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Original Research Paper

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PROSTHETIC INTRANASAL STENTS-A COMPREHENSIVE REVIEW

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ABSTRACT

STATEMENT OF THE PROBLEM: The fabrication of an effective nasal stent which is unique and custom-fashioned to conform to the individual's nasal passageway has always been a challenge to the maxillofacial prosthodontist. **OBJECTIVE:** To review and summarize the various techniques and materials used for the fabrication and retention of nasal stents. **REVIEW METHODS:** A total of 45 articles from the year 1967 to 2020, obtained through electronic literature search were analyzed with respect to the medical condition of the patient, the impression technique and the materials. The descriptive statistics were then represented graphically. **CONCLUSION:** The results of this review yielded that 91% of the nasal stents were custom fabricated, out of which 45% were made of hard acrylic and 19% with silicone, while 9% authors chose preformed stock stents. Only 67% of the authors resorted to impression procedures while 33% had customized silicone catheters and endotracheal tubes to fit the nasal passageway and maintain its patency, without performing any impression procedure. The prognosis greatly depends upon a thorough diagnosis, treatment sequence and patient compliance.

KEYWORDS : : Nasal Stenosis, Obstruction, Prosthetic Nasal Stent.

INTRODUCTION:

The nose is the most prominent feature on the face, which provides balance and harmony as well as acts as a safety apparatus. Nasal obstruction and nasal deformities can lead to a serious negative impact on the patient's quality of life. [1-2]. Prosthetic therapy compliments surgical intervention in nasal reconstructive procedures by fabrication of nasal stents, which are used to support the transplants, maintain contour, minimize and counteract scar tissues and to combat nasal stenosis which occurs during healing [3]. The greatest challenges lie in maintaining the corrected position of the nasal passageway and prevent restenosis as a result of post operative scar contracture [4].

This review article aims at exploring the various prosthetic treatment options available in the fabrication of intranasal stents. A literature search was performed using search terms 'nasal stents', 'nasal stenosis' in combination with prosthetic rehabilitation and management. Suitable references were also selected and reviewed. A total of 45 articles from the year 1967 to 2020 were analyzed with respect to the medical condition of the patient, the impression technique and the materials used in the fabrication of nasal stents.

REVIEW OF LITERATURE:

The most logical approach in the fabrication of nasal stent requires an accurate impression of the defect. A wide array of materials and techniques have been tried to maintain the patency of the nasal passageway with varying degrees of success. Modeling plastic, silicones, elastomeric impression materials, impression wax and scanning techniques have been used with or without a custom receptacle to record the stenosed intranasal anatomy (67%). A few other authors have customized silicone catheters and endotracheal tubes to fit the nasal passageway and maintain its patency, without performing any impression procedure (33%).

Based on the nature of the defect, preformed and custom fabricated nasal stents were used by various authors. While most of the nasal stents were made self retentive, others required sutures or extra retentive elements like thread or implants to secure them in place during the healing period.
In relation to this review, the majority of the published studies and reports utilized custom-fabricated intranasal stents (91%) made from elastomeric impression materials with or without a receptacle. Out of these, hard acrylic resin stents (45%) sustained the test of time when compared with silicone (19%) and other custom fabricated stents (36%). Preformed, stock nasal stents were rarely utilized (9%) because of the difficulty in conforming to the contour and anatomical confines of the nasal vestibule. The retention mechanism posed a challenge and the fear of causing pressure sores was also a major concern. The paucity of commercially available nasal stents limited its wide usage in the routine practice.

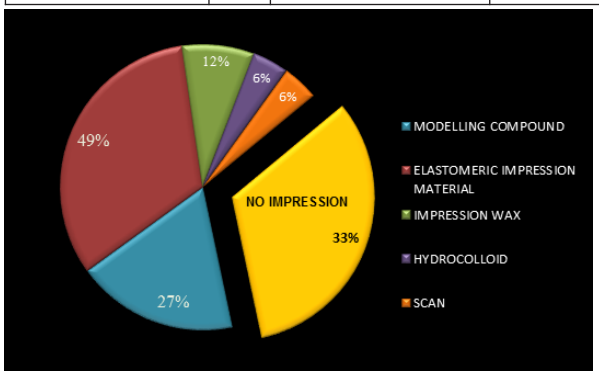
The medical condition of the patient, impression technique, the material used in the fabrication and retentive mechanism of the nasal stents, by different authors since 1967 is collated in tabular format.

AUTHOR	YEAR	PATIENT	IMPRESSION MATERIAL & TECHNIQUE	NASAL STENT MATERIAL	RETENTIVE ELEMENT
Shah J.S. [5]	1967	3.5yr /F Small pox	Gutta percha	Acrylic resin	Thread retained
Bajaj P.S., & Bailey B.N. [6]	1969	5yr /M Chemical cauterization to stop epistaxis 11yr /M Cleft lip and palate 15yr /M Small pox	Nil	Perspex prosthesis	Self- retentive
Young J.M. [7]	1970	39yr /F Deviated nasal septum	Low heat modeling plastic with impression wax surface	Heat- cure methyl methacrylate resin	Self-retentive

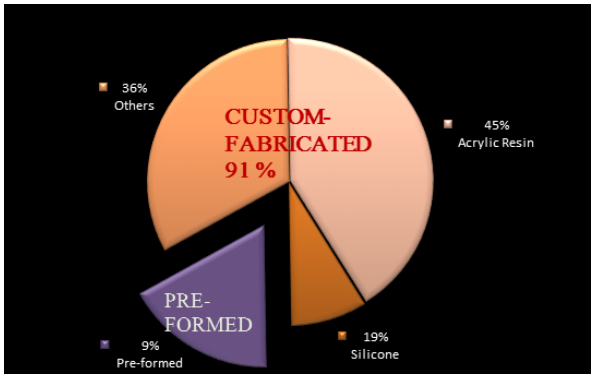
Doran P. C. [8]	1975	Multiple keloid scar contractures	Silastic 388 with a core of polyethylene tubes from the spindles of dental floss rolls	Heat- cure methyl methacrylate resin	Self-retentive (Expandable with jack screws)
Parel S.M. [9]	1980	Tumor resection	Modeling compound sticks corrected with body temperature flowing wax	Cold-cure methyl methacrylate resin	Self-retentive with velcro inserts
Davenport J.C. [10,11]	1981	10 patients Alar collapse due to congenital weakness	Putty and low viscosity silicone rubber (Incremental method)	Heat-cure methyl methacrylate resin	Self-retentive
McKinstry R.E., & Zini I. [12]	1985	Deviated nasal septum	Green stick modeling compound Silastic 382 mold	Cold-cure methyl methacrylate resin Slush method	Self- retentive
Gleeson M.J., & Hibbert J [13]	1985	Infant Bilateral choanal atresia	Nil	Portex Z79-1T endotracheal tubes	Sutures and washer
Lancer J.M. & Jones A.S [14]	1986	59yr /M Trauma & burns	Nil	Francis Alae Nasi prop	Self-retentive
Gadre A.K., Savant R., Gadre K.C., Bhargava K.B., & Juvekar R.V [15]	1988	5 patients Closed nostril in Atrophic rhinitis	Nil	Vaseline impregnated gauze	Nasal pack
Seals R.R., Bohnenkamp L.G., & Parel S.M [4]	1988	Review article	-	Intranasal prostheses,splints,stents	-
Nakajima T., Yoshimura Y., & Sakakibara, A [16]	1990	3 cases 10yr /F; 8wks /M ; 20yr /M Cleft lip and palate	Dimethyl polysiloxane refined moldable Quick Set Silicone	Commercially available nasal splints	Self -retained
Costa P., Orlando A., Mascio D.D [17]	1995	Iatrogenic anterior nasal stenosis after cauterization of a septal varicosity	Moldable dental silicone supported by twisted wax	Heat-cure methyl methacrylate resin expandable stent	Orthodontic expansion screw (Dentaurum 600-30B with expansion range of 6.5 mm
Zaki H.S., & Myers E.N [18]	1997	Nasal septal defect	RTV silicone with cotton tipped applicators	Self- cure methyl methacrylate with bulk formed by heat-cure methacrylate resin	Self- retentive
Hickey A.J., & Vergo T.J [19]	2000	Infant Bilateral choanal atresia	Irreversible hydrocolloid	Portex attached with self-cure methacrylate resin	Adhesive
Sharon-Buller A., Golender J., Savion I., & Sela M. [20]	2003	3 months /F Choanal atresia	Optosil silicone	Heat-cure methyl methacrylate resin	Occipital orthopedic headgear
Menger D.J., Lohuis P.J.F.M., Kerssemakers S., & Trenite G.J.N [2]	2005	52 patients (Unilateral cleft lip-67% Bilateral cleft lip-15% Tumor surgery-17%)	Regular body hydroxyvinylpolysiloxane	Thermoplastic acrylic material	Self retentive
Egan K.K., & Kim D.W [21]	2005	7 patients Functional rhinoplasty for nasal valve collapse	Nil	Standard 34 French nasal airway tube	Self -retentive
Savion I., Miler L., & Maloy R.B [22]	2005	19yr /M Gunshot wound	Modeling plastic sticks and Vinyl polysiloxane	Self cure methacrylate resin and endotracheal tube	17 gauge orthodontic wire
Smith L.P., & Roy S [23]	2006	3 cases of premature infants Extended use of nasal prongs and nasogastric tube	Nil	3.0 Endotracheal tubes with 0.4 mg/ml of Mitomycin c	4-0 prolene sutures
Jones E., Youker S., & Fosko S. [24]	2006	Post Mohs surgery during melolabial interpolation flap	Nil	Nasal trumpet Orthosis (semi rigid plastic device)	4-0 nylon suture
Zemnick C., Asher E.S., Wood N., & Piro J.D [25]	2006	36yr / F HIV patient –nose erosion due to CMV infection	Soft wax forming a pseudoflange and irreversible hydrocolloid impression material	Silicone	Adhesive

Salvado A.R., & Wang M.B. [26]	2008	68yr /F Burns	Nil	No.6 endotracheal tube	Prolene sutures and dental cotton rolls
Weber R.K. [27]	2009	Review article	-	New generation of nasal packs –hemostatic, resorbable and biodegradable packs	-
Wong F., & Smith C.R [28]	2009	3 yr / M Unilateral choanal atresia	Modeling plastic compound sticks and dental impression wax	RTV silicone	Suture
Javia L.R., Shah U.D., & Germiller J.A [29]	2009	Choanal atresia	Nil	Ring Adair Elwyn endotracheal tube	4-0 or 3-0 polypropylene suture
Ciocca L., Fantini M., Crescenzio F.D., Persiani F., & Scotti R [30]	2010	58yr /M Gunshot wound	Laser Scanning	CAD-CAM Rapid prototyping silicone prosthesis	Eye glass retained
Pavithran, P., Pujary K., Mahesh S.G., Parul P., & Aziz B [31]	2010	16 patients Recanalisation of modified Young's procedure	Dental wax	Heat cure methyl methacrylate resin (6) Suction tube tip (7) Dental wax plates (3)	Self retentive
Gunay Y., Uygur F., Atay A., & Celiköz B [32]	2010	60yr /F Road traffic accident	Silicone	Silicone nasal prosthesis with tules	Eyeglasses and implants
Ethunandan M., Downie I., & Flood T [33]	2010	34 patients Rhinectomy	Nil	Silicone	Implants (bars and magnets-retained)
Qiu J., Gu X.Y., Xiong Y.Y., & Zhang F.Q. [34]	2011	70yr /M Rhinectomy due to carcinoma	CT Scanning	CAD-CAM Rapid prototyping silicone prosthesis	Eye glass retained
Goveas R., Puttipisitchet O., Shrestha B., Thaworanunta S., & Srithavaj M.L.T. [35]	2012	61yr /M Papillary Squamous cell carcinoma	Low fusing modeling plastic compound followed by acrylic resin reinforced with 21 gauge orthodontic wire (custom receptacle)-vinyl polysiloxane medium body and light body elastomer	RTV silicone	Self retentive
Bassam W.A., Bhargava D., & Al-Abri R [36]	2012	16 mo /M Trauma with deep laceration wound	Nil	V- silicone stent {0.5 mm silicone sheet (2cm x 1 cm) inverted V shape}	4-0 silk suture
Bajaj A., Shetty V., Pahwa I., & Bajaj M. [37]	2012	Infant Cleft lip and palate	Standard endotracheal tube (5.5mm)	Soft denture liner	Self -retentive
Visvanathan V & Wynne D.M. [38]	2012	10 cases of congenital nasal pyriform aperture stenosis	Nil	3.5 Portex endotracheal tube	Anterior cuff
Jindal S., Bhatnagar A., Singh A., Soni R., & Singh B.P. [39]	2013	23yr /F Chemical burn	Green stick compound and addition silicone	Heat -cure methyl methacrylate resin	Self- retentive
Naqash T.A., Yaqoob A., Gulzar S., & Bashir S. [40]	2014	24yr /M Trauma	Medium fusing impression compound and addition silicone elastomer	Heat- cure methyl methacrylate resin	Self -retentive
Chander K.S., Komala J., Reddy R., Umair M., Rajender K., & Venkatesh K. [3]	2015	18yr /F Congenital nasal defect	Modeling plastic impression compound using matchsticks	Heat -cure methyl methacrylate resin	Self- retentive
Rathee M., & Malik P. [41]	2015	24yr /F Deviated nasal septum	Addition silicone putty and light body elastomer	Heat- cure poly methyl methacrylate resin	Self- retentive
Sekine K., Matsune S., Shiiba K., Kimura M., Okubo K., Kaneshiro T. [42]	2015	18yr /M Autistic patient with severe burn injuries	Nil	Self expandable Ultra Flex Esophageal stent system made up of NiTinol knitted into cylindrical shape	Nylon thread
Fernandez T., Karunakaran H., & Rodrigues S.V. [43]	2016	35yr /F Deviated nasal septum	Addition silicone putty and light body elastomer with stainless steel ball pen refill	Heat- cure methyl methacrylate resin	Self- retentive
Kumar P., Ajai K.S., & Sharma R.K. [44]	2016	24y/F Burns	Nil	Silicone urinary catheter	1mm K wire

Khatri A., Kalra N., Tyagi R., Panwar G., & Garg K. [45]	2019	14yr /F Trauma	High viscosity putty elastomer with sand paper mandril	Self- cure methyl methacrylate resin	Serial dilatation by sequential relining of nasal stent with soft liner
Gupta S., Gupta B., & Motwani B.K. [46]	2020	28yr /F Basal cell carcinoma	Vinyl polysiloxane light body	RTV silicone	Spectacles



Graph 1:- Descriptive Statistics Of Impression Technique And Materials Used



Graph 2:- Descriptive Statistics Of The Prosthetic Materials Used In Fabrication Of Nasal Stents

DISCUSSION:

The objectives of reconstruction of any nasal defect must include restoration of its esthetic (qualitative and quantitative) and functional characteristics. Symmetry, contour and function are the three main goals of reconstruction [1]. Nasal stents should serve the purpose of preventing stenosis as well as achieve the desired outcome of any surgical treatment performed. There is no generally recognized standard that is suited to all indications of nasal stenosis. Therefore the treatment modality also varies in different countries. The risk-benefit ratio, the operator's dexterity and patient comfort are the main factors that determine the choice of the treatment procedure [27].

With the advancement in technology and material science, evidence based practice and a diversity of promising modalities are being tested from time to time. The nasal stent materials must be thoroughly tested prospectively, complimented by stringent follow up protocols. The future aspects such as microbial interactions, adhesion and repellant qualities of the material, preservation of olfaction, hemostasis and medication releasing nasal stents are yet to be explored.

High quality patient care can be assured with proper integration of multidisciplinary approach and training. A basic knowledge of the impression techniques and, command over the material manipulation allows for innovations in the fabrication of intranasal stents.

CONCLUSION:

The complex anatomy and critical features of the nasal passageway poses a major challenge in fabrication of nasal stents, to prevent nasal stenosis which also acts as a scaffold for the healing tissues [41]. Although this literature review has compiled the conventionally used methods for the construction of prosthetic intranasal stents, further studies are required to explore new arenas in the treatment of nasal stenosis.

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