

# **Protective Effects of Intraoperative Nerve Monitoring (IONM) for Recurrent Laryngeal Nerve Injury in Thyroidectomy: Meta-analysis**

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**Appendix Table 1.** Incidence of total, transient and permanent RLN injury

Study	Patients, NAR		Total RLN injury		Transient RLN injury		Permanent RLN injury	
	IONM	Non-IONM	IONM	Non-IONM	IONM	Non-IONM	IONM	Non-IONM
Brauckhoff <sup>50</sup>	91	78	1	3	1	2	0	1
Thomusch <sup>2</sup>	2483	4650	41	136	32	99	9	37
Dralle <sup>5</sup>	17832	5517	626	193	483	144	143	49
Robertson <sup>3</sup>	116	120	5	8	4	5	1	3
Yarbrough <sup>4</sup>	72	79	11	11	9	8	2	3
Witt <sup>34</sup>	83	107	6	4	4	3	2	1
Chan <sup>6</sup>	501	499	21	26	17	20	4	6
Netto <sup>35</sup>	169	158	12	12	6	7	6	5
Shindo <sup>36</sup>	671	372	13	7	11	6	2	1
Terris <sup>37</sup>	92	84	4	5	4	5	0	0
Atallah <sup>38</sup>	181	240	16	22	9	13	7	9
Barczynski <sup>51</sup>	1000	1000	27	65	19	38	8	12
Dionigi <sup>39</sup>	55	57	1	3	1	3	0	0
Frattini <sup>40</sup>	152	152	4	7	2	6	2	1
Sari <sup>41</sup>	146	140	3	3	3	3	0	0
Barczynski <sup>42</sup>	302	302	9	20	6	15	3	5
Alesina <sup>8</sup>	128	161	8	5	8	4	0	1
Gremillion <sup>43</sup>	41	121	2	4	2	3	0	1
Chuang <sup>44</sup>	70	15	NS*	NS*	NS#	NS#	1	3
Prokopakis <sup>45</sup>	60	61	1	6	1	6	0	0
Alesina <sup>46</sup>	553	1155	17	34	15	31	2	3
Barczynski <sup>14</sup>	500	826	20	72	13	52	7	20
De Falco <sup>47</sup>	600	600	5	13	1	8	4	5
Sanguinetti <sup>48</sup>	210	490	9	17	9	13	0	4
de Danschutter <sup>49</sup>	85	85	2	8	2	2	0	6
Page <sup>15</sup>	612	922	22	24	16	18	6	6
Anuwong <sup>10</sup>	1545	698	91	59	74	47	17	12
Brajcich <sup>21</sup>	531	517	NS*	NS*	NS#	NS#	4	3
Calo <sup>22</sup>	2712	2018	32	29	25	21	7	8
Hei <sup>11</sup>	47	60	1	1	1	1	0	0
Lv <sup>23</sup>	156	185	2	14	2	14	0	0
Vasileiadis <sup>24</sup>	2962	2150	19	71	15	51	4	20
Xie <sup>25</sup>	98	69	6	9	5	7	1	2
Kai <sup>26</sup>	455	381	8	18	6	14	2	4
Total	35311	24069	1045	909	806	669	244	231

Incidence	-	-	3.01%	3.86%	2.32%	2.84%	0.69%	0.96%
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Abbreviation: NS, not stated.

\* Total RLN injury referred to all postoperative RLN injury, including transient and permanent injury. The total RLN injury in studies, without data of transient injury, were also considered as NS.

**Appendix Table 2.** Details about factors of concern, population type, multicenter or single center and NOS score.

Author	Factors of concern			Operation type*	Multicenter or single center	Newcastle-Ottawa Scale		
	Bilateral procedure	Re-operation	Mali-gnancy			Selection	Comparability	Outcome
Brauckhoff <sup>50</sup>				Open	Single center	4	1	2
Thomusch <sup>2</sup>	√			Open	Multicenter	4	1	3
Dralle <sup>5</sup>	√	√	√	Open	Multicenter	4	1	3
Robertson <sup>3</sup>				Open	Single center	4	1	2
Yarbrough <sup>4</sup>		√		Open	Single center	4	1	2
Witt <sup>34</sup>				Open	Single center	4	0	3
Chan <sup>6</sup>		√	√	Open	Single center	4	2	3
Netto <sup>35</sup>				Open	Single center	4	2	2
Shindo <sup>36</sup>				Open	Single center	4	1	2
Terris <sup>37</sup>				Endoscopic	Single center	4	1	3
Atallah <sup>38</sup>				Open	Single center	4	1	3
Barczynski <sup>51</sup>				Open	Single center	4	2	3
Dionigi <sup>39</sup>				Endoscopic	Single center	4	2	2
Frattini <sup>40</sup>	√		√	Open	Single center	4	2	3
Sari <sup>41</sup>				Open	Single center	4	2	3
Barczynski <sup>42</sup>	√		√	Open	Single center	4	2	3
Alesina <sup>8</sup>		√		Open	Single center	4	1	3
Gremillion <sup>43</sup>				Open	Single center	4	1	1

Chuang <sup>44</sup>		√		Open	Single center	4	1	1
Prokopakis <sup>45</sup>		√		Open	Single center	4	1	2
Alesina <sup>46</sup>				Open	Single center	4	2	3
Barczynski <sup>14</sup>		√		Open	Single center	4	0	3
De Falco <sup>47</sup>	√			Open	Single center	4	1	3
Sanguinetti <sup>48</sup>	√			Open	Single center	4	0	2
de Danschutter <sup>49</sup>				Open	Single center	4	2	3
Page <sup>15</sup>	√			Open	Single center	4	1	3
Anuwong <sup>10</sup>				Open	Single center	4	0	3
Brajcich <sup>21</sup>	√	√	√	Open	Single center	4	1	3
Calo <sup>22</sup>	√	√	√	Open	Single center	4	2	3
Hei <sup>11</sup>			√	Endoscopic	Single center	4	1	3
Lv <sup>23</sup>				Endoscopic	Single center	4	1	3
Vasileiadis <sup>24</sup>	√			Open	Single center	4	2	3
Xie <sup>25</sup>			√	Endoscopic	Single center	4	2	3
Kai <sup>26</sup>				Open	Single center	4	2	3

\* Operation type was divided into two type: open operation and endoscopic surgery (minimally invasive surgery and total endoscopic surgery).

**Appendix Table 3.** Meta-analysis of subgroups based on factors of concern.

Subgroups	IONM		Non-IONM		RR [95% CI] or RD [95% CI]	p value	Number of studies
	Events	overall NAR	Events	overall NAR			
<b>Bilateral procedure</b>							
Total injury	157	10746	351	11667	0.57 [0.37, 0.87]	0.0086	9
Transient injury	115	10746	247	11667	0.57 [0.36, 0.91]	0.0182	9
Permanent injury	115	22817	123	16502	0.68 [0.46, 0.99]	0.0433	11
<b>Reoperation</b>							
Total injury	48	908	104	1203	0.64 [0.33, 1.24]	0.1843	7
Transient injury	37	908	75	1203	-0.0113 [-0.0502, 0.0276]*	0.5687	7
Permanent injury	44	1902	42	1565	-0.0082 [-0.0176, 0.0013]*	0.0906	9
<b>Malignancy</b>							
Total injury	41	1579	57	1307	0.61 [0.41, 0.91]	0.0163	6
Transient injury	31	1579	44	1307	0.61 [0.38, 0.97]	0.0355	6
Permanent injury	34	2837	20	1824	-0.0008 [-0.0061, 0.0046]*	0.7801	8
<b>Operation sites per year &lt; 300</b>							
Total injury	272	6463	353	6657	0.78 [0.63, 0.97]	0.0271	20
Transient injury	209	6463	265	6657	0.79 [0.63, 0.99]	0.0454	20
Permanent injury	68	7064	94	7189	-0.0012 [-0.0041, 0.0016]*	0.4003	22
<b>Operation sites per year ≥ 300</b>							
Total injury	92	7484	195	6258	0.49 [0.26, 0.93]	0.0292	5
Transient injury	69	7484	131	6258	0.52 [0.25, 1.12]	0.0962	5

	Permanent injury	23	7484	49	6258	0.46 [0.23, 0.91]	0.0247	5
Permanent injury definition >6 months and laryngoscopy as measurement								
	Permanent injury	232	33756	210	22518	-0.0025[-0.0040, -0.0011]*	0.0005	24

\* Data was presented as RD [95% CI] because of studies without any event in either IONM or non-IONM.