



MINIMALLY INVASIVE VERTICAL EXTRACTION SYSTEM BENEX – A NARRATIVE REVIEW

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ABSTRACT The aim of this review is to assess data in published clinical papers about the minimally invasive properties and application of the vertical tooth extraction system Benex (Benex extractor, Hager & Meisinger GmbH, Neuss, Germany and Helmut Zepf Medizintechnik, GmbH, Tuttlingen, Germany). A search of PubMed, ResearchGate and Google Scholar was conducted without a set publication year limit, using different keywords. The search found 15 papers, which were all included in the review. Benex system is an effective minimally invasive tooth extraction device, especially for teeth with single roots. Authors have found a variety of other effective applications of the system, which further confirms its minimally invasive properties.

KEYWORDS : atraumatic, benex, dental implants, minimally invasive, tooth extraction

INTRODUCTION

Tooth extraction, or exodontia, is arguably one of the earliest treatment options in dental medicine, and even in modern day times, in some countries, it is still one of the most frequent performed surgical interventions.¹ It is performed on a daily basis by oral surgeons, implantologists, general practitioners and even dentistry undergraduates. Due to the innovation and success of dental implantology, more and more teeth with dubious prognosis, which are otherwise treatable with conservative techniques, are considered for an extraction and a following implant placement. The success and the result of the latter largely depends on the condition, especially the volume, of the remaining bone in the site of extraction. Therefore, being as less traumatic as possible during the extraction is somewhat crucial.

LITERATURE SEARCH AND INCLUSION CRITERIA

The literature survey for this narrative review was conducted using the PubMed, ResearchGate and Google Scholar electronic databases and search engines, without a set limit for the year of publication. Only papers in English were included in the final review. Keywords based on MeSH terms as well as free text were used to filter the results and find clinical studies that investigate the application of the vertical extraction system Benex. The keywords, used in different combinations, were as follows: "atraumatic", "minimally invasive", "tooth extraction", "fractured teeth", "mutilated teeth", "decayed teeth", "single-rooted teeth", "multi-rooted teeth", "vertical extraction system", "Benex", "comparison", "evaluation", "implant placement", "immediate implant placement".

BACKGROUND

A conventional tooth extraction is performed primarily with dental elevators and extraction forceps. Depending on the condition and anatomy of the tooth and the tissues in the area, a conventional extraction includes an expansion of the socket, typically by pressing on to the tooth against the alveolar bone, or by wedging an elevator in between the tooth and the socket bone. Once the tooth is completely loose, it is salvaged out of the socket by gently pulling. The anatomical structure of some teeth also allows for a rotational movement to be utilized, which aim to sever the periodontal ligament by rotating the tooth around its axis and somewhat additionally expand the socket. Even for experienced practitioners, a simple tooth extraction could easily end up being a very traumatic procedure in regard to the alveolar bone around the tooth.²

Although the idea of an atraumatic extraction is nothing new, the interest and research in this direction is even bigger nowadays, due to the general knowledge that less traumatic extractions preserve more bone, which is ever more needed for successful implant and prosthetic restorations. It is practically impossible to avoid doing at least some harm to the soft tissues and the socket bone during a tooth extraction. For this very reason some authors consider the term atraumatic incorrect and prefer to refer to it as minimally invasive instead.³

Meisinger GmbH, Neuss, Germany and Helmut Zepf Medizintechnik, GmbH, Tuttlingen, Germany). It aims to reduce the amount of trauma during an extraction by simply pulling onto the tooth in an upright direction, tearing the periodontal ligament apart, causing no direct harm to the alveolar bone. The action of this system is very similar to that of a corkscrew, when removing the cap of a bottle of wine.³ With Benex, a canal is drilled with a calibrated burr into the tooth. Then a matching post is screwed into the tooth and a metal traction string is attached to it and with its other end to the Benex extractor. The force with which the string is pulled is gradually increased by turning the extractor's hand screw in a clockwise direction, until the periodontal ligament gives in and the tooth is ultimately pulled out of its socket. In all cases of teeth without divergent or curved roots, this extraction technique is expected reduce the trauma to a minimum.⁴

DISCUSSION

Muska et al.⁵ studied this by extracting 111 teeth with Benex. Of all these, 83% of the extractions were perfectly successful. Furthermore, they noted that based on their estimation, about 44% of these teeth would have otherwise required a surgical extraction, if it weren't for the possibility of a vertical extraction of the tooth. This last part is further confirmed by the study of Hong et al.⁶ who use the system to extract a total of 323 teeth, 43 of which were included in the study following an extraction failure with conventional forceps. Out of these 323 teeth 276 were successfully extracted, which turns out to be 85.4% - a number very much comparable with that of the study of Muska et al. These studies show that Benex is not only perfectly usable but is also handy when dealing with deeply fractured teeth. Allowing for such teeth to be extracted without surgery is a great example of a case where this device can give us an undisputedly minimally invasive extraction, regardless of the amount of actual trauma that it causes.

The success rate of Benex extractions is not equal for all teeth. Both studies conclude that the Benex extractions are far more successful for teeth with single roots in comparison to multi-rooted ones. In fact, Hong et al. calculated the odds of failure to be about 2.2 times higher when multi-rooted teeth are concerned. However, the lowest success rate noted was not for a multi-rooted tooth, but instead for the maxillary lateral incisors, since these teeth very often have a well pronounced curvature in the apical portion of their root, combined with the fact that the root is very tiny in this very same area. Of course, the number of successfully extracted multi-rooted teeth can be increased by dividing their roots and extracting them as if they were separate single-rooted teeth, which is in fact the recommended approach. Regardless of this, the roots of the molars have individual undercuts and anatomical variations, which make their extraction similarly risky to that of the maxillary lateral incisors.

As for the amount of trauma that Benex introduces to the bone and soft tissues, the study of Katarzyna Gurzawska and Harlene Kaur⁷ is very indicative. They used the Benex system to extract roots on a patient with anti-VEGF (anti-vascular endothelial growth factor) intake, which bears a risk of a follow-up osteonecrosis. They extracted two

Benex is a vertical tooth extraction system (Benex extractor, Hager &

roots with conventional instruments and two roots with Benex. A complete healing, without any remaining bone exposure, in the extraction area where Benex was used was noted by the end of the 8th week, whereas it wasn't until the 12th week for the wounds left by the conventional instruments to be considered completely healed in the same way.

Another very recent study by Makki et al.⁸ evaluated the post extraction wound healing of Benex against the conventional means. Using the H₂O₂ epithelisation test, they were able to determine that on the fourth week, 42.1% of the Benex extractions showed complete epithelisation, while the epithelisation was incomplete for all extractions with conventional instruments. This is a strong indication of how much less damage the vertical extraction causes to the tissues as a whole.

Dental implant placement is perhaps the treatment which is most required to be atraumatic. It also frequently includes a prior extraction of a tooth, or even an immediate one, at the time of placement. In their updated clinical and technical protocols for predictable immediate implant placement, Gamborena et al.⁹ outline that the success of this type of treatment really depends on the extraction being as atraumatic as possible. According to them, a fundamental rule is to never place any instrument between the crestal bone and the tooth, which is going to directly damage the bone and affect the result. Instead, to avoid this, the adjacent tooth should be used as a support, a trough should be made in the tooth and be used for its extraction, or a system like Benex should be used. Multiple studies^{10,11,12} use this vertical extraction system when doing immediate implant placement in different approaches and report successful results. However, there doesn't seem to be any clear data on how much of this success is due to the minimally invasive extraction with Benex and the amount of bone preserved by using it.

In their study Robert Kelly et al.¹³ used the Benex system, not for the extraction of teeth, but for their surgical extrusion instead. They achieved an extrusion of 4mm for each tooth, and although the teeth were splintered to the adjacent ones, one week after the extrusion, when the splinting was removed, the tooth showed no signs of mobility. Both the 9-month and 20-month follow-ups confirmed that the extruded teeth showed no signs of mobility, an x-ray image characteristic to a healthy bone tissue around the tooth, as well as no subjective complaints on behalf of the patients. The study of Krug et al.¹⁴ did a similar thing, but instead of simply pulling the teeth up a certain amount, they performed an actual extraction and then placed them back into their sockets at a desired height, thus extending their clinical crowns. 51 teeth were included in the study and were followed up period of 6 months to 6.5 years. They noted that all teeth showed no subjective complaints on behalf of the patients and a normal percussion sound, proof of an absent akylolysis. X-ray examination showed that only 10% of the teeth had a minor apical resorption. 8 out of 51 teeth had minor marginal bone loss, while 2 teeth had a moderate to advanced bone loss. A recent study by Cassus et al.¹⁵ suggests that Benex can be an additional tool in the armamentarium for the extrusion of teeth with traumatic intrusion. Although they followed a case for 4 years and found no bone resorption and a normal percussion sound, they noted that the insertion of the screw will inevitably require that the tooth is endodontically treated.

Even the more unexperienced practitioners can achieve less invasive extractions with Benex, so long as the screw is fixed correctly into the tooth. The latter was identified by Muska et al.⁵ to be the most probable cause for a Benex extraction failure. Another possibility of a negative outcome is when the Benex extractor is not pulling the tooth in a strictly vertical direction, but this is exactly where the Benex impression tray should be used.

CONCLUSIONS

We can say that the Benex system is a very well applicable device for minimally invasive tooth extractions, especially when teeth with single roots are concerned. The variety of use cases that different authors have found for this system somewhat prove its minimally invasive nature from different perspectives. It is in no way a complete replacement for the conventional extraction means, but some additional research can help identify more practical cases, which can benefit from this system.

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