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REVIEW ARTICLE

Advances in Methods of Atraumatic Tooth Removal: An Update

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ABSTRACT

Dental extraction, once considered as punishment, has now become one of the finest works in dental surgery. Traumatizing the entire being with this deed was the idea 200 years ago, on the contrary today we try completing the procedure without the need of gingival reflection. This paradigm shift gave birth to atraumatic extraction techniques (AETs), which intend the removal of tooth or tooth root, while maintaining a harmonious relation with gingiva, bone, and other surrounding hard and soft tissue structures. Instruments, such as Benex vertical extractor, powered periotome, piezosurgery, sonosurgery, physics forceps, Ogram system, Easy X-Trac system and techniques, such as the orthodontic extrusion technique and rubber band extraction help in achieving this noble goal.

The main benefits of AET are immediate implant placement, faster healing, and reduced need for bone grafting and soft tissue augmentation, leading to faster prosthetic rehabilitation in a limited time span.

This review is an insight into each technique and instrument highlighting its advantages and drawbacks to instigate awareness and also allow for the better understanding among maxillofacial and dental professionals.

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BACKGROUND

Introduction of AETs in this phase of dentistry follows what was earlier characterized as "brutalizing methods—like the knee and chest technique for tooth removal"[1] two centuries ago. The AET is a comprehensive method to remove tooth or tooth root, while preserving all the surrounding structures like gingiva, bone and other hard and soft tissue structures. The rationale behind such techniques is to make the socket heal faster with minimum bone loss, so as to make it available immediately for prosthetic rehabilitation. The ultimate goal achieved is better functional and esthetic outcome in a very short duration of time.

For the last two decades, research to find newer, safer and quicker methods for tooth removal has revolutionized dentistry. Newer instruments like Benex vertical extractor, powered periotome, piezosurgery, sonosurgery, physics forceps and techniques like implant drill placement for tooth removal, Ogram system, and the Easy X-Trac system have been specially formulated for dental extractions atraumatically.[2]

The sequence of extraction by conventional methods involves stripping of the periodontium around the tooth followed by luxation with an elevator and removal using an elevator or forceps. This method invites inadvertent trauma to the surrounding hard and soft tissues and may aggravate if forceps extraction fails and surgical removal is done. If surgical removal is performed, the amount of soft tissue and bone loss increases, which may lead to unfavorable postoperative sequel, thereby comprising the harmony.[3,4]

Immediately after tooth removal, bony walls of the extraction socket undergo remodeling by simultaneous resorption and deposition, which leads to reduction in the bone height by 1 to 2 mm in all dimensions.[2] Once

the wound is left to heal, considering ignorance and economy of rehabilitation, atrophy occurs as the socket is not replaced with a suitable prosthetic component. This disuse atrophy causes further loss in bone width by a quarter.

The AET or strategic extraction minimizes such untoward complications by allowing the socket and surrounding tissues to heal faster and quicker with minimal loss. Hence, this comprehensive review aims to enlist all the instruments and techniques along with their merits and demerits inculcating better understanding among dental surgeons.

Atraumatic Methods in Tooth Removal

In developing countries, dental caries is the commonest reason for tooth removal. This may be either due to lack of awareness for treatment or its high cost. Other reasons which can be accounted include poor periodontal condition, traumatic injuries, and removal due to an underlying pathological cause.

Postremoval, a suitable prosthetic replacement should be given in order to restore normal form and function. Earlier, before the advent of implants in dentistry, dental prosthesis was given only after adequate bone and soft tissue cover was restored postextraction. This complete process of wound closure and healing took approximately 2 to 3 months.

Introduction of implants into the dental arena has zeroed down this gap of removal and replacement from 2 months to 2 minutes as immediate implants are the cornerstone of modern dentistry. With such progress made and time of prosthetic rehabilitation reduced to less than a day, AET has made implant placement faster and precise with a predictable clinical outcome (Table 1).

Root Preservation Technique

Published by von Wowern and Winther[5] with an intention to preserve the alveolar ridge from further resorption, the authors concluded that this trial showed lesser bone resorption when compared with adjacent areas where roots were removed. Major disadvantage with this technique is that its use is limited to single-rooted teeth.

Table 1: Atraumatic extraction techniques

Mechanical	*Motorized*
Root preservation technique	Piezosurgery
Rubber band extraction	Sonosurgery
Physics forceps	Powered periotome
Benex Extractor	
Easy X-Trac system	
Luxator periotome	
Orthodontic extrusion technique	

Easy X-Trac System

Easy X-Trac® engages into the tooth root through a screw, which aids in better retention and control. With equal distribution of forces, both the screw and root can be removed. Three color-coded drills in increasing diameter are available with two X-Trac screws of sizes 28 and 33 mm respectively, along with protective plates to disperse the pressure equally on both sides and a ratchet wrench to engage the screw. This technique can be used for single- and double-rooted tooth, which are ankylosed or fractured.

Advantages

By this method, two main goals of atraumatic tooth removal are achieved. First, there is minimal trauma to the surrounding, as it is a flapless technique and secondly, there is negligible fatigue to the operating surgeon's wrist. It is contraindicated for use in teeth with narrow roots or tooth that has vertical fracture.[6]

Rubber Band Extraction

Regev et al[7] proposed an alternate method for the removal of teeth to avoid bone exposure, so that osteonecrosis does not set in bisphosphonate-treated patients. Ten patients with 15 teeth were treated using this technique. Elastic bands placed on teeth tend to reposition themselves apically from larger to smaller diameters. As these bands move apically, they sever the periodontal fibers resulting in tooth extrusion. Average time taken for exfoliation was 5 to 8 weeks. Around 10 molars (9 mandibular and 1 maxillary), 2 mandibular premolars, and 3 incisors (2 mandibular and 1 maxillary) were extracted. About 19 roots were exfoliated spontaneously with no signs of inflamed tissue or bone exposure. Apart from being an inexpensive technique, no learning curve was required; hence, it is easy to apply. The chief disadvantage is the long-term follow-up and patient compliance.

Luxator Periotome

Manufactured by Directa (Sweden)®, these sharp slender instruments are inserted between the tooth and the gingiva trying to engage them in a plane that strips the periodontal fibers through slight, yet firm, rotatory motion. While stripping these fibers when a rocking motion is given continuously, the socket also expands. One should be aware of the fact that a luxator may look similar to an elevator, but the amount of force applied during its use is significantly less.[8]

Extraction using Implant Drill

This is a simplified method used for exfoliation of single-rooted teeth. It is a surgical technique that involves

insertion of a tapered instrument to widen the root canal diameter to accommodate pilot implant drill. After sequential insertion of drills (diameter 2.0 and 3.3 mm), the tooth structure is grossly reduced and fractures. This can be further removed by use of artery forceps.[9]

Powered Periotome

Powertome 100S (WestPort Medical, Salem, OR) is a mechanized periotome with a handpiece microprocessor unit and a foot control. The unit has 10 power settings, which are used according to the size and location of tooth to be removed. Ultrafine metallic blades are used to enter the periodontal space circumferentially to sever the Sharpey's fibers and expand the socket as well. Similar to the aforementioned instruments, flapless removal of tooth is possible without a doubt of fracture of any of the plates (buccal/lingual). This is considered to be a reasonable advantage of this instrument over its manual counterpart.[10,11]

Sonosurgery

Papadimitriou al[12] reported cases using a sonic instrument for atraumatic tooth removal. Sonic handpiece with various inserts (Komet, Rock Hill, SC)® was first introduced by Dr Ivo Agabiti (Italy). This instrument can be used for sectioning the teeth and for syndesmotomy. It vibrates at a frequency as high as 6 Hz and a wavelength of 240 μm. With three inserts of dimensions (0.25 mm thick, 2.4–3.5 mm wide, and 10 mm long), it provides precise cutting without inducing any injury to the soft tissue. Advantages include reduced operative time when compared with periotomes, average heat generated is less (1.54–2.29°C) when compared with piezotome, and is similar to the conventional rotary instruments. Smooth cutting surface with minimal damage to adjacent structures provides better tactile perception and makes it safer for adjacent hard and soft tissues. Disadvantage with its use is long working time (3–4 times more than normal rotary instrument). If the direction of instrument while insertion is wrong, it may fracture while oscillating. Sonic instruments are contraindicated in patients with pacemaker as the oscillations might interfere with their functioning. In addition to this, it is not advised to use sonic instruments in patients with infectious diseases as the aerosols may further aggravate the condition.

Piezosurgery

It is a procedure for hard tissue surgery, sparing the soft tissue surrounding it. The working principle is based on the ultrasonic microvibrations. Piezosurgery unit is three times more powerful than the routine scalers. Piezoelectric handpiece is connected to the main unit, which supplies the foot control and also has an attachment for irrigant. The frequency ranges from 25 to 30 kHz, causing microvibrations with amplitudes ranging between 60 and 210 mm. Low mode is useful for apical root canal treatment in dentistry. High mode is useful for cleaning and smoothing the bone borders. Boosted mode is most often used in oral and maxillofacial surgery during osteoplasty and osteotomies. Performing dental extractions with piezoelectric instruments aids in faster healing as the damage to surrounding soft tissue is significantly reduced and it also leads to reduced postoperative pain. The advantages of this technique include reduced bleeding, thereby, providing a clearer surgical field and causing insignificant damage to adjacent soft tissues including lingual nerve, inferior alveolar nerve, and Schneiderian membrane. Disadvantages during its use are increased heat generation and increased surgical time along with high cost of its armamentarium.[13]

Ultrasonic bone surgery device (Resista, Omegna, Italy)®[14] is one of the most recent devices to be categorized under piezosurgery. Apart from its use to remove the tooth from socket (infected/uninfected), this novel product has vibrating osteotomy tips, which are inserted postremoval into extraction sockets to prepare the bed for immediate implant placement. Meaning, a single instrument with various combinations of tips can be used for both purposes at one time. The pilot blade which is arrowlike is used to penetrate the PDL fibers coronally. Deeper access is available with four syndesmotomes used sequentially and specially designed to match the socket geometry. Once extraction is done, drills of diameter 2.0, 3.2, 3.8, and 4.5 mm with standard lengths of 8, 10, 13, and 15 mm are used to place implants. The conical shape of these vibrating drills allows the condensation of bone of the socket mechanically. A 98.8, 94.4, and 100% survival rate was achieved in noninfected, acutely infected, and chronically infected groups respectively. This higher survival rate has been credited to the cavitation effect leading to bactericidal action, which can be achieved by using vibrating tips for additional 30 seconds at 72 W.

Benex System

Saund and Dietrich[15] mentioned another breakthrough that works on the principle of vertical pulling only. This technique is specifically designed for single-rooted tooth below the marginal gingiva. The apparatus comprises a Benex extractor, diamond drill (1.6, 1.8 mm), self-tapping screws, a pullstring, and a sectional impression tray. Overall success rate was found out to be 83%; 89% with single-rooted tooth, whereas 43% multi-rooted teeth. The disadvantages of this technique are that it cannot be used in the cases where there is inappropriate root morphology

and in grossly carious teeth where retention of screw is not possible.[16]

Physics Forceps

Two first class levers connected with a hinge is the standard working principle of conventional dental forceps. Shaft/handle of these instruments allows the operator to grasp and amplify force applied, but this does not provide mechanical advantage.[17] Physics forceps® (Golden Dental) that work on the same principle allow mechanical advantage by virtue of its design. Removal of bottle cap (tooth) can be achieved by two means; either by the use of pliers (conventional forceps) or by the use of a bottle opener (Physics forceps). The latter gives better results than the former in either case (bottle cap/tooth). Similar to its older counterpart, this instrument has two handles, the first which has a bumper (to adapt to the buccal surface) and a beak (for the palatal surface). Major advantage of this novel instrument is that no squeezing/rocking motion is required. Light gentle pressure directed buccally serves its purpose.[3,4] Hariharan et al[18] compared its use on orthodontic extraction of first premolars and found that significant observed in regards to postoperative pain on the first day. Madathanapalli S , Surana S and colleagues[19] conducted a similar study on maxillary first molars and found significant difference in time taken for tooth removal and reduced pain on third postoperative day when compared with conventional counterparts. Similar findings have been reported by Fazio,[20] Feck,[3] Leziy,[21] Nazarian,[22] Timothy,[23] Perkins et al,[24] Patil et al,[2] Mandal et al,[25] El-Kenawy and Ahmed,[26] as they find this instrument ideal for atraumatic tooth removal followed by immediate implant placement. Advantage of this set of armamentarium is minimal force requirement with maximum output. It has gained popularity globally as its use is simple when compared with other techniques and it is more economical. There are certain disadvantages to this instrument as well. It has a learning curve, so if excess force is applied, fracture of tooth crown or bone might take place. Also, this instrument is 15 times more expensive to its conventional counterpart.

Orthodontic Extrusion Technique combined with Atraumatic Surgical Extraction

Choi and Bae[27] presented a case series of 96 molars and premolars, which were treated with intentional reimplantation. Teeth were orthodontically extruded for 2 to 3 weeks to increase the mobility and periodontal volume. Preceding this was extraction using Physics forceps followed by apicectomy and replantation. The overall success rates of atraumatic surgical extraction were found to be 95 and 100% respectively, for molars and premolars; no failure was observed

CONCLUSION

The AETs are comprehensive methods using various techniques based on different principles of physics with an aim to remove tooth/tooth structure inducing minimal trauma to the surrounding, thereby permitting the extraction socket to accept immediate implants and accelerate rehabilitation of the lost structures. Shorter waiting period for socket healing leads to fewer surgical sessions and reduced time for prosthesis delivery, thus making it cost-effective with preservation of bone and soft tissue.[9]

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