# Review of: "[Mini Review Article] Practicality of Piezo Surgery in Periodontics"

Martin Hofmann[1]

1 University of Berne

Potential competing interests: No potential competing interests to declare.

Dear Authors,

Ultrasonic osteotomy (not limited to dentistry) is a very interesting topic of both clinical and technical interest that offers great potential for further research and the optimization of devices and procedures.

However, this mini-review does not contain a specific research objective, and I consider its impact to be limited. It is more of a brief explanation of the technology and a specific device and its applications that have already been described in various scientific publications, reviews, and textbooks. It would be interesting to examine the literature in detail on the clinical outcome of ultrasonic osteotomy compared to e.g. oscillating saws. There are other commercial ultrasonic devices besides Mectron that could also be compared. Of course, there are also many technical aspects that need to be investigated and are part of my own research: What makes an osteotomy insert efficient (geometry, dimensions, surface, material, irrigation channels, operating frequency, and vibration amplitudes, etc.)? At the end of the manuscript, the limitations are explained very briefly in bullet points. It would be interesting to address these points in detail and describe why ultrasonic osteotomy devices are not yet in use everywhere. The list of limitations is certainly not exhaustive either. For example, what about the production of aerosols that can lead to the transmission of pathogens (was a major issue during the COVID pandemic)?

Moreover, the manuscript is quite limited and difficult to understand as far as the introduction to the technical operating principle and the biophysical effects, i.e., cavitation and shock waves, is concerned. I recommend the following reviews that explain all these details:

- O'Daly et al. [1]
- Lea et. al. [2]

In addition to the book "Piezoelectric Bone Surgery, ISBN 978-0-86715-832-8[3] by Prof. Vercellotti, which has already been recommended in one of the reviews [4], I also recommend the following textbooks:

- Newman and Carranza's Clinical Periodontology, ISBN 978-0-323-87887-6[5]/ Chapter: Piezoelectric Bone Surgery
- Gallego-Juarez, J: Power Ultrasonics - Applications of High-intensity Ultrasound, ISBN 978-1-78242-028-6[6]/ Chapter: Ultrasonic surgical devices and procedures

Further details (specific text sections):

*In Introduction:*

- *“Dr. Thomas vercelloti” → Prof. Tomaso Vercellotti*
- *In Piezoelectric Bone Surgery Unit:*
  - There is not only the Piezo surgery system from Mectron. I would recommend describing the system in more general terms.
  - *“... over modulation of frequency”:* This is an interesting approach, but the advantage of overmodulation is not further described or evaluated in the paper.

*In Inserts of Mectron-Piezosurgery®:*

- This information is available on the Mectron website. I do not see the need to list all these instruments here.[7]

*In Principle & Mechanism of Action:*

- *“resonance tip”:* It is not only the tip that is operated in resonance, but the entire handpiece, including the insert. In addition, use the terms consistently and do not mix up the terms "insert" and "tip."
- *"linear movements":* What does it mean? What about curved inserts?
- *“ultrasonic produce piezoelectric effect”:* This statement is confusing and not correct. The correct principle would be:
  - A mechanical vibration in the ultrasonic range of 25-50 kHz is generated by the inverse piezoelectric effect, whereby the applied alternating electrical charge at the corresponding frequency excites the piezoceramics to deform and vibrate. The ultrasonic devices (transducers and inserts) are dimensioned so that the resonance frequency is at the desired operating frequency.
    - 25-50 kHz is a quite wide range. Please check if this is correct. As far as I know, Mectron Piezosurgery® Touch is operating in a frequency range of 24-36 kHz. [8]
- *“Piezoelectric crystals compress...”:* Crystals → “materials.” Be more general if you don't know exactly what kind of material is used in the devices (most likely a hard PZT ceramic).
- *“The cavitation effect produced by saline solution...”:* It is not the saline solution that produces the cavitation. It is the mechanical vibration that leads to pressure fields in the liquid that may cause the cavitation effect.
- *“This effect promotes hemostasis in the operating field, maintains pH and oxygenation of tissues and provides better visibility.”:* Is there a reference for this statement?

*In Scaling and Root Planning:*

- *“The piezosurgery device is also capable of pocket depth reduction*..”: For scaling and root planning, it is a different

device than for surgery (at least the insert). Therefore, it is not a “piezosurgery device” that improves pocket depth reduction.

*In Periodontal Surgery:*

- *“... manipulation of soft and hard tissues”:* In fact, ultrasonic surgical instruments exist for both soft tissue (generally higher frequencies of > 50 kHz) and hard tissue. However, the piezo surgery device (Mectron) described in this article is an ultrasonic osteotomy device that has the advantage of being tissue selective. This means that it only cuts hard, mineralized tissue, while the adjacent soft tissue is not affected due to the compliance of the soft tissue.

*In Advantages:*

- How does the cavitation effect contribute to reducing the risk of bone necrosis and improving visibility? Isn't it rather the irrigation itself (including the cooling effect) with saline solution?

### Final recommendation:

The manuscript should be carefully revised considering the above suggestions, and language and spelling errors need to be corrected. Illustrations would also strengthen the manuscript.

I hope this review and these recommendations will help you to improve your mini-review article.

## References


1. ^*Brendan J. O’Daly, Edmund Morris, Graham P. Gavin, John M. O’Byrne, et al. (2008).High-power low-frequency ultrasound: A review of tissue dissection and ablation in medicine and surgery. Journal of Materials Processing Technology, vol. 200 (1-3), 38-58. doi:10.1016/j.jmatprotec.2007.11.041.*
2. ^*Simon C. Lea, A. Damien Walmsley. (2009).Mechano-physical and biophysical properties of power-driven scalers: driving the future of powered instrument design and evaluation. Periodontology 2000, vol. 51 (1), 63-78. doi:10.1111/j.1600-0757.2009.00300.x.*
3. ^*Tomaso Vercellotti. (2020). Piezoelectric Bone Surgery.*
4. ^*Tomaso Vercellotti. (2024). Review of: "[Mini Review Article] Practicality of Piezo Surgery in Periodontics". doi:10.32388/fwiajk.*
5. ^*Michael G. Newman, Perry R. Klokkevold, Satheesh Elangovan, Yvonne Kapila. (2023).Newman and Carranza's Clinical Periodontology and Implantology.*
6. ^*Juan A. Gallego-Juárez, Karl F. Graff. (2015).Power Ultrasonics, Applications of High-Intensity Ultrasound.*
7. ^*Mectron Piezosurgery Inserts.*
8. ^*Mectron Piezosurgery Touch.*