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Reducing post-tonsillectomy haemorrhage: a multicentre quality improvement programme incorporating video-based cold technique instruction

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ABSTRACT

Objective Data from the Norwegian Tonsil Surgery Register (NTSR) showed large differences between the hospitals in Norway in the readmission rate due to post-tonsillectomy haemorrhage (rrPTH; range, 0%–25%; national average, 8%). Because of these large variations in the rrPTH, we conducted a quality improvement project involving hospitals with good and bad readmission rates.

Methods Seven hospitals with readmission rates greater than 10% and four with rates lower than 5% participated in this project. We recorded videos of ear, nose and throat surgeons from the hospitals with low readmission rates when they performed extracapsular tonsillectomy, and these videos of cold dissection tonsillectomy were used as teaching material for examples of good surgical skills for the other hospitals. After a 2-day workshop, all participants from the hospitals went back to their institutions and prepared local plans to improve their results. We used the Plan–Do–Study–Act model. The primary outcome variable was the patient-reported rrPTH in the NTSR. As secondary goal, we aimed to identify aspects of the tonsillectomy procedure that could help achieve a lower rrPTH.

Results The participating hospitals reduced their rrPTH from 18% at baseline (2017/2018) to 7% in 2020. Six of seven hospitals changed their dissection technique significantly to more use of cold dissection.

Conclusion By learning cold dissection tonsillectomy from surgeons with low rrPTH, it seems possible to decrease the rates of bleeding complications after tonsillectomy. A combination of videos as a teaching tool, new treatment plans, and focus on quality and improvement may effectively improve surgical results. The videos can show details that are difficult to convey in the literature. Quality registers can be used to identify areas requiring improvement and evaluate the effects of changes in practice.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Postoperative haemorrhage after tonsillectomy is problematic and can be dangerous for the patient and lead to increased costs for the healthcare system.

WHAT THIS STUDY ADDS

⇒ Focus on quality improvement and learning the right technique for extracapsular cold dissection tonsillectomy can help lower the readmission rate because of postoperative haemorrhage.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ We need large future registry based-RCTs to help us find an optimal surgical procedure for tonsillectomy.

INTRODUCTION

Systematic national data collection is a prerequisite for gaining new knowledge about tonsillectomy and tonsillotomy. The Norwegian Tonsil Surgery Register (NTSR) is a national quality register that aims to increase the quality of diagnosis and treatment of patients undergoing tonsil surgery in Norway,[1] where approximately 10 000 patients undergo these surgeries annually. The register is based on the National Tonsil Surgery Register in Sweden,[2] and can be used to evaluate the criteria used for surgical treatment, the choice of surgical technique and haemostasis used, and complications after treatment. The establishment of the Nordic Tonsil Surgery Register Collaboration has led to good collaboration among countries, with the common goal of better treatment.[3] The NTSR collects data from three questionnaires: a validated questionnaire filled out by surgeons[4] on the day of surgery and two other forms answered by the patients/caregivers 30 days and 6 months after the surgery. The 30-day questionnaire was validated in 2020.[5] These validation studies showed that the reliability of the NTSR was high for both questionnaires. Thus, the NTSR is an excellent data source for research and a register that provides surgeons the opportunity to continuously evaluate the complications associated with their procedures and to make improvements if needed.

All national medical quality registers in Norway use indicators to measure the quality

and effect of treatment in their corresponding fields.[6 7] The quality indicators in the NTSR are readmission due to bleeding, contact with the health service due to pain, contact with the health service due to infection, and asymptomatic status after 6 months. Thus, surgeons in Norway receive direct feedback from patients regarding complications, which is presented in the form of indicators such as the readmission rate due to post-tonsillectomy haemorrhage (rrPTH).

International research shows that the choice of the surgical technique has a major influence on complications after tonsillectomy, and a change from hot to cold techniques is important in this regard.[8–12] For tonsillotomy, studies have shown that hot and cold techniques produce an equal number of complications.[2 13] However, data from the Swedish tonsil surgery register showed a lower rrPTH when using cold steel in combination with cold haemostasis during tonsillectomy. Postoperative bleeding after tonsillectomy is the most common complication associated with this procedure and may occasionally require acute readmission. In the worst cases, postoperative haemorrhage can have life-threatening consequences.[14 15] The results from Sweden showed that hot techniques were associated with more bleeding than cold technique.[9] Thus, currently, the Swedish national group for tonsil surgery (NAG) and a reference group for the tonsil surgery register in Sweden recommend that tonsillectomy should be performed with cold dissection and cold haemostasis techniques.[16]

In 2013, the Swedish tonsil surgery register conducted a quality improvement project (QIP) focusing on reduction of postoperative bleeding in tonsillectomy. The clinics that participated in the project showed a significant reduction in the number of readmissions due to postoperative bleeding, with the rrPTH reducing from 13% to 7%.[17] The NTSR data in 2017 showed large variations between the hospitals in Norway (range 0%–25%) for the indicator 'Readmission due to bleeding,' where the national average for 2017 was 8%.[18] Considering these large variations in the rrPTH, we decided to conduct a QIP involving hospitals with low and high readmission rates. The primary goal of our project was to reduce the PTH rate and number of readmissions after tonsil operations by making new treatment plans in the participating hospitals and using video recordings as a teaching tool. As secondary goals, we aimed to identify aspects of the tonsillectomy procedure that could help achieve a lower rrPTH.

Materials and methods

Study design

In this study, we used data from NTSR to identify hospitals with high and low rrPTHs in Norway,[18 19] and invited seven hospitals with high rates to participate in the project. We also filmed four experienced surgeons from four hospitals with low rrPTHs while they performed tonsillectomy.[20] These recordings were used as the reference for development of improvement plans by the participating hospitals.

In 2017 and 2018, the four hospitals with the lowest rrPTH in Norway did tonsillectomy with cold instruments. All patients that underwent tonsillotomy were excluded from the study.

We recommended watching the videos, especially those from Førde and Ålesund, which have been among the best hospitals in Norway for 4 years in a row with rrPTHs of approximately 3% in 2020 and 2021. Similar results have also been confirmed in a local study from Ålesund.[21] Data from the annual NTSR reports in 2017, 2019 and 2020 showed that all four hospitals used the same techniques for dissection in this period.[13 18 22]

Participating hospitals and data sources

To identify hospitals with high and low readmission rates due to PTH, we used data from the NTSR for the baseline (2017/2018).[18 19] Seven hospitals with readmission rates greater than 10% and four with rates less than 5% were invited to participate in the project. One of the seven hospitals refused to participate in the study, while another hospital with a high readmission rate requested participation on the basis of local data. Thus, a total of seven public hospitals with high readmission rates were included in the project. At each hospital, the head of the department appointed a surgeon and a nurse who were primarily responsible for the project-related activities during the project period.

We used the Plan–Do-Study–Act–model and invited the participants to a 2-day start-up workshop in January 2019. On the first day video recordings were taken of experienced surgeons from the hospitals with low rrPTHs. The surgeons used their own surgical instruments when they performed the surgery. On the second day, the participants from hospitals with high readmission rates presented how they practiced tonsil surgery in their institutions. The video recordings from the first day of the workshop were studied and given to these participants, who conducted group discussions to identify measures to reduce the rrPTH. After the workshop, the participants went back to their institutions and developed local plans together with their fellow ear, nose and throat (ENT) surgeons and the head of the department to improve their own results. The plan had to be accepted by the local department leader.

The start-up workshop was arranged in January 2019, and the project was completed in December 2020. During the study period, the participating hospitals received NTSR reports regarding the rrPTH at approximately 3-month intervals. The project leaders provided regular support to the participants via phone and email. The reports were produced to maintain the focus on reducing rrPTH at the hospitals and to evaluate if the interventions done at the hospitals had effects on rrPTH. In December 2019, we arranged for a 1-day meeting where the participants reported their local measures and received input from a representative from Sweden, which has shown an

Table 1 Themes of improvement activities—including local plans

Themes of improvement activities—local plan	Tromsø	Namsos	Trondheim	Molde	Gjøvik	Tønsberg	Haugesund
General changes							
Discuss the quality improvement project in staff meetings	X	X	X	X	X	X	X
Use the videos for internal teaching	X	X	X	X	X	X	X
Improve inclusion routines to the register	X	X		X		X	
Review of literature			X				
Training at another hospital							X
Fewer operators performing tonsillectomy			X				
Stricter use of indications for tonsil surgery			X	X			
Changes in surgical procedures							
Increase in the use of cold dissection techniques for tonsillectomy	X	X	X	X	X	X	X
Decrease the use of diathermy for haemostasis		X	X			X	X
More time for compression to achieve haemostasis		X	X	X		X	X
Increase tonsillotomy in children	X						
Order new equipment for cold dissection	X		X	X		X	X
Standardised surgical instruments			X	X		X	

Activities and changes implemented by hospitals as a means to reduce the readmission rate due to post-tonsillectomy haemorrhage.

impressively low readmission rate over time, as evidenced in the Swedish National Tonsil Surgery Register. In the final report, we compared data from 2017/2018 and 2020 to determine if the participating hospitals had improved their readmission rate.[23]

The patients who underwent the procedures documented in the videos used in this study had all been included in the NTSR after obtaining informed written consent.[1] Our study used information from the questionnaire filled out by the surgeon the day of surgery and the questionnaire filled out by the patients 30 days after surgery.[1] The patients reported readmission for PTH in the 30-day questionnaire.

At the end of the project, we used a questionnaire to collect information from participating hospitals. This information was used to summarise the strategies to reduce the rrPTH (table 1).[23]

Outcome variables

The primary outcome variable in this study was the rrPTH reported by the patients in the 30-day questionnaire after discharge from the hospital. The other variables were collected from the questionnaire filled out by the surgeon at the day of surgery and included the indications for surgery, dissection technique and haemostasis technique.[1]

Statistical analyses

Categorical variables are shown as percentages, while continuous variables are presented as means (SD). Fisher's exact test was used to compute the p values between the baseline and follow-up groups. One-sided tests were conducted to check for a reduction in the rrPTH and an increase in the use of cold dissection over hot dissection. Tests were conducted at a 5% significance level and computed by using R statistical software.

RESULTS

Patient data at baseline and follow-up are shown in table 2.

Subanalyses of the patients from 2020 showed that 157 of 937 patients underwent surgery with cold instruments and cold haemostasis. Ninety-nine of these 157 patients completed the 30-day questionnaire after surgery. None of these patients required reoperation because of bleeding, but 4 of the 99 patients had to go to the hospital for observation because of PTH. We also performed subanalyses of the readmission rates among the sexes and found that 5.4% of the women and 9.7% of the men in the seven surgical centres were readmitted to the hospital because of bleeding after tonsillectomy in 2020. Dissection technique for tonsillectomy and the use of hot and cold haemostasis at baseline and follow-up in the participating hospitals are shown in table 3.

The p values in table 3 show a statistically significant increase in the use of cold dissection instead of hot dissection from baseline to follow-up in all except one of the participating hospitals. Table 3 also shows that all hospitals reduce their rrPTH. Three hospitals manage to reduce the rrPTH significantly from baseline to follow-up. Three of the four hospitals that did not manage to reduce the rrPTH significantly continued to use hot dissection to a greater extent during the project.

Table 2 Demographics, dissection and haemostasis for tonsillectomy at baseline and follow-up

Tonsillectomy	Tromsø	Namsos	Trondheim	Molde	Gjøvik	Tønsberg	Haugesund	Total participants
Baseline 2017								
Tonsillectomy cases (n)	40	55	209	65	38	102	133	642
Sex male/female (n)	16/24	20/35	101/108	35/30	11/27	45/57	51/82	279/363
Age males (SD)	12.5 (11.5)	15.6 (13.6)	14.5 (13.2)	18.6 (9.7)	19.9 (16.5)	14.7 (11.6)	14.1 (10.9)	15.1 (12.4)
Age females (SD)	18.2 (9.4)	19.2 (9.5)	16.9 (12.5)	17.3 (7.8)	18.1 (11.1)	20.1 (13.9)	18.7 (11.5)	18.2 (11.7)
Hot dissection (%)	82.5	96.4	95.7	26.2	60.5	100	56.4	78.3
Cold dissection (%)	17.5	3.6	4.3	73.8	39.5	0	43.6	21.7
Cold dissection and haemostasis (%)	2.5	3.6	0.5	0	2.6	0	0.8	0.9
Follow-up 2020								
Tonsillectomy cases (n)	56	89	181	118	138	212	143	937
Sex male/female (n)	20/36	26/63	55/126	42/76	39/99	94/118	65/78	341/596
Age males (SD)	15.0 (10.4)	16.6 (9.1)	19.7 (13.5)	18.7 (10.5)	19.6 (15.3)	17.0 (13.4)	14.9 (10.0)	17.4 (12.4)
Age females (SD)	18.9 (18.1)	21.2 (10.6)	20.0 (11.0)	19.8 (9.6)	23.0 (12.9)	20.1 (11.9)	17.0 (9.8)	20.1 (11.8)
Hot dissection (%)	87.5	65.2	10.5	2.5	35.5	0.5	15.4	21.5
Cold dissection (%)	12.5	34.8	89.5	97.5	64.5	99.5	84.6	78.5
Cold dissection and cold haemostasis (%)	3.6	10.1	37.0	1.1	1.4	23.6	18.9	17.0
P value for change from hot to cold dissection baseline to follow-up	0.84	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Age is presented as mean (SD).

DISCUSSION

In this study, our primary goal was to reduce the rrPTH at the participating hospitals. All seven hospitals reached their goal of decreasing the rrPTH during the project period, and three out of the seven hospitals managed to significantly reduce their postoperative haemorrhage-related readmission rate (table 3). These good results can be attributed to the focus on high quality and

Table 3 Dissection technique, haemostasis and rrPTH at baseline and follow-up

Participating hospitals	Tromsø	Namsos	Trondheim	Molde	Gjøvik	Tønsberg	Haugesund	Total participants
Baseline 2017								
Tonsillectomy cases (n)	40	55	209	65	38	102	133	642
Hot dissection (%)	82.5	96.4	95.7	26.2	60.5	100	56.4	78.3
Cold dissection (%)	17.5	3.6	4.3	73.8	39.5	0	43.6	21.7
Cold dissection and haemostasis (%)	2.5	3.6	0.5	0	2.6	0	0.8	0.9
rrPTH (%)	11.1	18.8	15.2	16.0	25.0	17.9	21.7	17.8
Follow-up 2020								
Tonsillectomy cases (n)	56	89	181	118	138	212	143	937
Hot dissection (%)	87.5	65.2	10.5	2.5	35.5	0.5	15.4	21.5
Cold dissection (%)	12.5	34.8	89.5	97.5	64.5	99.5	84.6	78.5
Cold dissection and cold haemostasis (%)	3.6	10.1	37.0	1.1	1.4	23.6	18.9	17.0
rrPTH (%)	8.3	10.0	6.1	9.0	4.7	5.7	6.3	6.8
P value for change from hot to cold dissection	0.84	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
P value for reduction in rrPTH levels	0.55	0.28	0.042	0.26	0.082	0.026	<0.01	<0.01

rrPTH, readmission rate due to post-tonsillectomy haemorrhage.

improvement, on new treatment plans, the surgical technique and postoperative haemostasis.

The main reason for the reduction in the rrPTH appears to be the change from hot dissection to cold dissection techniques for tonsillectomy. As shown in table 3, six out of seven hospitals who joined the study used essentially hot technique at baseline. While cold instruments were used in an average of 22% of the tonsillectomies performed at the participating hospitals at the time of inclusion in the project, this proportion had increased to 79% at the end of the project. This change in the dissection technique seems to have contributed significantly to the reduction in the average rrPTH from 18% to 7% (table 3).

Importantly, in addition to the dissection technique, the technique used for haemostasis after dissection also had a major influence on the rrPTH. Our analysis showed an increase in the adoption of cold haemostasis techniques from 1% to 17% during the project period. Other studies have confirmed that cold dissection together with cold haemostasis results in less postoperative haemorrhage after surgery in comparison with the outcomes after hot dissection with hot haemostasis.[2 9] The rrPTH and reoperation rates among the patients who underwent cold/cold procedures were 3.6% and 0%, respectively. Therefore, when performing tonsil surgery, it seems meaningful to perform haemostasis without using hot instruments. Although this is the recommendation,[16] many surgeons resort to hot techniques such as bipolar or monopolar diathermy to manage bleeding, since it may be too time-consuming and difficult to stop the bleeding with compression only or other cold methods such as sutures.

The videos from the teaching hospitals in this study showed how to remove the tonsils with cold dissection technique.[20] One hospital used an elevator, and three hospitals used dissection-suction to loosen the tonsils. Two of the hospitals used local anaesthesia with epinephrine because of effects of the local anaesthetic and the vasoconstriction of the supplying blood vessels of the tonsils. This approach yielded a clearer field of operation, less surgical time,[20] less postoperative pain for the patients when waking up[24 25] and may have reduced anaesthetic requirements in general anaesthesia. Dissection-suction is also useful for removing blood from the operative field and allows the surgery to be performed with or without local infiltration of local anaesthesia. Thus, many surgeons prefer to use these types of suction during surgery. Measures to achieve haemostasis used by the teaching hospitals were prolonged compression for approximately 7 min on both sides, occasionally followed by careful use of bipolar diathermy after 7 min of compression. We also observed that the hospital in Ålesund used an artery forceps for direct compression of a bleeding vein and sutures to stop the bleeding (Roeder loop application). Nevertheless, in our QIP, the use of hot haemostasis techniques as bipolar and monopolar diathermy in the participating hospitals reduced from 99.1% to 83% at the end of the project. Six of the seven hospitals significantly changed their dissection technique to include greater usage of cold dissection tonsillectomy, but three hospitals in our project continued with hot dissection to a greater extent than the other four hospitals (table 3).

Table 2 shows that more female patients undergo tonsillectomy than male patients.[23] The reason for this difference among the sexes is unclear. One reason why fewer male patients undergo tonsillectomy might be that boys have a tendency to undergo surgery in childhood; thus, many boys undergo tonsillotomy because it is regarded as a safer procedure in children.[26 27] Most of the patients who undergo tonsillectomy have problems with infections, and do not often show obstructive symptoms. Patients with obstructive symptoms of tonsil hypertrophy seem to be children and should thus undergo tonsillotomy instead of tonsillectomy because of less postoperative pain and bleeding complications.[27 28] Tonsillotomy cases were excluded from this study. Our study showed another interesting difference between the sexes: 5.4% of women and 9.7% of men in the seven surgical centres were readmitted to the hospital because of bleeding after tonsillectomy in 2020. This finding indicates that men may have to be even more careful than women postoperatively and avoid excessive activities during the sick leave period. Other studies and reports have also confirmed that men bleed more often than women after tonsillectomy.[29 30]

In this study, we used video recordings of surgeons from hospitals with proven low rrPTH after surgery. We believe that the use of videos as a teaching tool was successful. The reason for this is probably that the videos clearly show how tonsillectomies can be performed safely and quickly. Videos can show details that are difficult to convey in the literature,[31] and videos of surgeries performed by experienced surgeons with proven low rrPTH can reflect various aspects of their expertise in the procedure. Newer surgeons can adopt these experience when they start with tonsillectomies, and they can always rewatch the videos and study details in the procedure. This may probably shorten the tonsillectomy learning curve.[32–34] The use of a quality register to identify complication rates in hospitals is very useful. The patients reported complications toNTSR, and the complication rate was continuously updated in a database accessible to all participating doctors in the hospitals. This allowed surgeons to study their own complication rates and to compare them with the results from their own hospital and with other hospitals in Norway. For surgeons and hospitals with high complication rates, the surgeons or the leader of the surgical department could use the numbers to initiate improvement activities to reduce the complication rates. Although 92% of the patients reported that their symptoms had improved or disappeared 6 months after tonsillectomy, similar to the results reported in Sweden,[13 35] tonsillectomy is a potentially dangerous procedure, and it is important to minimise the complication rate.

Children have been shown to experience fewer bleeding complications after tonsillectomy than adults.[36] The annual report from NTSR in 2020 showed that 4.3%

of children under 12 years of age were readmitted due to postoperative haemorrhage. For patients aged 12 years or older, this figure was 8.6%.[13] This might imply that tonsillectomy performed on younger patients may yield a lower rrPTH than surgery is performed on adults. Table 2 shows that the male patients in this project were younger than the female patients. Patient age was similar in all hospitals at baseline and at follow-up. Therefore, the age of the patients in the participating hospitals could not explain the improvement in the rrPTH in this project. The focus on quality improvement, greater use of cold dissection tonsillectomy, cold haemostasis and new treatment plans seems to be a better explanation for the lower rrPTH at follow-up than at baseline (table 3).

Strengths and limitation

Video recordings as teaching tools must be carefully used. When using video recording to show skills, it is important that the teacher can document good or very good results through research or quality registers. The video recordings in this QIP were taken from surgeons with extensive experience, and their hospitals had shown better results than the average hospital in Norway when they were asked to participate in the study; their good results were also confirmed in NTSR during the project period and after.[13 22 37] Although the participants developed their own improvement plans for the changes they intended to introduce in their own departments, all of them wanted to use the videos from the first day of the workshop as a tool to teach and motivate surgeons to change their surgical technique, when needed. All four videos demonstrated the use of the cold technique for dissection, and the local plans from all hospitals aimed to increase the use of the cold technique for tonsillectomy. At the end of the project, the participating hospitals were asked if they had used the videos in the department. The answers indicated that the videos were important, and all departments responded that the videos were useful and of high quality (table 1).

In one department (Tønsberg), all surgeons watched the films with the intention of performing the procedure with as much consistency as possible. In another department, all new doctors or doctors returning from other hospitals had to watch the videos before they changed from hot to cold techniques. The answers from the hospitals show that the videos were frequently used in the training of new doctors and for internal discussions in hospitals. One advantage of using videos as a tool for education is that they can be watched several times, stopped when necessary, and rewound. This is especially helpful for learning small details.

Anchoring with the head of the department at the hospital was necessary and important at the beginning. Positive and motivated participants with great commitment were one of the reasons for success in this project, since the participants got an opportunity to see and learn from departments that had achieved very good results with a low rrPTH. This led to constructive dialogue and a fruitful exchange of experiences.

All hospitals in this QIP were teaching hospitals with trainees. This indicates how important it is to learn the right surgical technique and the most correct method to achieve haemostasis from the beginning. Maybe should all trainees learn cold tonsillectomy before they are allowed to use hot instruments for dissection?

The annual reports show that the participants increased their coverage rate from 36% in 2017 to 81% in 2020.[13 18] Although higher coverage is desirable, the proportion of readmissions due to bleeding is consistent with data from the Norwegian Patient Register, which includes most patients that undergo medical treatment in Norway. The low coverage rate in 2017 might have introduced some uncertainty in the results, but studies in Sweden and Norway have shown that the bleeding rate appears to be equal among the patients who answer the 30-day questionnaire and those who do not.[5 9]

This study has limitations. The NTSR has three questions regarding PTH in the 30-day questionnaire. Did you contact the healthcare system because of PTH? Were you readmitted to the hospital because of PTH? Did you undergo surgery because of PTH? Our primary outcome is the readmission rate because of PTH. This because the readmission points out that the bleeding is considerable and needs to be evaluated by a competent ENT surgeon. Analyses of the annual report in NTSR indicate that approximately 50% of the patients readmitted needs a reoperation to stop the bleeding.[13 37] In any case, the healthcare costs increase considerably with the readmission to hospital and the PTH can have serious consequences for the patients. Thus, we mean rrPTH is a meaningful outcome in a QIP.

The QIP is not meant to compare hot and cold dissection tonsillectomy. Nevertheless, our QIP show that cold methods, done right, seem to lead to less rrPTH than hot dissection tonsillectomy. Many surgeons claim that hot techniques, done right, are faster and might achieve identical results as cold dissection. Regarding tonsillotomy this is confirmed in the annual reports of NTSR and the Swedish tonsil surgery register.[2 37] Regarding hot extracapsular tonsillectomy, results in the annual reports of the national quality registers in Norway and Sweden show more rrPTH in an average from hospitals using hot dissection techniques.[9 37]

In NTSR, the patients report directly to the register about postoperative complications. The coverage rate in 2020 was 81% in the participating hospitals. Therefore, there is some uncertainty regarding the results. This is the same for all participating hospitals. We have done an investigation among patients not answering the 30-day questionnaire and we found the same complication rate among these patients.[5] Studies from Sweden also ensure that data from national registers can be used to monitor clinical practices and outcomes.[9 38] So, we believe we can trust our results. However, using hospital data might be a better method to evaluate complications.

It is important to know if the results are sustainable. A quality register can not only be used to identify areas in need of improvement, but also to initiate measures and evaluate the consequences of improvement measures. We used the Plan–Do–Study–Act method as an improvement tool in this project.[39] At the end of the project period in 2020, the participating hospitals had an average rrPTH equal 6.8%. In the annual report for 2021 from NTSR the average rrPTH had increased to 8.5% in the participating hospitals, still much lower than 17.8% at the beginning of the project.[37] For the teaching hospitals, the average rrPTH at the beginning of the project in 2017 was 2.8%, in 2021 the average rrPTH was 3%.[18 37] So, the improvement seem to be sustainable, but there is still a potential for further improvement. Nevertheless, also in this QIP it is possible that other unmeasured factors or processes contributed to the observed improvements.

CONCLUSION

Haemorrhage after tonsillectomy is potentially life-threatening and has serious consequences for the patient, caregivers and healthcare system. In this study, we showed a reduction in the rrPTH from 18% in 2017/2018 to 7% in 2020. Using videos of surgeons from hospitals with proven low rrPTH as a teaching tool and facilitating the development of new treatment plans together with focus on quality and improvement may be an effective way to improve surgical results. Our project has shown that it seems wise to change from hot to cold dissection and to increase the use of cold methods for haemostasis. Quality registers such as the NTSR can be used to identify areas with the need for improvement and to evaluate the effects of changes in practice.

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Contributors VB: Accepts full responsibility for the finished work and the conduct of the study, had access to the data, and controlled the decision to publish, developed the study design, conducted the study, performed analyses, drafted the manuscript, performed critical revision and approved the final manuscript. SW: developed the study design, conducted the study, performed analyses, drafted the manuscript, performed critical revision and approved the final manuscript. MFA: conducted the study, performed analyses, drafted the manuscript, performed critical revision and approved the final manuscript. MABB: performed analyses and critical revision and approved the final manuscript.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval The patients who underwent tonsil surgery during the workshop signed a written consent form agreeing to the use of the videos as tools for teaching. The Regional Committees for Medical and Health Research Ethics approved the study (REK Midt No. 229044). Data management was handled according to Norwegian laws and regulations. Written informed consent was obtained from all participants included in the study.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request.

REFERENCES

1 Norwegian tonsil surgery register. official webpage. Available: https://www.kvalitetsregistre.no/register/ore-nese-hals/norsk-kvalitetsregister-ore-nese-hals-tonsilleregisteret
2 Lundström F, Stalfors J, Østvoll E, *et al*. Practice, complications and outcome in Swedish tonsil surgery 2009-2018. An observational longitudinal national cohort study. *Acta Otolaryngol* 2020;140:589–96.
3 Ruohoalho J, Østvoll E, Bratt M, *et al*. Systematic review of tonsil surgery quality registers and introduction of the Nordic tonsil surgery Register collaboration. *Eur Arch Otorhinolaryngol* 2018;275:1353–63.
4 Wennberg S, Karlsen LA, Stalfors J, *et al*. Providing quality data in health care - almost perfect inter-rater agreement in the Norwegian tonsil surgery register. *BMC Med Res Methodol* 2019;19:6.
5 Intra-rater reliabilitet, relevans og økt dekningsgrad for PROM-skjema- en datakvalitetsstudie, 2020. Available: https://www.kvalitetsregistre.no/artikkel/intra-rater-reliabilitet-relevans-og-okt-dekningsgrad-prom-skjema
6 Nasjonalt servicemiljø for medisinske kvalitetsregistre. Available: https://www.kvalitetsregistre.no/kontakt-nasjonalt-servicemiljo
7 Norwegian Directorate of health. Kvalitet OG kvalitetsindikatorer (2021).., October 15, 2021.. Available: https://www.helsedirektoratet.no/statistikk/kvalitetsindikatorer/kvalitet-og-kvalitetsindikatorer
8 Lowe D, van der Meulen J, National Prospective Tonsillectomy Audit. Tonsillectomy technique as a risk factor for postoperative haemorrhage. *Lancet* 2004;364:697–702.
9 Söderman A-CH, Odhagen E, Ericsson E, *et al*. Post-Tonsillectomy haemorrhage rates are related to technique for dissection and for haemostasis. An analysis of 15734 patients in the National tonsil surgery Register in Sweden. *Clin Otolaryngol* 2015;40:248–54.
10 Tomkinson A, Harrison W, Owens D, *et al*. Risk factors for postoperative hemorrhage following tonsillectomy. *Laryngoscope* 2011;121:279–88.
11 Windfuhr JP, Toepfner N, Steffen G, *et al*. Clinical practice guideline: tonsillitis II. surgical management. *Eur Arch Otorhinolaryngol* 2016;273:989–1009.
12 Georgalas CC, Tolley NS, Narula A. Tonsillitis. *BMJ Clin Evid* 2009;2009. [Epub ahead of print: 26 Oct 2009].
13 Norwegian Tonsil Surgery Register.. Annual report, 2020. Available: https://www.kvalitetsregistre.no/sites/default/files/2021-06/Tonsilleregisteret%20%C3%85rsrapport%202020.pdf
14 Østvoll E, Sunnergren O, Ericsson E, *et al*. Mortality after tonsil surgery, a population study, covering eight years and 82,527 operations in Sweden. *Eur Arch Otorhinolaryngol* 2015;272:737–43.
15 Windfuhr JP, Schloendorff G, Baburi D, *et al*. Lethal outcome of post-tonsillectomy hemorrhage. *Eur Arch Otorhinolaryngol* 2008;265:1527–34.
16 Nasjonal rekommendation for teknikk ved tonsilleoperasjoner. Available: https://registercentrum.blob.core.windows.net/ton/r/Nationell-rekommendation-for-teknik-vid-tonsilloperation-rkgyiZIzlF.pdf
17 Odhagen E, Sunnergren O, Söderman A-CH, *et al*. Reducing post-tonsillectomy haemorrhage rates through a quality improvement project using a Swedish national quality register: a case study. *Eur Arch Otorhinolaryngol* 2018;275:1631–9.
18 Norwegian tonsil surgery register. annual report 2017. Available: https://www.kvalitetsregistre.no/sites/default/files/47_arsrapport_2017_norsk_tonsilleregister_0.pdf
19 Norwegian tonsil surgery register. annual report 2018. Available: https://www.kvalitetsregistre.no/sites/default/files/45_arsrapport_2018_norsk_tonsilleregister_1.pdf

20 Video recording of tonsillectomi., 2019. Available: https://stolav.no/fag-og-forskning/medisinske-kvalitetsregistre/norsk-tonsilleregister/kvalitetsforbedringsprosjekt-norsk-tonsilleregister-2018-19
21 Zahl SM. [Postoperative bleeding after tonsil surgery]. *Tidsskr Nor Laegeforen* 2021;141.
22 Norwegian tonsil surgery register. annual report 2019. Available: https://www.kvalitetsregistre.no/sites/default/files/2021-02/%C3%85rsrapport%202019%20Tonsilleregisteret.pdf
23 Reduksjon av antall reinnleggelser pga blødning etter tonsilleoperasjon- Kvalitetsforbedringsprosjekt, 2020. Available: https://stolav.no/fag-og-forskning/medisinske-kvalitetsregistre/norsk-tonsilleregister/rapporter
24 Sørensen WT, Wagner N, Aarup AT, *et al*. Beneficial effect of low-dose peritonsillar injection of lidocaine-adrenaline before tonsillectomy. A placebo-controlled clinical trial. *Auris Nasus Larynx* 2003;30:159–62.
25 Yap D, Ng M, Moorthy R. #10-Year Challenge: Local anaesthetic for post-tonsillectomy pain: Update meta-analysis. *Clin Otolaryngol* 2020;45:517–28.
26 Odhagen E, Stalfors J, Sunnergren O. Morbidity after pediatric tonsillotomy versus tonsillectomy: a population-based cohort study. *Laryngoscope* 2019;129:2619–26.
27 Hultcrantz E, Ericsson E, Hemlin C, *et al*. Paradigm shift in Sweden from tonsillectomy to tonsillotomy for children with upper airway obstructive symptoms due to tonsillar hypertrophy. *Eur Arch Otorhinolaryngol* 2013;270:2531–6.
28 Mitchell RB, Archer SM, Ishman SL, *et al*. Clinical Practice Guideline: Tonsillectomy in Children (Update)-Executive Summary. *Otolaryngol Head Neck Surg* 2019;160:187–205.
29 Windfuhr JP, Chen Y-S. Do changing trends in tonsil surgery affect hemorrhage rates? A longitudinal study covering 1,452,637 procedures. *Eur Arch Otorhinolaryngol* 2019;276:2585–93.
30 Coordes A, Soudry J, Hofmann VM, *et al*. Gender-Specific risk factors in post-tonsillectomy hemorrhage. *Eur Arch Otorhinolaryngol* 2016;273:4535–41.
31 Johnson J, Misch E, Chung MT, *et al*. Flipping the classroom: an evaluation of teaching and learning strategies in the operating room. *Ann Otol Rhinol Laryngol* 2022;131:573–8.
32 Lowe D, van der Meulen J, Cromwell D, *et al*. Key messages from the National prospective tonsillectomy audit. *Laryngoscope* 2007;117:717–24.
33 Wei P-Y, Chu C-H, Wang M-C. Learning curve of tonsillectomy. *Auris Nasus Larynx* 2018;45:514–6.
34 Hinton-Bayre AD, Noonan K, Ling S, *et al*. Experience is more important than technology in paediatric post-tonsillectomy bleeding. *J Laryngol Otol* 2017;131:S35–40.
35 Stalfors J, Ericsson E, Hemlin C, *et al*. Tonsil surgery efficiently relieves symptoms: analysis of 54 696 patients in the National tonsil surgery Register in Sweden. *Acta Otolaryngol* 2012;132:533–9.
36 Windfuhr JP, Chen Y-S. Incidence of post-tonsillectomy hemorrhage in children and adults: a study of 4,848 patients. *Ear Nose Throat J* 2002;81:626–34.
37 Norwegian tonsil surgery register. Anual report 2021. Available: https://www.kvalitetsregistre.no/sites/default/files/2022-06/%C3%85rsrapport%202021%20Tonsilleregisteret.pdf
38 Lundström F, Odhagen E, Alm F, *et al*. A validation study of data in the National tonsil surgery Register in Sweden: high agreement with medical records ensures that data can be used to monitor clinical practices and outcomes. *BMC Med Res Methodol* 2022;22:3.
39 Taylor MJ, McNicholas C, Nicolay C, *et al*. Systematic review of the application of the plan-do-study-act method to improve quality in healthcare. *BMJ Qual Saf* 2014;23:290–8.