Torque Factor in Implant Dentistry

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Introduction

Dental implants have revolutionized dentistry, providing a permanent, functional, and reliable solution for missing teeth. With advancements in technology, the success rates and outcomes of dental implants have become more predictable, solidifying their role in restorative dentistry.

The practice of implant dentistry should be informed by the clinical outcomes from a clinician's own cases based on long-term records. Clinicians should embrace the role of practice-based researchers, using their experiences and documented evidence to help refine implant dentistry into a more straightforward, predictable, and affordable method for restoring missing teeth.

Numerous implant manufacturing companies around the world produce a variety of implant designs and suggest different surgical and restorative protocols, each with various claims. However, many novice practitioners face challenges in selecting the appropriate dental implant system and developing the necessary skills to achieve clinical competency. This often results in an overreliance on guidance from mentors, company-backed speakers, marketing materials, social media, and financially motivated offers from implant suppliers.

To address this issue, leading clinicians worldwide are collaborating to share their long-term research findings, clinical experiences, and expert opinions through unbiased, philanthropic educational platforms. These efforts aim to support young practitioners and simplify the field of implant dentistry, enhancing affordability and quality of care.

Implant Systems

Implants are designed to support the restoration of missing teeth and remain in the jawbone long-term, making the selection of the right implant system crucial for success. Simplifying the learning and adoption of these systems is essential for long-term practice success.

There are multiple approaches to classify dental implant systems, such as implant design, surface treatment, materials used, implant length and diameter, placement level and site, prosthetic design, and surgical and restorative protocols. If you carefully examine the key factors of dental

implant systems based on fundamental biomechanical principles and core benefits, you will likely find the same factors that guide my practice.

In my 32 years of clinical practice and extensive involvement in teaching and mentoring minimally invasive comprehensive dentistry (MiCD), one of the most challenging questions I frequently encounter from fellow practitioners and trainees worldwide is, "Which implant system is best and easiest to master?" While this question seems simple, it requires long-term practice-based research and clinical experience to effectively teach or share skills and concepts with colleagues in implant dentistry.

Owing to my passion for sharing and teaching clinical skills based on my own practice-based research, I have had the opportunity to work with many like-minded friends who are researchers, academicians, and well-recognized clinicians worldwide. This collaboration has given me the opportunity and confidence to use different dental implant systems and observe their clinical predictability and long-term success in my own practice. Our group at MiCD Global Academy has witnessed both successes and failures across various systems, emphasizing the importance of respecting biology and individual biomechanical adaptation capacity.

Based on these observations, I have proposed a simplified classification for dental implant systems based on the application or avoidance of the Torque Factor in implant dentistry. By carefully examining the implant system used in your practice and how you approach the Torque Factor, you can understand the sensitivity of this art and science during surgical and restorative processes.

In this brief article, I summarize the clinical and scientific facts and contemporary professional understanding about the Torque Factor (references 1-78), that we apply, knowingly or unknowingly, in our implant dental practice.

New Classification of Dental Implant Systems

I propose a new classification of dental implant systems based on the use or avoidance of the torque factor in implant placement and prosthesis fixation. This classification aims to simplify clinical practice, enhance teaching methodologies, and support practice-based research in implant dentistry. By categorizing the available systems into two simple groups, clinicians can more easily choose the appropriate system for their patients, improving outcomes and streamlining the learning process.

Table 1 : Key issues related to torque factor in dentistry. This helps differentiate torque-based implant system and torque-free implant system, enabling clinicians to understand the long-term benefits and technique sensitivity of the system they are using or planning to adopt.

Torque Factor in Implant Dentistry

Sn	Key issues	Torque-based implant system	Torque-free implant system
1	Implant macro-design	Screw root form	Plateau root form
2	Healing chambers	None/limited	Well focused and in-built design
3	Primary mechanical stability	Considered foundation for success	Not applicable
4	Osteotomy diameter	Smaller than implant diameter	Similar to implant diameter
5	Preferred implant length	Longer/standard	Shorter (minimally invasive)
6	Torque application stages	Multiple	Not necessary
7	Implant insertion torque	Multiple recommendations	Not applicable
8	Cover screw placement/ removable torque	Necessary and based on implant design	Screwless, so not applicable
9	Healing abutment placement/removable torque	Necessary and based on implant design	Screwless, so not applicable
10	Abutment screw placement/ removable torque	Necessary and based on implant design	Screwless, so not applicable
11	Prosthetic screw placement/ removable torque	Necessary and based on implant design	Screwless, so not applicable
12	Healing pathway	Interfacial bone remodelling	Intramembranous-like bone remodelling
13	Healing speed	1–2 µm per day	20–50 µm per day
14	Primary stability dip phase	Present	Not present
15	Functional loading protocols	Multiple approach	Single approach
16	Delayed functional loading (gold standard)	Biological stability dependent	Biological stability dependent
17	Early functional loading	Possible if primary stability value permits	Not recommended
18	Immediate functional loading	Possible if primary stability value permits	Not recommended

Torque-Based Implant System

Torque-based implant system utilizes a threaded design and appropriate torque to place the implant in the jawbone, following the concept of primary mechanical stability as the foundation for secondary biological stability, or osseointegration. Primary mechanical stability is achieved by applying a specific amount of torque to insert the implant into an under-prepared osteotomy site, creating a mechanically stable environment. The primary mechanical stability achieved by this implant system must endure the primary stability dip phase of the healing process.

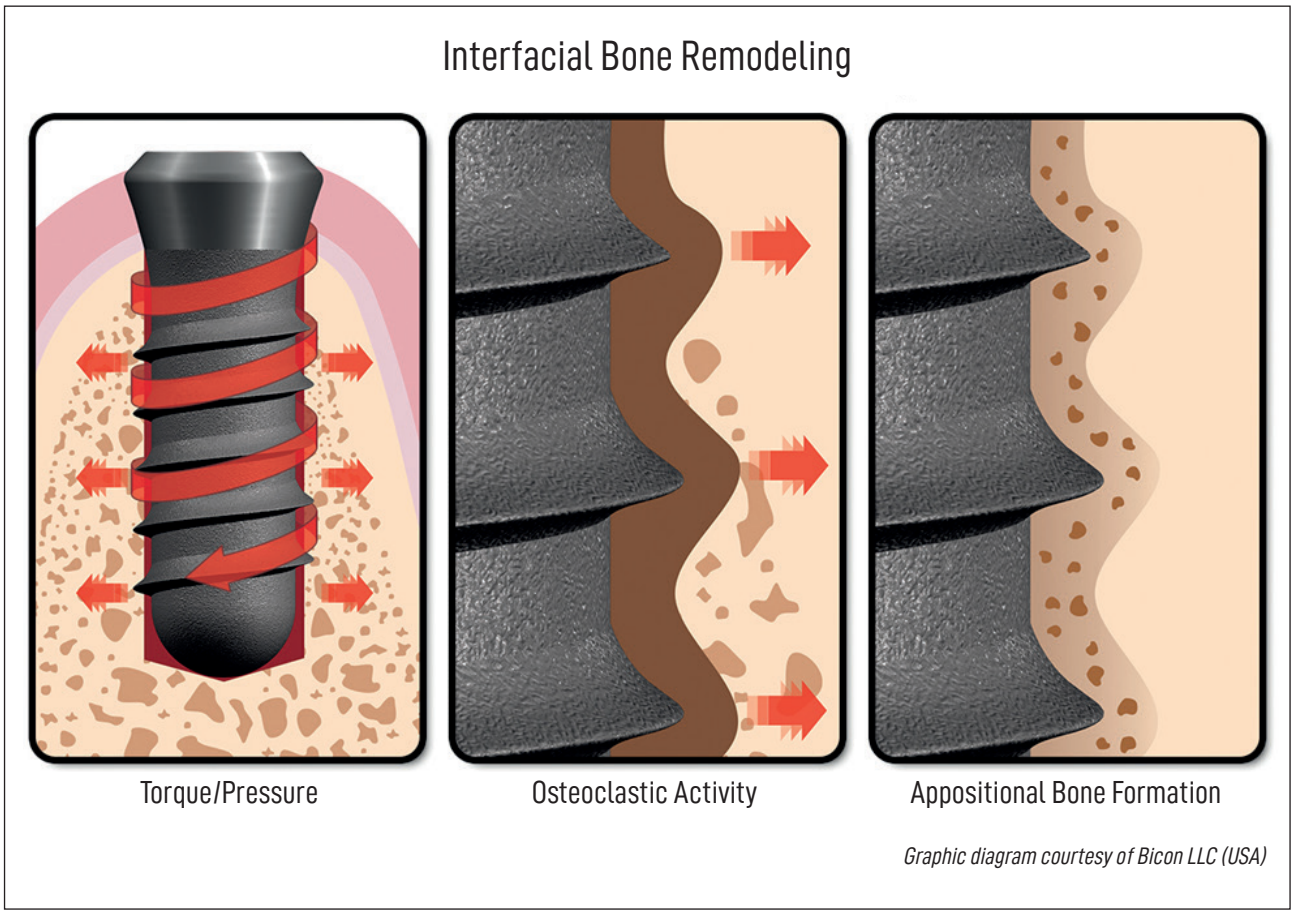


Fig 1 : Interfacial bone remodeling : Insertion torque generates pressure around the surrounding bone of the implant and osteoclastic activities start taking place with bone resorption. Slowly this resorbed area will be altered by newly formed woven bone, which eventually re-establishes the contact to the implant interface (secondary biological stability), and will subsequently remodel multiple times toward a lamellar configuration that will support the metallic device throughout its lifetime.

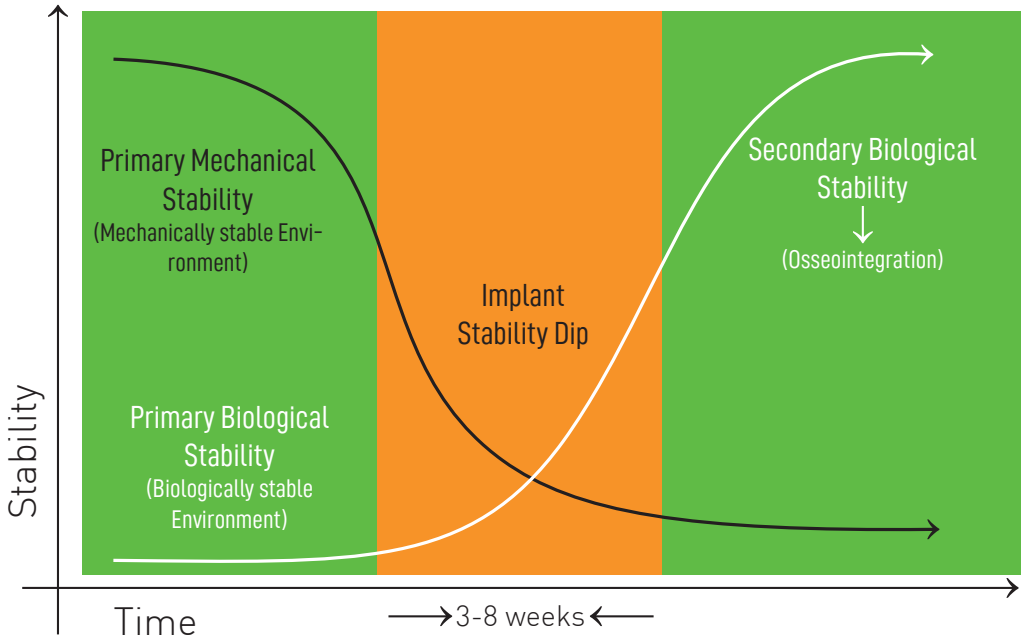


Fig 2: Graphic representation of osseointegration pathway of torque-based implant system.

The general clinical implications of torque-based implant system are as follows:

1. Primary mechanical stability depends on factors such as bone density, implant design, and the level of torque application.
2. Assessing the patient's bone quality is essential before determining the appropriate torque level. Dense bone typically requires higher torque, while softer bone necessitates a more conservative approach.
3. High torque during implant insertion can induce stress, potentially compromising healing. Primary mechanical stability may decrease during the initial healing phase, making immediate and early loading protocols sensitive and often requiring special measurement tools to confirm stability.
4. Precise torque application demands a high level of surgical skill and experience. Using high-quality, calibrated torque instruments is essential to ensure accuracy. Digital torque wrenches provide precise control, reducing the risk of human error.
5. Mechanical complications may arise from incorrect torque application during the restorative phase, such as screw loosening, fractures, or implant failure.
6. Long-term secondary biological stability is often reliable if primary mechanical stability is successfully achieved by respecting bone biology and the healing approach.
7. Immediate and early functional loading protocols in torque-based implant system are becoming popular, demanding optimal primary mechanical stability and objective confirmation before loading the prosthesis.

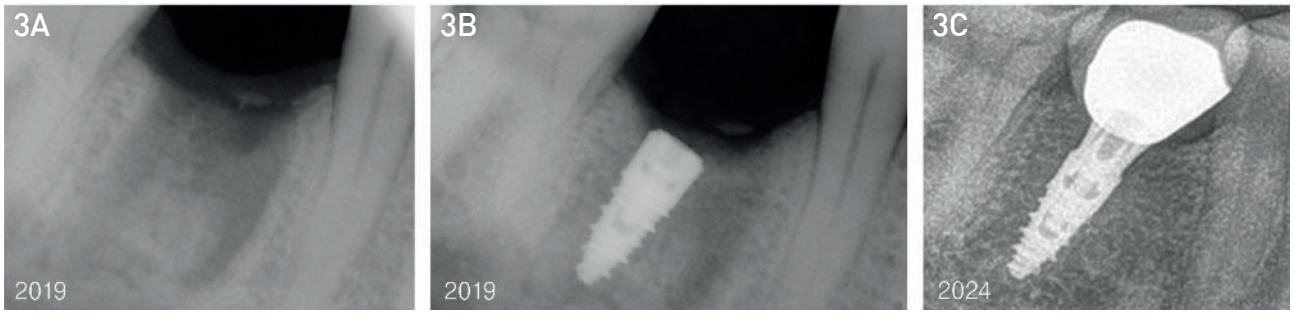


Fig 3A: Healing extraction socket. **Fig 3B:** Torque-based implant (Intra-Lock LLC, USA) was placed with a torque range of 25 Ncm due to the low density of bone at the time of implant placement (2019), and functional loading was done after 4 months. **Fig 3C:** Bone gain is evident in follow-up x-ray of 2024.

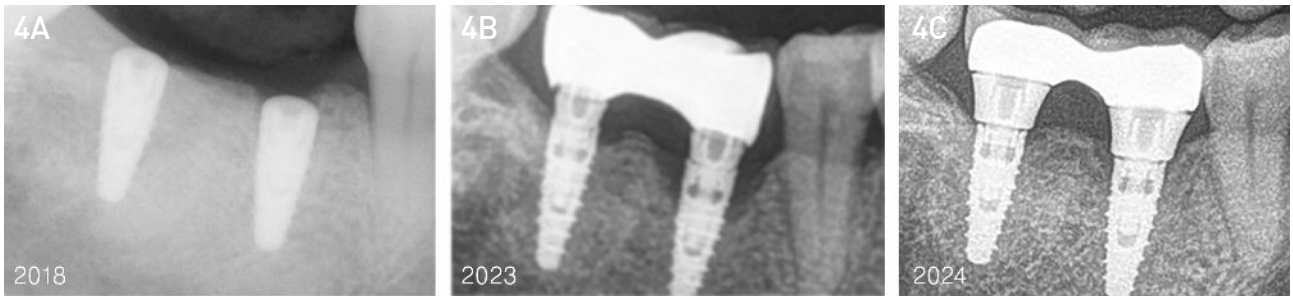


Fig 4 A: Two torque-based dental implant (Intra Lock LLC, USA) were placed (2018) with a torque range of 45–55 Ncm. **Fig 4B:** Bone loss was observed (2023) around implant no. 46, hence the prosthesis was removed for thorough debridement of the affected area. A new prosthesis with a wider gingival diameter was provided after two weeks. **Fig 4C:** Bone healing noted after one year (2024).

Torque-Free Implant System

Torque-free implant system avoids primary mechanical stability by keeping the final osteotomy size similar to the implant diameter. These implants have built-in healing chambers that increase the implant surface area, promoting a primary biological stability (biologically stable environment) that facilitates faster secondary biological stability. Additionally, this system incorporates bioactive surface treatment technology, enhancing the implant's ability to bond with bone cells. Since this system does not rely on primary mechanical stability, there is no primary stability dip phase during the healing process.

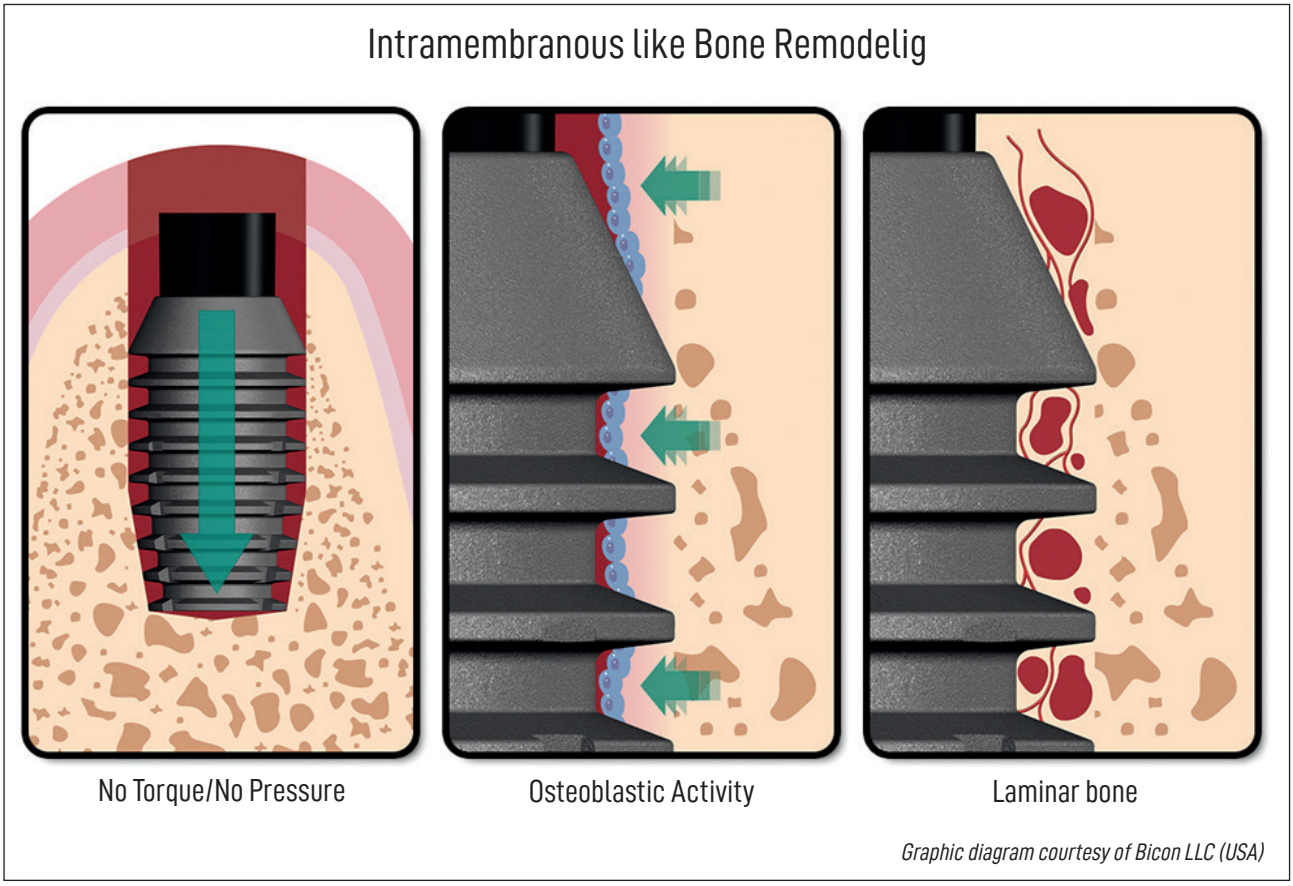


Fig 5: Intramembranous like bone remodeling : The void spaces left between bone and implant bulk, is referred as healing chambers, will be filled with blood clot immediately after placement and will not contribute to primary stability. Such healing chambers, filled with the blood clot, will evolve toward osteogenic tissue that subsequently ossifies through an intramembranous-like pathway.

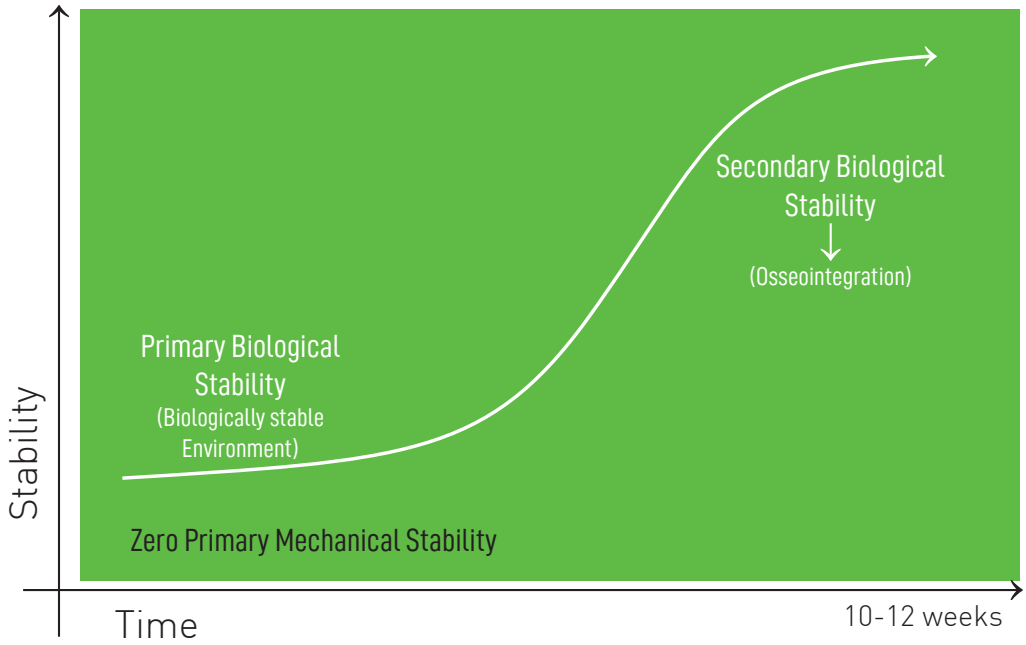


Fig 6 : Graphic representation of osseointegration pathway of torque-free implant system.

The general clinical implications of torque-free inplant systems are as follows:

1. The gentler approach of placing implants without torque preserves bone integrity, creating a biologically favorable and stable environment for healing.
2. Placement is less invasive and technically less demanding, potentially reducing surgery time and improving patient comfort.
3. Patients with poor bone quality or density can benefit from these innovative solutions.
4. The bioactive surfaces of the implants can accelerate bone healing and help achieve earlier secondary biological stability.
5. These implants are beneficial in areas with limited bone volume, where achieving primary stability through torque-based methods is challenging.
6. Since the implant sits passively within the bone, immediate functional loading is not possible, and early loading is not advisable.
7. Torque-free implant system are suitable for cases with low bone volume and density.

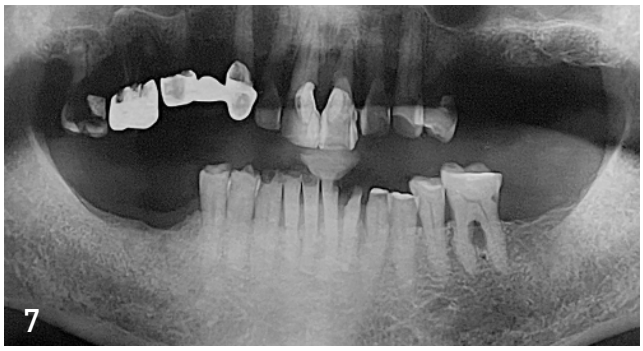
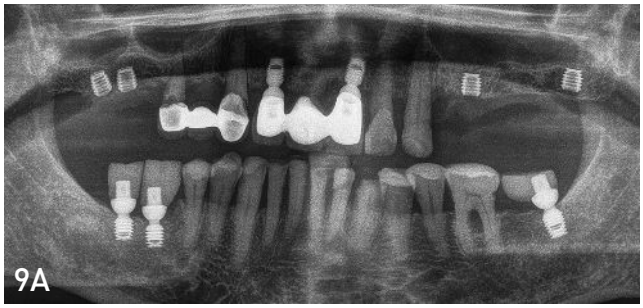


Fig 7: The patient had a history of conventional implant failure, so we decided to place torque-free short implants (Bicon LLC, USA). **Fig 8:** Three torque-free short dental implant (Bicon) were placed in the posterior region of the mandibular arch, and the patient was provided with a removable upper denture.



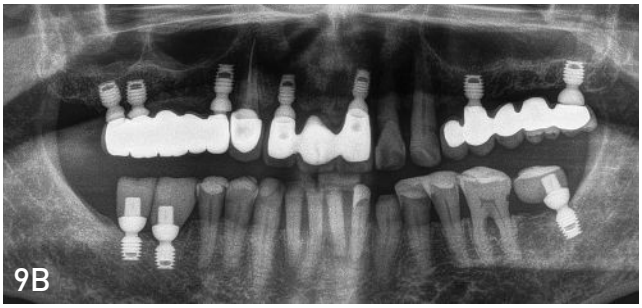


Fig 9A,B: With the success of torque-free short dental implants, the patient was encouraged to have similar implants placed in the upper arch to avoid sinus lift and bone graft procedures.

Conclusion

As dentists integrate implant dentistry into their practices, understanding the role of torque and selecting the right implant system is crucial. Torque-based systems provide reliable results when precise torque application is achieved, requiring clinical skill and additional instruments to confirm primary stability for successful immediate or early functional loading. Torque-free systems offer predictable results with simplified instruments, ideal for practitioners who prefer less invasive and predictable techniques, often avoiding sinus lifts and grafting procedures.

Both systems have their place in modern implantology, each with unique advantages. Recent research and developments indicate that contemporary implant manufacturers are focusing on combining both the benefits of mechanically stable environment (tight fit) and biologically stable environment (healing chambers) in a single implant through innovative implant design, leading to the emergence of hybrid implant systems. Only long-term clinical and practice-based research will determine their future success.

By leveraging shared knowledge and experience, dentists can enhance their skills and make implant dentistry more accessible and rewarding. For further learning, explore the MiCD Learning Station at www.micdglobalacademy.com. ■

A list of references can be available through by publisher.