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ORIGINAL RESEARCH

Radiofrequency assisted plasma ablation and carbon dioxide laser in benign lesions of larynx: A randomized comparative study

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ABSTRACT

Background: The advent of Microspot Carbon dioxide laser (250microns) made laser an appropriate tool for excision of superficial lesions of vocal cords which were initially treated only by micro dissection. The constant search for minimally invasive micro laryngeal surgery with maximum intact function saw the introduction of radiofrequency assisted plasma ablation as a tool in benign lesions of the vocal cords. Our study intends to find out the difference in outcome of Benign lesions of larynx, treated by Radiofrequency assisted plasma ablation and Carbon dioxide Laser, the potential advantages and disadvantages of each procedure, and any difference in duration of surgery. **Methods:** Adult patients who were presenting to ENT OPD and suspected to have benign lesions of the larynx are subjected to Videostroboscopy and diagnosis is confirmed. The patients are randomly allocated to treatment with Radiofrequency assisted plasma ablation and Carbon dioxide laser. Pretreatment voice assessment was made using Voice Handicap Index-10 (subjective) and Maximum Phonation Time (MPT). **Results:** Though both the methods are similar in terms of outcome, Laser surgery has significantly longer surgical times, and recovery also takes slightly longer when compared to Coblation surgery. **Conclusions:** This study suggests that Radiofrequency assisted plasma ablation and Carbon dioxide Laser both are excellent treatment modalities for the surgical management of Benign Lesions of the Larynx in the hands of an experienced surgeon. There were no detectable differences in the outcome between the two methods and there were no complications in any of these methods.

Key words: Radiofrequency assisted plasma ablation, carbon dioxide laser, benign laryngeal lesions, micro laryngeal surgery, voice assessment

INTRODUCTION

The development of endoscopy and micro laryngeal surgery provided ground breaking development in the field of laryngology. Further advancements are made in the recent years including the introduction of videostroboscopy and high speed and high definition photography. Videostroboscopy provided a multidimensional approach which immensely improved the accuracy of diagnosis and planning the management of benign lesions of the larynx.

The field of laryngology took big leaps with the introduction of Lasers in 1960s for treating a variety of laryngeal pathologies, both benign and malignant. The better understanding of microarchitecture of vocal cords paved way for the use of Carbon dioxide laser in laryngeal lesions. The advent of Microspot Carbon dioxide laser (250microns) made laser an appropriate tool for excision of superficial lesions of vocal cords which were initially treated only by micro dissection.

The constant search for minimally invasive micro laryngeal surgery with maximum intact function saw the introduction of radiofrequency assisted plasma ablation as a tool in benign lesions of the vocal cords. This technique has also got an added advantage of significantly faster recovery times. The

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Radiofrequency assisted plasma ablation or Coblation is widely used in surgery for obstructive sleep apnea syndrome, tonsillectomy, turbinate reduction, etc.

Our study intends to find out the difference in outcome of Benign lesions of larynx, treated by Radiofrequency assisted plasma ablation and Carbon dioxide Laser, the potential advantages and disadvantages of each procedure, and any difference in duration of surgery.

AIMS

- To compare the treatment outcome in Benign lesions of larynx usingRadiofrequency assisted plasma ablation and Carbon dioxide laser.
- To find out whether there are significant or potential adverse effects of either procedure.
- To determine whether any of these procedures is preferred treatment of choice in specific conditions.

REVIEW OF LITERATURE

The medical literature was searched to identify studies and reviews relevant to benign lesions of larynx, their diagnosis, and management relevant to usage of radiofrequency assisted plasma ablation and Carbon dioxide laser. The list of studies included in this review are as follows:

Aniket*et al.* [1] studied the incidence of various types of benign lesions of larynx and their modes of clinical presentation, etiological factors and correlate the clinical and histopathological diagnosis. They found out the male preponderance of the lesions, with vocal cord polyps and nodules constituting the majority of the cases.

Similar study by Om Prakash *et al.*[2] also reiterated the above facts, they also added that non-neoplastic lesions are more common, and the peak incidence is at the 40-50th decades.

Printza A*et al.*[3] studied the diagnostic value of Videostroboscopy in benign lesions of larynx and stressed the benefits of diagnosing small lesions of the vocal cords which were otherwise normal during unremarkable endoscopy, which is more important especially for professional voice users.

Mami Kaneko *et al.*[4] studied about the optimal period of voice rest after surgery for effective recovery.

Sharon S. Tang *et al.*[5] studied the timing of voice therapy after surgery, they found out greater gains in vocal function and quality if the patients are started on voice therapy preoperatively and then continued postoperatively.

Wang ZY *et al.*[6] analysed the outcome of benign lesions of larynx treated by radiofrequency ablation and found out that the technique is minimally invasive causing minimal trauma, less bleeding, high safety, and causes very few complications. They also discuss about the wide applications of radiofrequency ablation in ENT.

The National Institute for Health and Clinical excellence and British Association of Otolaryngologists[7] conducted a review of the safety and efficacy of radiofrequency ablation in recurrent respiratory papillomatosis, they found out reduced number of frequency of procedures needed to maintain airway, but they were uncertain of the advantage over other gold standard methods like laser and cold steel excision.

Hardik Shah *et al.*[8], compared the efficacy of laser with conventional techniques in treatment of benign vocal cord lesions, they found out that postoperative pain and intraoperative bleeding was less in patients treated with laser. But surgical technique for laser requires expertise and more training.

MATERIALS AND METHODS

TYPE OF STUDY

Prospective Randomized Double Blind Clinical Trial.

STUDY PERIOD

June 2022 to May 2024.

NUMBER OF CASES

30.

SOURCE OF DATA

Patients who were presenting to ENT Outpatient department, Government Arignar Anna Memorial Cancer Hospital and Research Institute, Kanchipuram with voice complaints.

INCLUSION CRITERIA

All patients who are 18 years or older (to exclude the possibility of inconsistencies in voice during puberty), diagnosed to have Vocal cord polyps, vocal cord nodules, mucous retention cysts, epidermoid cysts, Reinke's edema, recurrent laryngeal papillomatosis, etc.

EXCLUSION CRITERIA

Persons diagnosed to have

- Malignant lesions.
- Pregnant women.
- Mentally impaired persons.
- Persons with comorbid medical conditions who cannot tolerate general anesthesia.
- Patients who show good response with voice therapy and medical management.

METHODOLOGY

Adult patients who were presenting to ENT OPD with voice complaints like hoarseness, breathy or rough voice, diplophonia, etc. are evaluated. Complete head and neck examination and Indirect laryngoscopy examination (with topical 10% lignocaine spray if required) was done. Patients suspected to have benign lesions of the larynx like vocal cord polyps, vocal cord nodules, Reinke's edema, recurrent laryngeal papillomatosis, intracordal cysts, etc. are subjected to Videostroboscopy and diagnosis is confirmed. The patients are randomly allocated for the proposed

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treatment modalities-Radiofrequency assisted plasma ablation and Carbon dioxide laser.
Pretreatment voice assessment was made using Voice Handicap Index-10 (subjective) and Maximum Phonation Time (MPT).

VOICE HANDICAP INDEX-10
It is a self-reporting questionnaire[9,10] by the patient regarding the voice symptoms, a set of 10 questions, and the response was graded on a scale of 0-4. Based on the response by the patients, the scores are obtained. Generally scores greater than 11 is considered significant for voice pathology.

MAXIMUM PHONATION TIME (MPT) [11]
This is calculated by asking the patient to take a deep breath, then sustain a vowel sound like "ah" or "ee" for as long as possible in pitch and loudness in which the patient is comfortable on one exhalation. The time is recorded in seconds using a stopwatch. Two more of such attempts are made. The longest time recorded of the three is taken into account for calculation of MPT. The value is considerably reduced in cases with voice pathology.

Table I: Maximum Phonation Time

Sex	Time (Seconds)
Men	25-35
Women	15-25

VIDEOSTROBOSCOPY
Preoperative Videostroboscopic findings[12] were also recorded with respect to 4 parameters:
- Glottal closure
- Regularity
- Mucosal wave
- Symmetry

All the patients were subjected to preoperative voice therapy[13] to prepare the patient for a prolonged postoperative voice rehabilitation.

SURGERY
The patients who agreed to participate in the study, with duly signed consent forms, were randomly assigned to receive radiofrequency assisted ablation or laser excision.

FOR RADIOFREQUENCY ASSISTED ABLATION
Procise LW Wand with integrated cable was used with a foot pedal controller, the base of the lesion in the vocal cord was traced as it is held with a forceps, and the base was then cut and ablated till the basal attachment was completely cut off.

FOR CARBONDIOXIDE LASER EXCISION
Endotracheal intubation with a laser safe tube was done. Operating microscope with a focal length of 400 mm was used after introducing the Suspension Laryngoscope. Carbondioxidemicrospot laser (250 microns) with superpulse mode was used, and adequate care was taken to dissect the lesion in the most superficial plane as possible, to avoid any trauma to the deep layers of the vocal cord.
Specimens were sent to histopathology for accurate tissue diagnosis. All the patients were given a dose of 8mg Dexamethasone IV intraoperatively. Surgical duration is noted. Complications, if any, are noted. All the patients were advised strict voice rest for first 2 weeks following surgery.
Postoperative follow up was done at 2 weeks and 8 weeks from the day of surgery. Videostroboscopic parameters and Voice assessment with Voice Handicap Index-10 and Maximum Phonation Time are recorded. The outcome was compared and final analysis of results was done.

OUTCOME
Cure was defined as the subjective feeling of improved voice quality and normal bilateral vocal cord mobility with constant periodicity and normal mucosal wave. The pre and postoperative MPT scores at 2 weeks and 8 weeks, pre and post-operative VHI scores are also taken into consideration.

RESULTS AND ANALYSIS
Table 2: Age-Wise Distribution of the Study Participants

Age-Group	Frequency	Percentage
21-30 years	3	10.0
31-40 years	5	16.7
41-50 years	7	23.3
51-60 years	10	33.3
61-70 years	5	16.7
Total	30	100.0

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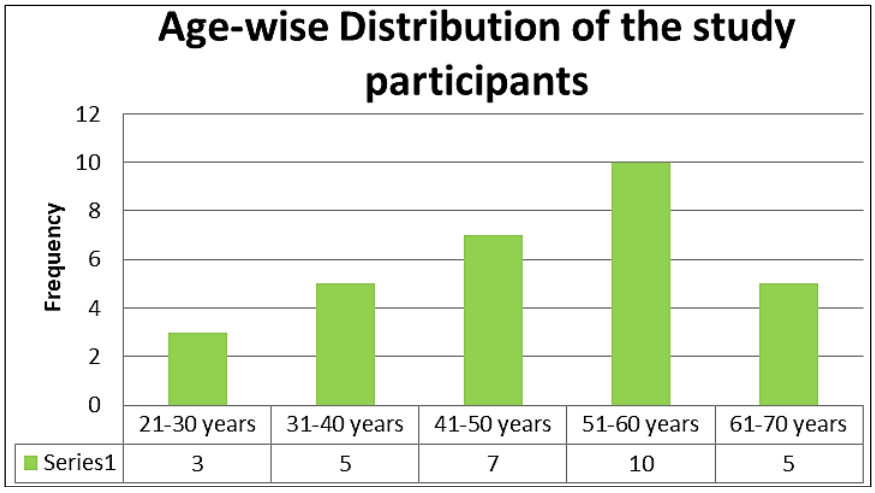

	N	Minimum	Maximum	Mean	Std. Deviation
Age	30	26	65	48.17	11.859

Table 3: Sex-Wise Distribution of the Study Participants

Sex	Frequency	Percentage
Males	23	76.7
Females	7	23.3
Total	30	100.0

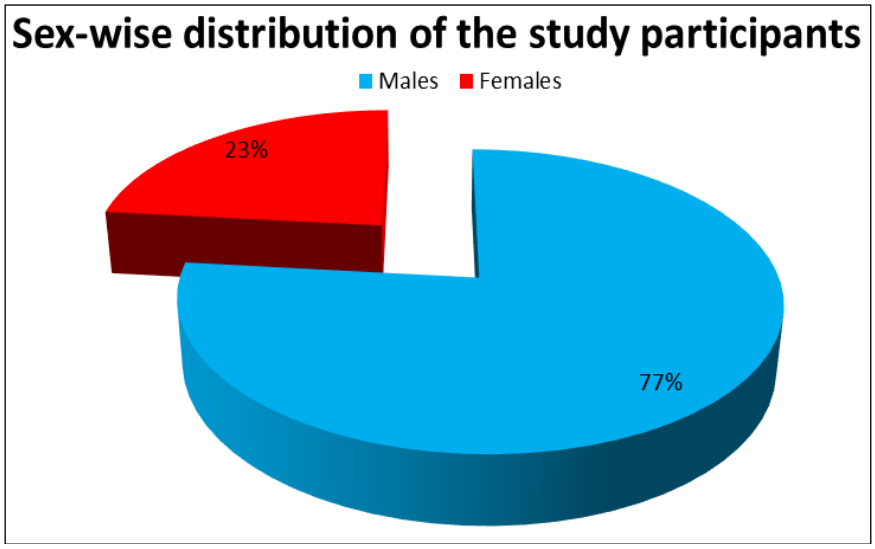

Table 4: Clinical Presentations of the Study Participants

Clinical Presentation	Frequency	Percentage
Hoarseness	15	50.0
Breathy voice	5	16.7
Rough voice	9	30.0
Diplophonia	1	3.3
Total	30	100.0

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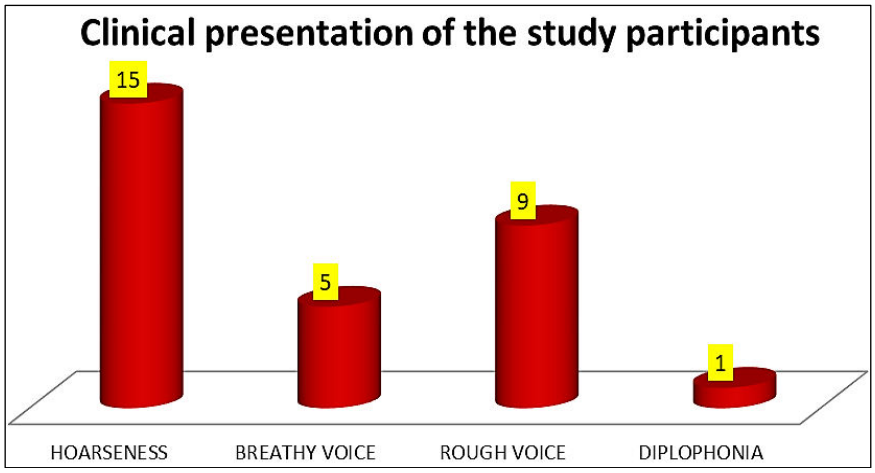

Table 5: Various Diagnoses in the Study

Diagnosis	Frequency	Percentage
Vocal Cord Polyp	14	46.7
Vocal Cord Nodule	8	26.7
Recurrent Laryngeal Papillomatosis	2	6.7
Reinke's Edema	2	6.7
Vocal Cord Cyst	2	6.6
Sulcus Vocalis	1	3.3
Vocal Cord Granuloma	1	3.3
Total	30	100.0

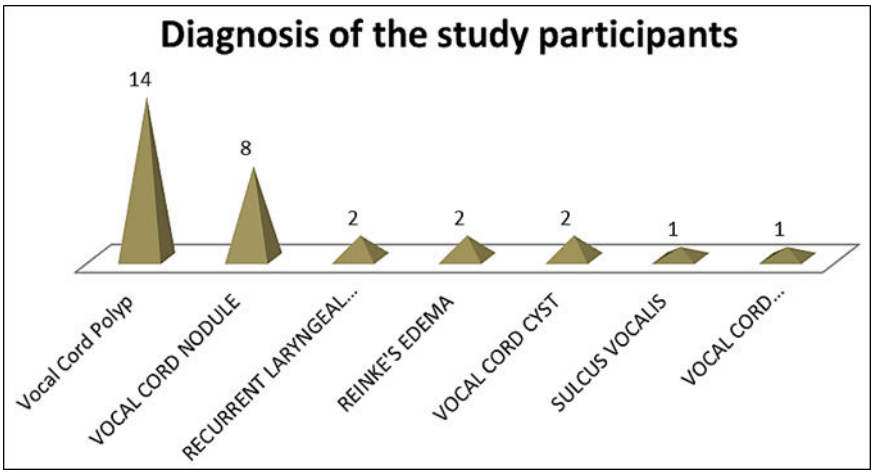

Table 6:Risk Factors/Precipitating Factors

Precipitating/Risk factors	Frequency	Percentage
Smoker	11	36.67
Voice Abuse	10	33.33
Laryngopharyngeal Reflux	5	16.67
Others	1	3.3
Nil	8	26.7

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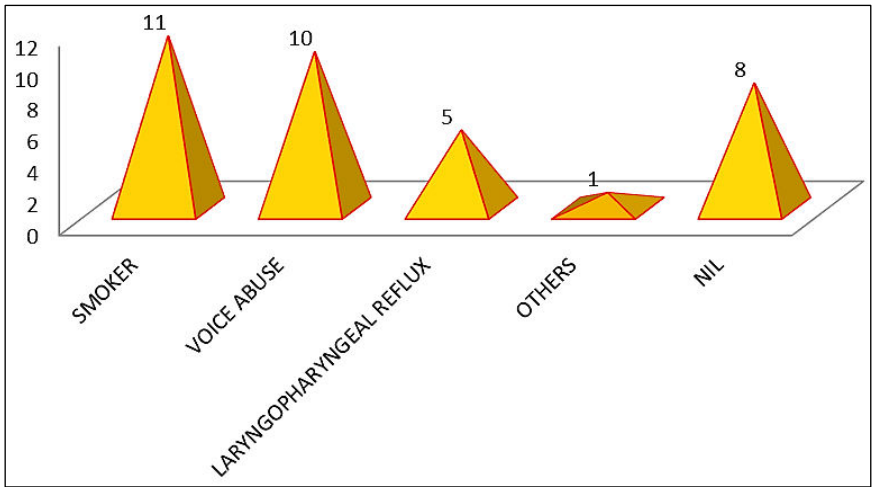

Table 7: Voice Handicap Index in the Study Participants

VHI Score	Frequency	Percentage
Normal	8	26.7
Abnormal	22	73.3
Total	30	100.0

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Pre Treatment VHI Score	30	11	18	13.00	1.894

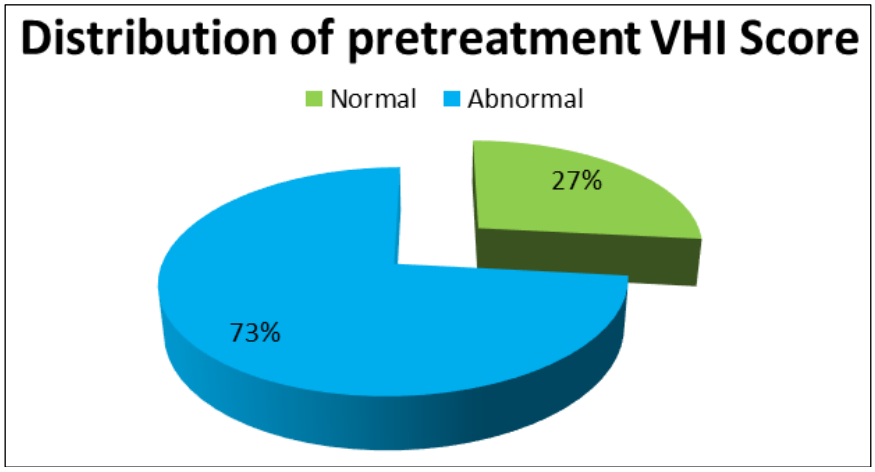

Table 8: Pretreatment MPT in the Study Participants

Gender	Duration	Frequency	Percentage	Total
Females	Normal (15-25s)	3	42.9	7
	Abnormal (less than 15s)	4	57.1	
Males	Normal (25-35s)	1	4.3	23
	Abnormal (less than 25s)	22	95.7	

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Pre Treatment MPT Score	30	12	26	18.47	3.159

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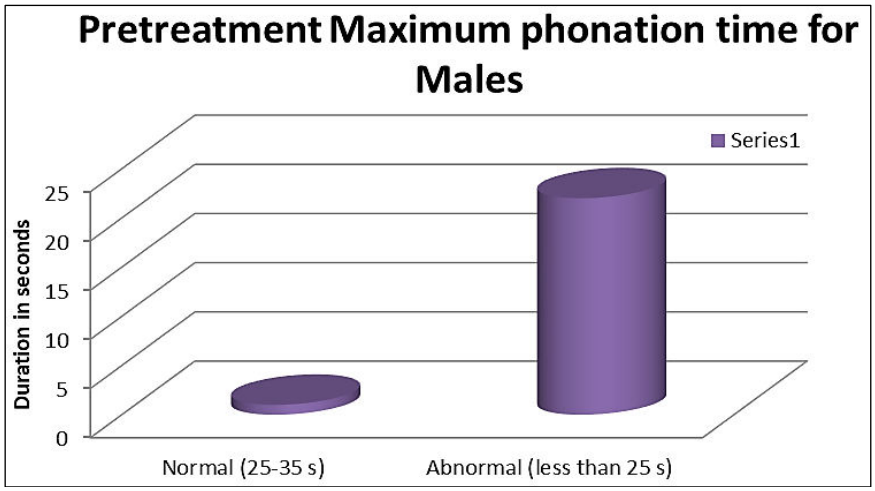

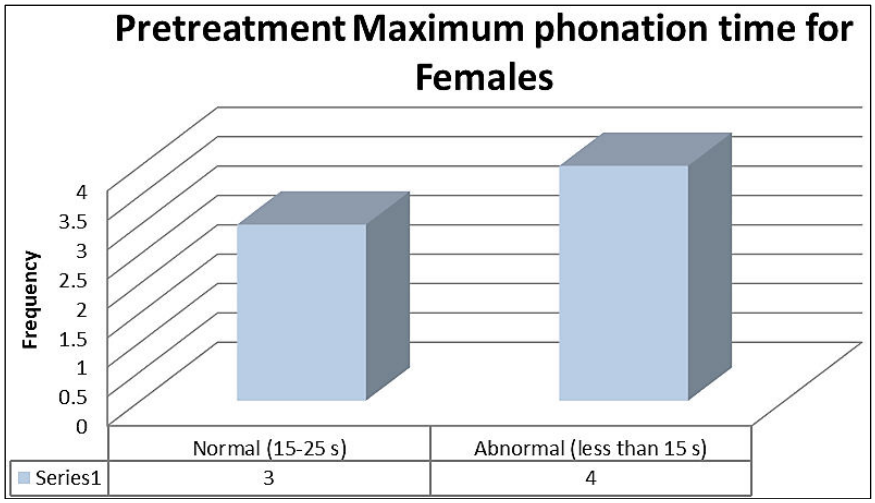

Table 9: Modalities Used

Treatment Groups	Frequency	Percentage
Coblation Therapy	15	50
Laser Therapy	15	50

Table 10: Surgical Time (In Seconds)

Treatment Method	Minimum	Maximum	Mean	SD
Coblation	10	30	18.00	5.398
LASER	18	30	24.20	4.296

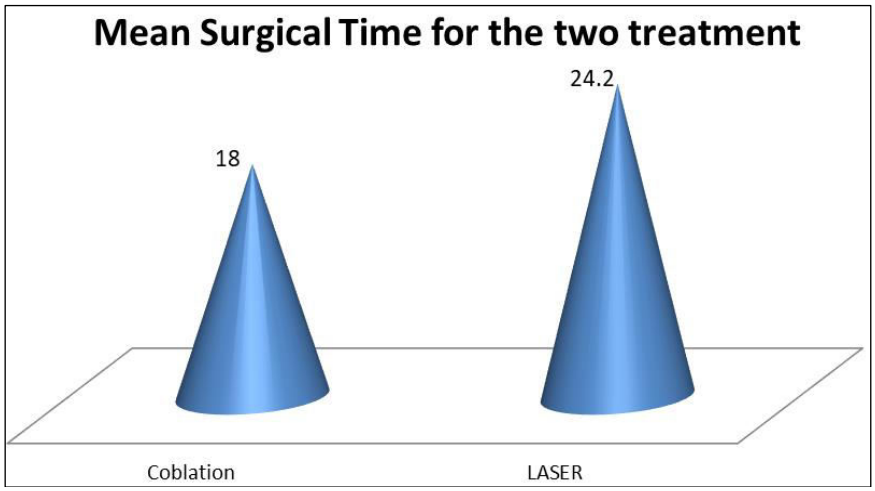

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Table 11: Comparison between Two Methods

Treatment Method	Meanin seconds	SD	Non-parametric Test (Mann Whitney U test)	P value
Coblation	18.00	5.398	0.41	**.002**
LASER	24.20	4.296		

The mean difference between the two methods is 6.2 seconds and it is obvious the duration for coblation therapy is less compared to LASER treatment and is found to be statistically significant by Mann Whitney U test.

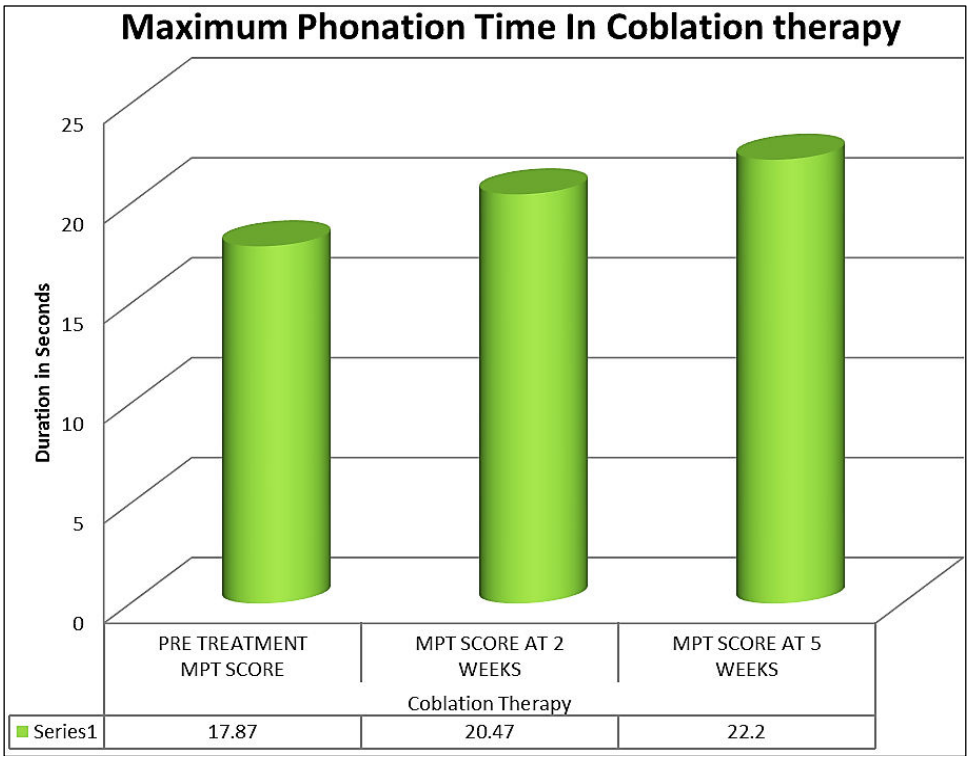
Table 12: Complications

Treatment Groups	Frequency	Complications
Coblation Therapy	15	NIL
Laser Therapy	15	NIL

In both treatment modalities there are no complications.

Table 13: Recovery Time

Treatment Method	MPT Score	Minimum	Maximum	Mean	SD
Coblation Therapy	Pre Treatment MPT Score	12	26	17.87	3.833
	MPT Score at 2 Weeks	14	28	20.47	3.944
	MPT Score at 8 Weeks	14	28	22.20	4.459
Laser Therapy	Pre Treatment MPT Score	14	23	19.07	2.282
	MPT Score at 2 Weeks	17	27	21.40	2.720
	MPT Score at 8 Weeks	20	31	24.20	3.385



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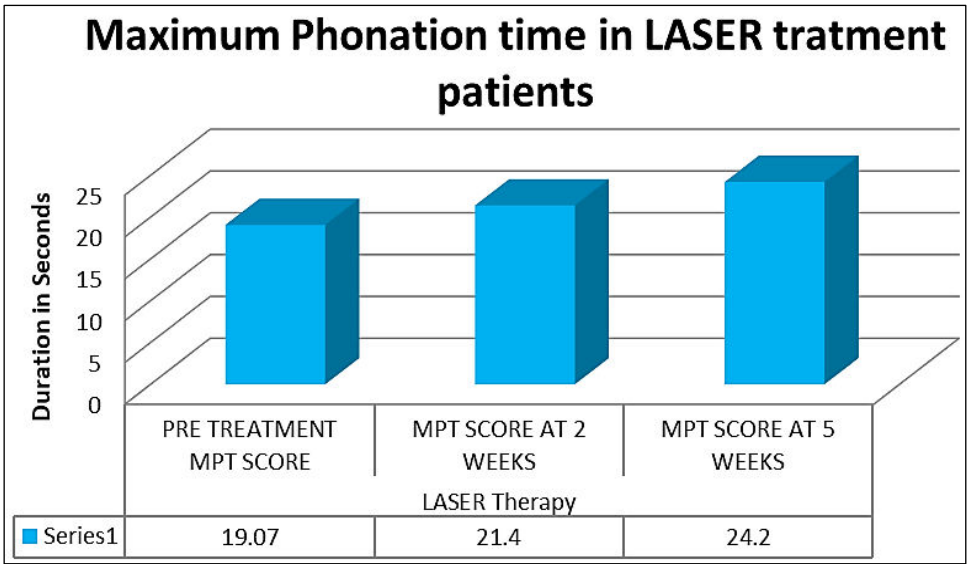

Table 14: Comparison of MPT Score within the Treatment Groups

Treatment Method	MPT Score	Mean	SD	Mann Whitney U Test	P value
Coblation Therapy	Pre Treatment MPT Score	17.87	3.833	84.5	**<0.05**
	MPT Score at 2 Weeks	20.47	3.944		
Laser Therapy	Pre Treatment MPT Score	19.07	2.282	91.5	.381
	MPT Score at 2 Weeks	21.40	2.720		
Treatment Method	MPT Score	Mean	SD	Mann Whitney U Test	P value
Coblation Therapy	MPT Score at 2 Weeks	20.47	3.944	91.50	.381
	MPT Score at 8 Weeks	22.20	4.459		
Laser Therapy	MPT Score at 2 Weeks	21.40	2.720	87.00	.289
	MPT Score at 8 Weeks	24.20	3.385		
Treatment Method	MPT Score	Mean	SD	Mann Whitney U Test	P value
Coblation Therapy	Pre Treatment MPT Score	17.87	3.833	82	**<0.05**
	MPT Score at 8 Weeks	22.20	4.459		
Laser Therapy	Pre Treatment MPT Score	19.07	2.282	56	**<0.05**
	MPT Score at 8 Weeks	24.20	3.385		

Table 15: VHI Score

	Minimum	Maximum	Mean	Std. Deviation
Pre Treatment VHI Score	11	18	13.00	1.89
Post Treatment VHI Score	5	13	8.03	1.93

Treatment		Minimum	Maximum	Mean	Std. Deviation
Coblation	Pre Treatment VHI Score	11	16	13.60	1.72
	Post Treatment VHI Score	5	13	8.93	1.90
Laser	Pre Treatment VHI Score	11	18	12.40	1.92
	Post Treatment VHI Score	5	10	7.13	1.55

Table 16: Comparison between the VHI Score

Treatment Method	VHI Score	Mean	SD	Mann Whitney U Test	P value
Coblation Therapy	Pre Treatment VHI Score	13.60	1.72	11.06	**<0.05**
	Post Treatment VHI Score	8.93	1.90		
Laser Therapy	Pre Treatment VHI Score	12.40	1.92	18.4	**<0.05**
	Post Treatment VHI Score	7.13	1.55		

Table 17: Comparison of MPT Score between the Two Groups

	Treatment	N	Mean	Std. Deviation	F value	P value
Pre Treatment MPT Score	1	15	17.87	3.833	4.183	.306
	2	15	19.07	2.282		

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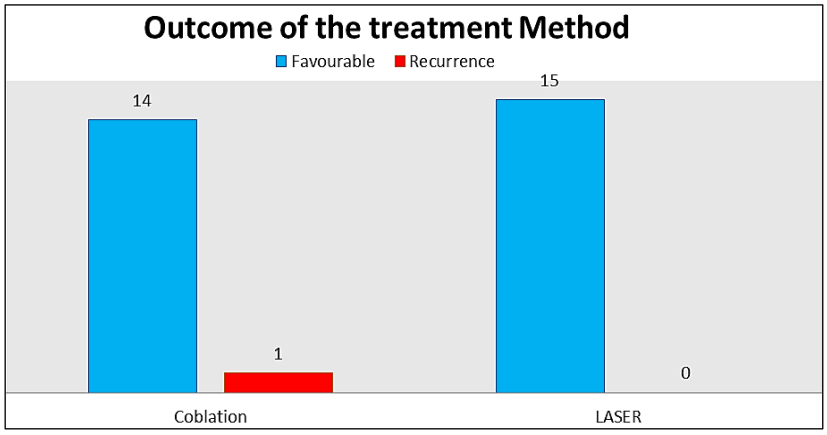
MPT Score at 2 Weeks	1	15	20.47	3.944	3.005	.457
	2	15	21.40	2.720		
MPT Score at 8 Weeks	1	15	22.20	4.459	1.990	.177
	2	15	24.20	3.385		

Table 18:Group Statistics

	Treatment	N	Mean	Std. Deviation	F value	P value
Pre Treatment VHI Score	1	15	13.60	1.724	.018	.082
	2	15	12.40	1.920		
Post Treatment VHI Score	1	15	8.93	1.907	.029	.008
	2	15	7.13	1.552		

Table 19: Outcome

Gender	Outcome	Frequency	Percentage
Coblation	Favorable	14	93.3
	Recurrence	1	6.7
Laser	Favorable	15	100.0
	Recurrence	Nil	-



DISCUSSION

Hoarseness was the most common presenting symptom, followed by roughness. Of the total 30 cases, 15 presented with hoarseness, 9 presented with roughness, 5 presented with breathy voice, diplophonia was present in one patient.

PRETREATMENT VHI-10 SCORE

22 of the 30 patients had abnormally high VHI scores, the remaining 8 patients had a borderline VHI scores, which further highlights the importance and clinical ease of using this tool as a reliable indicator of voice dysfunction. The mean VHI score is 13.00 with a standard deviation of 1.894.

PRETREATMENT MPT SCORE

95.7% of males and 57.1% of females in the study group had abnormal pretreatment MPT score. The mean MPT score of the study population was 18.47 with a standard deviation of 3.159.

SURGICAL TIMES

The mean surgical time of Coblation surgery is 18.00 minutes, with a standard deviation of 5.398, whereas for Carbon dioxide Laser, the mean time is 24.20 with a standard deviation of 4.296.

The mean difference of 6.2 between the two methods shows that the surgical times with coblation method are significantly lower than that ofCarbondioxide laser (Mann Whitney U Test 0.41, p value <0.05).

RECOVERY TIMES

Table 20: Comparison of MPT Score between Two Groups

Mean MPT Score	Pretreatment	2 WKS Postop	8 WKS Postop
Coblation	17.87	20.47	22.2
Laser	19.07	21.40	24.20

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The Mean MPT score in the coblation group showed statistically significant improvement after 2 weeks postoperatively, with further improvement after 5 weeks postoperatively. In Laser group, mean MPT score did not show significant improvement at 2 weeks, but eventually showed improvement at 8 weeks.

One case of recurrence was a case of Laryngeal papilloma, which occurred at a site different from the previous surgery done at our hospital, and was successfully treated by second surgery, following which the patient is symptom free.

Based on the above observation, it can be inferred that though both the methods are similar in terms of outcome, Laser surgery has significantly longer surgical times, and recovery also takes slightly longer when compared to Coblation surgery. This is attributable to the fact that Coblation carries less risk of injuring surrounding tissue, and that it operates at a much lesser temperature (40-70 degrees Centigrade) than that of Laser, which, on the other hand operates at 300 degrees Centigrade, which may cause heat damages in the lamina propria and deep tissues of the vocal cords.

LIMITATIONS OF THE STUDY

Because of the lack of availability of acoustic and aerodynamic analyses in our current set up, we mainly used videostroboscopic assessments and patient perceived tools like Voice Handicap Inventory 10, Maximum phonation time, etc.

CONCLUSIONS

This study suggests that Radiofrequency assisted plasma ablation and Carbon dioxide Laser both are excellent treatment modalities for the surgical management of Benign Lesions of the Larynx in the hands of an experienced surgeon.

There were no detectable differences in the outcome between the two methods and there were no complications in any of these methods.

The delay in recovery times, as evidenced by lower MPT scores at 2 weeks for Laser can be attributed to the fact that it operates at a higher temperature thereby causing more thermal damage to surrounding tissues. But at the end of 8 weeks, the scores are similar to both modalities.

Coblation, though an excellent tool with much lower complications than any other electrosurgical modalities, carries a huge disadvantage of incurring cost of wands. This is not the case in Laser, as the setup involves one-time investment with no incurring cost thereafter.

The importance of preoperative evaluation using Videostroboscopy as a diagnostic tool vastly improves the accuracy of the diagnosis, and also acts as an essential tool in assessing the recovery of the patients.

Moreover the importance of preoperative voice therapy in preparing the patient for much more prolonged post-operative voice rehabilitation is also stressed in our study. Adequate voice rest of at least 2 weeks with strict adherence to post-operative voice therapy is absolutely essential to ensure proper healing and improved outcome in these patients.

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