INDEX FOR VOLUME 5
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This index lists, in alphabetic order, the names of authors of all articles, letters, and editorials. Full citation is provided under the first author only, with references made from joint authors. Letters and editorials are distinguished from articles by the following code: L = letter, E = editorial.

A

Allard RHB: The thyroglossal cyst, 134–146
Appelblatt NH, McClatchey KD: Olfactory neuroblastoma: a retrospective clinicopathologic study, 108–113

B

Baker SR, see St. Pierre S
Batsakis JG: The pathology of head and neck tumors: the lymphoepithelial lesion and Sjögren’s syndrome, part 16, 150–163
Batsakis JG, Hybels R, Crissman JD, Rice DH: The pathology of head and neck tumors: verrucous Carcinoma, part 15, 29–38
Batsakis JG, Raymond AK, Rice DH: The pathology of head and neck tumors: the myoepithelial cell and its participation in salivary gland neoplasia, part 17, 222–233
Batsakis JG, Raymond AK, Rice DH: The pathology of head and neck tumors: papillomas of the upper aerodigestive tracts, part 18, 332–344
Batsakis JG, see Baker HL
Berghaus A, see Meyer R
Beutter P, see Laccourreye H
Bradley PJ: The complex nasal dermoid, 469–473
Brasnu DF, see Laccourreye H
Brooks BS, see Coker NJ

C

Cantlon GE, Gluckman JL: Sternoclavicular joint hypertrophy following radical neck dissection, 218–222
Carmody RF, see Miller RW
Chan PYM, see Hintz BL
Coker NJ, Brooks BS, El Gammal T: Computed tomography of orbital medial wall fractures, 383–389
Coulthard SW, see Miller RW
Crissman JD, see Batsakis JG
Crissman JD, see McDonald JS

D

DiBella NJ, see Pearlman NW
Dolan KD: Paranasal sinus radiology, part 2B: ethmoidal sinuses, 53–64
Dolan KD: Paranasal sinus radiology, part 3A: sphenoethmoidal sinus, 164–176
Dolan KD: Paranasal sinus radiology, part 3B: sphenoethmoidal sinus, 237–250
Dolan KD: see Khangure MS
Dolan KD, Smoker WRK: Paranasal sinus radiology, part 4A: maxillary sinuses, 345–362
Dolan KD, Smoker WRK: Paranasal sinus radiology, part 4B: maxillary sinuses, 428–446
Donegan JO, see Gluckman JL
Donegan JO, see Myer CM III

E

El Gammal T, see Coker NJ

F

Fabian RL, see Harris JP
Fanous N: Expression plasty: a new approach to esthetic surgery, 306–318
Flanigin H, see Lang NP
Flores L, see Hintz BL
Fried MP, Horowitz Z, Kelly JH, Strome M: The importance of the pedicle for the survival of a vascularized free flap: an experimental study on rats, 130–133
Fries R, see Platz H
Fukuda O, see Kobayashi T

G

Gerold FP, see Jun MY
Giammara B, see McDonald JS
Gittot A, see Tovi F
Gluckman JL, McDonough J, Donegan JO: The free jejunal graft revisited, 468–L
Gluckman JL, see Cantlon GE
Gluckman JL, see McDonald JS
Goldstein J, see Puterman M
Goodman ML, see Granich MS
Goodman ML, see Joseph MP
Granich MS, Pilch BZ, Goodman ML: Meningiomas presenting in the paranasal sinuses and temporal bone, 319–328

H

Handler SD, see Rubinstein JB
Harris JP, Fabian RL: Central island myomucosal tongue flap, 495–499
Harris JP, South MA: Immunodeficiency diseases: head and neck manifestations, 114–124
Harris TJ, Hinckley DM: Melanoma of the head and neck in Queensland, 197–203
Harrison DFN: Reconstruction after pharyngoesophageal resection, 92–L
Harrison R, see Beumer J III
Harwick RD, see Kaplan IB
Hinckley DM, see Harris TJ
Hintz BL, Kagan AR, Wollins M, Miles J, Flores L, Nussbaum H, Rao AR, Chan PYM, Ryoo MC: Local control of T1 vocal cord cancer with radiation therapy: the importance of tumor character vs. treatment parameters, 204–210
Hokanson JA, see Leipzig B
Horowitz Z, see Fried MP
Hudec M, see Platz H
Hybels R, see Batsakis JG

J
Jackson IT, Laws ER, Martin RD: A craniofacial approach to advanced cancer of the central face, 474–488
Johnson FB, see Pearlman NW
Joseph MP, Nadol JB, Pilch BZ, Goodman ML: Ectopic parathyroid tissue in the hypopharyngeal mucosa (pyriform sinus), 70–74
Jun MY, Strong EW, Saltzman EL, Gerold FP: Head and neck cancer in the elderly, 376–382

K
Kagan AR, see Hintz BL
Kaplan IB, Harwick RD: Pectoralis major myocutaneous island flap revisited: a sentinel vessel simplifying dissection, 452–456
Kelly JH, see Fried MP
Kendrick JH, see Lang NP
Khangure MS, Dolan KD: High resolution CT air cisternography in the diagnosis of small acoustic neuromas, 489–494
Kikawada T, see Kobayashi T
Koopmann CF, see Miller RW
Lang NP, Kendrick JH, Flanigin H, McDonald JS, Crissman JD, Gluckman JL: Verrucous carcinoma of the oral cavity, 22–28
McDonald JS, Miller RL, Wagner W, Giammara B: Acral lentiginous melanoma of the oral cavity, 257–262
Mckinney JG, see Gluckman JL
McElhinney AD, see Weitz JW
McGregor IA, MacDonald DG: Mandibular osteotomy in the surgical approach to the oral cavity, 457–462
Meyer R, Berghaus A: Closure of perforations of the septum including a single-session method for large defects, 390–400
Meyers AD, see Pearlman NW
Miles J, see Hintz BL
Miller RL, see McDonald JS
Miller RW, Carmody RF, Seeger JS, Coulthard SW, Smith JRL, Koopmann CF: Digital subtraction angiography: applications in otolaryngology—head and neck surgery, 280–292
Myer CM III, Donegan JO: Traumatic aneurysm of the proximal superficial temporal artery, 181–185

N
Nadol JB, see Joseph MP
Nahum AM: Cancer of the larynx: patterns of spread, 375–E
Nahum AM: Dental extractions and radiation therapy, 467–E
Nahum AM: Head and neck cancer: management of early lesions, 1–2–E
Nahum AM: Head and neck cancer in young black patients, 279–E
Nahum AM: The incidence of melanoma in Queensland is the highest in the world, 197–E
Nahum AM: When run-of-the-mill symptoms fail to respond, 91–E
Nussbaum H, see Hintz BL

O
Obwegeser HL, Makek MS: Benign lipoblastoma in the mandible, 251–256
Papsidero MJ, see Baker HL
Pearlman NW, Meyers AD, Johnson FB, DiBella NJ: Preoperative chemoradiotherapy in advanced head and neck cancer, 10–14
Pensaik ML, see Angel MF
Pilch BZ, see Granich MS
Pilch BZ, see Joseph MP
Pillbury HRC, see Angel MF
Pruet CW, see Loré JM Jr
Puterman M, Goldstein J: Primary lymph nodal Kaposi’s sarcoma of the parotid gland, 535–538

R
Rankin KV, see Wright JM
Rao AR, see Hintz BL
Raymond AK, see Batsakis JG
Rice DH, see Batsakis JG
Rubinstein JB, Handler SD: Orbital and periorbital cellulitis in children, 15–21
Rush BF Jr, see Slotman GJ
Ryoo MC, see Hintz BL

S
Saltzman EL: Aneurysmal bone cyst of the ethmoid, 468–L
Saltzman EL, see Jun MY
Sanders B, see Beumer J III
Sasaki CT, see Angel MF
Sciubba JJ, see Batsakis JG
Seeger JS, see Miller RW
Sessions DG: Recent advances in surgery of the larynx and trachea, 42–52
Shima K, see Kobayashi T
Slotman GJ, Swaminathan AP, Rush BF Jr: Head and neck cancer in a young age group: high incidence in black patients, 293–298
Smith AR, van Urk H, Vaandragter M, van der Meulen JC: Treatment of a large hemangioma in the head and neck region, 263–267
Smith JRL, see Miller RW
Smith KL, see Webster RC
Smith RC, see Webster RC
Smoker WRK, see Dolan KD
South MA, see Harris JP
Stewart A, see Angel MF
Strome M, see Fried MP
Strong EW, see Jun MY
Suen JY, see Lang NP
Swaminathan AP, see Slotman GJ

T
Tjoa AM, see Platz H
Tovi F, Gittot A: Sternoceleiomastoid myoperiosteal flap for the repair of laryngeal and tracheal wall defects, 447–451

V
Vaandragter M, see Smith AR
van der Meulen JC, see Smith AR
van Urk H, see Smith AR

W
Wagner RR, see Platz H
Wagner W, see McDonald JS
Webster RC, Smith RC, Smith KL: Face lift, part 1: extent of undermining of skin flaps, 525–534
Weitz JW, Weitz SL, McElhinney AD: A technique for preservation of spinal accessory nerve function in radical neck dissection, 75–78
Weitz SL, see Weitz JW
Westbrook KC, see Lang NP
Wetmore SJ, see Lang NP
Wilson JW, see Wright JM
Wollins M, see Hintz BL
Wright JM, Rankin KV, Wilson JW: Traumatic granuloma of the tongue, 363–366
This index gives the first author (in parentheses) and first page of the article, letter, or editorial in which the indexed subject occurs. The reader is referred to the author index for the full title and coauthors, where appropriate, of the piece. Letters and editorials are distinguished from articles by the following code: L = letter, E = editorial.

A
Acoustic neuromas
high resolution computed tomography of small acoustic neuromas (Khanguere) 489
Aneurysm, traumatic of the proximal superficial temporal artery (Myer) 181
Angiography, digital subtraction applications in otolaryngology—head and neck surgery (Miller) 280
Artery, superficial temporal traumatic aneurysm of (Myer)181

B
BCG cell-wall preparation for bovine ocular carcinoma (Kleinschuster) 401
Black patients high incidence of head and neck cancer in a young age group (Slotman) 293
Bone cyst, aneurysmal of the ethmoid (Baker) 177

Book reviews
Ackerman and Del Regato's Cancer: Diagnosis, Treatment and Prognosis, 5th Edition (del Regato and Spjut) 545
Aesthetic Plastic Surgery, Volumes 1 and 2 (Rees) 372-373
Atlas of Cranio-maxillofacial Surgery (Jackson, Munro, Salyer, and Whitaker) 87
Atlas of Sectional Human Anatomy, Volume 1: Head, Neck, Thorax (Kortiké and Sickt) 545
Atlas of Sectional Human Anatomy, Volume 2: Abdomen, Pelvis (Kortiké and Sickt) 545
Basics of Dermatologic Surgery (Stegman, Tromovitch, and Giogau) 546
Cancer: A Comprehensive Treatise, Volume 1, Etiology: Chemical and Physical Carcinogenesis, 2nd Edition (Becker, ed) 545

Clinical and Radiographic Interpretation of Facial Fractures (Gerlock, Sinn, and McBride) 373
Color Atlas of Head and Neck Anatomy (Mcminn, Hutchings, and Logan) 193
Color Atlas of Human Anatomy (Mcminn and Hutchings) 193
A Colour Atlas of Oral Cancers (Burkhardt and Maerker) 86–87
Colour Atlas of Oral Medicine (Tyldeley) 86–87
The Cover-Up: Neckwear for the Laryngectomee and Other Neck Breathers (Kelly and Welborn) 194–195
Disorders of the Facial Nerve: Anatomy, Diagnosis and Management (Graham and House, eds) 86
Head and Neck Surgery. Face and Facial Skull, Volumes 1 and 2 (Naumann, ed) 86
Microscopic and Endoscopic Surgery with the CO2 Laser (Andrews and Polanyi, eds) 372
Oculeoplastic Surgery (McCord, ed) 275
Operative Surgery: Head and Neck, Parts I and II, 3rd Edition (Rob and Smith, eds) 194
Psychosocial Aspects of Cancer (Cohen, Cullen, and Martin, eds) 193–194
Radiology of the Ear, Nose, and Throat (Valvassori, Potter, Hanafae, et al.) 276
Spastic Dysphonia: A Surgical and Voice Therapy Treatment Program (Dedo and Shipp) 193
Surgery for Cancer of the Larynx and Related Structures (Silver) 87

C
Cancer (see also carcinoma; lesions; melanoma; neoplasms; tumors) of the central face, advanced recurrent (Jackson) 474
Cancer, head and neck early management (Nahum) 1-E
in the elderly (Jun) 376
mechanisms of hypercalcemia in patients with (Angel) 125
pathology of verrucous carcinoma (Batsakis) 29
preoperative chemo-radiotherapy in advanced tumors (Pearlman) 10
in a young age group, high incidence in black patients (Slotman) 293
in young black patients (Nahum) 279-E
Cancer, larynx extralaryngeal spread (Lam) 410
patterns of spread (Nahum) 375-E
Cancer, scalp advanced, surgical management of (Lang) 299
Cancer, vocal cord local control with radiation therapy (Hintz) 204
Carcinoma (see also cancer; lesions; melanoma; neoplasms; tumors) of the laryngeal margin (Laccourreye) 500
Carcinoma, bovine ocular intratumoral BCG cell wall preparation therapy and surgery for (Kleinschuster) 401
Carcinoma, oral cavity analysis of various pretherapeutic classifications (Platz) 93
Carcinoma, squamous cell of the maxillary sinus (St. Pierre) 508
Carcinoma, tongue treatment of cervical lymph nodes (Leipzig) 3
Carcinoma, verrucous of the oral cavity (McDonald) 22
Cellulitis in children, orbital and periorbital (Rubinstein) 15
Chemo-radiotherapy preoperative, in advanced head and neck cancer (Pearlman) 10
Computed tomography
  high resolution air cisternography in
  the diagnosis of small acoustic
  neuromas (Khangure) 489
  orbital medial wall fractures
  (Coker) 383
CT (see computed tomography)
Cysts
  aneurysmal, of the ethmoid
  (Baker) 177
  thyroglossal (Allard) 134

D
Dental extractions
  before radiation therapy, incidence of
  bone necrosis (Beumer) 514
Dermoid, nasal (Bradley) 469
Diagnostic techniques (see computed
tomography)

E
Expression plasty
  a new approach to esthetic surgery
  (Fanous) 306

F
Face lift surgery (McCurdy) 211
  extent of undermining of skin flaps
  (Webster) 525
Flaps
  central island myomucosal tongue
  (Harris) 495
  free, the importance of the pedicle for
  the survival of a study on rats
  (Fried) 130
  pectoralis major myocutaneous island
  (Kaplan) 452
  sternocleidomastoid myoperiosteal, for
  repair of laryngeal and tracheal
  wall defects (Tovi) 447
Fractures
  of the orbital medial wall, computed
tomography of (Coker) 383

G
Geriatric patients
  head and neck cancer in (Jun) 376
  primary lymph nodal Kaposi’s sar-
  coma of (Puterman) 535
  retrieval during thyroidectomy (Loré)
  268
Granuloma, traumatic
  of the tongue (Wright) 363

H
Hemangioma
  of the head and neck (Smith) 263
Hypercalcemia
  mechanisms in patients with head
  and neck cancer (Angel) 125
Hypertrophy
  of the sternoclavicular joint following
  radical neck dissection (Cantlon) 218
Hypopharynx
  surgical management for ulceration
  and stenosis of (Kobayashi) 65
  Immunodeficiency disease (Nahum)
  91-E
  head and neck manifestations (Harris)
  114
  Irradiation (see radiation therapy)
K
Kaposi’s sarcoma
  primary lymph nodal of the parotid
  gland (Puterman) 535
L
Laryngeal margin
  carcinoma of (Lacourerraye) 500
  Larynx
  advances in surgery of (Sessions) 42
  cancer of, extralaryngeal spread (Lam)
  410
  cancer of, patterns of spread (Nahum)
  375-E
  repair of, using sternocleidomastoid
  myoperiosteal flap (Tovi) 447
Lesions
  lymphoepithelial, pathology of (Bat-
  sakis) 150
  pathology of papillomas of the upper
  aerodigestive tracts (Batsakis) 332
Lipoblastoma, benign
  in the mandible (Obwegeser) 251
Lymph nodes
  treatment in carcinoma of the tongue
  (Leipzig) 3
M
Mandible
  benign lipoblastoma of (Obwegeser)
  251
  osteotomy in the surgical approach to
  the oral cavity (McGregor) 457
Melanoma
  of the head and neck (Nahum) 197-E
  of the head and neck, incidence in
  Queensland (Harris) 197
  of the oral cavity (McDonald) 257
  Meningioma
  of the paranasal sinuses and temporal
  bone (Granich) 319
N
Nasal dermoid (Bradley) 469
  Neck dissection
  radical, preservation of spinal acces-
  sory nerve function in (Weitz) 75
  Necrosis, bone and preradiation dental
  extractions (Nahum) 467-E
  preradiation dental extractions and
  the incidence of (Beumer) 514
Neoplasms
  (see also cancer; carcinoma; lesions;
tumors)
  meningioma of the paranasal sinuses
  and temporal bone (Granich) 319
  lipoblastoma in the mandible (Ob-
  wegeser) 251
  Neoplasms, salivary gland
  pathology of (Batsakis) 222
Neuroblastoma, olfactory
  a retrospective clinicopathologic study
  of (Appelblatt) 108

O
Olfactory neuroblastoma
  a retrospective clinicopathologic study
  of (Appelblatt) 108
Oncology (see cancer; carcinoma; lesions;
tumors)
Oral cavity
  acral lentiginous melanoma of
  (McDonald) 257
  carcinoma, analysis of pretherapeutic
  classifications (Platz) 93
  surgical approach using mandibular
  osteotomy (McGregor) 457
  verrucous carcinoma of (McDonald) 22
Orbit
  computed tomography of fractures of
  the medial wall of (Coker) 383
  Osteonecrosis (see necrosis, bone)

P
Papillomas
  of the upper aerodigestive tracts,
  pathology of (Batsakis) 332
Parathyroid tissue
  ectopic, in the hypopharyngeal mucosa
  (pyriform sinus) (Joseph) 70
Pathology
  of the lymphoepithelial lesion (Bat-
  sakis) 150
  of papillomas of the upper aerodiges-
  tive tracts (Batsakis) 332
  of salivary gland neoplasia (Batsakis)
  222
  of Sjögren’s syndrome (Batsakis) 150
  of verrucous carcinoma (Batsakis) 29
Pediatrics
  orbital and periorbital cellulitis
  (Rubinstein) 15
Pedicule
  importance for the survival of vas-
  cularized free flaps, a study on rats
  (Fried) 130
Pharyngoesophageal resection
  reconstruction after (Harrison) 92-L
Plastic surgery
  an approach for face lifts (McCurdy)
  211
  expression plasty (Fanous) 306
  face lift, extent of undermining of skin
  flaps (Webster) 525

R
Radical neck dissection
  sternoclavicular joint hypertrophy fol-
Radiation therapy
after dental extractions, the incidence of bone necrosis (Beumer) 514
and bone necrosis after dental extractions (Nahum) 467-E
for vocal cord cancer (Hintz) 204

Radiology (see also computed tomography)
of the ethmoidal sinuses, Part 2B (Dolan) 53
of the maxillary sinuses, Part 4A (Dolan) 345
of the maxillary sinuses, Part 4B (Dolan) 428
of the sphenoidal sinuses, Part 3A (Dolan) 164
of the sphenoidal sinuses, Part 3B (Dolan) 237

Radiotherapy (see radiation therapy; see also chemo-radiotherapy)
Reconstruction
after pharyngoesophageal resection (Harrison) 92-L

Salivary gland
eoplasia, pathology of (Batsakis) 222

Scalp
advanced cancer of, surgical management (Lang) 299

Septum
perforations of, closure with a single-session method (Meyer) 390

Sinuses, ethmoidal
radiology of, Part 2B (Dolan) 53
radiology of, Part 4A (Dolan) 345
radiology of, Part 4B (Dolan) 428
squamous cell carcinoma of (St. Pierre) 508

Sinuses, paranasal
meningiomas of (Granich) 319

Sinuses, pyriform
ectopic parathyroid tissue in (Joseph) 70

Sinuses, sphenoidal
radiology of, Part 3A (Dolan) 164
radiology of, Part 3B (Dolan) 237

Sjögren's syndrome
pathology of (Batsakis) 150

Sternal clavicular joints
hypertrophy following radical neck dissection (Cantlon) 218

Surgical management
of advanced scalp cancer (Lang) 299
of ulceration and stenosis of the hypopharynx (Kobayashi) 65
Surgical techniques (see also plastic surgery; reconstruction; surgical management; surgery)
closure of perforations of the septum (Meyer) 390
a craniofacial approach to advanced recurrent cancer of the central face (Jackson) 474
mandibular osteotomy in the surgical approach to the oral cavity (McGregor) 457
pectoralis major myocutaneous island flap (Kaplan) 452
for the preservation of spinal accessory nerve function in radical neck dissection (Weitz) 75
Surgery (see also plastic surgery; reconstruction; surgical management; surgical techniques)
for bovine ocular carcinoma (Klein-schuster) 401
esthetic expression plasty (Fanous) 306
face-lift technique (McCurdy) 211
of the larynx and trachea, advances in (Sessions) 42

Temporal bone
meningioma of (Granich) 319

Thyroglossal cysts (Allard) 134

Thyroidectomy
parathyroid gland retrieval during (Loré) 268

Tongue
carcinoma, lymph node treatment of (Leipzig) 3
traumatic granuloma of (Wright) 363

Trachea
advances in surgery of (Sessions) 42
repair using sternocleidomastoid myoperiosteal flap (Tovi) 447

Tumors (see also cancer; carcinoma; lesions; neoplasms)
hemangioma of the head and neck (Smith) 263

Vocal cords
cancer of (Hintz) 204

X-ray techniques (see computed tomography; radiology)
It is the impression of the authors that, although the overall frequency of septal perforations has decreased, the proportion of large defects has increased. Therefore, in addition to the methods for surgical treatment of small perforations, a particular description is given of a new procedure in which an extramucosal technique is used, which permits closure of even large perforations in a single session. Very large defects of more than about 2 cm in diameter can be closed most reliably with a three-step procedure using a pedicled flap from the oral vestibule.

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CLOSURE OF PERFORATIONS OF THE SEPTUM INCLUDING A SINGLE-SESSION METHOD FOR LARGE DEFECTS

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In the past few decades, the frequency of septal perforations has declined. This is probably related to the fact that one of the main causes of such defects, submucosal septum resection according to Killian,1,2 is becoming more and more infrequent. However, the condition has not been eliminated by the abandonment of this operative technique alone, because there are, of course, other mechanisms by which perforations of the septum occur. These will be mentioned briefly below. In addition, we refer to the excellent survey of this topic by Horst Ganz.1

CAUSES OF SEPTAL PERFORATION
1. Congenital defects of the septum are extraordinarily rare according to studies by Ballenger and Peer (cited in reference 1).
2. Traumatically induced perforations of the septum are the most common and can be further subdivided as follows:
   (a) Facial macrotraumas that involve the septum, and undetected hematoma of the septum can lead to septal perforations. Septal microtraumas include nose picking, dry air, heat, and dust.2
   (b) Iatrogenic septum defects result from caustic agents and cauterization as well as from radiological and surgical tumor therapy. This category includes not only the above-mentioned submucosal septum resection according to Killian, which has been studied in more detail by Frey and Weinaug (cited in reference 1), but also every other improperly executed septal rhinoplasty. Finally, other therapeutic instruments, such as transnasal tubes and probes, can cause a perforation of the nasal septum.
   (c) Occupational causes, among which anorganic or toxic substances must be counted, are also microtraumatically active. They cause damage primarily to the cartilaginous part of the nasal septum, which is covered with a mucous membrane. Chrome can be mentioned as an example of the numerous substances which must be considered in this connection.
3. The third large group of causes of septal perforations is infection, wherein it is possible to differentiate between acute and chronic types.
Among the acute infections, perforation of the septum was most commonly caused in former times by scarlet fever (as a result of gangrene), followed by diphtheria, and, in rarer instances, typhus. More common now is the "banal" abscess of the septum, which, in principle, can occur as a result of any manipulation of the septum.

Among the chronic infections, the so-called rhinitis sicca anterior (ulcus septi perforans) must be given particular mention. Heat, dry air, dust and other primarily physical agents of damage are seen as its causes. Lues III leads to a connatal or inherited perforation, most commonly in the bony part of the nasal septum. It must be noted here that the saddle nose, which is a typical and well-known connatal phenomenon associated with lues, does not ordinarily appear until the third year of life. In contrast to the situation in lues, the bony septum is generally not affected in tuberculosis, which appears especially as a mucosal lupus of the nose. Still to be mentioned is leprosy, which, especially in the lepromatous form, leads to a final stage similar to ozena.

Metabolic disorders, such as diabetes mellitus, for instance, are rare causes of perforations of the septum.

Tumors also frequently lead to such defects. The therapeutic measures applied in case of a "bleeding polyp" in Kiesselbach's area can easily lead to perforation.

**SYMPTOMS OF SEPTAL PERFORATION**

The indication for closure of such defects depends on the symptoms that trouble the patients. The holes in the rear bony part of the septum can usually remain untreated because they do not cause any inconvenience. On the other hand, symptoms worth mentioning as typical for perforations of the forward cartilaginous part of the septum are: itching; scab formation with impairment of breathing; putrid fetor and dryness of the nose; and recurrent epistaxis. Whistling noises may occur during breathing and even lead to difficulty in falling asleep; however, they occur only in defects that are located well forward, are very small, or have been reduced in size by scab formation. Occasionally a septum perforation is bothersome because it is visible, especially, of course, when it leads to a deformity of the columella.

Of the symptoms mentioned as indications for surgery, particular emphasis should be placed on intense scab formation, recurrent bleeding, whistling noises, and deformity of the nose. Of course, a fresh traumatic perforation requires immediate treatment.

**TREATMENT METHODS**

Basically, the following choices of treatment are available.

1. Conservative therapy. Such treatment, which consists of the application of salves, etc., is indicated when an operation is contraindicated or refused by the patient.

2. Closure with obturators. This method, first proposed by Meyer and, independently, by Link in 1951, and later on by Papangelou (1969) and Von Dishoeck (1975), in which a button consisting of two plastic discs glued together in the middle is inserted into the defect, has been abandoned by us at the present time in favor of surgical procedures.

3. Surgical enlargement of the defect. Although Ganz lists some indications for this procedure, we see this measure at best as a last resort in case of a whistling defect, especially in a case in which the patient refuses a surgical closure. In this regard, it must be pointed out that surgical enlargement of the defect can give rise to new complaints, such as subsequent spontaneous increase in the size of the perforation, bleeding and fetor. As a matter of principle, we regard this method with extreme reservation.

4. Surgical closure of the perforation. In cases with the above-mentioned clinical symptoms, a total closure of the septal perforation will always be the goal to be strived for, and the surgical procedure chosen will be partly determined by the size of the defect.

**SURGICAL TECHNIQUES**

The extramucosal technique that we have been using routinely for years in all rhinoplasties is thereby so extraordinarily helpful that the procedure we used in previous years, in which local flaps were used for closure of small and medium sized perforations, is made superfluous in routine cases. This method, which we abandoned about five years ago, consisted in principle of mucoperichondrial flaps, one of which was cut from the area above the perforation, and one from the opposite side in the area below the perforation, and which were then pushed into place covering the
hole. Good reviews of such techniques can be found in Ganz\(^1\) and Masing.\(^2\)

In contrast, we now close small, medium sized, and even large perforations of the septum using variations of the extramucosal technique designed to fit the individual situation.

**Small Defects.** In closing small defects, it is sufficient to mobilize a large area of the mucoperichondrium coupled with the use of adaptation sutures free of tension. To make this possible, the transfixion incision is first extended downward running parallel to the lower edge of the aperture piriformis along the floor of the nose to the meatus nasi inferior and then upward somewhat under the concha inferior on the lateral nasal wall. On the other hand, an extension of the incision upward and dorsal leads beneath the roof of the nose to the lower edge of the upper lateral cartilage and then along this to the area of the limen nasi, so that this incision corresponds to the intercartilaginous incision (Fig. 1).

Proceeding from this incision, the mucoperichondrium is separated from the septal cartilage over a large area. Then, the mucoperiosteum of the nasal floor is also detached as far as the lower nasal meatus. Finally, the external skin over the upper lateral cartilage is mobilized. This can now be separated at its base in full length from the cartilaginous septum so that the result of the procedure up to this point is a hose-like structure consisting of mucoperiosteum and mucoperichondrium with the attached upper lateral cartilage. The perforation located therein has collapsed due to the elimination of tension.

The same principle is followed in the other nasal cavity. To mobilize the mucoperiosteum, an incision can be made along the lower edge of the lateral nasal wall extending deep into the bony cavity, but the anterior ethmoidalis artery must not be damaged. The loosely adjoining edges of the perforations in the mucoperiosteum can then be freshened and, following adaptation, sutured.

To reduce the size of the actual cartilage defect in the lamina quadrangularis, we basically use two different methods, depending on the location and nature of the perforation. If the hole does not lie too far to the rear, below and with its greatest diameter perpendicular to an imaginary line on the floor of the nose, we perform resections of cartilage strips above and below the edges of the perforation parallel to its largest diameter (Fig. 2). As a result of this procedure, the lamina quadrangularis is divided into two parts: the forward part can be fully mobilized and pushed backward and upward against the second part (Fig. 3). This alone effects a decrease in the size of the perforation, which can be further closed by inserting a piece of the resected cartilage. To avoid recession of the columella, the other strip of cartilage can be attached to the forward edge of the septum. If the largest diameter of the perforation is parallel

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**Figure 1.** (A) Type of incision used for small perforations (B).
Figure 2 (A and B). Strip resection for reducing the size of a small defect.

to an imaginary sagittal line at the floor of the nose, then it is possible, using the same procedure, to remove strips of cartilage in front of and behind the perforation, lengthening the maximum diameter. In this way, an upper septal plate is separated from a lower. The upper plate can be pushed down onto the second half after mobilization at the dorsum of the nose. The perforation, which becomes smaller due to this procedure, can now be closed further by inserting a strip of cartilage. It must be remembered that, in this procedure, it is also necessary to lower the bony framework of the nose.

If the perforation is located lower and farther back (which is more rare) so that the procedure described cannot be used, another method can be helpful for closure of the cartilaginous defect. With this method, after removal of a small strip of cartilage between the lower edge of the perforation and the crista maxillaris or vomer, the lamina quadrangularis and the mucoperichondrium are rotated into or across the defect from both sides (Fig. 4). This requires a rotation of the mucoperichondrium and the triangular cartilage on both sides toward the front and downward, whereby the forward lower edge of the upper lat-

Figure 3. Reduction of the size of the defect by displacement of the septum cartilage and closure of the perforation in the mucoperiosteum.

Figure 4. Rotation of the mucoperichondrium.
eral cartilage now reaches into the nasal cavity and becomes bothersome because it decreases the size of the lumen. Therefore, the upper lateral cartilage should be clearly shortened at the forward edge on both sides (Fig. 5). Thereafter, the mobilized and newly relocated flaps are attached with mattress sutures to the inner lining of the nose and additionally supported by tamponade.

For all the procedures mentioned, the access, especially for suturing, can be eased by separating one or both of the wings of the nose, and possibly the columella as well, from the skin of the lip and cheek and temporarily folding them upward and backward (Fig. 6). At the end of the operation, they can be folded back down and sewn in place. If suturing is done carefully, the results of such auxiliary incisions are usually not visible.

**Defects up to 2 cm.** The extramucosal technique is especially valuable in the treatment of perforations of up to 2 cm in diameter because it permits their closure in a single session. In contrast to the total number of septal defects, these large perforations have become relatively more common in the past few years. Therefore, it seemed of particular interest to work out a single-session method for closure of such perforations.

To do justice to the unusual extent of such perforations, we begin the operation in this case on one side with an incision, the course of which corresponds to that of the hemitransfixion incision, but starts at a substantially greater distance from the edge of the septum, so far forward that it is located in the skin of the columella, only a few millimeters behind the nasal orifice (Fig. 7). The further course of the incision then corresponds to that already described above, i.e., the incision extends to the rear and upward as an intercartilaginous incision and then downward parallel to the lower edge of the apertura piriformis at the floor of the nose, then extends to the lateral nasal wall. Where the incision passes beneath the dome of the wing, care must be taken to avoid damage to the cartilage.

Beginning at the incision at the edge of the columella, the skin of the lateral columella and the septum membranaceum must be dissected with the utmost care and caution and must not be perforated. For this purpose, we recommend the use of magnifying glasses. When the dissection has reached the forward edge of the septum, the mucoperichondrium of the nasal septum is peeled off, as are the mucoperiosteum of the floor of the nose and bony cavity, along with the external skin over the upper lateral cartilage (Fig. 8). Then the upper lateral cartilage can be separated at its base from the septum, at which point the perforation located in the mucoperichondrium...
narrowes automatically to a slit as the mucous membrane collapses (Fig. 9).

On the other side, the procedure is basically the same, but with the important difference that the vertical course of the incision before the edge of the septum corresponds to that of a hemitransfixion incision (Fig. 10). Care must be taken not to create a defect connecting the two nasal vestibules. On this side too, the edges of the perforation in the mucoperichondrium adapt of themselves after mobilization.

After freshening the edges of the defect in the cartilage, it can be closed by a cartilage transplant (Fig. 11), which can be taken without any danger from, for example, the dorso-caudal part of the septum—easily accessible at this point in the operation. It is also possible to cut around a segment of cartilage in the area beneath the edge of the perforation and rotate it into the defect.

The edges of the perforation in the mucoperichondrium, which become loosely adapted spontaneously, are freshened and closed with 5-0 sutures. Likewise, the other incisions in the mucoperichondrium and in the skin of the columella and vestibule are sewn with interrupted sutures of 4-0 or 5-0 nylon (Fig. 12). If dorsal displacement of the mucoperichondrium results in too much tension after final suture of the edge of the columella (danger of “hidden columella”), then the loss of skin material can be compensated for by a retroauricular skin transplant. So far, we have not seen any postoperative “hidden columella” in patients who have undergone surgery with this method. We have been using the extended method for three years, and have found nothing more than a single slight recidivous perforation in a total of 16 cases (Fig. 13). We successfully closed this remnant perforation one year later using the same techniques.

**Defects Larger than 2 cm.** If the diameter of the perforation exceeds 2 cm, so that an attempt at surgical closure is not very promising even with this method, then we must fall back upon another, substantially more complicated method, which was first mentioned in 1969 by Hertig and Meyer as Meyer’s method, and described again by Meyer in 1972. In 1971, this procedure was
Figure 10 (A and B). Type of incision used on the opposite side.

Figure 11. Closure of the cartilage defect by placement of a cartilaginous graft; readaptation of the mucoperichondrium.

Figure 12. After suturing, the closure of the perforation is complete.
also taken up by Nagel\textsuperscript{10} and in 1977 by Tardy.\textsuperscript{11} It is a three-step method in which a spoon-shaped distant flap from the oral vestibule with a piece of cartilage attached is first inserted into the perforation and then severed from its pedicle after the cartilage fragment, which is covered with mucous membrane on both sides, has grown into the septum.

The surgical procedure consists of the following individual steps:

1. Preparation of the distant flap in the mucous membrane of the oral vestibule. The flap, which will later consist of a pedicle and a piece of cartilage covered on both sides with mucous membrane, is begun in the gingivolabial or gingivobuccal fold of the oral vestibule, directly next to the frenulum above the upper row of teeth. The cartilage is taken from the external ear, which does not result in any substantial deformity. It is then sewn into a pouch of submucosal tissue in the oral vestibule (Fig. 14). Next to this, another flap is cut in the mucous membrane. This flap, however, retains a medial pedicle and is folded under the already existing cartilage-mucous-membrane pouch, so that the cartilage is now covered by mucous membrane on both sides. The defect resulting from the removal of this mucous membrane flap is closed with a simple suture. Between the frenulum and the main part of the distant
Figure 15. Schematic drawing of the distant flap in cross-section (A) and incision for inclusion of cartilage and for lining the flap (B).

Figure 16. Transfer of the flap into the defect (A and B); suturing brings the detached columella back into place (C).
flap, which is constructed in this manner, the pedicle is prepared by molding a longish horizontal roll of tissue using interrupted incisions and mattress sutures (Fig. 15).

2. After 3 to 5 weeks, during which time the cartilage and the mucous membrane flap grow in, a roughly spoon-shaped flap can be cut and fed into the nasal cavity and to the septum through a tunnel which has been constructed beginning at a point in front of the floor of the nose and next to the spina nasalis anterior. This is the second surgical step. The site of removal is sewn with 4-0 nylon sutures. It is helpful to sever and fold up not only the two wings of the nose, but also the base of the columella, so that the cartilage fragment covered with mucous membrane on both sides can be sewn into the perforation without any problem. The incision chosen for this purpose extends to the forward lower edge of the perforation, so that the portion of the septum located in front of the defect is raised along with the columella, and the perforation is opened wide. If the mucous membrane on both sides of the flap is now sewn to the local mucous membrane, the columella and the ventral portion of the septum are automatically brought back into their original position (Fig. 16). Thereaf-
ter, the columella is again sutured at the philtrum.

3. This new situation is again left for 3 to 5 weeks. Then the third step can be carried out without the patient’s being admitted to the hospital, and the separation of the pedicle can be performed under local anesthetic. At the same time, the normally necessary thinning out of the three-layered graft can be done.

This method, which we have used successfully since its first description, is always our method of choice for very large perforations. Due to the good prospects of success and the substantial postoperative improvement in the situation of the patient, we consider this relatively complicated and time-consuming operation suitable and reasonable in selected cases (Fig. 17).

REFERENCES


