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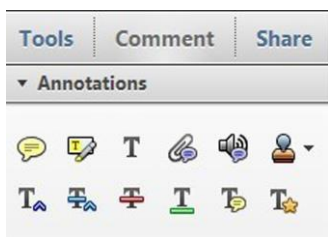


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# Energy based devices for transoral thyroidectomy

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**Abstract:** Instruments [energy based devices (EBDs)] that utilize energy to divide tissue with inappreciable bleeding serve surgical procedures. EBDs erroneous use increase morbidity [recurrent laryngeal nerve (RLN), injury]. This article reviews different EBD in terms of their possible application for transoral endoscopic thyroidectomy vestibular approach (TOETVA). Endocrine surgeon skills and perfect judgment on EBD proprieties are essential elements for safe use. Furthermore, surgeons should evaluate carefully if certain EBD is indicated for TOETVA.

**Keywords:** Energy based devices (EBDs); transoral thyroidectomy; safety; clips; transoral endoscopic thyroidectomy vestibular approach (TOETVA)

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## 1 Introduction

2 Energy based devices (EBDs) are essential accessories  
3 in endoscopic and robotic thyroidectomy (1). In a first  
4 study by Barczyński *et al.*, 67 patients were randomized  
5 into two groups for the minimally invasive video-assisted  
6 thyroidectomy (MIVAT) “Miccoli” technique (1): the clip-  
7 ligation group (CL-G) and the harmonic scalpel group (HS-  
8 G) use. HS-G *vs.* CL-G procedures were notably shorter  
9 (31.4 *vs.* 47.5 min). Mean blood loss was consequently  
10 smaller (12.9 *vs.* 32.8 mL). Mean scar length positively was  
11 shorter (15.6 *vs.* 21.5 mm), with better cosmetic results.  
12 The use of HS was 20–30 euros more expensive. No major  
13 complications were observed in both groups (1).

14 The thyroid surgeon cannot perform a transoral  
15 endoscopic thyroidectomy vestibular approach (TOETVA)  
16 with the hand ligation of the vessels, both of the mean  
17 thyroid vein, or the superior and inferior thyroid vessels  
18

(2-9). Intraoperative bleeding control cannot be managed  
without the aid of the EBD or clip applier (9-14).  
Furthermore, EBD provide a full range of solutions to  
support every phase of surgery including tissue and vessel  
dissection, sealing, cauterization, and ablation applications.

## EBD for TOETVA

Accurate haemostasis is imperative when working in a  
limited space, such as that encountered in TOETVA  
procedure (2-5). Bleeding may cause conversion to an open  
procedure (6,7). The following sections will explore the  
application and limitations of EBD when used in TOETVA.

**HARMONIC ACE® +7 Shears with Advanced Hemostasis**  
**(Johnson & Johnson, New York, NY, USA)**

HARMONIC ACE® +7 Shears is the ultimate refined



Figure 1 XXXXXX



Figure 2 XXXXXX



Figure 3 XXXXXX



Figure 4 XXXXXX

37 curved blade design, designed to enable visibility  
 38 and fine dissection, with fewer instrument exchanges  
 39 (Figure 1). The refined blade design includes a tapered tip  
 40 with a proprietary, nonstick coating to enable fast, precise  
 41 dissection. This EBD seals vessel sizes up to and including  
 42 7 mm diameter with hand control button. The adaptive  
 43 tissue technology of HARMONIC ACE® +7 Shears enables

greater surgical precision and performance, provides 44  
 critical thermal management by dynamically optimizing 45  
 energy delivery in response to changing tissue conditions. 46  
 This EBD is available in three shaft lengths: 23, 36, and 47  
 45 cm. According to neck length the surgeon will decide 48  
 for the 23 or 36 cm ones. The EBD provides reduced mist 49  
 generation helps maintain endoscopic visibility during 50  
 TOETVA. 51

**ENSEAL® Round Tip Tissue Sealer (Johnson & Johnson, 54  
 New York, NY, USA) 55**

The ENSEAL® Tissue Sealing Device is indicated for 56  
 bipolar coagulation and mechanical transection of tissue 57  
 during both laparoscopic and open procedures (Figure 2). 58

**THUNDERBEAT (OLYMPUS, Tokyo, Japan) 60**

THUNDERBEAT is a both bipolar and ultrasonic 61  
 technology device, i.e., surgeons no longer need to choose 62  
 between rapid dissection and reliable hemostasis when 63  
 selecting an advanced energy device (Figure 3). The EBD 64  
 allows the surgeon to simultaneously seal and cut vessels up 65  
 to and including 7 mm in size with minimal thermal spread, 66  
 with fewer instrument exchanges. The jaw design provides 67  
 precise, controlled dissection and fast available bipolar 68  
 hemostasis without sacrificing grasping ability. The EBD 69  
 provides reduced mist generation helps maintain endoscopic 70  
 visibility during TOETVA. 71  
 72  
 73

**LigaSure™ Maryland jaw (Medtronic, Dublin, Ireland) 74**

LigaSure™ Maryland jaw is a 37 cm laparoscopic sealer 75  
 and divider (code LF1737). This EBD is a multifunctional 76  
 device that delivers efficiency and versatility by combining 77  
 one-step sealing and the functionality of a Maryland 78  
 dissector, atraumatic grasper, and cold scissors with the 79  
 reliability of LigaSure™ technology (Figure 4). The design 80  
 of the LigaSure™ Maryland jaw allows for more efficient 81  
 transection speed with one-step sealing, allows for minimal 82  
 steps when sealing and dividing, and enables reduced 83  
 instrument exchanges. This EBD technology provides a 84  
 combination of pressure and energy to create vessel fusion. 85  
 It permanently fuses vessels up to and including 7 mm in 86  
 diameter and tissue bundles without dissection or isolation. 87  
 Average seal cycle is 2 to 4 seconds, when used with the 88  
 ForceTriad™ energy platform. Feedback-controlled 89  
 response system automatically discontinues energy delivery 90  
 91

92 when the seal cycle is complete, eliminating the guesswork.

93

## 94 **EBD safety**

95

### 96 *Smoke effect*

97

98 EBD in TOETVA may determine two problems during the  
99 procedures: (I) recurrent laryngeal nerve (RLN) thermal  
100 injury; (II) smoke effect which determines unsafe, bad  
101 vision and loss of time. At present is one of the significant  
102 obstacles of EBD use for TOETVA safety, because too  
103 much smoke effect disturb the view during important steps.  
104 “Smoke effect” is always discussed in the operating room  
105 with visiting surgeons. For the smoke effect, it is hard to  
106 prove if HARMONIC is better than THUNDERBEAT  
107 or LigaSure™, because it depends certainly on surgeon  
108 preferences, his perception of dissection and security and  
109 how much use of EBD. Furthermore, the use of one or the  
110 other depends on availability in the operating room and  
111 the lowest economic offered to the administration of the  
112 hospital.

113 The perception is that smoke effect is generally more at  
114 the beginning of TOETVA when creating the workspace,  
115 the air pocket. Probably because the working space is  
116 smaller, and more muscle needs to dissect. Then the  
117 perception is there is less smoke, probably because there is  
118 more working space available and the smoke is dissipated,  
119 and probably because there is less muscle to coagulate, more  
120 anatomical plane.

121 Possible tips to prevent dense smoke effect are: (I) keep  
122 the 5 mm ports valves open; (II) keep the tips of the EBD  
123 clean; (III) work on anatomical planes, **fascia < smoke** than  
124 muscle; (IV) keep CO<sub>2</sub> at maximum flow; (V) when too  
125 much smoke, pull/retract the camera just inside the 10 mm  
126 trocar without going out, waiting for the smoke melts; (VI)  
127 **tried to put needles 19 G in the neck (do not do it, it does**  
128 **not work at all); (VII) **tried to suck from one 5 mm trocar****  
129 **valve, it did not serve anything.**

130

### 131 *EBD around the RLN*

132

133 EBDs are designed to produce minimal temperatures and  
134 thermal spread to surrounding tissues. However EBDs are  
135 associated with inadvertent thermal transfer to surrounding  
136 tissue (15).

137 Recently, authors have alert that the temperature from  
138 EBD may cause laryngeal nerves injury, resulting in vocal  
139 cord palsy (15). Standardized experimental studies proved

that when EBDs are activated near the RLNs, the heat 140  
produced can be conducted through the tissues to the nerve 141  
and cause thermal trauma and risk of permanent function 142  
deficit (15). 143

De facto, thermal injury is the second most common 144  
mechanism of RLN damage after traction injury during 145  
thyroidectomy (15). 146

Furthermore, the effectiveness of saline irrigation 147  
to reduce the chance of nerve root injury during EBD 148  
application has not been investigated, despite irrigation 149  
having been shown to decrease the temperature. 150

## 151 **Conclusions**

152

153  
154 Currently there are no specific studies that evaluate or  
155 compare EBD in TOETVA (8-10). Current EBD developed  
156 meet stringent design specification and performance  
157 requirements for most of laparoscopic or thoracoscopic  
158 procedures. Unfortunately there are no EBDs with  
159 precise design specifications and requirements specifically  
160 developed for the TOETVA procedure (9).

161 The ideal EBD may present low temperatures proprieties  
162 in order not to damage the overlying skin of the airpocket, or  
163 other vital structures such as RLN and parathyroid glands.  
164 The ideal EBD should produce little or no smoke effect  
165 during their application, to maintain perfect endoscopic  
166 view and not to longer the operative time.

167 Considering the wide adaption of TOETVA, a full range  
168 of solutions to support every phase of the thyroid dissection  
169 for access instruments is required (11,12). Endoscopic  
170 thyroidectomy and TOETVA in particular is an exciting  
171 opportunity for improved techniques and accessories to  
172 improve EBD outcomes (13,14).

173 Future perspective for EBD in TOETVA is a  
174 neuromodulation product category that can offer a  
175 comprehensive breadth of technologies and capabilities,  
176 ensuring the surgeon that receives an EBD instruments  
177 superior quality in an efficient, cost-effective, repeatable/  
178 reusable, dissecting, coagulating, cutting and with neural  
179 monitoring capabilities.

180

## 181 **Acknowledgements**

182

None. 183

184

## 185 **Footnote**

186

*Conflicts of Interest:* The authors have no conflicts of interest 187

188 to declare.

189

190 *Ethical Statement:* The protocol, site-specific informed  
191 consent forms, participant education and recruitment  
192 materials, and other requested documents and any  
193 subsequent modifications were reviewed and approved by  
194 the **ethical review bodies**. Informed consent was obtained  
195 from all individual participants included in the study.

196

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