



BMJ Open Comparison of clinical practice of tonsil surgery from quality register data from Sweden and Norway and one clinic in Denmark

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ABSTRACT

Objectives To compare the application of indications, demographics, surgical and haemostatic techniques in tonsil surgery in three countries.

Design Non-randomised, prospective, observational cohort.

Setting All patients registered in the National Tonsil Surgery Quality Registers in Sweden, Norway and West Jutland, Denmark.

Participants Data were retrieved from 2017 to 2019; registered surgeries: Sweden: 20 833; Norway: 10 294 and West Jutland, Denmark: 505.

Results Tonsil surgery for obstruction was twice as common in Sweden (62.2%) compared with Norway (31%) and Denmark (27.7%). Recurrent tonsillitis was registered twice as frequently in Norway (35.7%) and Denmark (39%) compared with Sweden (16.7%). Chronic tonsillitis was registered more frequently in Norway (29.8%) than in Sweden (13.8%) and Denmark (12.7%). Day surgery (>76%) was comparable. The higher frequency of obstruction in Sweden affected age and gender distributions: Sweden (7 years, 50.4% boys), Norway (17 y, 42.1%) and Denmark (19 y, 38.4%). For obstructive disorders, tonsillotomy with adenoidectomy was used in a majority of Swedish children (72%), whereas tonsillectomy with or without adenoidectomy dominated in Norway (53.5%) and Denmark (57.9%). Cold steel was the technique of choice for tonsillectomy in all three countries. For tonsillotomy, hot dissection techniques dominated in all countries. Disparities were observed with regard to haemostatic techniques. Bipolar diathermy was commonly used in all countries. Monopolar diathermy was practically only used in Sweden. Infiltration with epinephrine in the tonsillar bed was registered in Sweden and Norway but not at all in Denmark. Combined cold surgical and cold haemostatic techniques were more commonly used in Sweden (22.7%) than in Norway (10.4%) and Denmark (6.2%).

Conclusions This study demonstrates disparities among the Nordic countries in tonsil surgery in terms of indications plus surgical and haemostatic techniques. Increased coverage and further monitoring of outcomes is needed to identify best practices and ideal guidelines for improved care.

Strengths and limitations of this study

- A Nordic Tonsil Surgery Quality register has been established in Sweden, Norway and Denmark using the same questions and definitions of indicators.
- The tonsil quality register in Sweden is established since 2009 with an 80% coverage while the registers in Norway and Denmark are still in start-up phase with lower coverage.
- When collecting data according to a mutual standard, analyses and comparison between the three countries tonsil surgery care processes are possible.
- For comparison of clinical practices for different patient groups, patients were categorised according to the surgical method and indication used.
- This study compares the use of indication, surgical methods and surgical techniques only.

INTRODUCTION

Tonsil surgery is a commonly used surgical procedure; however, the literature has demonstrated a large variation in clinical practice. Disparity in the incidence of tonsil surgery reflects the uncertainty of the indications.¹ There are differences in surgical methods, especially the practice of tonsillotomy (TT) vs tonsillectomy (TE) for upper airway obstruction but also regarding surgical techniques for removal of the tonsils and methods to control perioperative haemorrhage.^{2,3}

There is a need for more objective knowledge regarding the best practices for safe and efficient care of patient groups treated with tonsil surgery. There is a common understanding that randomised, controlled trials and subsequent meta-analyses provide the best evidence for comparison of efficacy. However, well-designed cohort studies have been demonstrated to provide additional knowledge, especially regarding mapping of the clinical practice used, comparison of complications and identification of rare events.

In Sweden, a quality registry for tonsil surgery, the National Tonsil Surgery Register in Sweden (NTSRS), has been operational since 1997 to monitor local clinical practices, identify areas for improvement and be used for research.⁴ Since 2016, quality registers monitoring tonsil surgery have been established nationally in Norway and in Denmark one clinic, but more clinics are joining in 2022. The registries comply with the same definitions (with some local additions) and use the same structure and questionnaires used as the NTSRS, thus enabling comparison of larger cohorts and among patients from the three different Nordic countries.⁵

The healthcare systems in Sweden, Denmark and Norway are primarily funded by the government. Ear, nose and throat care is offered by public and private care providers to different extents among the countries. In Sweden, approximately 95% of ears, nose and throat (ENT) care is provided through public care, and private care predominates in Stockholm and major cities. In Norway, approximately 75% of patients undergo surgery in public hospitals, and 25% of patients undergo surgery in private care. In Denmark, approximately 50% of the tonsil surgery procedures are performed in public care and 50% in private care. Since the care provided is primarily from government funds in all three countries, the governing bodies often require participation in quality registries.

From the EU official statistics website,⁶ data on the number TE and population are available. The calculation of incidence demonstrates large variation in the incidence rate for TE among the Nordic countries. The incidence rate was 125.4 tonsil surgeries per 100 000 in Sweden, while the incidence rate was 156.85 in Norway and 75.69 in Denmark for the period of 2017–2018.

A national clinical guideline for tonsil surgery from 2016 offers recommendation for both the indications for surgery, choice of surgical technique and on inpatient or outpatient surgery in Denmark.⁷ In Sweden the recommendation from Denmark is informally applied, however updated national guideline exists. In Norway the Paradise criteria for tonsil surgery are applied. Overall TT is primarily used for hypertrophy/obstruction in children and TE for chronic or recurrent tonsillitis and with peritonsillar abscess as TE á chaud.

This study compares data from two national and one local tonsil surgery registries using the same definitions and questionnaires. The aim of the study was to compare the application of indications and the characteristics of the demographics, as well as the use of surgical methods, surgical techniques and haemostatic techniques in tonsil surgery in Sweden, in Norway and at one clinic in Denmark.

MATERIALS AND METHODS

Variables collected

This study was a prospective study with comprehensive cohorts from the NTSRS and Norway and one clinic at Regional Hospital West Jutland, Denmark. The same

variables and structure for collection were used for all of the quality registries. Data were retrieved through three questionnaires in the registries, but for this study, only data from the first questionnaire were used. The included variables are presented in table 1. Descriptions of the complete quality registry have been published.⁵

The first questionnaire was completed by professionals and included data on patient demographics, indications for surgery, surgical methods and techniques used to remove the tonsils and to achieve haemorrhage control. Indications registered included tonsil hypertrophy with obstructive symptoms, recurrent tonsillitis, chronic tonsillitis, peritonsillitis and other (table 1). Obstruction here is the same as obstructive sleep-disordered breathing, meaning problems during sleep due to an obstruction of the upper airways, and they can range from snoring to sleep apnoea syndrome. In Denmark, foeter ex ore was also available as an option according to the Danish Health Authority.⁷ In Sweden and Norway, guidelines do not recognise foeter ex ore as a single indication for tonsil surgery, although it can be included in chronic tonsillitis.^{8,9} Quinsy tonsillectomies are not included.

Surgical methods include TE or TT with or without adenoidectomy (A), that is, TT, TTA, TE and TEA. The surgical techniques recorded were removal of tonsils with cold steel, radiofrequency, bipolar diathermy scissors and other techniques, including dissection with bipolar diathermy, ultracision. Solitary registration of the technique was required to include each technique, and all combinations using several techniques were recorded as others.

For haemostasis, any techniques beside compression of the tonsillar area were registered: bipolar diathermy, monopolar/unipolar diathermy, infiltration with epinephrine and radiofrequency. Other haemostatic techniques included ties, suture ligation, other techniques or combinations of techniques.

For specific comparison of clinical practices, patients were categorised according to the surgical method and indication used. This division created four surgical method-indication groups in the paediatric (<18 years old) population: TT obstruction, TTA obstruction, TEA obstruction and TEA recurrent tonsillitis. The four surgical method-indication groups in the adult population were TE obstruction, TE recurrent tonsillitis, TE chronic tonsillitis and TE peritonsillitis.¹⁰ We compared the number of patients in the groups and the mean age and sex distribution among the countries. We also compared surgical techniques and techniques registered for haemostatic control in the surgical method-indication groups among the different cohorts per country.

In 2015, the results from an extended adjusted multi-variable analysis on NTSRS data showed that both cold dissection with hot haemostasis (unipolar and bipolar diathermy) and hot dissection (bipolar scissors, coblation, ultracision) and thus per se hot haemostasis were associated with a significantly higher OR for 'admission due to bleeding' than purely cold techniques for surgery.¹¹

Table 1 Variables registered in the nordic tonsil quality registers with definitions

Variable	Definition
Date of birth	
Date of surgery	
Indication for surgery	
Airway obstruction/snoring/hypertrophic tonsils	Tonsils cause breathing disorder during sleep
Recurrent tonsillitis	At least three episodes of acute tonsillitis during the last 12 months
Peritonsillar abscess	Peritonsillar abscess or peritonsillitis warranting emergency operation or history of peritonsillar abscesses/peritonsillitis
Chronic tonsillitis	Prolonged inflammation of the tonsils (at least 3 months) affecting daily activities
Other	Free field to register other indications
Surgical unit	
Day case surgery	No admission overnight
Overnight surgery	Prearranged overnight admission
Type of surgery	
Primary surgery	No previous tonsil surgery performed
Revision surgery	Tonsillectomy or tonsillotomy performed previously
Extent of surgery	
Tonsillectomy only	Extracapsular removal of tonsils
Tonsillectomy and adenoidectomy	Extracapsular removal of tonsils and removal of adenoids
Tonsillotomy only	Partial removal of tonsils
Tonsillotomy and adenoidectomy	Partial removal of tonsils and removal of adenoids
Surgical technique	
Cold steel	Procedure performed with cold instruments only, for example, knife, scissors or elevatorium
Radiofrequency	Radiofrequency energy is used for cutting and coagulation
Diathermy scissors	Procedure performed with bipolar diathermy scissors, which can simultaneously cut and coagulate
Ultracision	Procedure performed with instrument, which simultaneously cuts and coagulates using ultrasonic vibration
Dissection with bipolar diathermy	Tonsils are dissected using bipolar diathermy
Other	Free field to register other techniques
Technique for haemostasis	
Infiltration with local anaesthetic and adrenalin	Haemostasis achieved with epinephrine vasopressor effect
Monopolar diathermy	Heat coagulation of the vessels using monopolar diathermy
Bipolar diathermy	Heat coagulation of the vessels using bipolar diathermy
Ligature	Suture used to stop haemorrhage
Suture ligature	Suture with needle used to stop haemorrhage
Radiofrequency	Haemostasis achieved using radiofrequency instruments
None	Haemostasis achieved with compression only
Other	Free field to register other techniques
Primary haemorrhage requiring intervention (yes/no)	Any haemorrhage requiring intervention during initial hospital stay

Therefore, in this study, the surgical techniques were categorised into the following groups: cold/cold (cold dissection with cold haemostasis), cold/hot (cold dissection with hot haemostasis), and hot/hot (hot dissection with hot haemostasis).

The National Tonsil Surgery Register in Sweden

The NTSRS was commissioned in 1997 by the Swedish Association for Otorhinolaryngology Head and Neck Surgery,

and it is funded by the Swedish Association of Local Authorities and Regions. The registry was revised in 2009 according to the design and definitions used by the Nordic group today. The results from the registry are updated daily and available online at <https://ton.registercentrum.se>. In Sweden, there are two national guidelines for tonsil surgery^{8,12} and one study showing high agreement between registry data and electronic medical records.¹³

The Norwegian National Tonsil Surgery Register

The Norwegian Tonsil Surgery Register was commissioned by the Norwegian Association for Otorhinolaryngology Head and Neck Surgery. In September 2016, the Ministry of Health and Care Services in Norway accredited the Norwegian Tonsil Surgery Register as a national registry. Inclusion in the registry started in 2017. From September 2019, all surgeons were obliged to report to the registry by the law. A paper demonstrating the high reliability of the variables in the first questionnaire was published.¹⁴ The results from the registry are available online at <https://www.kvalitetsregistre.no>. National guidelines for tonsil surgery in Norway have been published.⁹

The Tonsil Register of the Central Region in Denmark

The Danish Tonsil Surgery Register was first commissioned on 1 September 2017, at the Ear-Nose-Throat Department, Regional Hospital West Jutland. Written informed consent to register from the patient or the parents is mandatory. A paper was published describing the implementation of the registry and high reliability of the data in the registry.¹⁵ A national guideline has been published for tonsil surgery in Denmark.⁷

Statistics

Data are presented with regular descriptive statistics.

Patient and public involvement

No patient involved.

RESULTS

Data were retrieved from the three registries from a 2-year period: 30 September 2017 to 1 October 2019. The number of surgeries registered was 20 833 from Sweden, 10 294 from Norway and 505 from the Regional Hospital West Jutland, Denmark. The mean coverage rate for the period from 2017 to 2019 was 80.5% in Sweden, 48.7% in Norway and 58.4% from the West Jutland clinic in Denmark.

The demographics and main indications for benign tonsillar surgery, as well as the level of care for the surgeries, are described in [table 2](#). The distribution of indications for surgery demonstrated large differences, with obstruction twice as common in Sweden (62.2%) compared with Norway (31%) and the clinic in Denmark (27.7%). Correspondingly, infection-related indications were more frequent in Norway and Denmark than in Sweden. Infectious indications used in the registry included recurrent tonsillitis, chronic tonsillitis or peritonsillitis. Recurrent tonsillitis was registered twice as frequently in Norway (35.7%) and Denmark (39%) as in Sweden (16.7%). The indication of peritonsillitis was used more frequently for surgery in Denmark (7.1%) than in Sweden (5.2%) and Norway (1.8%). Chronic tonsillitis was more frequently registered in Norway (29.8%) than in Sweden (13.7%) and Denmark (12.7%). Foeter ex ore is available as an indication only in the Danish registry. In Denmark (West Jutland clinic), 9.9% of the patients

Table 2 Use of indications, level of care and demography from Sweden

	Total (n=31 632)	Sweden (n=20 833)	Norway (n=10 294)	West Jutland, Denmark (n=505)
Main indication				
Obstruction	16 278 (51.5%)	12 953 (62.2%)	3185 (31.0%)	140 (27.7%)
Recurrent tonsillitis	7350 (23.3%)	3489 (16.7%)	3664 (35.7%)	197 (39.0%)
Peritonsillitis	1310 (4.1%)	1090 (5.2%)	184 (1.8%)	36 (7.1%)
Chronic tonsillitis	5993 (19.0%)	2867 (13.8%)	3062 (29.8%)	64 (12.7%)
Other indication	615 (1.9%)	434 (2.1%)	164 (1.6%)	17 (3.4%)
Foeter ex ore	50 (0.2%)	0	0	50 (9.9%)
Missing	36	0	35	1
Sex				
Male	15 020 (47.5%)	10 489 (50.3%)	4337 (42.1%)	194 (38.4%)
Female	16 612 (52.5%)	10 344 (49.7%)	5957 (57.9%)	311 (61.6%)
Age at surgery	14.2 (12.6)	13 (12.5)	16.3 (12.2)	20.8 (13.2)
Mean (SD)/median (Min; Max)	9 (0; 88)	7 (0; 88)	17 (0; 80)	19 (1; 68)
N	n=31 632	n=20 833	n=10 294	n=505
Level of care				
Outpatient	24 234 (77.7%)	15 942 (78.1%)	7897 (76.8%)	395 (78.2%)
Inpatient	6971 (22.3%)	4482 (21.9%)	2379 (23.2%)	110 (21.8%)
Missing	427	409	18	0

Norway and Denmark for tonsillectomy and tonsillotomy with or without adenoidectomy.

Table 3 Categorisation according to surgical method and indication created eight different groups with different characteristics in gender and age, in addition to indication and use of surgical method. TT=tonsillotomy, TTA=Tonsillotomy+adenoidectomy, TE=Tonsillectomy, TEA=Tonsillectomy+adenoidectomy

Surgical method - Indication	Sweden (n=20 833)	Norway (n=10 294)	West Jutland, Denmark (n=505)
TT obstruction	n=918	n=376	n=21
Mean age	10 (9.6)	8.23 (9.59)	13.3 (10.1)
Median age (min-max)	6 (1; 68)	5 (1; 62)	10 (1; 38)
Female	417 (45.4%)	151 (40.2%)	12 (57.1%)
TTA obstruction	n=8417	n=1104	n=54
Mean age	4.81 (2.99)	4.31 (2.76)	5.50 (4.74)
Median age (min-max)	4 (0; 58)	4 (1; 39)	4 (1; 27)
Female	3559 (42.3%)	458 (41.5%)	22 (40.7%)
TEA obstruction	n=2238	n=1102	n=14
Mean age	6.13 ^{5 6}	4.93 (3.83)	12.9 (9.4)
Median age (min-max)	5 (0; 64)	4 (1; 42)	11.5 (3; 31)
Female	988 (44.1%)	491 (44.6%)	8 (57.1%)
TEA recurrent tonsillitis	n=552	n=626	n=27
Mean age	7.63 (5.10)	5.60 (4.46)	11.4 (7.2)
Median age (min-max)	6 (1; 40)	4 (1; 39)	10 (3; 26)
Female	281 (50.9%)	292 (46.6%)	21 (77.8%)
TE obstruction	n=1380	n=603	n=49
Mean age	22.1 (13.5)	18.6 (13.4)	26.6 (10.4)
Median age (min-max)	20 (1; 83)	17 (2; 72)	26 (3; 60)
Female	584 (42.3%)	265 (43.9%)	23 (46.9%)
TE Chronic tonsillitis	n=2598	n=2808	n=53
Mean age	24.7 (11.1)	23.4 (10.4)	28 (13.5)
Median age (min-max)	22 (2; 83)	21 (2; 80)	23 (7; 65)
Female	1697 (65.3%)	1904 (67.8%)	37 (69.8%)
TE recurrent tonsillitis	n=2900	n=3011	n=169
Mean age	20.9 (10.3)	20.4 (9.5)	20.9 (10)
Median age (min-max)	20 (2; 66)	19 (2; 67)	19 (4; 61)
Female	1885 (65.0%)	2029 (67.4%)	117 (69.2%)
TE peritonsillitis	n=1079	n=178	n=34
Mean age	29 (13.6)	29.1 (15.2)	28.8 (17.6)
Median age (min-max)	26 (2; 75)	25 (0; 79)	22.5 (4; 68)
Female	534 (49.5%)	98 (55.1%)	17 (50.0%)

TE, tonsillectomy; TEA, Tonsillectomy and Adenoidectomy; TT, tonsillotomy; TTA, Tonsillectomy and Adenoidectomy.

underwent surgery with this indication. If foeter ex ore is regarded as a symptom of chronic tonsillitis, the chronic tonsillitis group increased to 22.6% in West Jutland.

The implementation of day surgery (>76%) was comparable among the three countries (see [table 2](#)).

The high frequency of the indication obstruction in Sweden had an impact on the age and gender distribution. In Sweden, the median age was 7 years old, compared with 17 years old in Norway and 19 years old in Denmark. In Sweden, the proportion of boys operated on was 50.4%, compared with 42.1% in Norway and 38.4% in Denmark.

The demography of the patient groups is described for surgical method-indications categories in [table 3](#). The use of TT for obstructive indication was registered in all three countries but with different utilisation rates related to TT or TTA compared with TE or TEA. The usage of TT or TTA for obstruction as a proportion of all surgeries for obstruction (including TE and TEA) was 72% in Sweden, 46.5% in Norway and 42.1% in Denmark. Patients operated on for obstructive indications were typically of preschool age, and more boys underwent surgery for obstruction than girls ([table 3](#)).

Among the infectious indications, TE recurrent tonsillitis and TE chronic tonsillitis were the most common groups for surgery in all countries. TE recurrent tonsillitis was the largest group with a slight margin, constituting 40.6%, 45.5% and 59.7% of the patients operated on for infectious indications in Sweden, Norway and Denmark, respectively. In the second largest group, TE chronic tonsillitis constituted 36.4% of all patients operated on for infectious indications in Sweden. The corresponding data in Norway and Denmark were 42.4% and 18.7%, respectively. The third largest patient group was TE peritonsillitis, registered for 5.2% of the patients in Sweden, 1.8% in Norway and 7.1% in Denmark. The use of TE *à chaud* was registered for 284 (1.7%) of the patients in Sweden and 78 (0.8%) in Norway. There were few patients in the TEA recurrent tonsillitis group in all countries. The demographics of patients operated on for infectious indications were comparable in all countries. The patients were typically adolescents, and more female patients underwent surgery than male patients (table 3).

The use of the surgical methods and techniques for dissection of the tonsils are listed in table 4. Cold steel was predominately used for TE in all three countries. In Sweden and Denmark, cold steel was used to a greater extent for TE and TEA than in Norway, where approximately 23% of TE cases are performed with bipolar diathermy scissors. The hot technique seems to be the preferred technique for TT and TTA. In Sweden, radiofrequency is dominant; in Norway, bipolar scissors were used in 41% of the cases of TT/TTA. At the participating hospital in Denmark, a few TT and TTA procedures were registered (n=79), and most of them were performed with the radiofrequency technique. In Norway, large proportions (>25%) of TE chronic tonsillitis and TE recurrent tonsillitis were registered using another technique for dissection of the tonsils. Almost all of these registrations were cold steel consorted with diathermy or radiofrequency techniques.

The solitary techniques used for haemostasis are listed in table 5, and combinations of techniques are in the "other" category. After performing TE/TEA, the dominant solitary technique for haemostasis was bipolar diathermy in all three registries. Monopolar diathermy was only registered in Sweden and Norway for TE/TEA. Additionally, the use of infiltration of ephedrine in the tonsillar bed was registered only in Sweden and Norway and not at all in Denmark. In Denmark, the use of ties or suture ligatures was registered as the only haemostasis method for 17.2% (n=63) of the patients. The corresponding figures in Norway and Sweden were 4.1% (n=415) and 2.4% (n=496), respectively.

After TTA, the use of radiofrequency for removal of the tonsil tissue was also used for haemostasis for 74.6% (n=6322) of the patients in Sweden compared with 3.5% (n=40) in Norway and 7% (n=4) in West Jutland. In Norway, the most common haemostasis technique after TTA was bipolar diathermy (70%, n=799), and in West Jutland, only 12 registrations had any type of haemostasis

registered. The second most common haemostasis technique in Sweden after TTA was bipolar diathermy (21.7%, n=1554).

The use of warm, cold, surgical and haemostatic techniques is presented in table 6. In all three countries, cold dissection with hot haemostasis dominates TE and TEA. The use of both cold surgical and cold haemostatic techniques is more commonly used in Sweden (22.7%) than in Norway (10.4%) and Denmark (6.2%). For TT and TTA, warm dissection dominates due to the use of radiofrequency techniques in Sweden and bipolar diathermy scissors in Norway.

DISCUSSION

The comparison of the two national registries in Sweden and Norway and one regional registry in Denmark demonstrates large differences in the utilisation of indications, surgical methods and surgical techniques in tonsil surgery.

The indications seem to be applied differently even if the guidelines in all three countries are based on the same scientific evidence. These differences are likely due to local traditions, where Sweden has spearheaded the use of TT for obstruction and today this patient group dominates compared with Norway and the clinic in Denmark where a selection bias must be considered, due to small sample size.

In Sweden, obstructive sleep-disordered breathing was registered twofold more often than in Norway and Denmark. Instead, infectious indications dominated in Norway and Denmark. The preponderance of surgery for obstruction in Sweden caused several differences in the comparison of clinical practices. First, in Sweden, 72% of all surgeries performed due to obstruction were TT or TTA, and the remaining proportion was TE or TEA, while the corresponding proportion for TT/TTA was 46.5% in Norway and 42.1% in Denmark. Second, the dominant use of TT/TTA for obstruction affected the gender and age distributions: Sweden (7 years old, 50.4% boys), Norway (17 y, 42.1% boys) and Denmark (19 y, 38.4% boys). Previous research has shown that typically male preschool children are operated on for obstruction, while female adolescents are more prone to being operated on for infectious indications. In Sweden, TT is predominantly performed using radiofrequency, but some surgeons in Sweden and more clinicians in Norway use bipolar diathermy scissors for TT procedures. Additionally, solitary cold steel was registered for TT in Sweden and Norway but not in Denmark.

It has been demonstrated that TT emerged in Sweden after the turn of the millennium with a significant increase since 2006,¹⁶ propelled by Hultcrantz *et al* pioneering research.¹⁷ Since 2011, Swedish national guidelines have recommended TT or TTA to be considered as a surgical method for obstructive disorders.¹² The incidence of tonsil surgery doubled in Sweden from 1987 to 2013, mainly due to the increase in obstructive

Table 4 The use of surgical techniques for removal of the tonsils for the surgical method-indication category

	Technique used for dissection of the tonsils											
	Cold steel			Radio frequency			Bipolar diathermy scissors			Other		
	Sweden	Norway	Denmark	Sweden	Norway	Denmark	Sweden	Norway	Denmark	Sweden	Norway	Denmark
	n=10 686	n=6197	n=392	n=6889	n=464	n=35	n=2062	n=2402	n=15	n=1120	n=1231	n=63
Surgical method-indication												
TT obstruction	49 (0.5%)	47 (0.8%)	0 (0.0%)	769 (11.4%)	124 (27.2%)	11 (32.4%)	53 (2.6%)	173 (7.5%)	2 (16.7%)	45 (4.1%)	32 (2.7%)	8 (13.3%)
TTA obstruction	719 (7.1%)	185 (3.2%)	1 (0.3%)	5769 (85.2%)	264 (57.9%)	21 (61.8%)	1105 (54.4%)	441 (19.0%)	0 (0.0%)	792 (72.3%)	214 (18.1%)	32 (53.3%)
TEA obstruction	1972 (19.5%)	814 (13.9%)	10 (3.2%)	95 (1.4%)	8 (1.8%)	1 (2.9%)	96 (4.7%)	174 (7.5%)	1 (8.3%)	69 (6.3%)	106 (9.0%)	2 (3.3%)
TEA recurrent tonsillitis	450 (4.5%)	492 (8.4%)	24 (7.6%)	9 (0.1%)	3 (0.7%)	0 (0.0%)	60 (3.0%)	79 (3.4%)	1 (8.3%)	33 (3.0%)	52 (4.4%)	2 (3.3%)
TE obstruction	1243 (12.3%)	392 (6.7%)	41 (13.0%)	37 (0.5%)	11 (2.4%)	1 (2.9%)	60 (3.0%)	149 (6.4%)	2 (16.7%)	35 (3.2%)	51 (4.3%)	5 (8.3%)
TE chronic tonsillitis	2310 (22.9%)	1801 (30.8%)	52 (16.5%)	65 (1.0%)	22 (4.8%)	0 (0.0%)	162 (8.0%)	686 (29.6%)	1 (8.3%)	50 (4.6%)	299 (25.3%)	0 (0.0%)
TE recurrent tonsillitis	2420 (23.9%)	2002 (34.2%)	154 (48.9%)	11 (0.2%)	23 (5.0%)	0 (0.0%)	402 (19.8%)	592 (25.5%)	5 (41.7%)	52 (4.7%)	394 (33.4%)	10 (16.7%)
TE peritonsillitis	946 (9.4%)	118 (2.0%)	33 (10.5%)	19 (0.3%)	1 (0.2%)	0 (0.0%)	92 (4.5%)	26 (1.1%)	0 (0.0%)	20 (1.8%)	33 (2.8%)	1 (1.7%)
Missing	577	346	77	115	8	1	32	82	3	24	50	3

TE, tonsillectomy; TT, tonsillotomy.

Table 5 Techniques used for haemostasis for category of surgical method-indication group

	Technique for haemostasis														
	Bipolar diathermy					Monopolar diathermy					Radiofrequency				
	Sweden	Norway	Denmark	Sweden	Norway	Denmark	Sweden	Norway	Denmark	Sweden	Norway	Denmark	Sweden	Norway	Denmark
	n=7525	n=6044	n=311	n=738	n=54	n=2	n=728	n=443	n=1993	n=185	n=5	n=9849	n=3568	n=187	
Surgical method-indication															
TT obstruction	237 (3.3%)	234 (4.1%)	3 (1.2%)	16 (2.2%)	3 (6.1%)	0	38 (5.4%)	14 (3.3%)	203 (10.4%)	13 (7.2%)	1 (20.0%)	424 (4.5%)	112 (3.3%)	17 (10.6%)	
TTA obstruction	1554 (21.7%)	709 (12.3%)	5 (2.0%)	363 (49.9%)	4 (8.2%)	1	467 (65.9%)	30 (7.0%)	1659 (84.7%)	38 (21.1%)	4 (80.0%)	4374 (45.9%)	323 (9.5%)	44 (27.3%)	
TEA obstruction	946 (13.2%)	562 (9.7%)	7 (2.8%)	48 (6.6%)	8 (16.3%)	0	34 (4.8%)	76 (17.8%)	38 (1.9%)	4 (2.2%)	0	1172 (12.3%)	452 (13.4%)	7 (4.3%)	
TEA recurrent tonsillitis	210 (2.9%)	358 (6.2%)	24 (9.4%)	15 (2.1%)	1 (2.0%)	0	16 (2.3%)	23 (5.4%)	13 (0.7%)	10 (5.6%)	0	298 (3.1%)	234 (6.9%)	3 (1.9%)	
TE obstruction	783 (10.9%)	337 (5.8%)	36 (14.2%)	32 (4.4%)	2 (4.1%)	0	32 (4.5%)	41 (9.6%)	16 (0.8%)	14 (7.8%)	0	517 (5.4%)	209 (6.2%)	13 (8.1%)	
TE chronic tonsillitis	1351 (18.9%)	1765 (30.6%)	36 (14.2%)	56 (7.7%)	22 (44.9%)	0	34 (4.8%)	81 (19.0%)	18 (0.9%)	44 (24.4%)	0	1139 (12.0%)	896 (26.5%)	17 (10.6%)	
TE recurrent tonsillitis	1462 (20.4%)	1686 (29.2%)	118 (46.5%)	146 (20.1%)	8 (16.3%)	0	62 (8.7%)	158 (37.0%)	5 (0.3%)	56 (31.1%)	0	1225 (12.9%)	1103 (32.6%)	51 (31.7%)	
TE peritonsillitis	617 (8.6%)	116 (2.0%)	25 (9.8%)	51 (7.0%)	1 (2.0%)	0	26 (3.7%)	4 (0.9%)	7 (0.4%)	1 (0.6%)	0	378 (4.0%)	56 (1.7%)	9 (5.6%)	
Missing	365	277	57	11	5	1	19	16	34	5	0	322	183	26	

Most of the registrations under other were cold steel combined with diathermy or radiofrequency techniques.

TE, tonsillectomy; TT, tonsillectomy.

Table 6 The table demonstrates the use of warm, cold surgical and haemostatic techniques for tonsillectomy (TE) and tonsillotomy (TT)

	TE/TEA			TT/TTA		
	Sweden	Norway	Denmark	Sweden	Norway	Denmark
	N=11 304	N=8 748	N=421	N=9 453	N=1 546	N=79
Cold dissection/cold haemostasis	2551 (22.7%)	908 (10.4%)	26 (6.2%)	478 (5.1%)	32 (2.1%)	2 (2.5%)
Cold dissection/warm haemostasis	7284 (64.4%)	4609 (52.7%)	360 (85.5%)	317 (3.4%)	205 (13.3%)	0
Warm dissection	1381 (12.2%)	3228 (36.9%)	25 (5.9%)	8563 (90.6%)	1271 (82.2%)	64 (81.0%)
Other combination	78 (0.7%)	3	10 (2.4%)	95 (1%)	38 (2.5%)	13 (16.5%)

indications, while the use of infectious indications has been constant.¹⁰ According to the authors, the utilisation of TT is increasing in both Norway and Denmark. A Cochrane systematic review suggested that TE or TEA is beneficial for children with obstructive symptoms compared with nonsurgical management,^{17 18} and the use of TT compared with TE reduces complications and might be comparable in outcomes.²

The distinct differences in the application of indications between different healthcare settings are a consequence of the forces driving change management in healthcare. The impetus for change often originates from professional and academic communities rather than top-down communities from governing bodies or authorities.¹⁹ This fact can be a determined force, as in Austria, where the professional community agreed to shift from TE to TT for obstructive disorders after several fatal complications after surgery,²⁰ but most often, the translation dispersal of knowledge is patchy and typically requires up to 17 years,¹⁹ as demonstrated in Germany.²¹

The assorted proportion of registrations in the subgroups among the infectious indications is a reality check on the dilemma with clinical diagnosis. The Paradise criteria are referred to for the indications for surgery in all three countries guidelines, but the Swedish guidelines are phrased so that only three infections can qualify for surgery.⁸ A study confirmed that few patients in Sweden seem to meet the Paradise criteria.^{22 23} However, the criteria cover only recurrent tonsillitis and not surgical indications for chronic tonsillitis. The definitions of recurrent and chronic tonsillitis are clinically arbitrary²⁴ and complex and have been demonstrated to be difficult to recall correctly among clinicians.²⁵

The differentiation between recurrent and chronic tonsillitis is defined in the registry (table 1), but it is still general, and the practice of setting the diagnosis can be subjective and biased by the patient's memory. It is likely that patients can be pooled between the chronic and recurrent tonsillitis groups, rendering the comparison between the groups difficult. Additionally, the WHO ICD-10 system (International Classification of Diseases) does not provide a diagnosis code for recurrent tonsillitis. The codes available are J35 for chronic tonsillitis, J35.1 for hypertrophy of tonsils and J36 for peritonsillar abscess. The quality registry allows for specific registration of recurrent and chronic tonsillitis as diagnosed by

the physician. In Denmark, it is possible to register foeter ex ore (9.9% of the patients operated on) as an indication for surgery but not in Sweden and Norway, clearly demonstrating the varying practices among the countries. However, foeter ex ore can be hidden in the chronic tonsillitis group, but in the Swedish guidelines, solitary foeter ex ore is not recommended for surgery as the main indication. The most likely homogeneous diagnostic group is patients operated on for peritonsillitis. This diagnosis is often diagnosed or confirmed by an ENT doctor, but the results of this study still demonstrate large differences in treatment practices. The largest proportion of patients who underwent surgery for peritonsillitis was diagnosed at the clinic in Denmark (7.1%), while 5.2% were diagnosed in Sweden, and only 1.8% of the patients in Norway had peritonsillitis as an indication for surgery.

This paper is the first study based on a standardised national registry on tonsil surgery in three Nordic countries using the same definitions and structure for the registries. The coverage is greater than 80% in Sweden, but in Norway and the clinic in Denmark, the data in this study cover only approximately half of the patients who undergo surgery in Norway and in West Jutland, constituting a risk of selection bias. In Norway, the coverage gradually increased, and in 2019, the coverage was 65.2%.²⁶ In Denmark a selection bias is seen as the majority of TT in children indicated due to obstruction is performed in private ENT clinics, while most TE are performed in the public clinics. The authors estimate that overall TT and TE procedures are equally divided in Denmark.

Tonsil surgery can be used for two different diseases: tonsillar hypertrophy causing upper airway obstruction or infectious disorders of the tonsils. When analysing the data, we found it beneficial to present the data based on the surgical method-indication groups. This categorisation creates eight subgroups and describes the properties for more homogeneous groups. The demographics demonstrate that the subgroups have different characteristics. It has already been mentioned that TT in patients with obstruction is performed at preschool ages, and the patients are more often male. Patients who underwent surgery for chronic tonsillitis with TE were just slightly older than 20 years of age and were predominantly female. Another group consisting of patients older than 20 was the peritonsillitis group. In this group, both genders were equally distributed. All these differences have an impact

on the complications and possibly the outcomes. We suggest that tonsil studies in the future use the presentation of results based on surgical methods and indications for surgery. Doing so could increase the homogeneity of study populations and thus decrease biases and improve the generalisation between studies.

The use of surgical methods and techniques demonstrates both similarities and differences. TE, in all three countries, is predominately performed with cold steel dissection. There have been few studies performed with possible biases regarding different surgical techniques for TE.³ To achieve haemostasis after TE, compression and bipolar diathermy are the most common techniques in all countries, but only cold haemostasis can be used with success, predominantly in Sweden. There is a need to monitor the use of surgical and haemostatic techniques in tonsil surgery and their effects on complications, for which the tonsil surgery registry was designed, to allow for quality assurance, as well as implications after the introduction of new techniques.

Our study clearly demonstrates unwarranted differences in practices for tonsil surgery regarding indication plus surgical and haemostatic technique applied. In Sweden TT due to obstruction is dominant, while in Denmark and Norway data shows tonsillitis and TE to dominate.

Tonsil surgery can be beneficial for both obstructive and infectious indications, but considering the frequency of tonsil surgery, clear-cut evidence for best practices was expected, however, more evidence for the demarcation of the indications for surgery is needed.^{27 28} Areas of the greatest importance are objective measures for surgical indications and standards for the removal of tonsillar tissue and haemorrhage control.

The initiative to use the same definitions in the Nordic tonsil surgery quality registries and that the clinical practices differ enable the opportunity to further study the consequences of care and to add empirical evidence for the development of best practice guidelines.

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