

Evaluation of Post-tracheostomy`s Scars and its Impact on Persons Quality of Life: A Case Control Study

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Abstract

Background: Tracheostomy is one of the more commonly performed procedures in critically ill patients. Postoperative scarring is one of the bothersome sequelae of tracheostomies. Scars distorted the physical appearance, especially when found on the head and neck, which could cause a negative impact on quality of life. The aim of this study was to evaluate and assess the impact on quality of life of post-tracheostomy's scars, depending on the method of tracheostomy.

Methods: The prospective, single-center observational case-control study was conducted. One hundred and fifty-six persons with more than four months of post-tracheostomy surgical scars presence were observed using the Patient and Observer Scar Assessment Scale and Dermatology Life Quality index questionnaire. Persons were divided on two groups depending on method of performed tracheostomy, and duration of cannulated period was considered in both groups. Statistical analyses were performed by using SPSS ver. 16.0 (SPSS Inc., Chicago, IL, USA) and p -values of <0.05 were considered significant.

Results: The patients who had a tracheostomic tube cannulation period of less than 15 days had better cosmetic results than those who had tracheostomic tubes for more than 15 days, regardless of the method of tracheostomy 6.64 ± 0.082 vs. 16.15 ± 0.096 ($p < 0.001$) in surgical tracheostomy group and 7.26 ± 0.211 vs. 14.17 ± 0.379 ($p < 0.05$) in percutaneous dilatational group. The Dermatology Life Quality index scores have shown a mean value of 0.6 ± 0.01 , which means that post-tracheostomy scarring in the presented study, had no effect on the person's quality of life.

Conclusions: Aesthetic outcomes of post-tracheostomy's scars after the open surgical tracheostomy technique, performed using a minimally invasive approach, did not statistically differ from those of the percutaneous dilatational technique. Persons with a long duration of tracheostomic tube ventilation showed worse aesthetic outcomes compared with short-term tracheostomic cannulation, not dependent on the tracheostomy performing technique.

The Dermatology Life Quality index have shown that post-tracheostomy's scarring in the presented study had no effect on the person's quality of life.

Trial registration:

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Background

Tracheotomy is one of the oldest surgical interventions used in upper airway obstruction. Both open surgical tracheostomy (OST) and percutaneous dilatational tracheostomy (PDT) are methods used to perform tracheostomies in select individuals. The best technique for performing tracheostomy remains a matter of debate [1-4]. However, tracheotomies could have adverse effects such as procedure-related complications and future cosmetic concerns [5-8]. Postoperational scarring is one of the bothersome sequelae of tracheostomies. Since the defect resulting from a tracheostomy is often allowed to heal spontaneously by secondary intention, a hypertrophic scar formation is a frequent consequence [9]. A depressed tracheostomy scar can be aesthetically unacceptable and affects a person's quality of life [10]. Thus, a postsurgical scar assessment and analysis of its impact on person's quality of life is fundamental for a complete functional evaluation and as an outcome

measure [11]. Long-term complications of PDT and OST, including postoperative scarring have been explored by several authors [7, 12-15]. However, available studies have only determined percentage of the presence of tracheostomy related cosmetic deformities without individual scar assessments and its impact on quality of life.

Postsurgical scar assessment and analysis of its impact on person's quality of life is fundamental for a complete functional evaluation and as an outcome measure and may lead to an improvement of scar treatment and prevention.

The aim of this study was to evaluate and assess the impact on quality of life of post-tracheostomy's scars, depending on the method of tracheostomy.

Methods

The prospective, single-center observational case-control study was conducted from May 2019 to March 2020. The persons were recruited from the ENT and Maxillofacial Surgery Department of "Heratsi" №1 University Hospital in Yerevan, Republic of Armenia.

Informed consent was obtained from all participants after providing written and oral information about the study. The study protocol was approved by the Ethics Committee of Yerevan State Medical University and the trial "Quality of life in patients undergoing tracheostomy" was registered in ISRCTN24668317 (IRB no.YSMU №7/18-19).

The Patient and Observer Scar Assessment Scale (POSAS), which developed by Draaijers et al. [16] was designed for a subjective evaluation of various types of scar formation and is an appropriate subjective tool for the evaluation of linear scars [17, 18].

The The Dermatology Life Quality Index (DLQI) was developed in 1994 by Finlay and Khan [19], which was designed to measure the impact of skin conditions on quality of life. It has been a widely used questionnaire for life quality assessment and translated into 85 languages.

One hundred and fifty-six persons with more than four months of post-tracheostomy surgical scars were observed using the POSAS scale. All participants provided informed consent for trial participation. Of the 156 recruited persons, 76 underwent OST (Group 1) and 80 underwent PDT (Group 2). All persons were Armenians with a mean age of 54.7 years (range, 16-87 years). As demonstrated in Figure 1, the majority of patients undergoing tracheostomy were in the age range of 51-80 years. The male to female ratio was 2:1. All OSTs were performed by the same surgeon with 2-3 cm length linear horizontal skin incision and the PDT was performed by the standard technic. Observations showed that with the same operation technique, the aesthetic appearance of the scar differs in the studied groups. This fact prompted the idea of the influence of the duration of the cannulated period on the further post-decannulation secondary wound healing and the aesthetic and functional outcome of the formed scar. Considering that recruited persons were unsure about how many days they were with tracheostomic tubes, they were conditional asked to note more or less than fifteen days. Fifty-nine persons (37.8%) noted that they were decannulated in less than fifteen days and 97 persons (62.2%) noted more than fifteen days of tracheostomic cannulation.

Three observers (two residents and one medical doctor in the ENT and the maxillofacial surgery department) independently assessed post-tracheostomy scars using the POSAS scar scale on the same day.

The POSAS consist of two scales: the patient and observer scales. Both scales contain six items that are scored numerically. Each of the six items on both scales has a ten-step score, with 10 indicating the worst imaginable scar or sensation. The total score of both scales consists of adding the scores of each of the six items (range: 6 to 60). The lowest score, 6, reflects normal skin, whereas the highest score of 60 reflects the worst imaginable scar.

The observed component was composed of six parameters of scars: vascularity, pigmentation, thickness, relief, pliability, and surface area. Each parameter consisted of several categories. The degree of vascularity might be difficult to measure visually when there is pigmentation of the wound. Plexiglas was used to compress the blood vessels and assess the amount of blood return after blanching as well as to assess the degree of pigmentation since it eliminates the effect of vascularity.

The patients assessed their own scars using the patient component of the POSAS during the same day. The patient component consisted of six parameters: scar-related pain, itchiness, color, stiffness, thickness, and irregularity.

Internal consistency was assessed using Cronbach's alpha statistics, which considered values greater than or equal to 0.70 to be acceptable. Interobserver reliability was defined as "the extent of agreement between three observers" and was assessed by computing the intraclass correlation coefficient (ICC) using a two-way mixed model with measures of consistency. An ICC within the range of 0 to 0.20 was considered as "slight", 0.21 to 0.40 as "fair", 0.41 to 0.60 as "moderate", 0.61 to 0.80 as "substantial", and 0.81 to 1.0 as "almost perfect" [18].

The Dermatology Life Quality Index (DLQI) questionnaire was used to evaluate post-tracheostomy scars and their impact on the quality of life. The DLQI is designed for use in adults. It is self-explanatory and can be simply handed to the patient who is asked to complete it. The questionnaire consists of ten questions related to symptoms and feelings, daily activities, leisure, work and study, personal relationships, and treatment. The scores ranged from 0 to 30. The scores of 0 to 1 indicated no effect at all on patient's life, 2 to 5, mild effect, 6 to 10, moderate effect, 11 to 20 high effect, and 21 to 30, extremely high effect [19].

All statistical analyses were performed by using SPSS ver. 16.0 (SPSS Inc., Chicago, IL, USA) and p -values of <0.05 were considered significant.

Results

The internal consistency was acceptable for the observer components of the POSAS, with Cronbach's alpha values of 0.889, and 0.770 respectively.

The interobserver reliability (Table 1) was "almost perfect" for the OST Group and "substantial" for the PDT group of the observer component of the POSAS in terms of total score (the average measures of ICC were, 0.876 and 0.728, respectively). For the individual observer component of the POSAS in the OST group, interobserver reliability was "almost perfect" for vascularity, relief and surface area (0.913, 0.913, 0.947 respectively) and "substantial" for pigmentation, thickness and pliability (0.768, 0.802, and 0.627, respectively). In the group with PDT, interobserver reliability was "substantial" for pigmentation, thickness, relief, pliability and surface area (0.647, 0.672, 0.779, 0.693 and 0.713 respectively), and "moderate" for vascularity (0.440).

Table 1. Interobserver reliability of the observer component of the patient and observer scar assessment scale

Observer component of the POSAS	Single measure ICC (95% CI), OST group	Average measure ICC (95% CI), OST group	Single measure ICC (95% CI), PDT group	Average measure ICC (95% CI), PDT group
Vascularity	0.777 (0.689~0.845)	0.913(0.849~0.943)	0.207(0.078~0.350)	0.440(0.201~0.618)
Pigmentation	0.525 (0.395~0.646)	0.76 (0.662~0.846)	0.380(0.230~0.525)	0.647(0.473~0.768)
Thickness	0.575 (0.431~0.696)	0.80 (0.694~0.873)	0.405(0.253~0.550)	0.672(0.503~0.786)
Relief	0.777(0.681~0.849)	0.91 (0.865~0.944)	0.541 0.394~0.668)	0.779(0.661~0.858)
Pliability	0.359(0.219~0.501)	0.62 (0.456~0.751)	0.429(0.275~0.573)	0.693(0.532~0.801)
Surface area	0.856 (0.781~0.906)	0.947(0.914~0.967)	0.453(0.311~0.588)	0.713(0.575~0.811)
Total	0.702(0.585~0.793)	0.876(0.809~0.920)	0.472(0.303~0.618)	0.728(0.566~0.829)

CI: confidence interval, single measure ICC: intraclass correlation coefficient for a single observer, average measure ICC: intraclass correlation coefficient for the group of three observers.

The total observer scale parameter values vary from 6 (min) to 35 (max) in the OST group and from 6 (min) to 22 (max) in the PDT group. As shown in Table 3, the mean total values of the POSAS observer scale as well the separate parameters (except vascularity) are not statistically different in both groups. The mean total score using the observer component of POSAS for OST post-tracheostomic scars was 12.00 ± 0.370 , and that for the PDT group was 12.08 ± 0.280 ($p=0.86$) (Table 2).

Table 2. POSAS observer scale parameters mean values

Observer Scale parameters	POSAS Observer Scale Value, OST group	POSAS Observer Scale Values, PDT group	P value
Vascularity	1.79 ± 0.053	1.67 ± 0.037	0.18
Pigmentation	1.79 ± 0.007	1.87 ± 0.051	0.40
Thickness	1.94 ± 0.075	1.97 ± 0.050	0.76
Relief	2.38 ± 0.093	2.45 ± 0.073	0.56
Pliability	1.79 ± 0.068	1.90 ± 0.055	0.20
Surface	2.30 ± 0.096	2.48 ± 0.081	0.16
Total score	12.00 ± 0.370	12.08 ± 0.280	0.86

Differing cosmetic results have shown the POSAS Observer Scale data for persons with different durations of tracheostomic tube cannulation time. The results showed that the patients who had a tracheostomic tube cannulation period of less than 15 days had better cosmetic results than those who had tracheostomic tubes for more than 15 days, regardless of the method of tracheostomy. Thus, 36 patients from the OST group were cannulated for less than 15 days, and the average Observer Scale total score was 6.64 ± 0.082 in comparison with 40 patients with more than 15 days of cannulation period and total value of 16.15 ± 0.096 ($p < 0.001$). 23 patients from the PDT group had a tracheostomic tube cannulation duration of less than 15 days with average Observer Scale total score of 7.26 ± 0.211 in comparison with patients who underwent more than 15 days of cannulation period 14.17 ± 0.379 ($p < 0.05$). Persons that were cannulated for more than 15 days had the worst results in both groups and showed values of 16.15 ± 1.130 and 14.17 ± 0.379 , respectively, (Table 3).

Table 3. POSAS observer and patient scale values depending on duration of tracheostomic tube cannulation

Parameters	Less than 15 days cannulation	More than 15 days cannulation
POSAS observer scale mean total value, OST group	6.64 ± 0.13	$16.15 \pm 1.13^*$
POSAS observer scale mean total value , PDT group	7.26 ± 0.21	14.17 ± 0.38
POSAS patient scale mean total value, OST group	6.76 ± 0.23	13.12 ± 0.44
POSAS patient scale mean total value, PDT group	7.08 ± 0.19	12.50 ± 0.69

$P < 0.05$, $*P < 0.001$

This could be the consequence of tracheostomic tube flanges extended pressure on tissues around the incision zone, which results in tissue atrophy and worst cosmetic results, especially in the Relief and Surface parameters of the POSAS Observer Scale (Figs. 1 and 2).

Patient POSAS component self-assessment tool

On simple linear regression analysis, the patients' overall opinion regarding their own scars was significantly influenced by scar-related itchiness, color, stiffness, thickness, and irregularity ($p < 0.005$; Table 4).

Table 4. Simple linear regression analysis of variables associated with patient scar assessment scale scores

Items	Slope coefficient, OST	p-value, OST	Slope coefficient, PDT	p-value, PDT
Pain	0.65	0.000	0.65	0.000
Itchiness	0.66	0.000	0.75	0.000
Color	0.81	0.000	0.80	0.000
Stiffness	0.83	0.000	0.89	0.000
Thickness	0.88	0.000	0.91	0.000
Irregularity	0.81	0.000	0.89	0.000

As demonstrated in Table 5, the total scores of patients' self-assessment parameters in both groups were also not statistically different. They amount of 9.51 ± 0.441 in OST group and 9.49 ± 0.392 in PDT Group. The minimal value of total scores for each group is 6 and the maximum is 60. Therefore, generally, the total score amount for both groups could be interpreted as close to normal skin imaginable scars.

Table 5. POSAS patient scale parameters values

Patient Scale Parameters	OST Group	PDT Group	P value
Pain	1.22 ± 0.069	1.18 ± 0.049	0.64
Itchiness	1.24 ± 0.065	1.14 ± 0.041	0.23
Color	1.58 ± 0.088	1.54 ± 0.091	0.74
Stiffness	1.74 ± 0.098	1.75 ± 0.082	0.99
Thickness	1.71 ± 0.104	1.83 ± 0.085	0.38
Irregularity	1.80 ± 0.118	2.05 ± 0.117	0.13
Total score	9.51 ± 0.441	9.49 ± 0.392	0.96

However, when comparing the values of the total score of the patient assessment scale between persons who underwent tracheostomy intubation for less than 15 days duration with those who were cannulated for more than 15 days, the results were different as in the observer assessment scale: 6.76 ± 0.232 for the OST group and 7.08

± 0.396 in persons with less than 15 days of cannulation period and 13.12 ± 0.442 and 12.5 ± 0.696 , respectively, for longer than 15 days cannulated persons.

The Dermatology Life Quality index (DLQI) scores have shown a mean value of 0.6 ± 0.013 , which means that post-tracheostomic scarring in the presented study, had no effect on the patient's life.

Points 3, 5, 6, 7, 8, and 9 of the questionnaire had a value of 0 for all 156 persons. Point 10 (over the last week, how much of a problem has the treatment for your skin been, for example, by making your home messy, or by taking up time?) was not relevant for all participants involved. Point one (over the last week, how itchy, sore, painful, or stinging has your skin?) had a maximum value $\ll 1 \gg$, which is scored as a little impact at 39 persons. Points two and four of the questionnaire had a maximum value $\ll 1 \gg$ in an 11 persons.

Discussion

Every surgical incision renders a scar, which may lead to an array of functional, cosmetic, and psychological consequences [17]. Scar tissue is usually differing from healthy skin by an aberrant color, in thickening, surface irregularity, loss of elasticity, and contraction or expansion of the surface area. The patient frequently suffers from itching and pain, especially if the scar has become hypertrophic. The scars properties depend on etiology, size, location, suturing technique, wound treatment, as well as individual age, race, and genetic predisposition [20]. Postsurgical scar assessment is fundamental for a complete functional evaluation and as an outcome measure and may lead to an improvement of scar treatment and prevention [11, 17].

Tracheostomy is one of the more commonly performed procedures in critically ill patients yet the optimal method of performing tracheostomies in this population remains to be established [4]. The length of skin incision for OST is varies from 2 to 5 cm in horizontal or vertical direction between the cricoid cartilage and sternal notch, depending on preferred by surgeon technique [2, 6, 7, 21]. While a horizontal incision allows for improved healing and better cosmetic appearance, a vertical incision allows for extension of the incision and avoidance of the anterior jugular veins damage, but has worst cosmetic appearance [7, 22].

Postoperative scarring is one of the bothersome sequelae of tracheostomies. Scars distorted the physical appearance, especially when found on the head and neck, which could cause a negative impact on quality of life [23]. Since the defect resulting from tracheostomy is allowed to repair spontaneously by secondary intention, hypertrophic scar formation is a frequent consequence [9]. Depression also occurs due to the loss of subcutaneous tissue. If the contracted scar tissue comes into contact with the trachea, it adheres to the trachea. A depressed and fixed tracheal scar produces "tracheal tug", which occurs when the skin and the trachea move concurrently. Tracheal tug can cause dysphagia and pain with either lateral or vertical head movement in addition to an aesthetically unpleasing scar [9, 10, 24, 25]. In a presented study all persons in OST group underwent a small 2.5-3 cm horizontal neck incision and vertical tracheal rings incision, without Bjork flap formation. This prevents contact between the skin and the trachea, and thus, "tracheal tug" formation. However extended tracheostomic tube cannulation showed the worst aesthetic results in both groups compared with short time cannulation: 6.64 ± 0.082 in compare with 16.15 ± 0.096 ($p < 0.001$) in OST group and was 7.26 ± 0.092 in compare with 13.94 ± 0.096 ($p < 0.05$) in PDT group by Observers Total Parameters Value. The worst aesthetic values were in parameters of Relief and Surface area, which resulted from loss of subcutaneous tissues, because of tracheostomic tube extended flanges pressure to the underlying tissues.

A depressed tracheostomy scar can be aesthetically unacceptable, very distressing to the patient and affect the quality of life [7, 10]. Despite the fact that minimally invasive tracheostomy techniques with short horizontal skin incision usually healed with a small horizontal linear scar without significant puckering or irregularity, it is noted, that OST have more postoperational scarring incidence than PDT [7, 13, 15, 22]. In the present study, no statistically significant difference was observed in the OST and PDT groups by the observer and patient component of POSAS.

De Kleijn et al. [15] conducted a retrospective study, in which 305 consecutive patients undergoing tracheotomy between 2003 and 2013 were included. Long-term complications of PDT and OST, including postoperative scarring, were explored by the authors. A study of 171 patients in the total population showed 1.1% scarring in the PDT group and 10.7% in the OST group. However, in "high-risk" patients (who underwent pre- or postoperative radiation therapy, previous neck surgery, or thoracic surgery or a previous tracheotomy) subgroup, the scarring rates were 14.3% for PDT and 6.5% for OST. In this retrospective study, OSTs were performed using a Björk flap to prevent false routes when changing the tracheotomy tube. There was no information regarding the length of the incision. In the present study of 76 patients who underwent OST, all tracheotomies were performed by tracheal ring vertical incision in length appropriate to tube diameter. Thus, the values of scarring were almost identical in both groups. Therefore, to conclude about worst scarring of surgical tracheostomies in general should be not reliable.

Another meta-analysis comparing PDT and OST included pooled data on 973 patients from 15 randomized trials, and also found that PDT reduced long-term scarring in comparison with open surgical technique [13]. Hazard et al. [12] reported 25% cosmetic deformity in patients with OPS and 9 % in patients who underwent PDT. Gysin et al. [14] reported an unaesthetic scar in 40% of patients who underwent OST and 20% of patients with PDT. In the noted article, the skin incision for OST was performed horizontally 2 cm above the sternal notch. The above-mentioned studies determined only the percentage of the presence of tracheostomy related cosmetic deformities without individual scar assessment. Despite the fact, that the Patient and Observer Scar Assessment Scale is subjective tool for the evaluation of linear scars, it is an appropriate for detailed tracheostomy scar comparative analysis [17]. The POSAS is a standardized, validated, and comprehensive scar assessment tool in clinical care [18]. However, it does not assess the impact of scars on the quality of life of people. Thus, the Dermatology Life Quality Index (DLQI) was used to evaluate the impact of post-tracheostomy scars on quality of life. The results of a presented study of 156 persons have shown that post-tracheostomy scarring has "no effect at all" on the patient's life (0.6 ± 0.013).

We do not find any literature about studies that performed comparative OST and PDT scar assessment by any scar assessment or quality of life evaluation scales. To our knowledge, this is the first attempt to evaluate post-tracheostomy scars using POSAS and understand how it impacts the quality of life.

The POSAS had more advantages as its observer component showed better correlation with the patient's rating. The POSAS reflected the patient's perspective about scar-related symptoms such as pain and itchiness and its own position regarding scar esthetic view. Thus, most of the persons, who underwent tracheostomy did not complain of pain and itching and were more concerned about scar thickness and irregularity, but this generally not affect their quality of life. The results of the present observational study have shown that aesthetic outcomes of post-tracheostomy scars after open surgical tracheostomy could be close to the PDT technique, if it was performed using a minimally invasive approach. Depressed post-tracheostomy scars appear in both groups. In our opinion, this condition is the result of long-term tracheostomic tube cannulation. In the present study, persons

undergoing tracheostomy cannulation for more than 15 days had the worst aesthetic results and depressed scars in both groups.

Conclusions

Aesthetic outcomes of post-tracheostomy`'s scars after the open surgical tracheostomy technique, performed using a minimally invasive approach, did not statistically differ from those of the percutaneous dilatational technique. Persons with a long duration of tracheostomic tube ventilation showed worse aesthetic outcomes compared with short-term tracheostomic cannulation, not dependent on the tracheostomy performing technique.

The Dermatology Life Quality index have shown that post-tracheostomy`'s scarring in the presented study had no effect on the person's quality of life.

Abbreviations

OST- open surgical tracheostomy

PDT-percutaneous dilatational tracheostomy

POSAS- Patient and Observer Scar Assessment Scale

DLQI-Dermatology Life Quality index

ICC-intraclass correlation coefficient

Declarations

Ethics approval and consent to participate

IRB no.YSMU N°7/18-19

Consent to participate

Include appropriate statements in Supplementary files

Consent for publication

Not applicable in this section

Availability of data and materials

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All data generated or analyzed during this study are included in this published article and its supplementary information files

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

P. A., T. A., S R., M. Kh., S. A., M. A., B. A., M. I., M. A. makes substantial contributions to conception and design, and acquisition of data, and analysis and interpretation of data; P. A., M. A., B. A., M. I., M. A., participates in drafting the article or revising it critically for important intellectual content; P. A., M. A. , B. A., M. I., M. A., give final approval of the version to be submitted and revised version.

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Figures

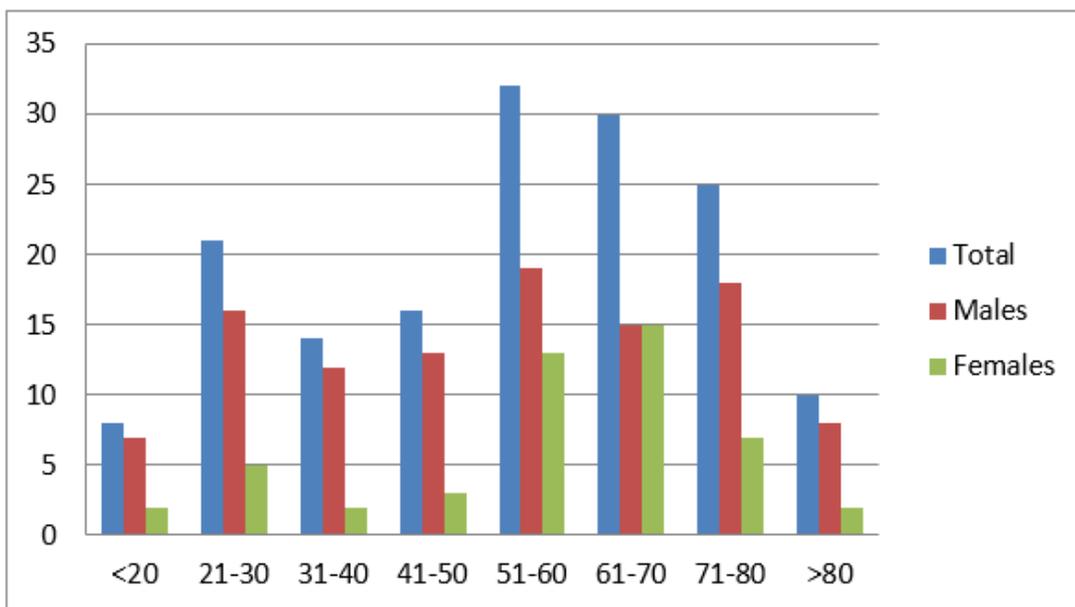


Figure 1

Age and sex distribution of recruited persons undergoing tracheostomy



Figure 2

Post-tracheostomy scar of person who underwent OST a) with less than 15 days cannulation period, b) with more than 15 days cannulation period

Figure 3

Post-tracheostomy scar of person who underwent PDT a) with less than 15 days cannulation period, b) with more than 15 days cannulation period