



Recent Advances In Atraumatic Extraction Techniques: A Review

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Abstract

Tooth extraction is among the most common yet technique-sensitive procedures in dentistry. Conventional exodontia often compromises alveolar bone and soft tissues, leading to postoperative complications and challenges in prosthetic rehabilitation or implant therapy. The modern concept of atraumatic extraction emphasizes socket preservation through minimally invasive protocols that sever periodontal fibers and deliver teeth with minimal lateral force. Recent advances including physics forceps, powered periostomes, piezosurgery, sonic instruments, and axial extraction systems like the Benex and Easy X-Trac have enhanced precision, reduced trauma, and optimized conditions for immediate implant placement. Additional innovations such as vestibular socket therapy, root preservation, and digital integration via CBCT and artificial intelligence have further improved surgical planning, healing outcomes, and esthetics. Despite promising results, widespread adoption is limited by cost, training needs, and procedural complexity.

Keywords: Atraumatic Extraction, Alveolar Preservation, Physics Forceps, Piezosurgery, Benex System

Introduction

Tooth extraction is one of the most frequently performed procedures in dentistry, yet it remains one of the most technique-sensitive. The modern concept of atraumatic extraction emphasizes the preservation of alveolar bone and surrounding soft tissues, with the goal of achieving improved functional and esthetic outcomes. Maintaining socket integrity is particularly important for prosthetic rehabilitation and implant dentistry, as it simplifies treatment planning, reduces the need for additional grafting procedures, and supports faster, more predictable healing.¹ Over the past five years, advances in surgical workflows and biomaterial science have renewed interest in atraumatic extraction techniques. This shift has been largely driven by the rising demand for immediate implant placement, socket preservation strategies, and minimally invasive dentistry.² Traditional exodontia, performed with conventional forceps and elevators, relies heavily on buccolingual or rotational forces. While effective in delivering teeth, these forces frequently compromise the buccal or lingual plate, damage adjacent soft tissues, and increase the risk of complications such as alveolar bone fracture, socket wall loss, or delayed healing.³ The consequences of such trauma include compromised vascular supply, increased postoperative pain, inflammation, and reduced bone availability for future restorative procedures. In contrast, atraumatic extraction aims to sever the periodontal ligament fibers and mobilize the tooth with minimal lateral pressure, thereby safeguarding both hard and soft tissues. This philosophy has led to the evolution of specialized instruments and

techniques including periostomes, luxators, piezosurgical units, physics forceps, and axial extraction systems that allow clinicians to remove teeth in a more controlled, predictable, and patient-friendly manner. Collectively referred to as Atraumatic Extraction Techniques (AET), these innovations reduce intraoperative trauma, enhance wound healing, and optimize conditions for immediate implant placement and esthetic zone rehabilitation.⁴ Given the growing clinical importance of preserving socket anatomy, this review seeks to provide a comprehensive overview of recent advances in atraumatic extraction techniques. It highlights the principles, available instruments, clinical applications, as well as their merits and limitations, with the aim of fostering a deeper understanding among dental practitioners. By integrating these modern methods into routine practice, clinicians can minimize complications and deliver improved outcomes that align with the goals of contemporary implantology and patient-centered care.⁵ This article gives an overview on Recent Advances in Atraumatic Extraction Techniques

Review of Literature

Recent innovations in atraumatic extraction have introduced a variety of tools and techniques designed to minimize surgical trauma and preserve peri-alveolar structures. Physics forceps and powered periostomes, as reported by Kumar (2015)⁶ and Sharma (2022)⁷, provide controlled, gentle tooth removal that reduces the likelihood of alveolar bone fracture compared to conventional forceps. Similarly, piezosurgery and sonic instruments employ ultrasonic vibrations for precise bone cutting, thereby limiting collateral soft-tissue injury and enhancing postoperative healing outcomes (Kumar, 2015; Sahithi, 2023).⁸ Mechanical extraction systems such as the Benex extractor and the Easy Xtrac system have also been described as effective methods for tooth removal with minimal force application, enabling preservation of surrounding bone integrity (Sahithi, 2023).⁸ More recently, techniques like endoscopically assisted root splitting have been highlighted by Sharma (2022)⁷ for their precision in root sectioning, significantly reducing alveolar trauma. In terms of clinical outcomes, vestibular socket therapy has emerged as a novel approach, demonstrating improved soft-tissue parameters and higher esthetic scores for immediate implant placement when compared to conventional extraction protocols (Ghallab et al., 2022).⁹ Furthermore, atraumatic methods are consistently associated with superior preservation of the periodontal ligament, alveolar bone, and gingival architecture, factors essential for optimal healing and predictable implant positioning (Singla & Sharma, 2020).¹⁰ Despite these advantages, widespread clinical adoption remains limited by challenges such as the higher cost of specialized instruments, increased chairside time in some cases, and restricted availability of comprehensive training and literature to support routine integration into practice (Sharma, 2022).

Principles and Protocols of Atraumatic Tooth Extraction

The foundation of atraumatic tooth extraction rests on four key principles aimed at preserving both soft and hard tissues. First, the periodontal ligament and connective-tissue fibers must be carefully severed circumferentially around the tooth, as vigorous tearing of Sharpey's fibers can cause bleeding, delayed healing, and trauma to the surrounding bone; this step is best achieved using a No. 15c surgical blade or thin periostomes. Second, soft-tissue reflection should be minimized, since unnecessary flap elevation compromises periosteal blood supply, leads to gingival recession, and increases tissue shrinkage, particularly in the papillary region; if a flap is unavoidable, a conservative envelope flap without vertical incisions is preferred. Third, reduction of contact areas with adjacent teeth is recommended to avoid chipping enamel, fracturing bone, or damaging restorations, thereby enabling a smoother, less traumatic pathway for tooth removal.¹¹ Fourth, conventional forceps should only be applied once the tooth exhibits significant mobility, ensuring that buccal plate integrity is preserved. Among atraumatic techniques, the periostome method remains a cornerstone: the blade is inserted along the long axis of the root in the interproximal area to sever periodontal fibers below the alveolar crest, creating controlled wedging against the cribriform plate; gradual apical advancement with light tapping and brief waiting periods allows bone "creep" and progressive tooth mobility, ultimately facilitating elevation and coronal displacement without excessive force.¹² Additionally, atraumatic extraction kits such as those by COWELMEDI provide simplified protocols using drills, extraction screws, torque heads, rest plates, and elevators. In this system, the coronal tooth structure is reduced, a precise hole is drilled into the root following the canal path, and an extraction screw is anchored within. A torque head and rest plate—equipped with silicon protection to

shield adjacent teeth—are then connected, serving as a stable support for the elevator or torque wrench. By applying controlled axial and directional force, the tooth can be gently luxated and removed while preserving alveolar bone and adjacent structures. Collectively, these principles and devices illustrate how atraumatic extraction has evolved into a refined, minimally invasive procedure that prioritizes biological preservation, postoperative comfort, and enhanced outcomes for subsequent implant therapy.¹³

Sonic and Ultrasonic Approaches in Atraumatic Extraction

The use of sonic and ultrasonic technologies has introduced new possibilities for minimally invasive tooth removal, offering greater precision and safety compared to conventional instruments. Sonosurgery, as reported by Papadimitriou et al. (2012), employs a sonic handpiece with specialized inserts for tooth sectioning and syndesmotomy.¹⁴ Operating at frequencies up to 6 Hz with a wavelength of 240 μm , the system provides accurate cutting with minimal soft-tissue trauma. Its slim inserts (0.25 mm thick, 2.4–3.5 mm wide, and 10 mm long) allow controlled tooth sectioning while generating less heat (1.54–2.29°C) than piezosurgery and producing smoother cutting surfaces. The advantages of sonosurgery include enhanced tactile feedback, reduced damage to adjacent structures, and decreased operative time when compared with periostomes, although limitations include longer working duration than rotary instruments, potential instrument fracture if misdirected, and contraindications in patients with pacemakers or infectious diseases due to oscillatory effects and aerosol generation.¹⁵ Piezosurgery, in contrast, operates on ultrasonic microvibrations (25–30 kHz) with amplitudes of 60–210 μm and is nearly three times more powerful than conventional scalers. Depending on the mode, it is suitable for root-end treatments, smoothing bone borders, and performing osteotomies. Its clinical benefits include minimized bleeding, reduced postoperative pain, faster healing, and protection of critical anatomical structures such as the lingual nerve, inferior alveolar nerve, and Schneiderian membrane. However, piezosurgery is associated with higher costs, increased surgical time, and possible heat generation. Newer devices like the Resista ultrasonic bone surgery unit (Omegna, Italy) further expand its application by combining tooth removal and implant site preparation in one system. This device utilizes vibrating osteotomy tips for precise PDL fiber penetration and socket-specific syndesmotomes, followed by conical vibrating drills (2.0–4.5 mm, varying lengths) that condense bone mechanically while preparing implant sites. Clinical outcomes have been promising, with survival rates of 98.8%, 94.4%, and 100% reported in noninfected, acutely infected, and chronically infected sockets, respectively.¹⁷ The bactericidal effect attributed to cavitation during tip vibration further enhances healing and implant success. Collectively, sonic and ultrasonic methods represent significant advancements in atraumatic extraction, combining precision, safety, and biological preservation to support predictable implant therapy.¹⁷

Novel and Conservative Approaches in Atraumatic Tooth Extraction

Several innovative methods have been developed to achieve atraumatic extractions with maximum preservation of alveolar bone and surrounding tissues. The Root Preservation Technique, first described by von Wowern and Winther, demonstrated reduced alveolar resorption compared to conventional extraction, though its application remains limited to single-rooted teeth. The Easy X-Trac System utilizes screw engagement into the root with color-coded drills, protective plates, and a ratchet wrench, allowing controlled removal of single- or double-rooted fractured or ankylosed teeth, thereby reducing surgical trauma and operator fatigue, although contraindicated in narrow or vertically fractured roots.¹⁷ An unconventional alternative, the Rubber Band Extraction technique proposed by Regev et al., has been particularly useful for bisphosphonate-treated patients, where elastic bands gradually migrate apically, severing periodontal fibers and allowing tooth extrusion within 5–8 weeks, though requiring long-term follow-up and patient compliance. The Luxator Periostome (Directa, Sweden) provides a slender, sharp instrument for severing periodontal fibers through gentle rotational and rocking movements, enabling socket expansion with minimal force compared to traditional elevators. Similarly, the Implant Drill Extraction method offers a simplified surgical approach for single-rooted teeth, where sequential tapered drills (2.0–3.3 mm) reduce root structure, facilitating removal with artery forceps.¹⁸ Finally, the Powered Periostome (Powertome 100S), equipped with microprocessor-controlled settings and ultrafine blades, allows circumferential severing of Sharpey's fibers and atraumatic socket expansion without flap elevation,

providing significant advantages over manual periostomes in minimizing fracture risk of buccal or lingual plates. Collectively, these methods underscore the shift toward minimally invasive, flapless extraction protocols aimed at enhancing surgical outcomes and preserving anatomical integrity.¹⁹

The Benex System and Emerging Conservative Extraction Techniques

The Benex System, introduced by Saund and Dietrich, represents a significant advancement in atraumatic extraction by employing the principle of vertical traction rather than lateral expansion. Specifically designed for single-rooted teeth located below the marginal gingiva, the apparatus consists of a Benex extractor, diamond drills (1.6–1.8 mm), self-tapping screws, a pullstring, and a sectional impression tray.²⁰ By delivering the tooth along its long axis, the system minimizes socket expansion and flap elevation, thereby preserving alveolar bone and soft tissues while promoting faster healing and reduced postoperative morbidity. Clinical studies have reported an overall success rate of 83%, with outcomes markedly better for single-rooted teeth (89%) compared to multi-rooted teeth (43%), where root morphology or severe caries may limit screw retention.²¹ Beyond Benex, several newer techniques using standard armamentarium have been explored to simplify atraumatic extractions. The “Button Sewing” technique involves creating small perforations around the root surface (4–5 mm deep) with a long-shaft bur, disrupting the periodontal ligament (PDL) fibers, lowering hydraulic pressure, and promoting hyaluronic acid buildup, ultimately reducing extraction trauma by 40–50%.²² Similarly, the “Wiggle and Wait” technique applies continuous force via forceps or elevators for 2 minutes, followed by a 10-minute rest period, during which hyaluronic acid accumulation weakens the PDL, allowing for easier tooth delivery with minimal trauma. A related method, the Modified Elevator technique, also relies on leaving an elevator or luxator in place for a set period, maintaining constant pressure that facilitates ligament loosening and simplifies the extraction process. Collectively, these approaches highlight a growing trend toward minimally invasive exodontia by combining mechanical innovations with biologically informed strategies to enhance tissue preservation and patient outcomes.²³

Clinical and Digital Integration in Atraumatic Extraction

The integration of digital technologies has significantly enhanced the precision and predictability of atraumatic tooth extraction. Cone-beam computed tomography (CBCT) provides three-dimensional visualization that allows clinicians to accurately plan extraction sites, assess anatomical structures, and minimize the risk of damaging adjacent vital tissues, while also facilitating immediate implant placement with greater confidence. In parallel, the use of artificial intelligence (AI) algorithms is emerging as a powerful tool for personalized treatment planning, offering capabilities such as bone density assessment, virtual simulation of healing, and optimization of surgical pathways, thereby improving both safety and clinical outcomes.²⁴ These advancements collectively support the primary objectives of atraumatic extraction: preservation of bone and soft tissue, particularly the alveolar ridge, which reduces or eliminates the need for subsequent grafting procedures. Furthermore, they create optimal conditions for immediate implant placement, expediting patient rehabilitation and minimizing the number of surgical interventions. By ensuring minimally invasive techniques and accurate planning, such approaches contribute to faster recovery, reduced postoperative discomfort, and overall improvement in the patient experience—the value of clinical and digital integration in modern exodontia.²⁵

Conclusion

Atraumatic extraction techniques and devices like periostomes, physics forceps, axial extractors like Benex, piezotome-assisted approaches, and socket-shield/vestibular methods have matured into practical options that can meaningfully preserve alveolar architecture and improve outcomes for immediate implant and aesthetic workflows. Current evidence supports their benefit in appropriate hands and cases, but higher-quality, longer-term comparative trials and standardized outcome reporting are needed to define clear guidelines and broaden adoption.

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