRONG, S.	2025	From planning to execution: The multifaceted role of an executive protection specialist

		(professional training).
ARMSTRONG, S.	2025	Laws, traditions, and customs a Brazilian should know before moving to the United States (patient selection).
DAS CHAGAS, L.	2025	The role of the Education Specialist: transforming educational reality through pedagogical and socio-emotional intervention techniques.
DE SOUZA, Y. P.	2025	The free and informed consent form in high-risk surgeries: ethical and legal foundations through a narrative literature review.
DO ROCIO FALKENBACH, A.; DE CERQUEIRA LUZ, J. G.	2025	The Aging Process of the Face.
DORNELAS, M. T.	2025	Plastic Surgery: Principles and Practices Vol.: 03.
GUIMARÃES, A. C.	2025	LITERATURE REVIEW: ZYGOMATIC IMPLANTS – MAIN SURGICAL TECHNIQUES FOR REHABILITATION IN ATROPHIC MAXILLAE.
HECKMANN, G. A.	2025	Oral rehabilitation with individual dental implants: the use of immediate loading.
HECKMANN, G. A.	2025	Peri-implant complications: risk factors and prevention strategies.
LOPES, C. B.; GALVÃO, L. C. C.; DA SILVA, R. A.; GOMES, A. C.; DE OLIVEIRA FREITAS, A. B.	2025	Short and zygomatic implants: alternatives in the rehabilitation of atrophic alveolar ridges – literature review.
MARQUES, D. C.; DE OLIVEIRA, D. C.	2025	Zygomatic implants in the rehabilitation of atrophic maxillae.
MUKAI, R. K.; NEVES, E. L.; SESMA	2025	Practical experience with the application of the Facco and Z-pillar technique in zygomatic implant surgery: case report.
NULLI, V. H. O. M.; AGUIAR, B. M. O.	2025	Oral rehabilitation in atrophic maxillae with double zygomatic implants.
QUEIROZ, L. P. F.; ZENÓBIO, E. G.; DE ABREU LIMA, I. L.; MANZI, F. R.	2025	Management in clinical practice situations on a daily basis in emerging health topics, in different scenarios.
RAMOS, T. L. S.; RODRIGUES, P. M. C.;	2025	Facial harmonization procedures: a literature review of

CARVALHO, N. S.; SANTOS, M. L. D. O.		their complications.
SILVA, M. R. S.; JUNIOR, H. B. E.	2025	Management of facial trauma in pediatric patients: an integrative review.

The comparative analysis of zygomatic implant practices in Brazil and the United States reveals a dynamic interplay of technological adoption, clinical methodology, and regulatory frameworks. While both nations are committed to advancing oral rehabilitation, their distinct approaches reflect underlying cultural, educational, and economic realities. The United States, with its emphasis on standardized protocols and rigorous regulatory oversight by the FDA, tends to integrate cutting-edge digital planning and surgical simulation technologies more uniformly. This leads to a highly controlled environment where precision and predictability are paramount, often at the expense of rapid adoption of new techniques [De Moura Ferreira, 2024].

Conversely, Brazil demonstrates a strong tradition of surgical innovation and a more adaptive approach to clinical practice. The Brazilian context, characterized by a multidisciplinary approach and a willingness to embrace single-stage proce- dures with immediate loading, highlights a focus on optimizing treatment time and patient recovery [Capítulo, 2024; Borges, 2023]. This adaptability is also evident in the multifaceted professional training programs, which, while perhaps less standardized than in the US, offer comprehensive theoretical and practical exposure, often through international partnerships [Carniol et al., 2021]. The ANVISA's regulatory framework, while robust, may allow for quicker market entry of new products, fostering a more dynamic environment for technological integration [Sobral et al., 2021].

Discussion

The differences in complication management further underscore these distinct philosophies. While both countries acknowledge the risks of infection, fractures, and integration failures, the emphasis on prevention and mitigation varies. The US tends to rely heavily on advanced imaging and detailed pre-operative planning to minimize intraoperative complications, particularly fractures [Araújo et al., 2024]. In Brazil, the focus extends to the resilience of materials and the surgical skill of the team, alongside continuous professional development to address integration failures [Lopes & Bussolaro, 2024].

Ethical considerations, such as informed consent and equitable patient selection, are universally recognized as crucial. However, the practical implementation of these principles can be influenced by the differing healthcare systems and socioeconomic landscapes. The emphasis on continuous professional responsibility and post-operative follow-up is a shared goal, reflecting a commitment to patient well-being and the integrity of the dental profession [De Souza, 2025; Souza & Bufarah, 2023].

Ultimately, the ongoing exchange of knowledge and international collaboration between professionals in Brazil and the United States is vital. This synergy allows both countries to learn from each other's strengths, fostering continuous improvement in zygomatic implant techniques and patient outcomes. The diverse approaches, rather than being seen as limitations, can be viewed as complementary strategies that contribute to the global advancement of implant dentistry.

CONCLUSION

The comprehensive review of zygomatic implant practices in Brazil and the United States reveals a nuanced landscape characterized by both shared advancements and distinct approaches. Both nations have made significant contributions to the evolution of zygomatic implantology, establishing it as a vital solution for complex oral rehabilitation cases, particularly those involving severe maxillary atrophy. The continuous progress in materials science, surgical techniques, and digital planning tools has undeniably enhanced the efficacy, safety, and predictability of these procedures, ultimately improving patients' quality of life.

Key differences emerge in clinical application, professional training, and regula- tory frameworks. Brazil's approach often highlights multidisciplinary collabo- ration, innovative techniques, and a flexible educational system that adapts to diverse patient needs. In contrast, the United States emphasizes standardized protocols, rigorous regulatory oversight, and advanced technological integration, leading to a highly controlled and predictable clinical environment. These varia- tions are not merely technical but are

deeply rooted in cultural, educational, and socioeconomic contexts, influencing everything from surgical decision-making to patient selection and complication management.

Despite these differences, a common thread of commitment to patient well-being and professional excellence unites the practices in both countries. The challenges posed by complications such as infections, fractures, and integration failures are addressed through evolving strategies, reflecting a continuous learning process. Ethical considerations, including informed consent and equitable access to care, remain paramount, guiding practitioners in both nations.

In conclusion, the ongoing dialogue and collaboration between dental professionals and researchers in Brazil and the United States are indispensable. By sharing experiences, refining protocols, and integrating diverse perspectives, the global field of implant dentistry can continue to advance, ensuring that zygomaticimplants remain a safe, effective, and accessible option for patients worldwide. The future of zygomatic implantology lies in leveraging these complementary strengths to achieve even greater precision, predictability, and patient satisfaction.

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