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Mini Review

Applications of Piezosurgery in Oral and Maxillofacial Surgery

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Abstract

Piezoelectric bone surgery is a relatively novel alternative to routine bone cutting tools to overcome limitations of hard tissue surgery in maxillofacial surgery practice. Clinical applications of piezosurgery in oral and maxillofacial surgery are varied and range from dentoalveolar and maxillary sinus procedures to implant and temporomandibular joint surgeries. Its advantages over other methods make piezoelectric surgery a technique of choice for osseous surgeries today.

Introduction

Piezoelectric bone surgery is a relatively novel alternative to traditional bone cutting tools to overcome limitations in oral hard tissue surgery. It is a promising and improved technology for bone cutting that is meticulous and soft tissue-sparing, based on ultrasonic micro-vibrations [1].

Clinical applications of piezosurgery in oral and maxillofacial surgery are:

Dento-alveolar procedures

a) Root resection,

b) Hemi-section, root amputation,

c) Periodontal surgery (osseous bone contouring),

d) Apical resection and endodontic treatments,

e) Alveolar decortication and corticotomy,

f) Alveolar distraction,

g) Dental extractions,

h) Removal of impacted teeth (In and around the mandibular ca¬nal or maxillary sinus, piezosurgery helps prevent nerve damage, even in case of accidental contact with the working insert tips) [2].

Maxillary sinus surgeries

a) Preparation of bone window with lateral approach [3],

b) Sinus floor elevation,

c) Atraumatic sinus mucosa dissection [4].

The risk of perforating Schneiderian membrane is reduced from 30% to 7% during the osteotomy procedure for bone window confection or during membrane lifting [5].

Bone grafting

a) Harvest of intra-oral autogenous bone chips with a good number of viable osteocytes [6].

b) Mandibular ramus block bone graft as an onlay graft for increasing bone thickness [7].

c) Harvesting iliac block bone graft for jaw reconstruction.

d) Piezosurgery provides high precision and operating sensitivity and easy differentiation between cortical and cancellous bone while removing blocks of monocortical cancellous bone [8].

Dental Implantology

a) Implant socket preparation called 'differen¬tial ultrasonic socket preparation' is performed with selective enlargement of one socket wall [3].

b) Alveolar ridge splitting and expansion without the risk of thermo-necrosis of bone with reduced risk for adjacent soft tissues damage [9].

c) Re-contouring of alveolar crest with enhanced vibratory efficiency.

d) Mental nerve reposition.

e) Implant removal.

f) Maxillary sinus lifting [4].

g) Better primary stability and short-term survival rate of the implant.

Orthognathic surgeries

Like Sagittal split ramus osteotomies, Le Fort I osteotomies, and surgically assisted rapid maxillary expansion [10,11]. The operative time taken for remains the same with lesser blood loss especially in LeFort I osteotomies.

Enucleation of jaw cysts, Removal of odontogenic tumours, Jaw Resection

Piezo instruments enable cautious handling of the cystic lining without tearing the epithelial wall with careful removal of the surrounding thin cystic bone [12,13]. This has favourable implications of markedly reduced postoperative recurrence and complication rates. The resection of odontogenic tumors is also possible with piezosurgery, albeit time consuming.

Temporomandibular joint ankylosis and condylar hyperplasia osteotomy procedure with decreased risk of bone fracture as bones become elastic after osteotomy with ultrasonic intermediate vibration, minimizing complications like risk to the middle meningeal artery.

The main advantages of piezosurgery are

a) Enhanced patient comfort during procedures due to the absence of macro-vibrations,

b) Direct visibility of the surgical site from pressurized irrigation and cavitation effect,

c) Bone sectioning with micrometric sensitivity,

d) Haemostasis through direct cavitation effect,

e) Avoiding adjacent soft tissue damage [14],

f) Quicker bone healing-no thermal trauma, with earlier bone morphogenetic protein release,

g) No osteonecrosis as it avoids excessive temperature,

h) Precise and safe hard tissue cutting due to adaptation to the vibration frequency [15],

i) Harvested bone can be modified and shaped according to recipient site,

j) Less strength required for bony cuts as instruments are three times more powerful,

k) Better surgical control.

Disadvantages are

a) Contraindicated in patients with pacemakers,

b) Not cost effective,

c) Increased operative time,

d) Learning from experience curve for the technique,

e) Adequate dexterity and gentle touch is essential,

f) Pressure above certain limits impedes insert vibrations, decreasing efficiency,

g) Increase compared to traditional cutting instrument,

h) Difficulties in deeper osteotomy site like pterygomaxillary dysjunction,

i) Need regular sharpening/replacement-inserts get worn away and may break,

j) May cause thermal tissue damage.

Conclusion

Piezosurgery outweighs traditional instruments for bone cutting and its clinical and biological advantages contribute to improved bone health making it a highly effective tool in maxillofacial clinical practice.

References

1. Thomas M, Akula U, Ealla KK, Gajjada N (2017) Piezosurgery: A boon for modern periodontics. J Int Soc Prevent Communit Dent 7(1): 1-7.
2. Schaeren S, Jaquiery C, Heberer M, Tolnay M, Vercellotti T, et al. (2008) Assessment of nerve damage using a novel ultrasonic device for bone cutting. J Oral Maxillofac Surg 66(3): 593-596.
3. Vercellotti T (2009) Essentials in piezosurgery: Clinical advantages in dentistry. (1st edn), Quintessenza Edizioni, Milan, Italy, pp. 65-107.
4. Wallace SS, Mazor Z, Froum SJ, Cho SC, Tarnow DP (2007) Schneiderian membrane perforation rate during sinus elevation using piezosurgery: clinical results of 100 consecutive cases. Int J Periodontics Restorative Dent 27(5): 413-419.
5. Flemmig TF, Petersilka GJ, Mehl A, Hickel R, Klaiber B (1998) The effect of working parameters on root substance removal using a piezoelectric ultrasonic scaler in vitro. J Clin Periodontol 25(2): 158-163.
6. Stubinger S, Ghanaati S, Saldamli B, Kirkpatrick CJ, Sader R (2009) Er: YAG laser osteotomy: preliminary clinical and histological results of a new technique for contact-free bone surgery. Eur Surg Res 42(3): 150-156.
7. Happe A (2007) Use of a piezoelectric surgical device to harvest bone grafts from the mandibular ramus: report of 40 cases. Int J Periodontics Restorative Dent 27(3): 241-249.
8. Sohn DS, Ahn MR, Lee WH, Yeo DS, Lim SY (2007) Piezoelectric osteotomy of intraoral harvesting of bone blocks. Int J Periodontics Restorative Dent 27(2): 3-7.
9. Blus C, Szmukler-Moncler S, Vozza I, Rispoli L, Polastri C (2010) Split-crest and immediate implant placement with ultrasonic bone surgery (piezosurgery): 3-year follow-up of 180 treated implant sites. Quintessence Int 41(6): 463-469.
10. Landes CA, Stubinger S, Rieger J, Williger B, Ha TK (2008) Critical evaluation of piezoelectric osteotomy in orthognathic surgery: operative technique, blood loss, time requirement, nerve and vessel integrity. J Oral Maxillofac Surg 66(4): 657-674.
11. Robiony M, Polini F, Costa F, Zerman N, Politi M (2007) Ultrasonic bone cutting for surgically assisted rapid maxillary expansion (SARME) under local anaesthesia. Int J Oral Maxillofac Surg 36(3): 267-269.

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12. Yaman Z (2010) Enucleation of the jaw cysts using a piezoelectric ultrasonic device. Presentation. The 1st Scientific Congress of Hellenic, Israeli and Turkish Associations of Oral and Maxillofacial Surgeons (HITAOMS) Istanbul, Turkey.

13. Kocyigit ID, Atil F, Alp YE, Tekin U, Tuz HH (2012) Piezosurgery versus conventional surgery in radicular cyst enucleation. J Craniofac Surg 23(6): 1805-1808.

14. Sivolella S, Berengo M, Scarin M, Mella F, Martinelli F (2006) Autogenous particulate bone collected with a piezo-electric surgical device and bone trap: A microbiological and histomorphometric study. Arch Oral Biol 51(10): 883-8891.

15. Crosetti E, Battiston B, Succo G (2009) PIezosurgery in head and neck oncological and reconstructive surgery: Personal experience on 127 cases. Acta Otorhinolaryngol Ital 29(1): 1-9.