# Introduction:

Subglottic stenosis is defined as a cricoid lumen of less than 4mm in a full term newborn or 3mm in a preterm. However, there is no generally accepted definition. It is classified into congenital and acquired. A congenital stenosis is considered when past history of airway trauma or instrumentation is absent. An acquired stenosis usually results from intubation, external trauma, infection or inflammation. The acquired subglottic stenosis became a recognized medical issue in 1965 **(REFERENCE**). The marked advancements in ICU care with regard to intubation and long term ventilation have saved lives**, however, resulted in an increased number of SGS.**

Stenosis in the subglottic region could be cartilagenous or limited to the soft tissue. Cartilagenous stenosis could be either small diameter of a normally shaped cricoid or abnormally shaped cartilage. The soft tissue type is due to submucosal gland hyperplasia or fibrosis.

Depending upon the severity of the stenosis, symptoms and signs could range between mild respiratory distress and life threatening situation. Several grading systems has been published in order to help planning the management and predicting the prognosis. The most accepted one is the Myer- Cotton grading system that relay on the endotracheal tubes to predict the percentage of obstruction. Based on this system, SGS is graded into four grades: grade I (0-50% obstruction), grade II (50-70% obstruction), grade III (70-99% obstruction), and grade IV ( total obstruction).

Surgical management of subglottic stenosis has advanced greatly since the introduction of open reconstruction with grafting during the seventies. However, simple dilatation still

plays its role for mild grades. In this study, we are reviewing our cases of subglottic stenosis and discussing our different approaches.

## Method:

Our study is a review of all subglottic stenosis cases that presented between 1999 and 2007 at King Abdulaziz Aziz University Hospital in Riyadh, Saudi Arabia. Patient population consisted of 25 cases. In this review, we tried to compare our results with those published before.

A retrospective review was done for all patients who presented with subglottic stenosis **and tracheotomy** including both adults and pediatric patients.

Aspects that were considered were: surgical techniques, post operative complications, further dilatation procedures needed, time for decannulation, and final outcome.

The intervention was either endoscopic or open **surgical technique**. Either staged laryngotracheal reconstruction (SLTR) with rib grafting or resection and reanastomosis were undertaken as our open surgical technique.

## Results:

Twenty five cases of subglottic stenosis were received. They aged between 1year and 60 years with an average of 12.58 years. Out of 25, 18 were male and 9 were female; and 5 were adults and the remaining 20 were pediatric. All cases were graded according to Cotton Meyer classification.

Our cases were  divided into 3 groups with regard to the surgical intervention: 10 underwent endoscopic dilatation, 12 underwent LTR, and 3 underwent cricotracheal resection (CTR).

Among the ten cases that underwent CO2 laser dilatation, 2 were of grade I, 4 were of grade II, 1 was of grade III, and 2 did not have their grade documented. One case had very mild stenosis and was managed by granulation tissue removal only. Three patients required further dilatation procedures: two required one, and the third required two. Decannulation time ranged between 2 and 9 months with a mean of 4.28 months, except for the patient that only underwent granulation tissue removal who was decannulated after 2 days. One case is still not fit for decannulation and another  **was** lost to follow up. There were no reported post operative complications. Satisfactory results were achieved in all cases regarding airway and feeding.

**(Whatever mentioned in the table don't talk about it in the results)**

Twelve patients underwent SLTR. Seven of them required anterior and posterior **rib** graft while the remaining 4 needed only anterior graft. Among the group of the anterior and the posterior graft, 4 were of grade IV, 2 were of grade III, and one was of grade II. With regard to the group with anterior graft only, 3 had grade I and 2 had grade II. All cases of anterior and posterior graft had stent that remained between 3 and 8 weeks with mean of 6.5. Decannulation time ranged between 4 and 8 months for anterior and posterior graft cases, and 1 and 4 months for the anterior graft with mean of 4.58 and 2.5 respectively. One of the cases with anterior and posterior graft is still not fit for decannulation because of sever GERD. Number of further dilatation procedures after LTR ranged between 0 and

3 for cases with anterior and posterior graft. For cases with anterior graft only, one case required one dilatation procedure before decannulation.

Post operative complications were encountered in three cases of those who had anterior and posterior grafting: transglottic stenosis, aspiration pneumonia, and bilateral vocal cord paralysis. The case with transglottic stenosis was managed by revision LTR and was decannulated successfully inspite of collapse of the anterior wall. The case that developed aspiration pneumonia recovered and was decanulated after 3 months. The third one whom developed stridor due to bilateral vocal cord paralysis after decannulation, tracheostomized and arytenoideactiomy was done. Patient was decanulated after 4 months with satisfactory results. **(include LTR cases in one table**)

Three cases underwent cricotracheal resection and reanastomosis. One of them was decannulated successfully in 7 months. Second case is still not fit for decannulation. This patient developed restenosis and revision surgery was done. The third case had a psychiatric issues and her follow up was lost.

Discussion:

Subglottic stenosis is a disease that has a great impact on quality of life. Resulting in tracheostomy dependency, surgical management has impressively evolved over years in attempt to restore normal physiologic breathing.

Multiple staging systems have been created trying to predict a prognosis for each individual case. However, this goal was difficult to reach specially with the presence of other airway anomalies.

Dilatation has been greatly replaced by open reconstruction procedures, especially with widespread of the single **stage technique**. However, since our patients were all tracheostomized, trials of dilatation were considered. Mondar et al, published a study concluding that open surgery is superior to **endoscopic** dilatation. In that study, laser dilatation was done for 13 patients with airway stenosis of grade 2-4 with stenting. However, the study was limited by small sample size. Moreover, there was significant difference between open surgery group and dilatation group regarding age, with dilatation group being older.

Another study considering laser dilatation was published by Giudice et al. His study was limited to cases of idiopathic subglottic stenosis. Out of 30 cases, only 5 required open surgical procedure after failure of frequent trials of dilatation. The number of laser procedures needed for the total population ranged between 1 and 13 with mean of 2.4. However, because of unknown nature and prognosis of the pathology of interest in that study, comparing his results to ours is questionable. Out of our patient , 10 cases underwent trial of dilatation. **Eight cases** were decannulated: 4 **of them** did not required subsequent dilatation. The rest underwent further management with a mean **dilatation** of 1.25. Decannulation was achieved **within** 2 and 9 months with mean of 4.28. Three of the cases had associated anomalies beside subglottic stenosis: left vocal cord paralysis, glottic scar and left vocal cord paralysis and rhinoscleroma with supra and glottic scar. There were no reported complications.

SLTR has been tremendously replaced by SSLTR. One of the criticisms against SSLTR is the exposure to prolonged ICU admission, sedation and muscle relaxant. Gustafson et al, proved in his paper that such cases may not necessarily need muscle relaxant and that

sedation could be kept at a low level. However, 29% of the cases required reintubation with 15% of the total group required tracheostomy. Perhaps one of the advantages of having a tracheostomy is in cases of dynamic airway lesions like laryngomalacia **!!!**. Rutter et al, came across this point in his study. He published that most of SSLTR cases that had an underlying dynamic airway lesion needed tracheostomy.

In our study, twelve patients underwent LTR and all of them were staged procedures. Most of these patients were of grade III and IV. Out of 12, 7 patients had anterior and posterior graft with stent. The remaining 5 cases had anterior graft only without a stent. Namit et al published a study showing their results of LTR over ten years and comparing between SLTR and SSLTR. The mean number of further procedures required for SSLTR and SLTR were 4.6 and 2.7 respectively. Comparing with our results, the mean number of further procedures was **0.63**. However, it should be beard in mind that our group of cases is small. Our mean duration of decannulation was 3.6 months. Those patients with anterior and posterior graft required **longer time** for decannulation compared to those with only anterior graft with mean of 4.28 and 2.5 respectively. Moreover, complications rate were higher among the anterior and posterior graft group (**examples: were mentioned in detail in the result, should I mention them again?)**. These differences in decannulation period and complication could be attributed to the worst starting condition of the anterior and posterior graft group. Most of them were of grade four while those with anterior graft were of grade II to III. Gustafson et al published his results in SSLTR. In his experience, patients who underwent anterior and posterior grafting had higher rat of reintubation and post operative tracheostomy comparing to those with only anterior graft.

Conclusion:

Surgical management of subglottic stenosis is showing a very promising future. SSLTR has evolved very rapidly; however, SLTR still plays its role in some selected cases and situation. In addition, dilatation could be implemented in certain indications avoiding morbidities of open procedures. In spite of good airway patency results, the impaction of open surgical procedures on voice quality and language development in children is lacking. More long term follow up regarding that aspect is needed.

**Robert R. Lorenz: Adult laryngotracheal stenosis: etiology and surgical management. Current Opinion in Otolaryngology & Head and Neck Surgery 2003, 11:467–472**

**Heather C. Herrington et al: Modern Management of Laryngotracheal Stenosis. Laryngoscope 2006, 116: 1553- 1557**

**Michael J. Rutter et al: Laryngotracheal Reconstruction and the Hidden Airway Lesion. Laryngoscope 2000, 110: 1871- 1874**

**Mohammed Mandour et al: Chronic subglottic and tracheal stenosis: endoscopic management vs. surgical reconstruction. Eur Arch Otorhinolaryngol 2003, 260: 374–380**

**Namit Agrawal et al: Ten-year review of laryngotracheal reconstruction for paediatric airway stenosis. International Journal of Pediatric Otorhinolaryngology 2007, 71: 699—703**

**Marco Giudice et al: Idiopathic subglottic stenosis: management by endoscopic and open-neck surgery in a series of 30 patients. Eur Arch Otorhinolaryngol 2003, 260 :235–238**

**L. MARK GUSTAFSON et al: Single-stage laryngotracheal reconstruction in children: A review of 200 cases. Otolaryngology– Head and Neck Surgery 2000, 123 (4): 430-434**

**Robin T: Management of subglottic stenosis. Otolaryngologic clinics of North America 2000, 33 (1):112- 130**

**Christopher J et al: Congenital Laryngeal Anomalies: laryngeal atresia, stenosis, web and clefts. Otolaryngologic clinics of North America 2000, 33 (6): 1293-1308**

**Charles Myer et al: Proposed Grading System For Subglottic Stenosis Based On Endotracheal Tube Sizes. Ann Otol Laryngol 1994, 103: 319- 323**

## Laser Dilatation :

| grade | ass anomalies | dilatation after | decanulation | complication | airway |
|---|---|---|---|---|---|
| 2 | lt vc paresis | 1 | 4m | | |
| ? | | | 5m | | OK |
| 2 | glottic scar+lt vc paresis | | 2m | | OK |
| 3 | | 1 | 2m | | OK |
| 3 | | 2 | 6m | | OK |
| 3 | | 1 | 2m | | OK |
| ? | supra+glottic scar | | 9m | | OK |
| 2 | | | | No follow up | |
| 1 | | | 2 days | | OK |
| 1 | | | | pending | |

## CTR and Reanastomosis:

| grade | ass anomalies | dilatation after | decanulation | complication | airway |
|---|---|---|---|---|---|
| ? | | 2 | 7m | | OK |
| ? | | 2 | No F/U | | |
| ? | iterarytenoid scar+bilat VC paralysis | 2 | pending | Restenosis<br><br>( revision ) | |

## LTR with anterior grafting:

| grade | ass anomalies | procedure | dilatation after | decanulation | complication | airway |
|---|---|---|---|---|---|---|
| 3 | glottic web | LTR+ant | | 1.5m | | OK |
| 3 | | LTR+ant | | 3m | emergency trach | OK |
| 1 | rt vc paralysis | LTR+ant | | 3m | | OK |
| 1 | | LTR+ant | 1 | 3m | | OK |
| 1 | bilat vc paralysis | LTR+ant | | 2m | ant+post shelfing | OK |

LTR with anterior and posterior graft:

| grade | ass anomalies | stent removal | dilatation after | decanulation | complication | airway | comments |
|---|---|---|---|---|---|---|---|
| 4 | | 3w | 2 | pending | | | |
| 4 | | 5w | 1 | | transglotic stenosis (4m) | | Revision done |
| same | | 5w | 3 | 4m | collapse of ant wall | OK | |
| 4 | glottic scar | 6w | 1 | 3m | aspiration pnumonia | OK | |
| 3 | BA | 2m | 1 | 8m | | OK | |
| 4 | lt vc paralysis | 1m | | 5m | | OK | |
| 3 | glottic web | 2m | | 3.5m | | OK | |
| 3 | | 2m | 1 | 4m | bilat vc paralysis+stridor | | Trach done |
| same | | | 1 | 4m | | OK | |